QUEENSLAND
STATE EARTHQUAKE RISK ASSESSMENT 2019

Australian Government
Geoscience Australia

The University Of Queensland
AUSTRALIA

Queensland Government

Sources for the images used in this document:

- Front and back covers – Source: Adobe Images
- Inside back cover – A panoramic view of Christchurch town centre taken from Port Hills is seen at 12:58, 7 minutes after the 6.3 magnitude struck central Christchurch at 12:51 on February 22, 2011 in Christchurch, New Zealand. Source: Getty Images

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Thank you

The Queensland State Earthquake Risk Assessment 2019 was a collaborative effort, bringing together the expertise of multiple stakeholders. QFES would like to thank all the organisations and individuals who assisted us in developing this document. Particular thanks to Geoscience Australia, The University of Queensland and Local Government Association of Queensland.

Foreword

Disaster events affect the lives of all Queenslanders and have a significant impact on the economy and our environment. Whether of natural or human origin, disasters are becoming increasingly extreme and complex, exacerbated by our globally interlinked economies.

We realise, since a significant earthquake has not impacted Queensland in recent memory, that this does not mean it cannot happen. Earthquakes represent a rare but ever-present risk to all communities across Queensland.

Following the release of the State Natural Hazard Risk Assessment in 2017 and through consultation with stakeholders at all levels of Queensland's Disaster Management Arrangements (QDMA), the need for detailed and consistent information regarding Queensland's risk from earthquake was identified.

Our collective ability to assess and more deeply understand disaster risk is the first step towards the development of resilience. 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.

Queensland is exposed to a range of natural hazards which can lead to significant consequences for our communities. Within the last decade we have experienced natural disasters of a size and scale that are almost unprecedented in our Nation's modern history. These events reinforce the need to communicate appropriate risk information across the three tiers of QDMA: Local, District and State.

Hon. Craig Crawford MP
Minister for Fire and Emergency Services

Mike Wassing AFSM
A/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 risk-based plans across QDMA. 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, 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 Geoscience Australia and the University of Queensland for partnering with QFES on this initiative, and local governments for their ongoing cooperation.

We encourage all Queenslanders affected by disaster 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.

Executive Summary

Although the risk of a significant earthquake event occurring in Queensland is low, extreme events such as earthquakes present a significant challenge for all levels of government and emergency management personnel. It is essential to gain a better understanding of the probable impacts before attempting to mitigate identified vulnerabilities and consequences.

As such, the Queensland State Earthquake Risk Assessment (SERA) provides a comprehensive overview of earthquake risk in Queensland and 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 probable impacts of a significant earthquake event.

By increasing our collective understanding of Queensland's earthquake risk, we can increase our ability to deal with the impacts of events with a severity beyond our existing individual knowledge, skills, experience, and collectively, beyond our existing resources, 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)

Context

In 2017 Queensland Fire and Emergency Services (QFES) completed the first State Natural Hazard Risk Assessment using the QERMF methodology. The 2017 assessment evaluated the risks presented by seven in-scope natural hazards. The risks presented by earthquakes 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.

The SERA was developed using the QERMF to undertake a scenario-based analysis of Queensland's earthquake risk. Overall, the SERA seeks to complement and build upon existing Local, District and State earthquake risk assessments, disaster management planning, and business continuity planning by providing updated and validated information relating to the changes in understanding of Queensland's earthquake potential.

Development and Consultation

Substantial stakeholder engagement and consultation was undertaken during the development of the SERA. Stakeholders included those from the emergency management sector and organisations that support QDMA, volunteer organisations, and public and private infrastructure operators.

Importantly, the development of the SERA was conducted in partnership with Geoscience Australia (GA) through the provision of expert advice, relevant spatial datasets and the development of the scenarios used through this assessment. Input has been sought from GA to help contextualise the findings of the National Seismic Hazard Assessment 2018 for Queensland.

Consultation with the University of Queensland has been sought to provide the 'Queensland Context', capitalising on the 80-year history of earthquake research and study undertaken by the university and State of Queensland.

A robust scientific basis enhances the assessment and enables all levels of QDMA to inform their disaster management and business continuity planning.

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

Although widespread destruction due to 'great' earthquakes (as observed in plate boundary regions such as New Zealand) is highly unlikely within Queensland, the consequences of these events can be devastating and have 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 report by applying the scenario-based approach to evaluate and understand:

1. The probability of occurrence of an earthquake of the magnitude required to deliver potentially destructive ground shaking within the location under assessment. This can be derived from comparing the Source zone of a region shown in Figure 9 (Page 13 of the report) with the exceedance probabilities shown in Figure 8 (Page 12 of the report).
2. The vulnerability of the location under assessment through analysis of local ground conditions and the topography (with respect to landslides). Note: This may require specialist capability beyond that inherently available to most Local Governments. Refer to the Summary for further advice.
3. The elements 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 an earthquake event occurring outside of the region.
4. The existing controls to manage or mitigate this type of event at the respective level of QDMA (such as building codes, community warning strategies and specific agency disruption or continuity plans).
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 and this executive summary.

Key Observations from the Assessment

For the purposes of this report, impact has been assessed against the Newcastle scenario with an MMVI-VIII range of intensity (refer to Page 9 of the report). This assessment is applicable for the whole of Queensland, but must be rationalised against the probabilities of occurrence highlighted in Figures 9 and 10 (Page 12 and 13 of the report.)

Assessing hazard interaction and the impact of hazard characteristics on exposed elements provides a clear understanding of vulnerabilities. The SERA highlights those elements susceptible to the characteristics of a significant earthquake event.

The key observations for communities across Queensland are presented below, according to the six exposed element categories outlined within the QERMF.

This list is not exhaustive and will not be applicable to every Local Government Area within Queensland.

Essential Infrastructure: Key points

- Water supply and sewerage systems are highly vulnerable to damage
- Restoration of power and communications following disruption will depend on the level of damage, site accessibility, availability of response personnel and equipment, and identified priorities
- Aged in-ground gas and liquid fuel lines are vulnerable to rupture
- Fuel and water tanks without baffling are vulnerable to damage or failure.

Community and Social: Key points

- Vulnerability of poorly constructed and maintained buildings presents the most significant risk to public safety during an earthquake
- Secondary (consequential) hazards such as fire, landslides, or infrastructure failure will exacerbate the risk to public safety
- Buildings constructed prior to 1993 are at high risk of damage
- Buildings constructed to comply with wind loading code for cyclonic areas are at least risk due to a high level of structural resilience.

Medical, public and mental health: Key points

- An earthquake of this magnitude may lead to a mass causality event
- Sole reliance on external supply of utilities (power, water, fuel, sewerage etc.) increases vulnerability
- Backup equipment may fail if it is damaged during the event or not adequately built and maintained
- Psychological trauma or distress should be expected across large proportions of the population.

Access/Resupply: Key points

- Road and rail networks are vulnerable to considerable protracted damage from earthquake and landslide which may affect response and recovery activities
- Fixed wing aircraft movements may be disrupted due to impacts on associated on-ground infrastructure
- Port facilities, where available, may become the priority route for access and resupply.

Significant industries: Key points

- Heavy industry and manufacturing sites may suffer damage, become unsafe, and/or suffer significant productivity losses
- Disruption to transport and logistics routes will likely have knock-on impacts to regional and State economies
- Coastal tourism hotspots are likely to be vulnerable because of their construction type and location on softer soils. Vulnerability of tourists is also of concern.

Environment: Key points

- Earthquakes and/or landslides can have devastating effects on wildlife and their habitats
- Release of hazardous materials from damaged containers, pipes, or industrial sites is likely to have adverse effects on environmental health

Damage sustained within the town of Kalgoorlie-Boulder, Western Australia as a result of the magnitude 5.0 earthquake which occurred on 20 April 2010.
Source: images courtesy of Department of Fire and Emergency Services, Western Australia

Risk Management Considerations

Noted below are considerations for further discussion when determining risk management strategies that may address issues arising from the implementation of this assessment.

These considerations are not prescriptive or exhaustive, as it is expected other risk management strategies may be identified.

Consideration 1: If any entity using this assessment identifies exposures and or vulnerabilities and there is uncertainty as to how these may be managed/mitigated it is suggested that this information can be used to inform exercises.

Due to the complex consequences inherent with earthquakes any exercise, would benefit from agency representation at Local, District and State levels to enable contingent planning at all levels of QDMA.

Gaps in capability and capacity (residual risk) identified as a result of exercising, may be escalated via the Queensland Emergency Risk Management Framework (QERMF) to ensure appropriate planning in the management of that risk.

Use of accurate modelling and scenario planning in the development of these exercises will increase preparedness and prevention work across QDMA and enhance specialist capability development for the hazard.

Consideration 2: Broad areas of strategic and economic importance identified during this risk assessment as being exposed to a higher potential of earthquake risk, may benefit from further in-depth earthquake studies.

In-depth studies can identify specific areas exposed to amplified earthquake shaking and enable the development of adequate mitigation strategies to help manage the risk.

Consideration 3: In areas where uncertainty exists regarding the potential risks posed by localised tsunamis, and landslides being initiated by a close earthquake of moderate or greater magnitude, consideration should be given to research opportunities in partnership with relevant academic institutions, research bodies, and State and Federal agencies, that could yield appropriate strategies to manage these risks.

Consideration 4: Awareness and education are fundamental to reducing potential risks and consequences associated with earthquake (and tsunami) occurrence. Engagement with relevant stakeholders to investigate opportunities within existing community education programs would be a key step toward enhancing resilience.

Consideration 5: If vulnerability of water and sewerage systems is identified, where practical and fiscally viable, consideration is given to the lining or replacement of brittle pipelines with High Density Poly-Ethylene (HDPE) pipe to improve their resilience (across all hazards).

Rescue efforts at the Kent Hotel, Newcastle. Source: Telstra Museum, Newcastle

The impact to the RSL Club building, Newcastle. Source: Telstra Museum, Newcastle

Summary

As reported in the State Natural Hazard Risk Assessment 2017, the risks associated with earthquake activity remain Queensland's fifth natural hazard risk priority.

However, a key finding of this 2019 updated assessment is that Queensland's exposure to significant earthquake activity may have been underestimated in many previous assessments of the hazard across all levels of QDMA.

Specifically, the area of highest risk from significant earthquake occurrence and impact is those areas of Zone 003 which includes Gladstone in the north, extending south to incorporate the Greater Brisbane area and Ipswich, and west to include areas bordering the Great Dividing Range, as shown in Figure 19, Page 31. This analysis takes in to consideration several factors which include:

- Density of population within this zone. The population of Local Government Areas (LGAs) within this zone accounts for close to two-thirds of Queensland's total population.[1]
- The cross dependency of critical infrastructure within this area. A significant proportion of the State's transport and logistical network, power generation and transmission capability operates within this zone.
- Economic activity. The Gross Regional Product (GRP) of LGAs within this zone accounts for approximately 60% of Queensland's total GRP.[2]
- The historical record of earthquake activity[3] and probability of future occurrence in these zones (refer to Figure 9 on page 12 of the report).

As such, Zone 003 (as defined in Figure 19, Page 31 of the report). is accorded Queensland's highest priority area for significant earthquake risk and should therefore be a priority for any future Queensland based studies or considerations of potential earthquake impact.

Zone 002 (highlighted overleaf), encompassing areas of Mackay to Rockhampton in the south and extending to areas surrounding Townsville in the north, is accorded Queensland's second priority area for significant earthquake risk. This is in part due to considerations around economic and industrial activity as well as the probability of future earthquake occurrence.

Despite according these two zones first and second priority, the risk to other zones within Queensland should not be discounted. It is hoped that further future studies will explore this risk in greater detail and as a result, better define Queensland's risk from significant earthquakes.

If further research, analysis or assessment are required after reviewing this document to understand the earthquake 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.

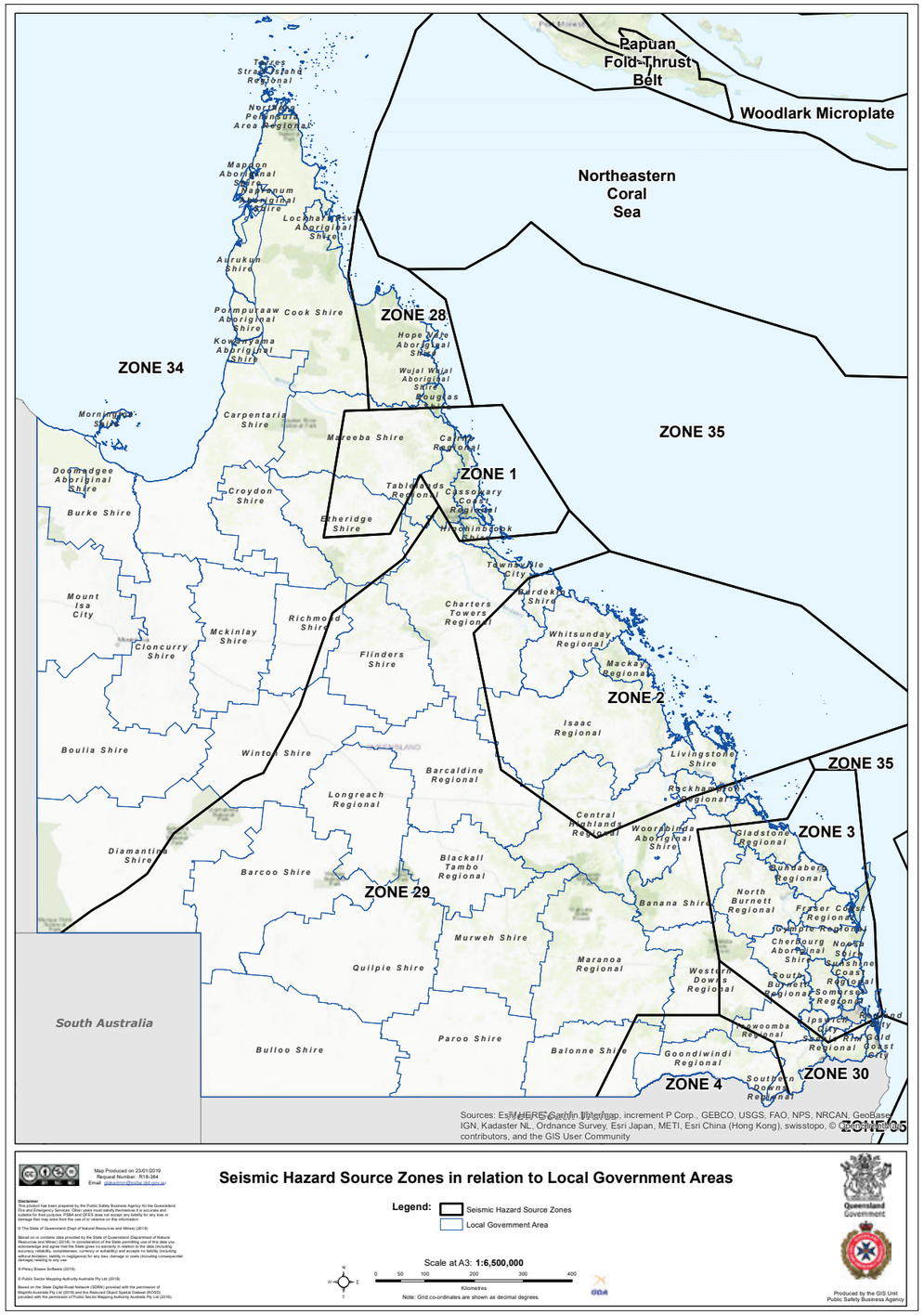
Key agencies:

- Queensland Fire and Emergency Services (Hazard and Risk Unit)
- University of Queensland
- Geoscience Australia.

[1] Queensland Government Statistician's Office. (2018) Queensland Government population projections, 2018 edition: LGAs and SA2s. Queensland Treasury

[2] Information on GRP of Zone 003 received from Queensland Treasury (February 2019) based on estimates published in *Experimental Estimates of Gross Regional Product.*

[3] Noting the caveat placed on the historical record within Figure 4 of the assessment.



Map Produced on 23/01/2019
Request Number: R18-384
Email: gisunit@psba.qld.gov.au

Seismic Hazard Source Zones in relation to Local Government Areas

Legend: Seismic Hazard Source Zones; Local Government Area

Scale at A3: 1:6,500,000

0 50 100 200 300 400
Kilometres

Note: Grid co-ordinates are shown as decimal degrees.

Produced by the GIS Unit
Public Safety Business Agency

Seismic Hazard Source Zones in relation to Local Government Areas.
Source: produced by Public Safety Business Agency using source zones obtained from Geoscience Australia

Australian Government
Geoscience Australia

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