



2015 Callide Creek Flood Review

Volume 1 : Report



Front cover images

Upper: Callide Dam gates 21 February 2015.

Photo courtesy E. Clarke

Lower: Aerial view of Jambin area 21 February 2015.

Photo courtesy S. Wilkie

Office of the Inspector-General Emergency Management

Phone (07) 3227 6588

Email info@igem.qld.gov.au

Web www.igem.qld.gov.au

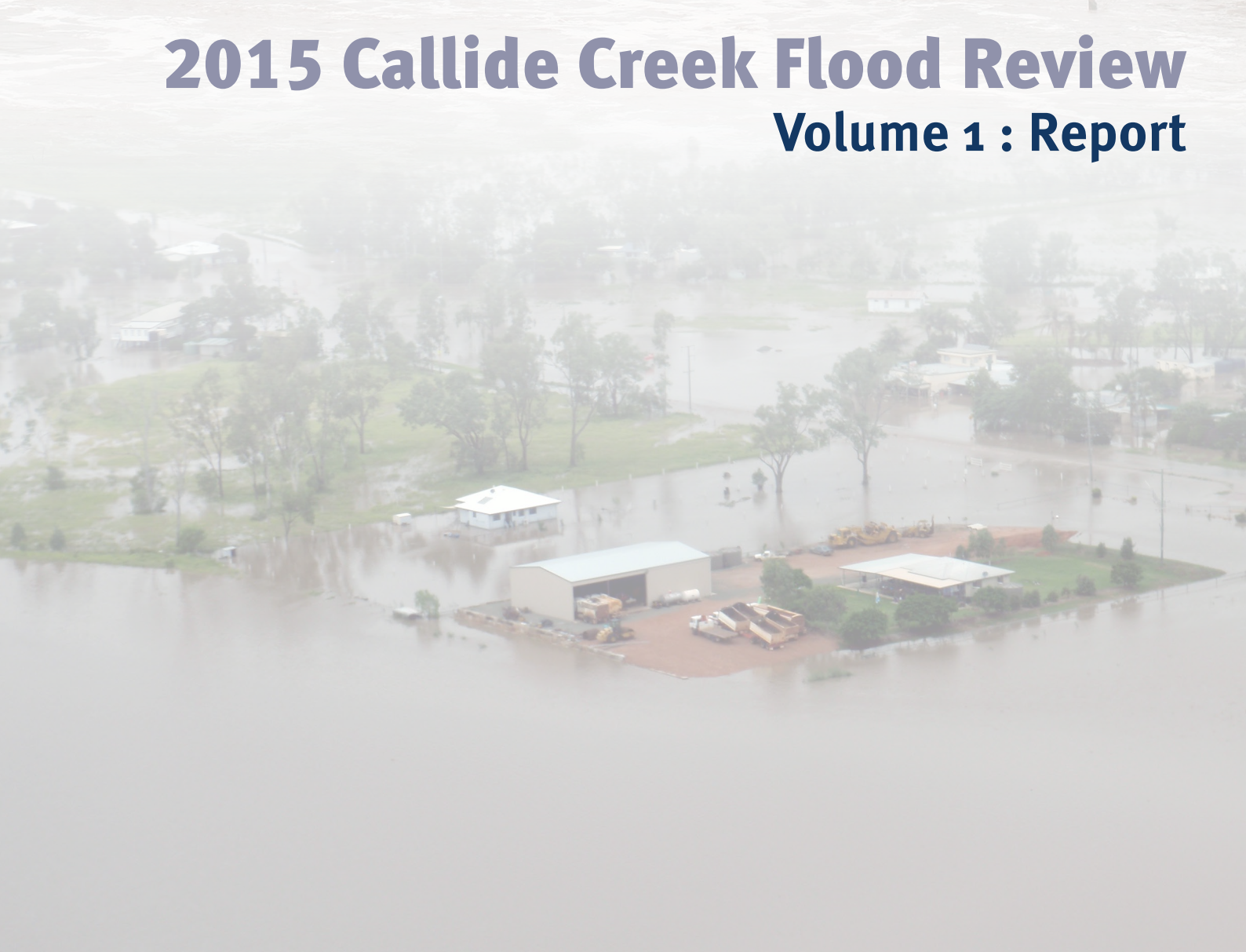
Postal address GPO Box 1425, Mail Cluster 15.7
Brisbane, Queensland 4001

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*Upper: Callide Dam gates
21 February 2015*

Photo courtesy E. Clarke

*Lower: Aerial view of Jambin
area 21 February 2015*

Photo courtesy S. Wilkie

Contact details

All enquiries regarding this document should be directed to the Office of the Inspector-General Emergency Management:

- Email info@igem.qld.gov.au
- Telephone 07 3227 6588
- Postal address IGEM Mail Cluster 15.7
GPO Box 1425
Brisbane Qld 4001

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3 June 2015



**Inspector-General
Emergency Management**

The Honourable Jo-Ann Miller MP
Minister for Police Fire and Emergency Services and
Minister for Corrective Services
GPO Box 15195
CITY EAST QLD 4002

Dear Minister

In accordance with your instruction of 2 March 2015, I present a report into the flooding of Callide Creek during Tropical Cyclone Marcia.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Iain S MacKenzie'.

Iain S MacKenzie AFSM
Inspector-General Emergency Management

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Foreword

The Callide Creek Flood Report presents the findings of a comprehensive review, conducted by my office, into the events associated with the impact of Tropical Cyclone Marcia in the Callide Valley area. Our terms of reference required particular attention to flooding that occurred downstream of the Callide Dam, and the operation of the Dam. The report also provides commentary on flooding events in other catchments at the time and the cumulative effect this had at various locations. The review included commissioning an independent hydrologist report, provided by BMT WBM, to capture, analyse and model relevant data to assist us to make a range of findings and recommendations.

The review was instigated as a commitment by the Premier and Minister for the Arts, the Honourable Annastacia Palaszczuk MP, to those affected by flooding; to discover what role, if any, the Callide Dam played in the event.

The review has considered the actions of those entities that share disaster management responsibilities in the context of this event; and, has made recommendations designed to enhance the safety and well-being of affected communities in the future. The review has highlighted the complexities of disaster management and the need for thorough and proper planning, preparation and practicing of those arrangements.

I acknowledge that officers who work in these entities often make difficult decisions with limited information during times of stress, and that these decisions have been subject to scrutiny by this review in hindsight, without these same pressures. The review team has been cognizant of this and consciously applied a test of reasonableness to their deliberations.

The review has revealed systemic difficulties, particularly in relation to warnings and education. Matters relating to improvements to flood monitoring and predicting capabilities are achievable, but will require coordinated effort and the support of a number of entities. Other longer term improvements to flood modelling, should have a direct impact on future town planning and building approval processes. These are matters of urgency that should be commenced as soon as practical. The approach needs to include open and frank discussion with, and disclosure to, current residents about risks faced.

I have been privileged through this review to be invited into people's homes, when they are suffering and desperately trying to recover, and have been privy to people's raw emotions. I have heard of remarkable bravery and willingness to help neighbours. I have been told heartbreaking stories such as that of a husband and wife separated in floodwaters while trying to save their children, not knowing if they would see each other again; and of the heartbreak of children losing favourite toys, not realising how close they may have been to losing a lot more. To those people I can only offer my genuine thanks and admiration.

This report has sought to answer as many questions as possible surrounding the flooding of Callide Creek. In doing so, we have been faithful to our commitment to determine and report on the facts. My hope and belief is that the recommendations will ease future risk through better access to information, understanding, improved disaster management response, and planning.

I must commend those entities from whom we sought information, in particular SunWater, the Banana Shire Council and the Department of Energy and Water Supply. They freely, willingly and enthusiastically assisted, realising the gravity of the matter and the opportunity for improvement. They showed what I believe to be a genuine commitment to deliver improved outcomes.

I thank and acknowledge all of the staff of my office, in particular those who worked directly on the review and those who willingly assisted. My thanks also to those seconded onto the team, who transitioned seamlessly and became much valued members.

I need also to highlight that, in our visits to those affected, not one issue was raised in relation to poor performance or lack of empathy shown by insurance companies. Given the often adverse media coverage after previous events, this was particularly pleasing to note.

The recommendations in this report cannot stop future flood events. However, if adopted, implemented, rehearsed and reviewed, situations should not be repeated where:

- people are trapped in their house looking at a one metre wall of water pressing against glass doors
- children are being evacuated within minutes of houses being inundated
- elderly couples find themselves driving through water over their headlights.

The clarification, documentation, and exercising of roles and responsibilities of all entities that contribute to effective disaster management, are critical to this success.

The challenge is for all entities to acknowledge accountability for matters identified; and to take the concept of 'shared responsibility', so often talked about in disaster management circles, from rhetoric to reality.

Iain S Mackenzie

Inspector-General Emergency Management

Executive Summary

Background

For the second time in two years, the Callide Valley in the Banana Shire has experienced major flooding. Several large floods in 2013 caused the Callide Dam gates to be opened. The association between flooding and the dam gates prompted community concern that the operation of the Callide Dam had exacerbated flooding.

On the evening of 20 February 2015, Tropical Cyclone Marcia impacted the Callide Valley bringing significant rainfall and Category 1 wind gusts. The rain was intense over a short period of time causing rapid stream rises. As the Callide Dam quickly filled, the gates opened automatically releasing water through the gates.

Many in the community saw the Callide Dam gates as the cause of the disaster. The Inspector-General Emergency Management (IGEM) was commissioned to report on the circumstances of the Callide Creek flood event during Tropical Cyclone Marcia to determine whether disaster management arrangements and Callide Dam planning and operations were effective, and to identify opportunities to improve disaster management outcomes.

The impact to the community

While no lives were lost in the floodwaters, many were significantly and irrevocably affected. Homes and livelihoods were destroyed, businesses suffered losses, livestock perished, and crops and fences were washed away. Many people's safety was placed at risk by self-evacuating at night, with little warning.

Tropical Cyclone Marcia had immeasurable impact on the community of the Callide Valley in February 2015. Many people had not fully recovered from several flood events in January and February 2013. A community survey told us that 92% (n=374) of respondents had been personally affected in some way by flooding in the Callide Valley as a result of Tropical Cyclone Marcia.¹ Many entities had a positive influence on the outcomes for the Banana Shire, not least the community. The people of the Banana Shire shared information, helped to prepare, checked on, and came to the aid of others evacuating, returning home and cleaning up after the flood.

The operation of the Callide Dam

This review commissioned an independent hydrologist to undertake a technical assessment. The hydrologist report addressed the impact of discharges from the Callide Dam, aspects of the dam operation, and whether different operating rules could provide greater flood mitigation.

The report concluded that *'regardless of how Callide Dam was operated during the February 2015 event, the communities along the Callide Valley would still have experienced a major flood.'* A variety of scenarios modelled by the hydrologists concluded that the effect on flood levels in Jambin and Goovigen would have been minimal had the gates been manually operated, had the dam been full, or even had the dam been reduced to 50% of the full supply level.

The hydrology report confirmed that SunWater's Emergency Action Plan (EAP) was followed, but that the tools SunWater uses to carry out flood forecasting are inadequate. As a result, the likelihood of the dam gates opening could have been predicted earlier had the storage estimates been accurate, or based on more robust modelling tools.

Disaster Management arrangements

In the lead up to Tropical Cyclone Marcia passing Biloela, the Banana Shire Council (the Council) shared weather intelligence and basic preparedness information with the community. The review did not find evidence of adequate information being passed on to residents regarding what predicted rainfall in the area, or the forecast possibility of flash flooding, could mean for them. The Council appears to have access to limited flood studies and there are too few river gauges to adequately inform their disaster management planning, preparations and response. We consider that given the information available, along with the knowledge and experience of the Council staff and Local Disaster Management Group (LDMG) as a collective, there was opportunity for more information to be made available to the community.

As the cyclone intensified most of the focus was on the possible opening of the dam gates. This may have distracted attention from the range of other hazards and risk treatment strategies that some Local Disaster Coordination Centre (LDCC) staff had identified.

The absence of rain during the day of the cyclone appears to have influenced planning activities for the forecast event. Consequently, this affected the efficacy of the response when flooding rain began impacting creeks and rivers across the Banana Shire. The Council knew there were many houses in the Banana Shire built before cyclone ratings, and advised the community to shelter in place or with friends and families. Places of refuge were opened after the cyclone passed but significant flooding had already been experienced in many northern parts of the Banana Shire. Many evacuations at that time were dangerous or impossible.

While it was reasonable to be surprised by the magnitude of the flood event and speed of stream rises, we consider that both the LDMG and SunWater had sufficient information to better prepare the community. We believe better use could have been made of recent experience, risk assessments or flood mapping (albeit limited and dated). Those who were likely to be at risk could have been identified and told more about what was known. Noting the view of SunWater, that it has no choice under legislation than to rigidly adhere to the EAP, we do not consider that a plan that first notifies people at the time releases are expected to commence, is reasonable. In the context of warnings, SunWater's understanding of EAP compliance requirements is divergent to those of the dam safety regulator that supports the notion of flexibility to deal with emergent conditions. We note that the Department of Energy and Water Supply and SunWater have commenced work to clarify the legal status of EAPs.

The availability of information to the public could have made a difference to community preparedness. SunWater believed for days prior to the cyclone that Callide and Kroombit Dams were likely to spill, and shared this belief with the LDMG. By Friday morning SunWater's computer modelling predicted the Callide Dam could release water within 24 hours. Again, SunWater told the LDMG, but we could not identify where the public were subsequently informed.

The hydrologist's assessment considers SunWater's computer modelling was incorrect, yet even this imperfect information could have promoted more accurate community perceptions of risk. Though considered by SunWater staff, early advice of the potential for the dam to spill was not progressed to the public, because SunWater waited for the EAP activation.

Warnings were discussed during meetings of the LDMG, but the LDMG resolved only to 'monitor' the dam until an alert was attempted in the late afternoon of Friday 20 February 2015.

The exact time the gates opened is a matter of theory, modelling and conjecture, as no one witnessed the event and there is no telemetry or recording means to capture this information. The hydrologist has calculated an opening time of approximately 8.30pm, though a SunWater operator thought they heard the gates opening between 8.37pm and 8.42pm. The reality is that this is not the critical issue. The first warning for the Callide Dam issued by SunWater was at 8.39pm. Shortly thereafter (at 8.48pm), the LDCC requested an Emergency Alert by contacting the State Disaster Coordination Centre (SDCC). Staff within the LDCC have advised us that they verbally requested a warning message earlier, but there was trouble with the maps used. In any event, the alert was not sent until around an hour later at 9.40pm. We consider that the timing of these alerts in relation to the opening of the dam gates and the magnitude of the event could have been considerably reduced.

Warning messages had not been adequately prepared to enable efficient use of the Emergency Alert system, and aspects of the warnings issued by both SunWater and the LDCC could have been improved to provide greater clarity for residents. Some residents told us that messages were too late, while others did not receive them at all.

We were told that the LDMG was not aware SunWater's warning service was by subscription only, and that not all residents in the area were subscribed. Some warnings issued by the LDCC were inconsistent with others they provided via Facebook and media releases. The warnings did not consider residents on many other creeks and rivers that were flooding or at risk of flooding. For example, the LDMG received warnings from SunWater about spilling from Kroombit Dam, but no further information was provided to the public by the LDCC.

The scarcity and delays in information exchange, with the community and between disaster management entities, on the evening of 20 February 2015 meant that the public did not have the best chance to anticipate or respond to the flood.

Telecommunications infrastructure

Telstra has several redundancies built into the fibre optic network. Damage to the Telstra fibre optic cable occurred approximately one hour before water started to be released from Callide Dam. The community survey that accompanies this report indicated that during the event, 50% (n=198) of residents experienced issues with landlines and 44% (n=165) with mobiles.² The Council itself did not have adequate telecommunications redundancies in place for Tropical Cyclone Marcia.

The future

While the flooding in Callide Creek was larger than many had previously experienced, it was not unprecedented. The few records available for the history of flooding in the area suggest flash flooding and events of a similar size to February 2015 have come before. Although the plans and flood risk studies owned by the Council require considerable updating, these past floods are documented in them. We are pleased to be told that the Council has commissioned the required flood study, and that a draft planning scheme has been submitted to Government.

There is every indication that floods of a devastating magnitude will occur again in the numerous watercourses in the Banana Shire. Improving the accuracy of predicting the extent of flooding depends on regular flood modelling to account for changes to topography from land clearing, levy banks and other man-made or natural changes to the landscape. It also requires reliable data sources from ground surveys, river and rain gauges. The data sources to inform accurate models are scarce. This also leaves town planning without a solid evidence base for decision-making. Ineffective land use planning is a persistent challenge for floodplain management in Queensland. The Council's approach to flood risk management, including town planning, cannot progress without these fit for purpose flood studies.

Floodplain management must be multi-faceted, multi-agency, and deal with competing interests for water. In Queensland, floodplain management is dispersed across various state-level agencies. This review proposes improved policy coordination across these agencies.

The water stored in the Callide Dam must be considered in the context of water security for the people and environment of Queensland. The operation of the Callide Dam cannot overlook the safety and wellbeing of the community living and working downstream. Balancing the competing interests for water in the Callide Dam is a complex process.

Minimising the flood impact to the residents of the Callide Valley is not as simple as reducing the storage level of the Callide Dam. Flood risk management, primarily the responsibility of the Council, must be prioritised to develop a broad suite of mitigation options. Community consultation on the mitigation options will promote a shared understanding of risk and enable mutual agreement on how to prioritise and share responsibility for the management of risk.

Providing comprehensive information about hazard identification and risk management is important in empowering the community to prepare for and respond to future events. Also vital is providing the community with better information about the operation of the dam, and the impacts that may result from various scenarios.

It will be crucial that SunWater, the Council and the LDMG more broadly, work closely together to improve risk-based disaster management planning, preparedness and response, including more coordinated and timely warnings.

Findings

#	Finding	Theme	Chapter	Page
1	There is currently insufficient information available to allow a fully informed decision on the use of Callide Dam to provide more active flood mitigation than its original design.	Operation of the Callide Dam	04	
2	Improved policy coordination of flood risk management would support councils to develop better flood risk management and town planning.	Managing Floods	05	
3	Improvements to Banana Shire Council's approach to flood risk management, including town planning, are dependent upon the Council having access to fit-for-purpose flood studies.	Disaster Management Planning & Preparation	06	
4	Of those surveyed, 55% indicated they had limited or no knowledge of disaster management arrangements.	Disaster Management Planning & Preparation	06	
5	It is difficult for residents to easily understand the implications of an Emergency Action Plan activation.	Disaster Management Planning & Preparation	06	
6	Believing there to be no legal option, SunWater followed the Emergency Action Plan, despite having information regarding emerging risks to downstream residents.	Disaster Management Planning & Preparation	06	
7	In relation to warnings, SunWater's understanding of Emergency Action Plan compliance requirements is divergent to that of the Department of Energy and Water Supply, which supports the notion of flexibility to deal with emergent conditions.	Disaster Management Planning & Preparation	06	
8	For flood events, there are significant gaps in the availability of operational information sources (such as real-time river and rainfall gauges) for the Banana Shire Local Disaster Management Group to utilise. This limits its ability to produce actionable intelligence and plan effectively for these events.	Disaster Management Response	07	
9	SunWater's reliance on rudimentary gauges and manual monitoring systems did not enable effective situational awareness and delayed warnings to downstream residents in this event.	Disaster Management Response	07	
10	The Bureau of Meteorology's ability to accurately forecast flood events in the Callide Valley is significantly limited by the quality and quantity of data sources.	Disaster Management Response	07	
11	Although the Banana Shire Council and SunWater communicated regularly during the event, this collaboration did not result in consistent and timely warnings being delivered to the community.	Disaster Management Response	07	

#	Finding	Theme	Chapter	Page
12	The prepared warning messages within the Local Disaster Coordination Centre were not adequate to enable rapid and efficient processing through the State Disaster Coordination Centre and into the Emergency Alert system.	Disaster Management Response	07	
13	The community was not provided with all the available risk information relevant to this event.	Disaster Management Response	07	
14	There is opportunity for improvement in the operation of the Local Disaster Coordination Centre across the full range of incident management functions that will particularly enhance planning, decision making, and warning processes in the future.	Disaster Management Response	07	
15	Issues related to telecommunications difficulties within the Local Disaster Coordination Centre may have been identified prior to the event if a business continuity plan had been completed and tested.	Disaster Management Response	07	
16	The event has highlighted opportunities for improvement in activation of the evacuation sub-plan and associated activities.	Disaster Management Response	07	
17	State Disaster Coordination Centre situational awareness would be improved through direct access to representatives of critical infrastructure owners.	Disaster Management Response	07	

Recommendations

#	Responsible entity	Recommendation	Chapter	Page
1	Department of Energy and Water Supply, SunWater	<p>The Department of Energy and Water Supply and SunWater, undertake the necessary studies to determine whether or not it is feasible to operate Callide Dam as a flood mitigation dam. Such studies should include matters in relation to, but not limited to:</p> <ul style="list-style-type: none"> • The effect on the Callide Valley water supply • Dam safety issues • Actual mitigation outcomes • Cost-benefit analysis of alternative strategies • Alternative means of effecting improved community outcomes. <p>The results of this work should be made public to enhance public knowledge and provide confidence regarding dam operations.</p>	04	
2	Banana Shire Council	<p>Banana Shire Council investigate means to prioritise the commissioning of a fit-for-purpose flood study for high-risk areas across the Banana Shire to better inform flood risk management, including improved town planning. The outcomes of such a study should be available to the public and inform flood awareness campaigns, flood warnings, and building approvals.</p>	05	
3	Banana Shire Council	<p>Banana Shire Council coordinates the development of a strategy to significantly enhance public education regarding local disaster management arrangements within the Banana Shire, focusing on key identified risks.</p>	06	
4	SunWater	<p>SunWater provide downstream residents with easily understood information regarding operation of the dam, and the impacts that various outflows may have for them, in accordance with mapping prepared for the Emergency Action Plan. This information should be complementary to any information from the Banana Shire Council.</p>	06	
5	Department of Energy and Water Supply, SunWater	<p>The Department of Energy and Water Supply, in conjunction with SunWater, seek clarification of the dam owners' legal obligation to comply with Emergency Action Plans and, if required, investigate how a more flexible approach may be adopted.</p>	06	
6	Banana Shire Council, SunWater, the Bureau of Meteorology	<p>In accordance with recommendations of the BMT WBM report, the Banana Shire Council, SunWater, and the Bureau of Meteorology, under the stewardship of the Department of Natural Resources and Mines, jointly identify the requirements for a suitable gauge network for the Callide Valley to allow meaningful and timely flood warnings. The review should identify key stakeholders, examine potential funding sources and include a cost benefit analysis.</p>	07	

#	Responsible entity	Recommendation	Chapter	Page
7	Banana Shire Council	Prior to September 2015, the Banana Shire Council develops a multi-channel warning strategy and associated public information campaign, including common language and consistent messaging, for the Banana Shire.	07	
8	SunWater and Banana Shire Council	Prior to September 2015, SunWater and the Banana Shire Council jointly develop a multi-channel, common warning strategy, including common language and consistent messaging, for residents downstream of SunWater assets within the Banana Shire Council, and clearly articulate procedures for dissemination.	07	
9	Banana Shire Council and SunWater	As part of the above, both the Banana Shire Council and SunWater ensure Emergency Alert messages are pre-formatted, consistent, polygons are identified according to risk, and that they are tested and practiced with the State Disaster Coordination Centre.	07	
10	Banana Shire Local Disaster Management Group	Local Disaster Coordination Centre capability and capacity should be reviewed to ensure adequate staffing arrangements are in place to fill key positions, and that operational protocols are known and practiced across all functions to provide redundancy. Assistance for review and necessary training should be sought from key Local Disaster Management Group member agencies.	07	
11	Banana Shire Council	Banana Shire Council completes business continuity planning as a matter of priority, including documentation and testing of the plan.	07	
12	Banana Shire Council	The evacuation sub-plan component of the Local Disaster Management Plan should be reviewed, including any identified triggers for activation. Ideally, the plan should be tested in a live, multi-agency exercise prior to next summer.	07	
13	State Disaster Coordination Centre	State Disaster Coordination Centre considers requesting a representative from critical infrastructure owners be present as a liaison officer in the State Disaster Coordination Centre during activations for events that may impact on their assets.	07	

We note the recommendations provided within the independent hydrologist report. We have considered these within the context of our review process. Where necessary, appropriate and substantiated through our own findings, we have drawn upon them in the formulation of this report's recommendations and findings, which are presented for consideration and action by the relevant entities.

Endnotes Chapter 01

1. Market & Communication Research (MCR), Callide Creek Catchment Area Survey Report, MCR, Fortitude Valley, May 2015, p. 11.
2. *ibid.* p. 90.

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Introduction

Purpose

Section 16C of the *Disaster Management Act 2003* (Qld) provides the Office of the Inspector-General Emergency Management (IGEM) with functions including:

- to regularly review and assess the effectiveness of disaster management by the State, and district and Local Disaster Management Groups (LDMG)
- to regularly review and assess cooperation between entities responsible for disaster management in the State, including whether the disaster management systems and procedures employed by those entities are compatible and consistent
- to work with entities performing emergency services, departments and the community to identify and improve disaster management capabilities
- to monitor compliance by departments with their disaster management responsibilities
- to identify opportunities for cooperative partnerships to improve disaster management outcomes
- to report to, and advise the Minister about issues relating to these functions.

In accordance with these functions, the IGEM has reviewed the circumstances of the Callide Creek flood event during Tropical Cyclone Marcia to determine whether disaster management arrangements and Callide Dam planning and operations were effective, and to identify opportunities to improve disaster management outcomes.

Terms of Reference

This review will report on:

- The impact to the community of the Callide Valley from the flooding event on Friday 20 February 2015.
- The operation of the Callide Dam in the lead-up to and during the event, including:
 - > whether recommendations from the report on the 'Review of Callide Dam Gate Operations in the January 2013 Flood Event' ¹ were implemented, and did, or would have if implemented, alter the impact to the community
 - > the application of the Emergency Action Plan (EAP) including integration with relevant disaster management plans
 - > whether the operating specifications of the Callide Dam at the time of the event were reasonable.
- Disaster management arrangements, specifically:
 - > risk assessment and hazard mitigation strategies
 - > disaster management planning and disaster operations, including warnings
 - > engagement and communications, including with the community.
- Performance of critical telecommunications infrastructure in the event.

In undertaking the review, the IGEM will seek public submissions and hold meetings in local communities. The IGEM will engage with a range of relevant parties, including government and non-government organisations. The review will include an independent hydrological assessment.

The IGEM will provide recommendations to improve disaster management and community outcomes.

Review Methodology

The review was conducted from late February to June 2015. We met with affected residents, inspected the impacts of the flood event on their properties, and considered written public submissions. The IGEM attended a town meeting to hear residents' concerns. In addition, an experienced and independent market research company was engaged to survey 406 Banana Shire residents regarding the impact of the flooding and associated matters pertaining to the event and disaster management.

We obtained records, written submissions and individual recollections, direct observations, and actions from a broad range of entities including, but not limited to:

- Banana Shire LDMG: individual member interviews, audio recordings and minutes of meetings prior to, during and after the event, the Local Disaster Management Plan and associated documents
- Banana Shire Council: individual interviews with staff, corporate documents, town planning records, internal emails, public engagement material and media releases, logs and other records from the Local Disaster Coordination Centre
- Gladstone District Disaster Management Group (DDMG): individual interviews with members, District Disaster Management Plan, logs and other records from the event management system
- State Disaster Coordination Centre (SDCC): individual interviews, logs relating to Emergency Alert, email communications (including circulated reports and materials), and audio telephone recordings
- Department of Energy and Water Supply (DEWS): written submission, email communications, and records and documentation relating to regulating dam safety
- Department of Natural Resources and Mines (DNRM): written submission, email communications, and records relating to river gauges
- SunWater: individual interviews, corporate documents, Emergency Event Report containing comprehensive event logs, and public engagement material and media releases
- Telstra: individual interviews
- Department of Justice and Regulation (Victoria): Emergency Alert records
- The Bureau of Meteorology (BoM): individual interviews, service level agreement, media releases and warning information, and weather data.

Relevant sections of the draft review report were provided to the above entities for procedural fairness and/or for validating the accuracy of our presentation of the evidence. A second right of reply to the full report was offered to those entities most impacted by our findings and recommendations. SunWater and Banana Shire Council elected to have responses published as appendices to this report: SunWater's response is Appendix C; Banana Shire Council's response (and on behalf of the LDMG) is Appendix D. SunWater's public submission is included as Appendix E in the public interest (although we have redacted sections to protect the operational security of the infrastructure and personal information, and omitted a publicly available appendix).

We carefully considered these responses and where appropriate we have made amendments, deletions or included additional information. Not all suggestions or requests have been actioned and we have reproduced the feedback in full to provide transparency.

Performance of the entities assessed by this review was considered in light of the Standard for Disaster Management in Queensland (the Standard), relevant legislation and/or guidelines as appropriate. Although the Standard was only recently released, it represents the input of disaster management practitioners from across Queensland about good practice, and sets a benchmark for organisations upon which improvement strategies can be based.

Context

*'Sweep of a hundred valleys with rocks and boulders piled,
The sheerness of the cliffside – the scrub-belts dark and wild!
Here when the storms have broken a thousand floods have flowed;
A rugged land of grandeur, this land where Rideout rode.'*

(excerpt from *Rideout's Land* by the late Lex McLennan)²

History of the Callide Valley

The Gaangalu Nation People and the Port Curtis Coral Coast People are the traditional owners of the Callide Valley and its catchment areas.³ Early European settlement of the Callide Valley occurred sometime between the late 1840s and early 1850s.⁴ Many Aboriginal people were relocated to reserves, such as Woorabinda and Taroom, after the introduction of the *Aboriginals Protection and Restriction of the Sale of Opium Act 1897 (Qld)*.⁵ A few Aboriginal people worked for graziers.⁶

The Callide Valley's agricultural and pastoral beginnings

In 1854 a pastoral run called 'Prairie' was set up as an agricultural demonstration farm to promote 'closer settlement' in the area now known as Biloela.⁷ In 1855 the 'Banana' run was established and named after a bullock that was used as a decoy to round up wild cattle.⁸ Closer settlement policies brought hopeful 'selectors' to Queensland from the 1860s.⁹ The Banana Divisional Board commenced in 1880 and was the first form of local government.¹⁰

Queensland pastoralists struggled with the variability and unpredictability of the climate.¹¹ Years of dry creek beds in the Callide Valley were interspersed with flooding rains.¹² Due to a lack of experience as graziers, poor land selection, and pests (rabbits, cattle ticks and prickly-pear), many selectors were ultimately unsuccessful.¹³

The Federation Drought of 1895 to 1902 had its peak in 1902 when drought affected 70% of Queensland, including the Callide Valley.¹⁴ In 1918, the area was flooded and two children were drowned.¹⁵ Water is said to have been just over two metres high in the Jambin township.¹⁶ To Biloela's west was a 'sea of water'.¹⁷

In newspapers, in Parliament and even in poetry, there was increasing interest in mitigating droughts by harnessing water during times of plenty with bores and dams.¹⁸ In 1919, Edward Granville (Ted) Theodore became the Premier of Queensland with a plan to reinvigorate large-scale rural settlement with irrigation projects in the Burnett and Callide Valleys.¹⁹

Premier Theodore introduced the *Irrigation Act 1922*.²⁰ The Dawson Valley town of Castle Creek was renamed Theodore after the Premier.²¹ It was a model town for the vision Premier Theodore had for rural Queensland, with its irrigated gardens, and palm-lined avenues and boulevards.²² Premier Theodore's 'Queensland System' was based on cooperative marketing, infrastructure development, scientific research into farming methods and comprehensive agricultural education programs.²³

The *Upper Burnett and Callide Land Settlement Act of 1923 (Qld)* resulted in a population of 131 expanding to 1,000 between 1924 and 1929.²⁴

Due to improved knowledge of farming methods, use of better equipment, and government support, large-scale cultivation became possible.²⁵ Premier Theodore's plans to bring 50,000 people to the area were thwarted by drought in the late 1920s, falling commodity prices and reduced demand.²⁶

Big flood of 1928

Drought was soon replaced by flooding in April 1928.²⁷ A tropical cyclone impacted near Mackay, resulting in significant floods in the Callide, Dawson and Dee Valleys.²⁸ There were reportedly nine deaths, houses washed away and many stock were lost.²⁹ One and a half metres of water was said to be in the Jambin Hotel.³⁰ Fences between Jambin and Rannes were all taken by the floods, and cattle carcasses left behind, six to seven metres up in the trees.³¹ Some settlers, dispirited and unaware they had built their homes on a floodplain, moved away from the area when their crops and dwellings were damaged.³²



**Above: Flood victim
1928 Flood near Goovigen.**

*Reproduced from
'The Big Valley Story'*



**Right: Rescuing stock during
the 1928 flooding in Goovigen,
Queensland.**

*Image found on the internet,
credited to the State Library
of Queensland*

Great Depression and climatic challenges

By the time the Great Depression impacted Queensland's economy in 1929, thousands of family farms had been abandoned.³³ In May 1930, extensive flooding south of Maryborough saw bridge damage, crop and cattle losses, and the drowning of a man in Callide Creek.³⁴ In 1932, the area suffered again from drought.³⁵ Rain in 1933 brought some relief, though also flash floods.³⁶ Cotton production peaked in 1934.³⁷ In November 1937, flood waters washed away the railway between Mt Morgan and Theodore, with flooding in the region again in 1939 and across Queensland in 1940.³⁸



Left: Russian immigrant selector Mr Kolishkin, a cotton farmer in the Callide Valley closer settlement area, beside his tractor and disc plough, circa 1936.

John Ovley Library,
State Library of Queensland

1942 flood

In February 1942, a tropical cyclone hit north Queensland near Cardwell and then travelled down the coast to the north of Mackay.³⁹ Rannes and Wowan were evacuated, though flooding still resulted in loss of life in the Dawson and Callide Valleys.⁴⁰ There was also widespread property loss, and the devastation was said to be more severe than the 'big flood' of 1928.⁴¹

One farmer wrote about the 'desolation' to his farm on the Callide Creek: one of his employees disappeared and was assumed drowned, and all cattle, fences and crops were destroyed by the 'raging torrent'.⁴² Another recalled that the 'Callide rose swiftly particularly the area between the Kroombit and the Callide. Fears were held for the safety of many farmers along the Jambin Road'.⁴³

Drought, dams and other development

The Callide Mine began production in 1944 after several individual leases were consolidated into one company.⁴⁴

Once more, drought in 1946 was relieved by heavy rains and flooding throughout much of south east Queensland in February and December 1947.⁴⁵ In March 1949, a tropical cyclone struck Gladstone and then continued over Rockhampton.⁴⁶ Flash flooding in the Callide Valley killed two, with one man drowned at Thangool and another at Biloela.⁴⁷

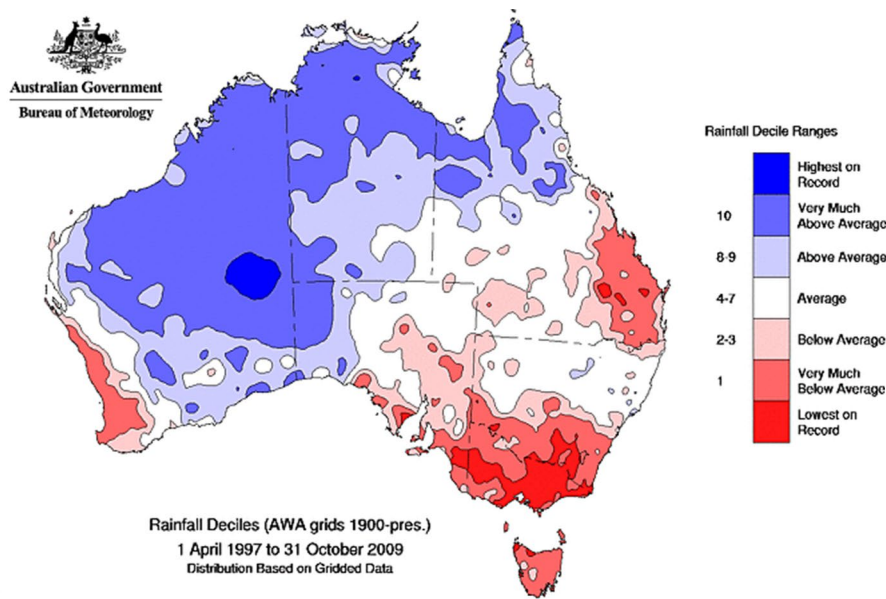
Drought hit Queensland again in 1951 and 1952.⁴⁸ Still, local flooding in the Callide and Dawson Valleys in January 1952 took the life of one man at Wowan.⁴⁹ One Callide Valley resident recalled a very wet year in 1956 and another told of lucerne crops being partially destroyed by one fall of heavy rain in 1957.⁵⁰

In Australia and around the world, the 1960s brought a significant increase in dam construction.⁵¹ The Callide Valley irrigation investigations coincided with the construction of the Callide Power Station.⁵² Both the Callide Dam and Callide A Power Station were completed in 1965, allowing the Banana Shire to further benefit from its rich coal reserves.⁵³

Drought affecting more than 10 percent of Queensland was experienced in 1965-66 and again in 1969-70.⁵⁴ Water drawn from the Callide Alluvium generally exceeded replenishment and groundwater resources declined.⁵⁵

From the 1980s, dams and weirs were used to artificially recharge aquifers.⁵⁶ As a result, the Callide Dam Stage II was completed in 1988 to enhance groundwater supply and to increase town water for Biloela.⁵⁷ The Callide B Power Station was commissioned in 1988 and the Awoonga-Callide Pipeline was built to meet increased demand for water from Callide Dam.⁵⁸

Kroombit Dam was built in 1989 to store water for aquifer recharge and was initially successful in replenishing groundwater.⁵⁹ Callide Creek flooded 10 houses above floor level in Goovigen in February 1997,⁶⁰ and one man lost his life in 2003 when flash flooding in the Dee River and tributaries inundated houses.⁶¹ Yet, drought saw Kroombit Dam empty by 2006,⁶² and the 'Millenium Drought' persisted until 2009.⁶³



Right: Rainfall decile ranges across Australia – 1 April 1997 to 31 October 2009. Bureau of Meteorology

Shrinking groundwater resources

In 2008, an independent assessment of the Callide 'groundwater dependent ecosystems' was completed to inform the Fitzroy Basin Water Resource Plan.⁶⁴ The assessment found it was 'highly likely' that groundwater dependent ecosystems in the Callide Alluvium had been 'significantly affected by depletion of groundwater resources ... since the 1960s'.⁶⁵ While there had been some stabilisation of groundwater levels in many areas, the catchment north of Goovigen was still in decline.⁶⁶ The report cited overuse of the alluvial aquifer as the cause of four of nine Biloela bores failing, both Thangool bores running dry and the depletion of a number of irrigation, stock and domestic bores.⁶⁷

Wet years

One of the strongest La Niña episodes on record impacted Queensland with significant and widespread flooding in 2010 and 2011.⁶⁸

A flood risk study was commissioned by the Banana Shire Council (Council) in 2010.⁶⁹ This study recognised that the Callide Valley is subject to flash flooding and cautioned that it was possible for flooding to occur 'with no advance warning'.⁷⁰

Callide Valley flooding 2013

Tropical Cyclone Oswald developed from a tropical low in the Gulf of Carpentaria to a Category 1 cyclone on 21 January 2013.⁷¹ As a cyclone, Oswald made little impact, but the subsequent low of ex-Tropical Cyclone Oswald caused record flooding, the largest number of tornadoes in Australia in a single event,⁷² and over \$10 billion in damage⁷³ as it moved south through Queensland and into New South Wales.⁷⁴

The system affected the Callide Valley area between Thursday 24 and Saturday 26 January,⁷⁵ over the Australia Day long weekend. At one point, almost 700mm of rain fell in the area over a 48 hour period.⁷⁶ The Callide Dam filled and water was released. By the afternoon of 27 January 2013, the weather system had moved, dam levels had stabilised and the dam gates had closed.⁷⁷

By 27 January 2013, many areas of the Banana Shire were isolated by flood water from a number of waterways, including Jambin, Goovigen, Thangool and Biloela.⁷⁸ Evacuees and some of their livestock were sheltering at the Jambin School.⁷⁹

The body responsible for regulating Queensland dams, the DEWS, commissioned an independent hydrologic review of the Callide Dam gate operations in the January 2013 flood event.⁸⁰ After consulting with SunWater and the Council, a report was completed in May 2013.⁸¹ The report was not publicly released.

The Callide Valley in 2015

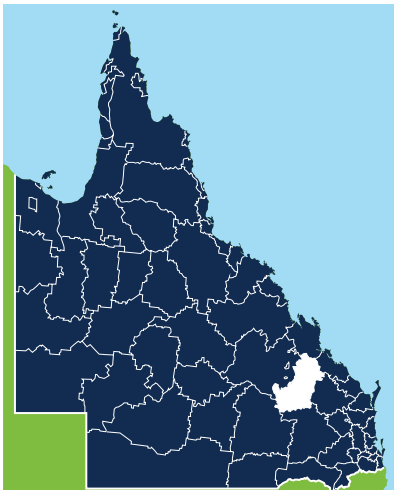
The Callide Valley is spread over 28,546km² and is home to approximately 15,200 people.⁸² Several townships are located in and around the valley, including Biloela, which is the main service and administration hub and is where the Banana Shire Council Chambers is located. Other smaller towns in the valley include Jambin, Goovigen, Taroom, Theodore, Moura, Wowan, Dululu, Baralaba, Rannes and Thangool.

The Callide Valley is rich in natural resources.⁸⁵ Banana Shire residents are primarily employed in the coal mining industry, beef production, dairy and agriculture, including dry crops (mung beans) and irrigated crops (cotton).⁸⁵ Moura, just west of Biloela, hosts one of the Queensland Cotton ginning facilities, which is part of one of the world's largest cotton companies.⁸⁶ The Leichhardt and Burnett Highways cross through the Banana Shire, and the Dawson Highway provides passage to the Port of Gladstone.⁸⁷



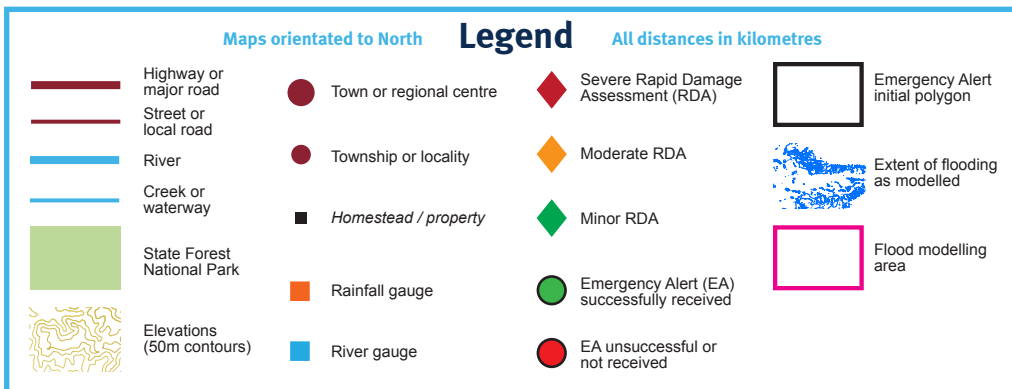
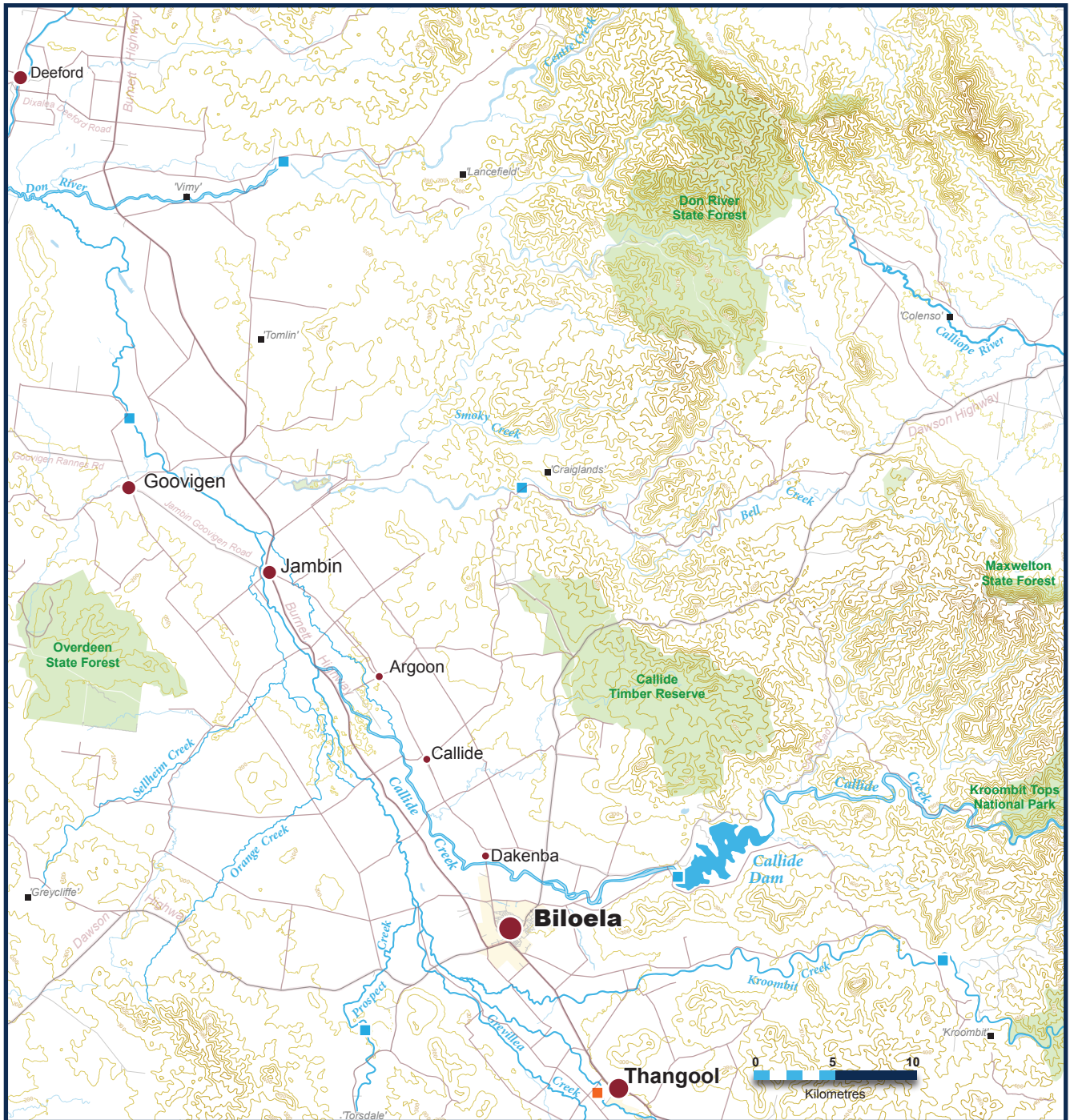
Right: Queensland map showing boundaries of Local Government Areas with Banana Shire Council highlighted in white.

Local Government Association of Queensland



Above: Map showing the Banana Shire in greater detail; the Study Area of the Callide Creek catchment in this Report is outlined in red.

Queensland Government



Above: Enlargement of the Study Area box on the previous page, showing details of the Callide Creek Valley from Thangool to Deeford.

This map forms the basis of many subsequent maps with different overlaid data in this Report.

Queensland Government

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The event

Tropical Cyclone Marcia

Impacts on the Banana Shire





Above: Jambin township.
Banana Shire Council

Images on this page are also numbered so they may be located on the study area map on the facing page.

Below: Burnett Highway, rail overpass.
Banana Shire Council

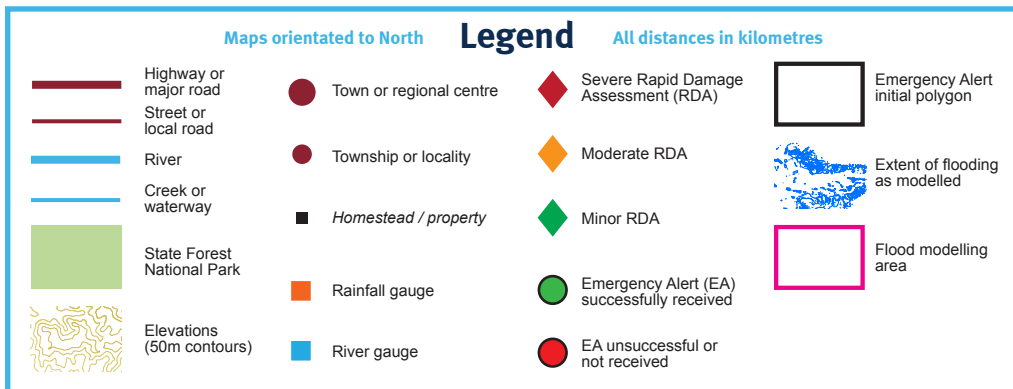
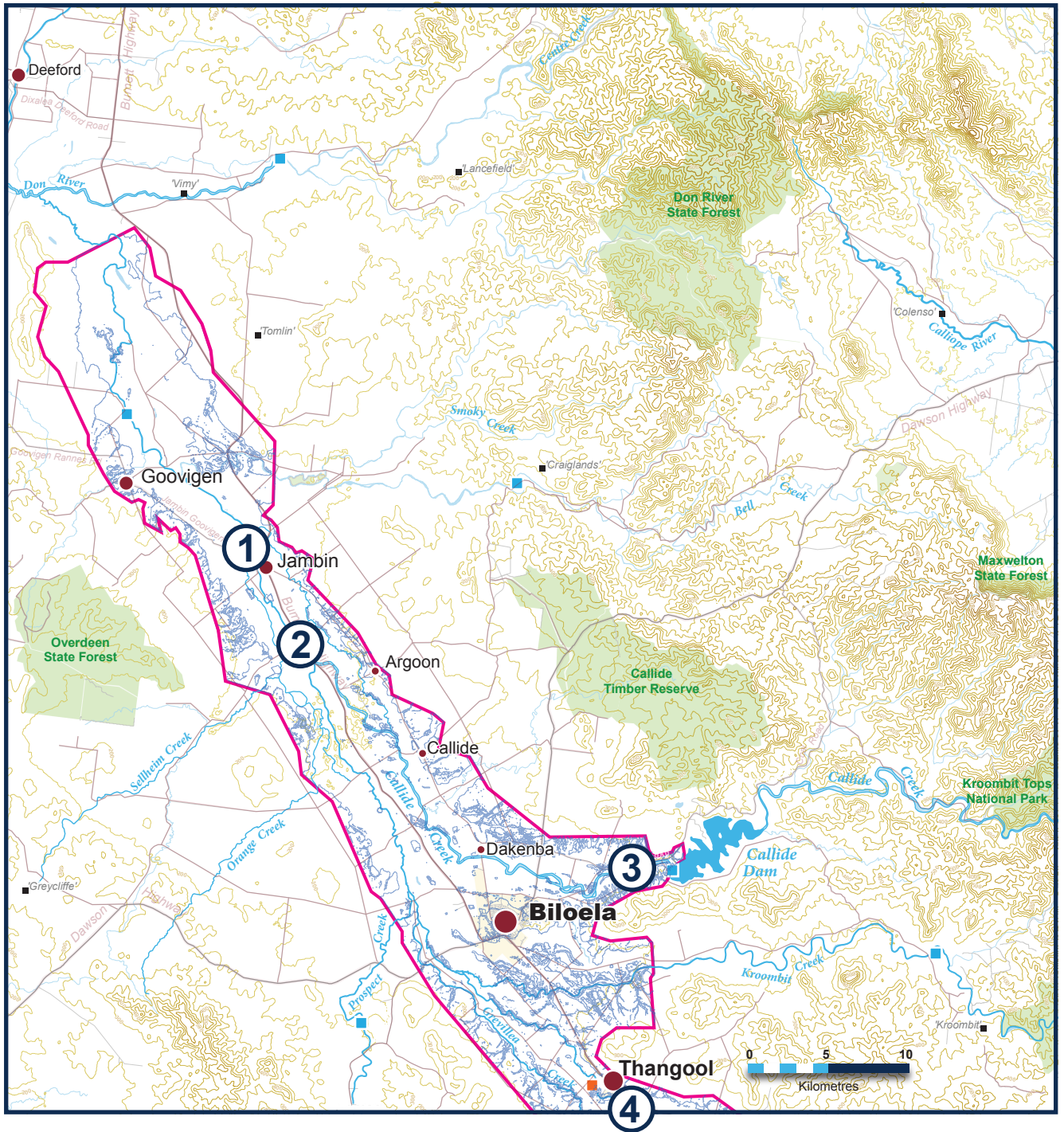


Below: Thangool aerodrome.
Banana Shire Council



**Above: Linkes Road,
Callide Creek.**
Banana Shire Council





Above: Close-up map of the study region, with overlays showing (a) in pink, the outline of the flood modelling area, and (b) in darker blue, the modelled extent of the flooding.

Inspector-General Emergency Management



Above: Mung bean crop damage.

Images on this page are also numbered so they may be located on the study area map on the facing page.

Below: Residential property flood damage and debris.

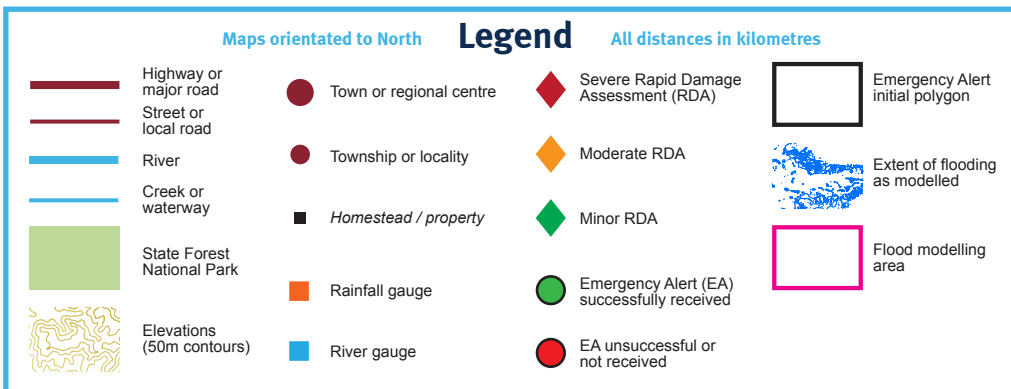
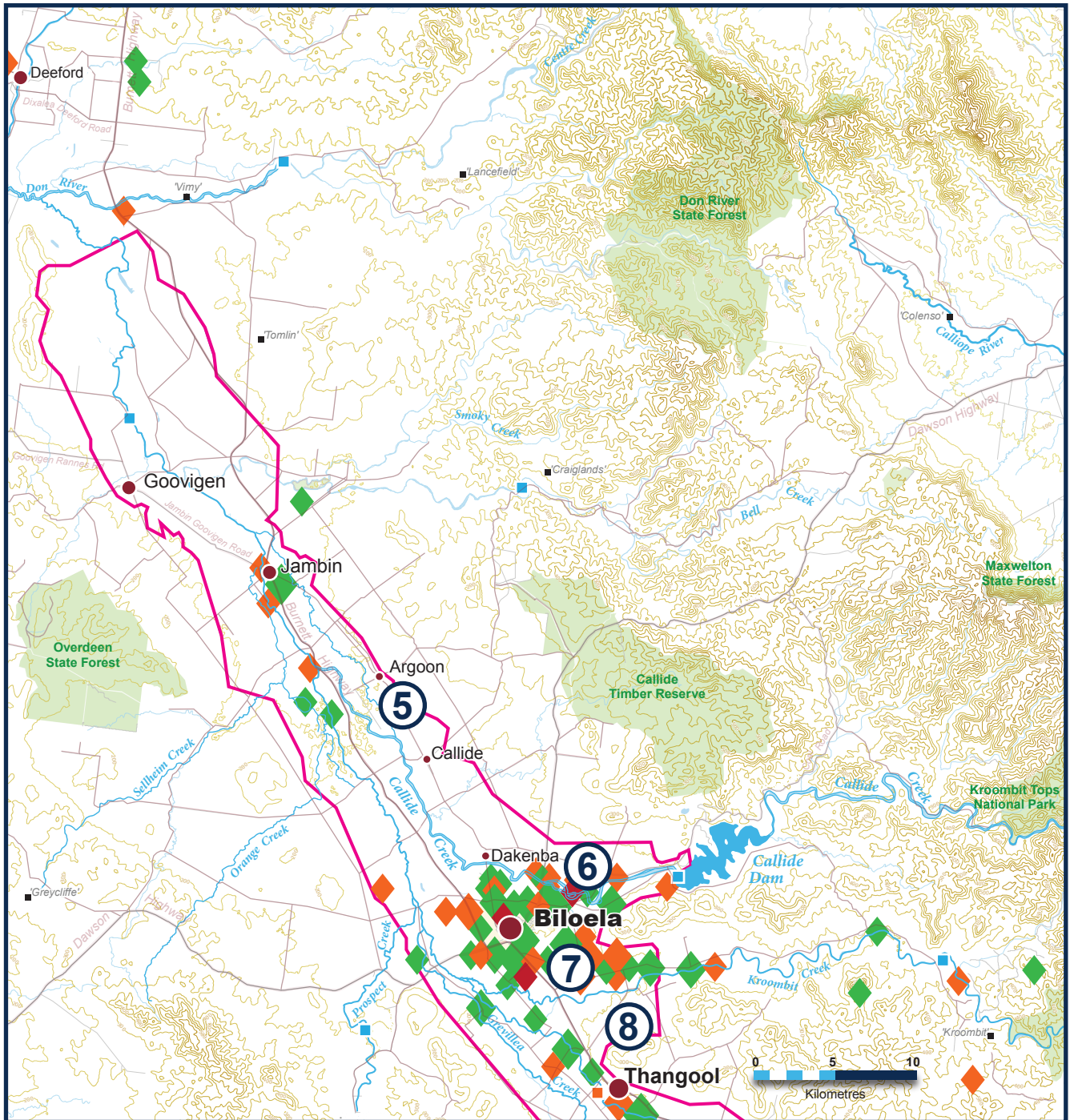


Below: Residential property – tree with level marks for three major flood events.
SunWater



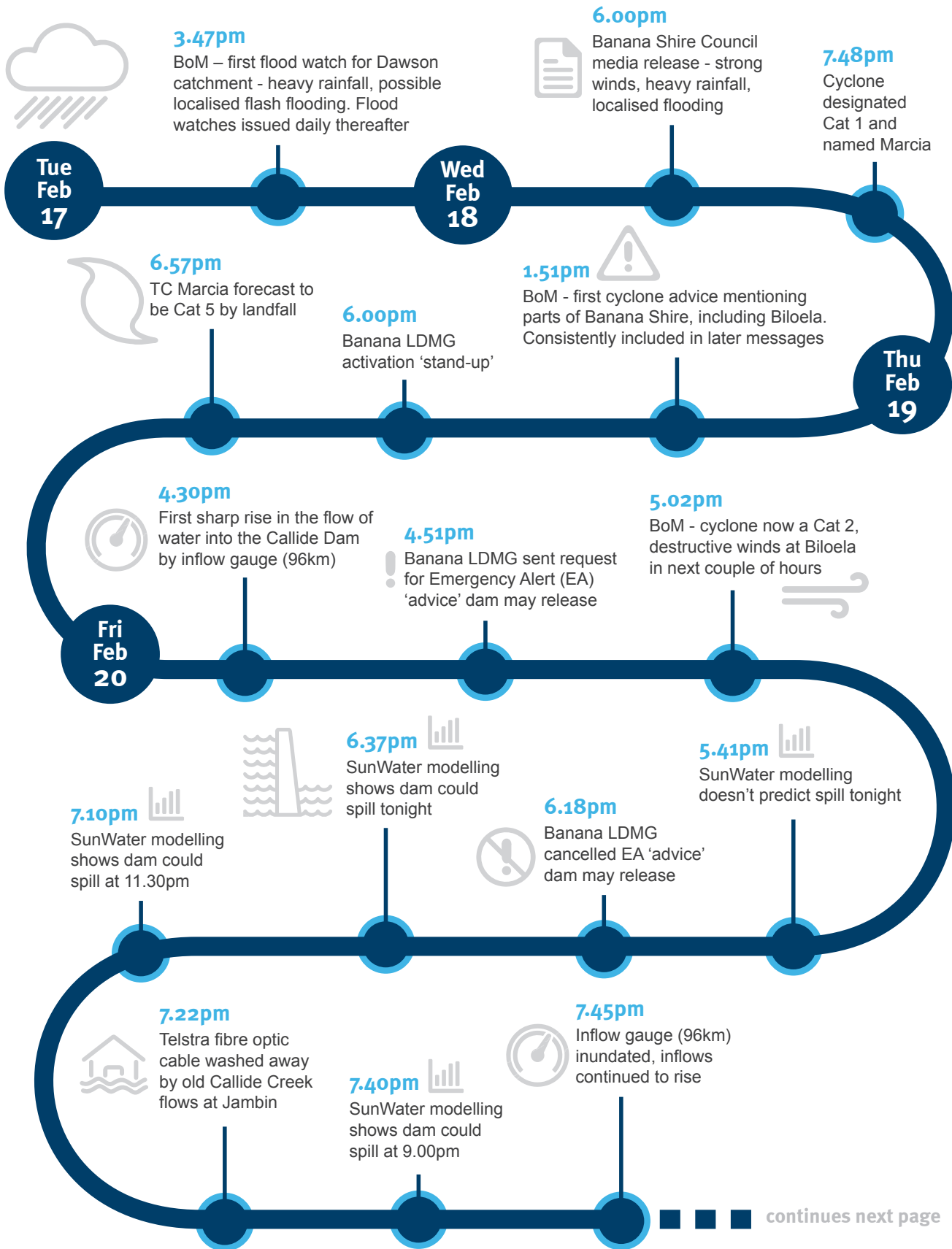
Above: Residential property inundation.
Photo by E. Barsby

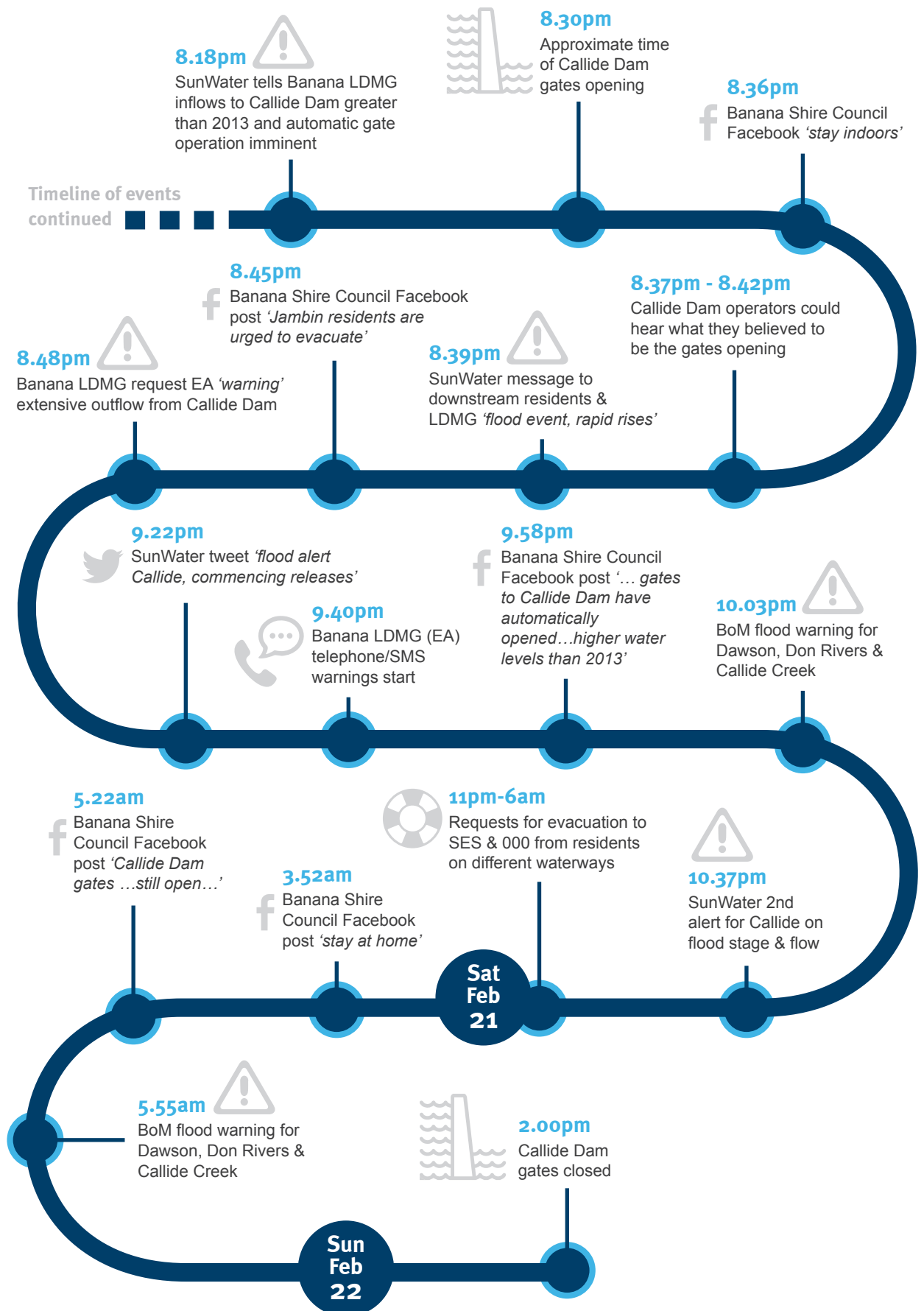




Above: Rapid Damage Assessment for the study area (note: these data are not definitive and provide an estimate of damage only). Queensland Reconstruction Authority RDA Data

Timeline of events





Summary of the Callide Creek flood event

The following summary includes key events in the lead up to, and during the February 2015 flood event. It is not an exhaustive chronology.

Cyclone forecast

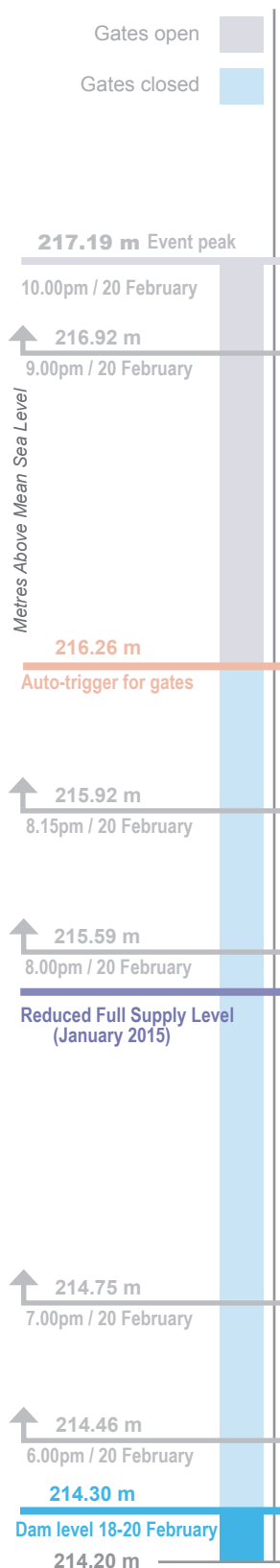
On Sunday 15 February 2015, a Tropical Low developed off the coast of Queensland.¹ The Bureau of Meteorology (BoM) forecast the Tropical Low would develop into a Category 1 cyclone bringing 200-300mm of rain from Rockhampton to the New South Wales north coast on Friday 20 February 2015.²

Wednesday 18 February 2015

On the evening of Wednesday 18 February 2015, the cyclone was designated Category 1 and named Marcia.³ The BoM issued regular updates on the cyclone and it was widely covered in print, television, radio and social media.⁴ The BoM also issued flood watches for the Dawson Catchment, which is part of the Banana Shire.⁵ These notifications mentioned the chance of flash flooding.⁶ The Banana Shire Council (the Council) issued a media release warning of heavy rainfall, localised flooding and strong winds in the Banana Shire.⁷

Many organisations and individuals began to prepare for the forecast bad weather. Disaster management groups at the local, district and state level began monitoring the weather system. At 4.00pm the Banana Local Disaster Management Group (LDMG) held its first meeting, discussing the dams, and developing a communication strategy for the event, including that it would utilise media releases, Facebook and warnings.⁸

SunWater checked its unmanned facilities, and ensured its generators and river height gauges were operable.⁹



Above: Graphic depicting indicative water levels, based on the gauge reading nearest the Callide Dam, as at the date / time of the sequence of events presented on this two-page spread.

Data from SunWater

Thursday 19 February 2015

On Thursday 19 February 2015, the agencies that are members of the LDMG were preparing individually. Queensland Fire and Emergency Services assigned swift water rescue teams to Biloela and they arrived that afternoon.¹⁰ The Queensland Police Service contacted evacuation centres, and visited vulnerable areas (e.g. aged care facilities) to check emergency action plans for evacuation.¹¹ The Department of Agriculture and Fisheries liaised with the community and primary producers about animal welfare.¹² The State Emergency Services assisted residents with sandbags.¹³

SunWater and the LDMG were in regular contact about the levels of the Callide and Kroombit dams, which were 84% and 98% respectively.¹⁴ SunWater provided reports to the State Disaster Coordination Centre (SDCC) and the dam safety regulator, the Department of Energy and Water Supply. These reports identified there was a high likelihood that the Emergency Action Plans (EAP) would be activated at both dams, meaning water would be released from Callide Dam and spill from Kroombit Dam.¹⁵

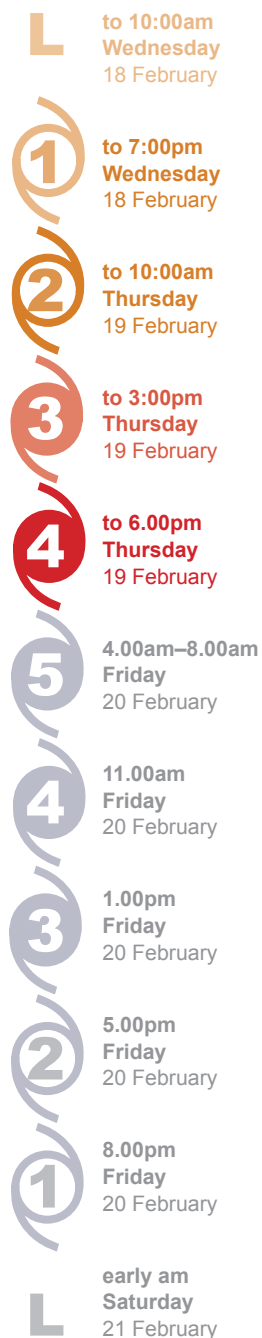
The LDMG met several times during the day.¹⁶ At its 1.00pm meeting, a SunWater representative suggested to the LDMG that if SunWater expected to release water overnight, it would activate its EAP and give the LDMG and downstream residents early advice during daylight hours.¹⁷

A risk assessment for Tropical Cyclone Marcia was prepared by Banana Shire Local Disaster Coordination Centre (LDCC) staff.¹⁸ It noted risks, including release of water from the Callide and Kroombit dams, and heavy rainfall leading to potential flooding.¹⁹ There was also concern about damaging winds and localised flooding.²⁰ The document was provided to the Council’s decision-makers.²¹ Although circulated to the LDMG,²² the risk assessment was not tabled or discussed at its meetings.²³

The Banana Shire Disaster Management Information Facebook page was updated, advising residents in low lying areas to prepare for flooding and informing them where to get sandbags.²⁴

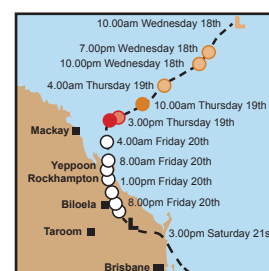
Several residents contacted SunWater to ask if it was possible to release water prior to the forecast rain.²⁵

During the day, Tropical Cyclone Marcia intensified from a Category 1 to a Category 4.²⁶ At 6.00pm, the LDMG moved to ‘stand up’ status, meaning they were fully activated with a staffed LDCC operating.²⁷



Cyclone strength (above) and position (below) at the date / time of the sequence of events presented on this two-page spread.

Bureau of Meteorology



Friday 20 February 2015

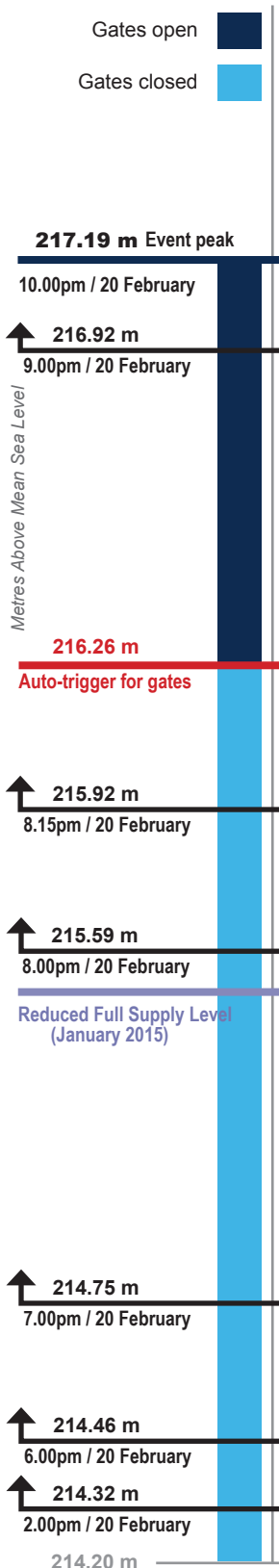
On Friday 20 February 2015 in the early hours of the morning, Tropical Cyclone Marcia was upgraded to a Category 5 system.²⁸ It was predicted to impact the Biloela area between 7.00pm to 9.00pm that night, although by that time it was expected to be a Category 2.²⁹

The BoM continued to issue flood watches for the Dawson Catchment, predicting widespread heavy rainfall of 200-300mm and possible flash flooding.³⁰ The BoM also issued cyclone warnings throughout the day, with the warning zone including parts of the Banana Shire.³¹

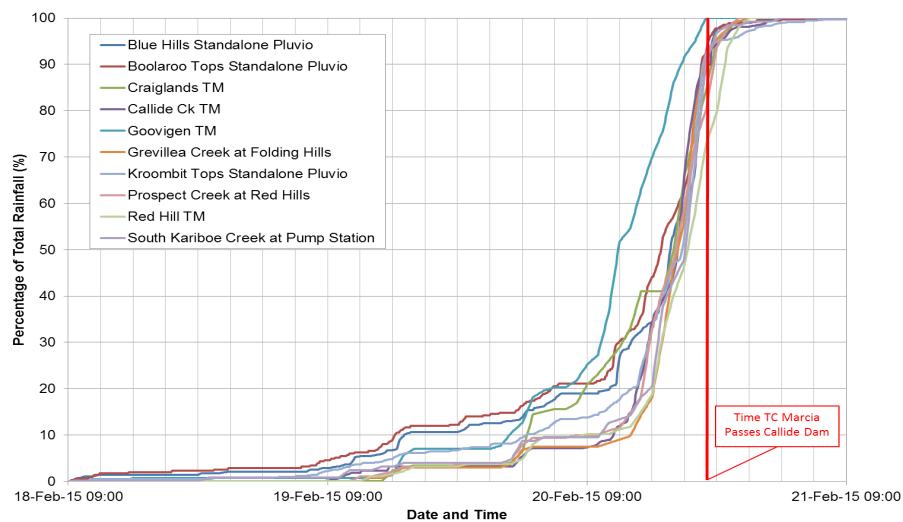
During the morning, both SunWater and the Council were posting dam-related information on social media.³² The LDCC stated that there were no issues with the water levels in the Callide Dam.³³ SunWater tweeted that its dams weren't for flood mitigation.³⁴

The LDMG had prepared draft 'trigger points' for the Callide Dam, to guide its decision making for issuing warnings.³⁵ We did not find evidence of trigger points for the issuing of warnings to the rest of the Banana Shire.

Heavy rainfall commenced at the Goovigen TM gauge from 10.00am.³⁶ From about 12.00pm, intense rainfall was recorded at the other gauges to the south of the cyclone.³⁷



Above: Graphic depicting indicative water levels, based on the gauge reading nearest the Callide Dam, as at the date / time of the sequence of events presented on this two-page spread.
Data from SunWater



Above: Cumulative normalised rainfall chart for the 24 hours from 9.00am Friday 20 February to 9.00am Saturday 21 February. BMT WBM report with Bureau of Meteorology data

4.30pm Friday

At 4.30pm the river gauge upstream from the Callide Dam showed the first sharp increase.³⁸ After stabilising for a period, the gauge showed a rapid rise from around 6.00pm.³⁹ This data was publicly available on the BoM website, with a link provided via SunWater's website.⁴⁰

4.51pm Friday

At 4.51pm, the LDCC sent a request to the SDCC for an Emergency Alert (location based SMS notification).⁴¹ The alert was intended to give early advice that the Callide Dam gates may need to be opened. There were problems with the compatibility of the map files that the LDCC sent to the SDCC.⁴² After multiple attempts to address this, at 6.18pm the LDCC told the SDCC to cancel the message before anything was sent out, saying it would soon issue a warning message.⁴³

5.00pm Friday

At the 5.00pm meeting of the LDMG, a SunWater representative said that if the rain continued in the catchment, there was every chance that the gates would open in the next 24 hours.⁴⁴ There was subsequent discussion regarding the consequences of water releases being known and that there was close, ongoing liaison with SunWater.⁴⁵

Over the course of the afternoon and into the evening, SunWater used modelling to predict the water levels and possible gate opening times for the Callide Dam. By 6.37pm, this modelling showed there was potential for the Callide Dam to fill that evening based on inflow rates, but the amount of rainfall at the time made it uncertain.⁴⁶ At 7.03pm, the LDCC was advised that the reduced full supply level trigger may be reached that evening and that the inflows were still rising, but rainfall needed to be monitored.⁴⁷ The LDCC representative asked if height and flows could be added to the SunWater SMS messages.⁴⁸

7.22pm Friday

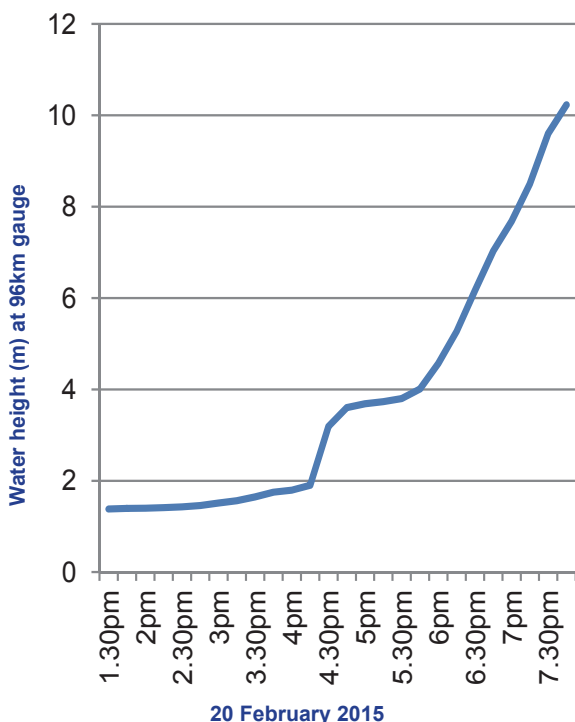
At 7.22pm, the flow in the Callide Creek (old channel) washed away a section of Telstra fibre optic cable just north of the intersection at Argoon and Jambin Dakenba Roads in Jambin.⁴⁹ This contributed to telecommunication difficulties in the Banana Shire, particularly for 3G and 4G mobile services.

7.40pm Friday

By 7.40pm, SunWater modelling showed that the Callide Dam gates could operate as early as 9.00pm.⁵⁰ The LDMG was notified at 7.52pm that gate operation would be 'within hours'.⁵¹

7.45pm Friday

The '96 kilometre gauge' that measures the inflow to the Callide Dam had been rising rapidly since 6.00pm.⁵² The gauge last read 10.231m at 7.45pm when flood water inundated the equipment.⁵³ Debris around the gauging station suggests the water level peaked above 11m.⁵⁴



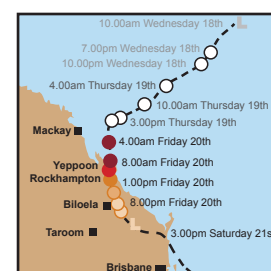
8.18pm Friday

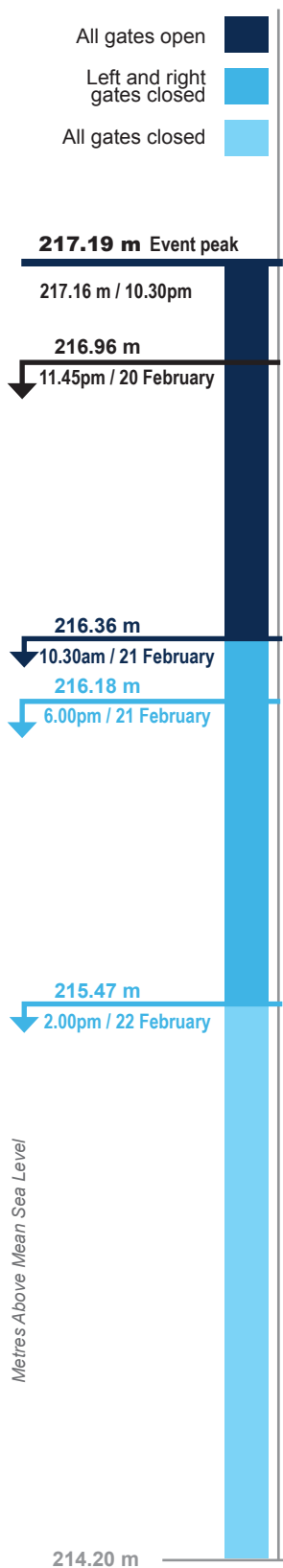
SunWater continued to update its modelling predictions for the gate opening. By 8.18pm Friday, when the LDMG called SunWater, they were told that modelling showed that automatic gate operation was imminent and that inflows to the Callide Dam were greater than those in the 2013 flood event.⁵⁵ As a result, SunWater 'activated' the Emergency Action Plan for Callide Dam and commenced the notification process.

Left: Data from gauge station 539111 'Callide Dam Inflow TM'. SunWater

- L to 10:00am Wednesday 18 February
- 1 to 7:00pm Wednesday 18 February
- 2 to 10:00am Thursday 19 February
- 3 to 3:00pm Thursday 19 February
- 4 6.00pm Thursday 19 February
- 5 4.00am–8.00am Friday 20 February
- 4 11.00am Friday 20 February
- 3 1.00pm Friday 20 February
- 2 5.00pm Friday 20 February
- 1 8.00pm Friday 20 February
- L early am Saturday 21 February

Cyclone strength (above) and position (below) at the date / time of the sequence of events presented on this two-page spread. Bureau of Meteorology





Above: Graphic depicting the progressive closing sequence of the pairs of gates on the Callide Dam as water levels began to subside from late evening on Friday 20 February.
Data from SunWater

8.30pm Friday

The Callide Dam gates opened at approximately 8.30pm.⁵⁶ The exact time of gate opening cannot be confirmed as there is no equipment connected to the gates that records this information.⁵⁷

The estimation is a theoretical calculation based on the known storage levels and the rate of rise in the storage level at the time.⁵⁸ A dam operator assumed a ‘rumble in the spillway’ between 8.37pm and 8.42pm was the sound of the dam gates opening.⁵⁹

8.39pm Friday

At 8.39pm, SunWater sent a text message warning to residents within 10km downstream of the Callide Dam who were subscribed to SunWater’s notification system.⁶⁰ SunWater also attempted to telephone 13 residents immediately downstream.⁶¹ SunWater tweeted that the dam gates were open at 9.22pm.⁶²

8.45pm Friday

At 8.45pm, the LDCC posted a Facebook warning urging Jambin residents to evacuate due to high water levels coming into the Callide Dam: ‘SunWater has advised to expect water to be released from the dam in the very near future’.⁶³ At 9.58pm the LDCC confirmed on its public Facebook page that the Callide Dam gates were open and urged people in low lying areas to self-evacuate.⁶⁴

8.56pm Friday

At 8.56pm, the LDCC provided the details for an Emergency Alert warning message via the SDCC.⁶⁵ The Emergency Alert text message to mobile phones and voice messages to landlines began at 9.40pm.⁶⁶ Delays were due to time taken to approve the message content and load the message and map into the Emergency Alert system.⁶⁷

10.03pm Friday

At 10.03pm, the BoM issued a ‘minor’ flood warning for parts of the Banana Shire.⁶⁸ This was the BoM’s first flood warning for the event.

SunWater and the LDMG continued to converse during the evening. Around 10.36pm, SunWater advised the LDMG that the Callide Dam gates had closed slightly.⁶⁹

10.37pm Friday

SunWater sent a second SMS ‘alert notification’ at 10.37pm,⁷⁰ warning subscribers within 10km downstream of Callide Dam about the escalation of the event to a Stage 4 flood, with 298,000ML per day outflow from the dam.⁷¹

Saturday 21 February 2015

Throughout the night and into Saturday morning, numerous calls were made to the LDCC, State Emergency Services and Queensland Police Service by residents seeking assistance to evacuate.⁷² Some residents spoke of rising waters being close to inundating their homes, while others already had water inside.⁷³ Many of the calls did not result in residents being evacuated. Poor weather and an inability for flood boats to navigate floodwaters to access properties were factors preventing evacuation.⁷⁴

Around 45 Jambin residents sought shelter at the Jambin State School after receiving Emergency Alert warnings. As water rose around the school, some elected to be evacuated by helicopter in the early hours of the morning.⁷⁵ Twenty-four residents were evacuated by air to the Biloela Civic Centre whilst 17 residents remained at Jambin at their request.⁷⁶

Throughout Saturday, SunWater continued to monitor the storage levels at Callide Dam and provide updates to the LDMG.⁷⁷ The gates were manually operated to allow the storage level to be safely reduced, which, by the evening, was a rate of about 40mm (storage height) per hour.⁷⁸

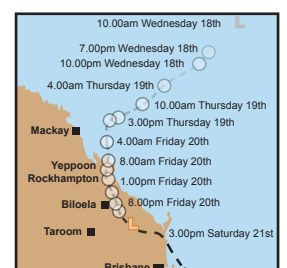
Sunday 22 February 2015

The Callide Dam gates closed at around 2.00pm when the lake level was around the normal operating level.⁷⁹ Small releases from the river valves continued in order to maintain the level of the dam.⁸⁰ At 3.41pm, SunWater advised the LDMG of the gate closure and continued minor releases.⁸¹



Cyclone strength (above) and position (below) at the date / time of the sequence of events presented on this two-page spread.

Bureau of Meteorology



Endnotes Chapter 03

1. Bureau of Meteorology, *Severe Tropical Cyclone Marcia*, 2015, <http://www.bom.gov.au/announcements/sevwx/qld/qldtc20150218.shtml>, accessed April 2015.
2. *ibid.*
3. *ibid.*
4. Bureau of Meteorology letter to Office of the Inspector-General Emergency Management dated 13 May 2015, p. 7.
5. Bureau of Meteorology, *Summary of Flood Watches 17 to 21 February 2015 and Fitzroy Flood Warnings 20 February to 25 February 2015* provided for Callide Review.
6. *ibid.*
7. Banana Shire Council, Media Release, *Stay Informed and Be Prepared*, 18 February 2015.
8. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recording, 18 February 2015, 4.00pm.
9. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 1), SunWater internal emails, pp. 50, 52.
10. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recording, 19 February 2015, 1.00pm.
11. *ibid.*
12. *ibid.*
13. *ibid.*
14. Sunwater Limited, *Callide Dam Emergency Event Report 20-22 February 2015*, EEC Communications details (Part 1), SunWater EEC email to Banana Shire LDC, p. 62.
15. SunWater Limited, Request for Information – DEWS 18 February 2015, p. 1; SunWater Limited, situation reports 19-20 February 2015.
16. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recordings, 19 February 2015, 1.00pm and 5.00pm.
17. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recording, 19 February 2015, 1.00pm.
18. Banana Local Disaster Coordination Centre (internal) email and attachment, 20 February 2015, 11.32am.
19. *ibid.*
20. *ibid.*
21. Banana Local Disaster Coordination Centre (internal) email and attachment, 20 February 2015, 11.32am.
22. Banana Shire Council email to Banana Shire Local Disaster Management Group, 20 February 2015, 3.32pm.
23. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recordings, 20 February 2015, 5.00pm.
24. Banana Shire Disaster Management Information Facebook page, 20 February 2015, 11.45am, <https://www.facebook.com/Banana-Shire-Disaster-Management-Information>, accessed April 2015.
25. Exact dates and times of most calls are not available. Media reports and interviews conducted by the review team indicate residents called SunWater as early as Tuesday 17 February 2015 and some made multiple calls during the week.
26. Bureau of Meteorology, *Severe Tropical Cyclone Marcia*, 2015, <http://www.bom.gov.au/announcements/sevwx/qld/qldtc20150218.shtml>, accessed April 2015.
27. Banana Shire Council, Media Release No 3, Banana Shire Local Disaster Coordination Centre, 19 February 2015; Banana Local Disaster Coordination Centre, Situation Report No 1, 19 February 2015, 6.00pm to 7.00pm.
28. Bureau of Meteorology, *Severe Tropical Cyclone Marcia*, 2015, <http://www.bom.gov.au/announcements/sevwx/qld/qldtc20150218.shtml>, accessed April 2015.
29. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recording, 20 February 2015, 12.00pm.
30. Bureau of Meteorology, *Summary of Flood Watches 17 to 21 February 2015 and Fitzroy Flood Warnings 20 February to 25 February 2015* provided for Callide Review.
31. Bureau of Meteorology, *Summary of Tropical Cyclone Warnings 18 February to 22 February 2015* provided for Callide Review.
32. Numerous Twitter, Facebook and web postings sighted by the Office of the Inspector-General Emergency Management.
33. Banana Shire Disaster Management Information Facebook page, 20 February 2015, 8.48am, <https://www.facebook.com/Banana-Shire-Disaster-Management-Information>, accessed April 2015.
34. @SunWaterLimited, Twitter 10.39am, 20 February, <https://twitter.com/SunWaterLimited/status/568570635930062849>.
35. Banana Shire Council email to Banana Shire Local Disaster Management Group, 20 February 2015, 3.32pm.
36. Report, *Independent Review of Callide Creek Flooding, Tropical Cyclone Marcia, February 2015*, BMT WBM, p. 51.
37. *ibid.*, p. 50.
38. SunWater Limited, 96km gauge readings 1 January 2015 to 20 February 2015.
39. SunWater Limited, Callide Dam reservoir gauge readings 19 February 2015 to 24 February 2015.
40. Bureau of Meteorology, *Latest River heights for the Baffle Creek, Boyne, Calliope, Fitzroy River and tributaries*, http://www.bom.gov.au/cgi-bin/wrap_fwo.pl?IDQ60289.html, accessed April 2015; SunWater Limited, *BOM Flood Plots and Catchment Map Links*, <http://www.sunwater.com.au/home/bom-flood-plots-and-catchment-map-links>, accessed April 2015.
41. Local Disaster Coordination Centre email to State Disaster Coordination Centre, 20 February 2015, 4.51pm.

42. Local Disaster Coordination Centre email to State Disaster Coordination Centre, 20 February 2015, between 4.57pm and 6.18pm.
43. Local Disaster Coordination Centre email to State Disaster Coordination Centre, 20 February 2015, 6.18pm.
44. Banana Shire Local Disaster Management Group, extraordinary meeting minutes and audio recording, 20 February 2015, 5.00pm.
45. *ibid.*
46. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 35.
47. *ibid.*, p. 36.
48. *ibid.*
49. Interview with Telstra, 15 April 2015.
50. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 36.
51. *ibid.*
52. SunWater Limited, 96km gauge readings 1 January 2015 to 20 February 2015.
53. *ibid.*
54. SunWater Limited, Public Submission, 17 April 2015, p. 14.
55. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 36.
56. Report, *Independent Review of Callide Creek Flooding, Tropical Cyclone Marcia*, February 2015, BMT WBM, p. iii.
57. *ibid.*, p. 114.
58. *ibid.*, p. 16.
59. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 37.
60. SunWater Limited, *Report to Support Callide Dam 2015 Flood Review Request for Documents*, 1 April 2015, p. 31; Interview with resident, 18 March 2015.
61. SunWater Limited, *Callide Dam Emergency Event Report – 20-22 February 2015*, EEC Communications details (Part 3), EEC Record of Communication, pp. 111-113.
62. @SunWaterLimited, Twitter, 20 February 2015, 9.22pm, <https://twitter.com/SunWaterLimited/status/568732488652058625>.
63. Banana Shire Council, Disaster Management Information Facebook post, 20 February 2015, 8.45pm.
64. Banana Shire Council, Disaster Management Information Facebook post, 20 February 2015, 9.58pm.
65. SunWater Limited, *Callide Dam Emergency Event Report - 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 39.
66. State Disaster Coordination Centre, *Emergency Alert log - Tropical Cyclone Marcia*, February 2015.
67. Audio recording of phone call from Local Disaster Coordination Centre to State Disaster Coordination Centre, 20 February 2015, 8.56pm; Interview with a State Disaster Coordination Centre officer, April 2015.
68. Bureau of Meteorology, *Summary of Flood Watches 17 to 21 February 2015 and Fitzroy Flood Warnings 20 February to 25 February 2015* provided for Callide Review.
69. Phone call from SunWater to Banana Shire Council, 20 February 2015, 10.36pm.
70. SunWater Limited, *Report to Support Callide Dam 2015 Flood Review Request for Documents*, 1 April 2015, p. 32; Interview with resident, 18 March 2015.
71. Interview with three residents who received SunWater warning, 15 March 2015.
72. Local Disaster Coordination Centre, *Summary for Operational Cyclone Marcia* (log of jobs), February 2015.
73. *ibid.*
74. Local Disaster Coordination Centre, *State Emergency Service tasking log*, 2015.
75. Local Disaster Coordination Centre, *Situation Report Banana Local Disaster Coordination Centre, number 6*, 21 February 2015, 4.00am-12.00pm.
76. State Disaster Coordination Centre, *State Update – 21 February 2015 0500-1100*, p. 12.
77. SunWater Limited, *Callide Dam Emergency Event Report - 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, pp. 40-41.
78. *ibid.*, p. 40.
79. Observations of dam gates log shows the gates open at 1.30pm observation, but closed at 2.10pm observation; report chronology of events has 2.00pm as the closing time; communication log of SunWater representative within the Emergency Event Report has closing time of 2.30pm, p. 41.
80. SunWater Limited, *Callide Dam Emergency Event Report - 20-22 February 2015*, EEC Communications details (Part 1), EEC Record of Communication, p. 41.
81. *ibid.*, p. 41.

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Managing dams

What is the purpose of the Callide Dam?

The Callide Dam was designed and constructed by the Irrigation and Water Supply Commission.¹ Callide Dam Stage One was constructed in 1965 to supply water to the Calcap Power Station on the Callide open cut coalfield, and to supply water to irrigators, industry and the township of Biloela.²

With the completion of Callide Dam Stage Two in 1988 (addition of radial gates), the storage capacity of the dam was more than doubled to 136,300 megalitres (ML).³ For comparison, Wivenhoe Dam's main water storage capacity is 1,165,238 ML,⁴ with capacity for flood mitigation storage of an additional 1,967,000 ML.⁵

The Callide Dam is the largest part of the Callide Valley Water Supply Scheme,⁶ owned and operated by SunWater.⁷ The Callide Weir and Kroombit Dam are the other main parts of this scheme.⁸ The dam is filled by the natural inflow from Callide Creek and by Awoonga Dam through the Awoonga-Callide Pipeline, Stag Creek, and the Stag Creek pipeline.⁹ Water is delivered from Awoonga Dam at a rate proportionate to the water used by the power stations.¹⁰ The balance of Awoonga water in Callide Dam at the end of January 2015 was 3,778ML or around 3% of the dam.¹¹

Callide Dam facts

The Callide Dam is managed under legislation as a 'referable dam' with a Category 2 failure impact rating, meaning more than 100 people are at risk if the dam fails.

As a water supply dam, there are constraints on removing water from the Callide Dam, as water security for end users needs to be maintained.

How does SunWater operate?

*'SunWater is a bulk water infrastructure developer and manager owning and managing around \$7 billion in water infrastructure assets and supplying approximately 40 percent of all water used commercially in Queensland.'*¹²

*'SunWater was established as a statutory Government Owned Corporation (GOC) in 2000 under the Government Owned Corporations Act 1993.'*¹³

In 2008, SunWater transitioned to a Company GOC under the *Corporations Act 2001* (Cth) and is registered as SunWater Limited ACN 131 034 985.¹⁴ The Treasurer and the Minister for Energy and Water Supply are Shareholding Ministers of SunWater on behalf of Queensland.¹⁵ Ministers are responsible to Parliament¹⁶ for the operation of all Government Boards and agencies within their portfolios. An *'important performance target for GOCs is to maximise the commercial return to the owners of the business – the Queensland community.'*¹⁷

SunWater has different water pricing arrangements for different user groups.¹⁸ The Queensland Government decides the prices that SunWater can charge its irrigation customers.¹⁹ The prices are recommended independently by the Queensland Competition Authority.²⁰

Each local government individually agrees on its water prices with SunWater.²¹ Industrial customers, such as mining companies, similarly agree on water prices with SunWater on an individual basis.²²

How do the gates on the Callide Dam work?

Full Supply Level

The Full Supply Level or FSL is the maximum operating water surface level of a reservoir when not affected by floods.

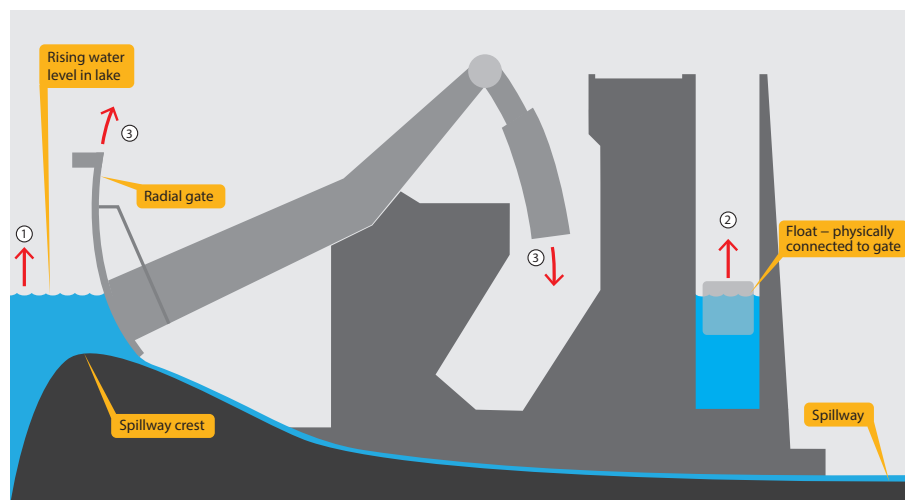
The regular FSL for the Callide Dam is 216.1 metres and 136,300ML of water.

The Callide Dam is currently operating under a reduced FSL due to works being carried out on the embankment.

The reduced maximum operating level was adjusted in January 2015 from a reduced FSL of 215.1m to 215.5m.

Callide is an earthfill dam with radial gates.²³ The spillway is fitted with gates that are designed to open automatically using a float system.²⁴ That is, when the storage reaches 0.159m above the full supply level (FSL) of 216.1 metres, the gates begin to open by being pulled up.²⁵ The gates continue to open as the storage continues to rise.²⁶ The gates lower as the inflows reduce.²⁷ The system is designed to pass the flows from upstream through the dam.²⁸ The gates operate this way to protect the integrity of the dam structure from water rising above the FSL.²⁹ The gates minimise the risk of ‘overtopping’ the dam.

The gates can be opened manually. This is a multi-step process that must be operated from the spillway bridge above the gates.³⁰ The gates must be constantly monitored through manual operations.³¹ Incremental adjustments are made at the direction of a technical specialist who would generally not be onsite.³² The gate opening rates are currently designed to operate the dam in the same manner as automatic opening.³³ That is, manual gate openings aim to match the outflow to the inflow, in order to maintain the lake level and protect the integrity of the dam, thereby minimising the risk to residents from dam failure.



Right: Schematic diagram of the operation of the Callide Dam gates.
SunWater

Figure showing simplified schematic of radial gates

The Callide spillway gates are configured to respond to rising storage levels. The gates have a series of chambers and counter weights that are connected to the water in the storage. Once the water level in the storage rises above the FSL the gates will begin to open.

If the water level continues to rise (1) the gates will continue to progressively open (2 & 3) until the discharge matches inflows and the storage level stabilises. The rate of gate opening is a function of the rate of rise of the storage. The gates do not rely on any computer or electrical control equipment to function.

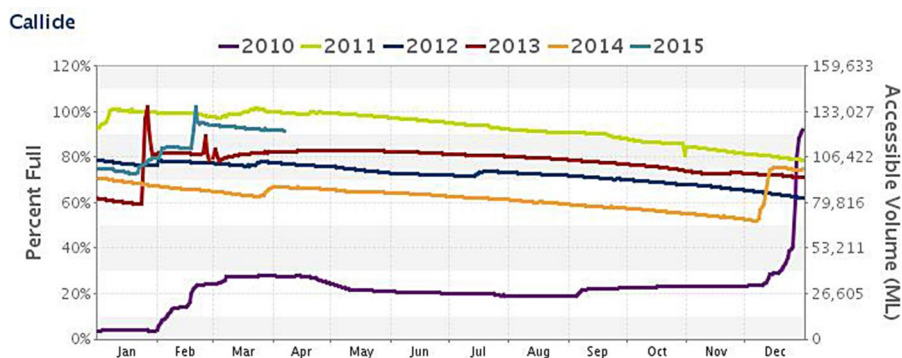
Can the Callide Dam be operated differently?

‘...you can decide that a dam like the Callide dam will become a dual-purpose dam and in that case its capacity for supplying irrigation water will be substantially reduced and the prosperity of the area will reduce accordingly and that’s the price that people would pay for having less storage compared to the risk they take of getting flooded from time to time.’³⁴

The question of whether the Callide Dam can be operated differently, to include any effective flood mitigation potential, is one that needs to be definitively answered through proper analysis. The Callide Dam is part of the way in which water is managed according to the sustainability requirements for the whole Fitzroy Basin.³⁵ Legislated sustainable management of water recognises, and attempts to balance, the many competing interests for the resource.³⁶

There are also several practical considerations for releasing water from Callide Dam, including:

- The potential exacerbation of flooding downstream as flows meet other watercourses, or rainfall occurs downstream coinciding with released water.³⁷ As one resident said:
 - > *'I believe it would have put more water down my end. We live right on the bottom end of Callide Creek, there are seven major creeks that feed the water that comes past our place and a bit further down there are two other major rivers from Mt Morgan way. If Callide Creek is pre-charged that's just going to back water up and add to the water. Releasing water from the dam is just going to add to the problem down the line. If they let water out early the creeks down around us will all peak at the same time.'*³⁸
- The ability to predict the impact of released water, which in the case of Callide Dam, is limited by:
 - > the uncertainty of rainfall forecasts and the temporal and spatial (when, where and how much) variability of the rainfall, both upstream and downstream of the dam.³⁹ The Department of Energy and Water Supply (DEWS) points out that *'even after many years of research and model development, rainfall forecasts are still not regarded as being reliable enough to confidently allow pre-emptive releases from Queensland's three, statutorily-declared, flood mitigation dams.'*⁴⁰ (refer also Operational Information and Intelligence: Bureau of Meteorology)
 - > the absence of a calibrated, finalised model for Callide Dam⁴¹ (see Hydrology Report)
 - > insufficient flood mapping for downstream areas⁴² (refer also Planning: Banana Shire Council)
 - > too few gauges in the catchment to monitor rainfall and creek levels to assist forecasting/modelling⁴³ (refer to: Operational Information and Intelligence: Bureau of Meteorology).
- The variable nature of rainfall and periods of drought. As the DEWS notes, *'[the] Callide Valley is a catchment that has a long history of low rainfall (noting Callide Dam did not fill until 2011 and Kroombit Dam ran dry) broken by floods caused by tropical cyclones, whether or not it is a wetter than normal season.'*⁴⁴



Left: Callide Dam storage levels, 2010–2015.

Bureau of Meteorology
Water storage Callide Dam

Rules for releasing water

The operation of the Callide Dam must consider the sustainable management of the wider Fitzroy Basin, in accordance with the *Water Act 2000* (Qld) and the *Fitzroy Basin Resource Operations Plan* (September 2014). The dam operator is bound by legislation to ensure it can deliver water allocations to end users, such as irrigators, industry and the community.⁴⁵ The sustainable management of the Fitzroy Basin takes into account ecological factors, as well as broader economic and social factors. The competing demands for water for industry, drinking water, the environment, irrigation, cultural uses, and recreation, among others, must be balanced using the rules set down by legislation.⁴⁶

The competing interests for the Callide Dam water were highlighted in the *Review of the Callide Dam Gate Operations in the January 2013 Flood Event*, which was completed by Water Solutions.⁴⁷ The report stated that any changes to incorporate an active flood mitigation purpose to the dam would need to carefully consider several competing and complex issues, one of which is the performance of water allocations to the Callide Valley.⁴⁸

SunWater responded in a letter to the DEWS:

*'... it is noted that the report explores a number of actions that could be taken to enable Callide Dam to provide more active flood mitigation. Callide Dam is a water supply dam only. It is also noted that the Banana Shire Council does not have any flood mapping or flood damage curves. Without such base information it would not be possible to assess the benefits (if any) of flood mitigation. SunWater does not intend to undertake any studies for flood mitigation.'*⁴⁹

At the time, the Banana Shire Council (the Council) was supportive of the dam being used for water storage to its maximum capacity. On 7 June 2013, the Council Mayor wrote to SunWater seeking:

*'repairs to the water leak at Callide Dam as a matter of urgency to allow the dam to retain 100% water capacity ... for too long Biloela and district has suffered from the Callide Dam having insufficient water ...'*⁵⁰

SunWater responded to the Council by outlining that the reduced FSL was purely for the purpose of ensuring dam safety and would be regularly assessed.⁵¹ Dam safety is yet another vital consideration for the sustainability of the resource, and the protection of the downstream community.⁵²

Since the 20 February 2015 flood event, SunWater's CEO has said that to *'... change those rules would require ... significant consultation and I imagine that will be something which we will be looking at closely after this event.'*⁵³

Increasing flood mitigation potential

Water supply dams can be modified, either structurally or through management practices, to support flood mitigation.⁵⁴ Structural modifications, such as raising the walls, require extensive modelling, consultation and capital expenditure.⁵⁵ Management practices include 'fixed' or 'variable airspace management'. This involves release of certain amounts of water from a dam before a wet season or a rainfall event based on modelling and weather predictions.

The amount of flood mitigation a dam can provide depends on a number of factors including:

- the size of the flood event
- the catchment size
- the level of water in the dam at the beginning of the event
- the capacity of the reservoir to store floodwaters above its FSL
- the area of uncontrolled catchment downstream of the dam
- the discharge capacity of the spillway.⁵⁶

Variable airspace management

'Variable airspace management' is used by authorities within South Australia and New South Wales on water supply dams, such as the Dartmouth, Blowering and Burrinjuck.⁵⁷ Queensland uses a type of variable airspace management for the three flood mitigation dams: Wivenhoe, Somerset and North Pine.⁵⁸ State Governments, in conjunction with advice from the Bureau of Meteorology, make decisions to pre-release water from the dams under conditions to ensure the security and continuity of water supply for end users is maintained. In New South Wales, one condition of mitigating floods through variable airspace management is that the water entering the dam from the event or season must replace the amount released.⁵⁹ This has not always worked well.⁶⁰ If water supply conditions cannot be met, State Governments can be required to compensate end users for changes to water allocations.

In Queensland, the statutory process for temporarily lowering a flood mitigation dam allows the Minister to make decisions to respond to seasonal rainfall forecasts.⁶¹ This process does not apply to water supply dams. According to the DEWS, the process takes about six to eight weeks including consultation and preparation of advice to the Minister, making it unsuited to lowering dam levels for imminent rainfall forecasts.⁶²

As part of this process, approval needs to be sought from the Department of Natural Resources and Mines (DNRM) for departure from normal operating protocols by submitting an 'interim program' to the Chief Executive of DNRM.⁶³ This may be done at short notice by the DNRM, and SunWater has experience in preparing interim programs for approval.⁶⁴ In the past, interim programs have been used for temporarily lowering Wivenhoe Dam, and to address periods of water shortage in the Fitzroy Basin.⁶⁵ Approval still requires evidence to support that the benefits of releasing water are likely to outweigh the risks. As the DNRM told us:

*'It would be unusual and potentially risky to be making ad hoc decisions to pre-emptively release water from a dam at short notice without doing significant pre-assessment on the risks (both in terms of downstream flooding and to water supply reliability). Proactive communication with potentially affected parties, and consideration of the potential implications for such parties, would ordinarily be prerequisite to any decision by DNRM's Chief Executive to approve an interim program.'*⁶⁶

There are also a number of legal steps that need to be undertaken by SunWater, with the discretion of their Shareholding Ministers, which adds significant time to the process before SunWater can submit an interim program.⁶⁷

Considering the options

Considerations for changing the purpose of the Callide Dam to include active flood mitigation are complex, which means decisions must be informed by comprehensive data collection and analysis. Attempting to balance the conflicting interests of stakeholders also requires extensive consultation and study. The DEWS estimates that the process for the Callide Dam to be considered as a flood mitigation dam under the *Water Supply (Safety and Reliability) Act 2008* (Qld) could ‘take over three years’.⁶⁸ According to the DEWS, the first stage is a comprehensive analysis of the costs and benefits of making Callide Dam a flood mitigation dam, which could take approximately one year. As an example, optimising the existing operations of Wivenhoe Dam took more than two years to complete.⁶⁹ If the Government decided that Callide Dam should be a flood mitigation dam, then a range of activities would need to be undertaken to improve the effectiveness of flood mitigation operations. This may involve significant structural changes to the dam, which could take two to three years to complete, depending on the magnitude and complexity of those changes.

Finding 1

There is currently insufficient information available to allow a fully informed decision on the use of Callide Dam to provide more active flood mitigation than its original design.

Recommendation 1

The Department of Energy and Water Supply and SunWater undertake the necessary studies to determine whether or not it is feasible to operate Callide Dam as a flood mitigation dam. Such studies should include matters in relation to, but not limited to:

- The effect on the Callide Valley Water Supply
- Dam safety issues
- Actual mitigation outcomes
- Cost-benefit analysis of alternative strategies
- Alternative means of effecting improved community outcomes.

The results of this work should be made public to enhance public knowledge and provide confidence regarding dam operations.

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Managing floods in Queensland

Floods as a hazard

floodplain management

*'Management of flood risk is essential to limiting the impacts of flooding on the community in balance with maintaining the benefits of occupying the floodplain to society and the benefits of flooding to the environment.'*¹

Understanding flood risk

Maps are often produced to highlight flood risk areas and to support decision-making about land use planning, community education and disaster management (including dam operation).

Residents can also access information on the possible flood risks to their properties as part of conveyancing, by contacting council, or searching for available flood studies on the Queensland Reconstruction Authority's Floodcheck online interactive maps.² The Callide Valley Flood Risk Study was completed for the Banana Shire Council (the Council) in 2010 and includes general flood maps.³ This study can be found through the Council's website or Floodcheck.⁴ The maps in this flood study are not designed to identify possible impacts at a property level.⁵

Flood events are often compared to:

- a 'flood of record', which is the highest recorded flood for a location
- the 'probable maximum flood event' for a location, which is the largest flood that could conceivably occur at a particular location, based on factors such as flood producing weather conditions.⁶

Floods of any magnitude can occur at any time. For example, a '1 in 100 year flood' has an Annual Exceedance Probability (AEP) of 1%, meaning there is a 1% chance of a flood of that magnitude occurring in any given year.⁷ According to our survey of Callide Valley residents, most feel confident that they understand the risk of flood to themselves or their properties (91%, n=369).⁸

Floodplain and flood risk management

Responsibility for flood risk management generally rests with local governments, because they are the major service provider to communities and are responsible for managing local development.⁹ Responsibility for floodplain management is more complex. Governance of floodplain management in Queensland is dispersed across various state-level agencies, including:

- Queensland Reconstruction Authority
- Department of Infrastructure, Local Government and Planning
- Department of Natural Resources and Mines
- Department of Energy and Water Supply
- Department of Science, Information Technology and Innovation
- Queensland Fire and Emergency Services.

As noted in a recent review by PricewaterhouseCoopers (PwC), floodplain management arrangements in Queensland are ‘*complex, with responsibility for key activities spread across a range of entities and levels of government*’.¹⁰

Legislation dealing with floodplain management in Queensland covers issues ranging from planning and corporate responsibility to emergency response. The principal Acts are:

- *Sustainable Planning Act 2009* (Qld)
- *Local Government Act 2009* (Qld)
- *Disaster Management Act 2003* (Qld).

The Queensland Reconstruction Authority has produced two floodplain management guidelines to help councils better align floodplain management and land use planning.¹¹

Effective and strategic floodplain management is important for the long-term ecological, social, and economic sustainability of Queensland.¹² Domestic and international post flood-event reviews often include floodplain management discussion and recommendations.¹³ While these reviews include similar suggestions and recommendations about the ways in which responsibility for floodplain management could be more effectively shared and implemented, actioning these approaches is not commonplace.

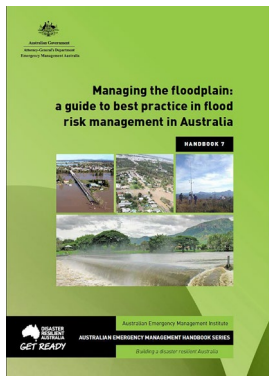
In its recent review, PwC found that Queensland can improve its approach through focusing on the best practice roles and responsibilities designated to state governments in the *Managing the Floodplain* Emergency Handbook produced by the Commonwealth Attorney-General’s Department.¹⁴

The PwC report also found that local governments vary in their ability to discharge their floodplain management roles and responsibilities.¹⁵ Financial capacity and exposure to flood risk are key factors that affect local governments’ capability in this regard.¹⁶

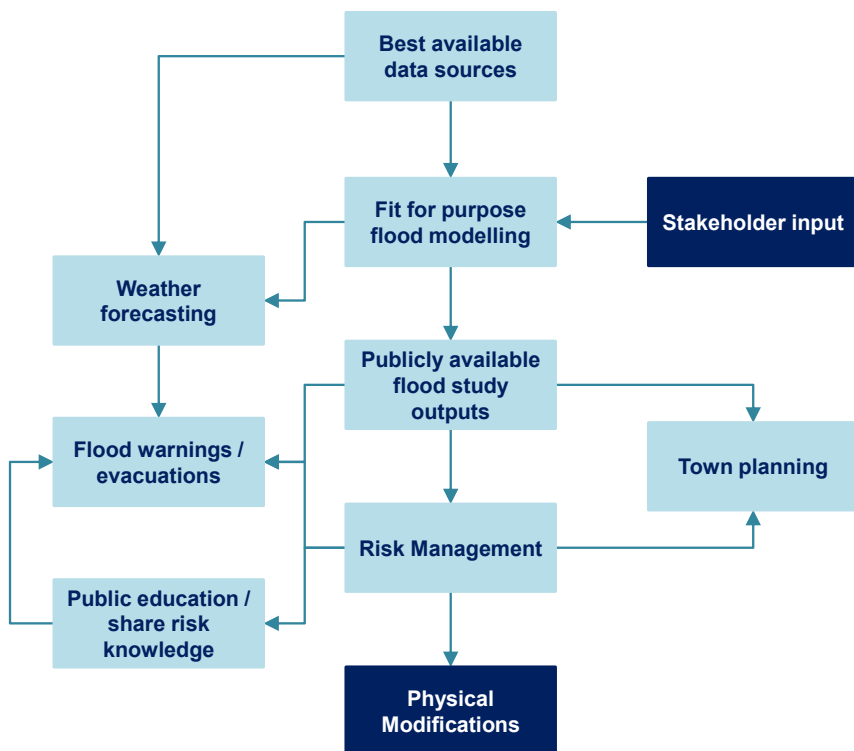
An integrated approach to floodplain management is required for optimal outcomes.¹⁷ As a key player in floodplain management, local government must partner with the community (including infrastructure owners) to develop a shared understanding of risk and risk tolerance.¹⁸ This must inform and enhance mitigation strategies.¹⁹

There are many components to effectively managing floodplains in order to reduce the impact floods have on the people living on them. Some flood mitigation approaches, like emergency warnings, are dependent on other parts of flood risk management being addressed in a comprehensive way. For example, warnings are more effective if local government issues them to the people at risk, and those people understand their personal risk, as well as their options for minimising their risk (e.g. evacuate, sandbag).²⁰

Where any of the components are significantly lacking, such as an absence of reliable data, the effectiveness of other mitigation strategies will be impaired.²¹ We developed the following diagram to illustrate the components of flood risk management that we have considered in our review (light blue boxes), and the major elements that we didn’t (dark blue boxes – physical modifications include levies, drainage, raising existing dwellings, improving evacuation routes and so on):



Above: ‘*Managing the floodplain*’ handbook.
Commonwealth of Australia



Left: Aspects of flood risk management considered in the IGEM review (light blue).
Inspector-General Emergency Management

The Council has taken some steps to improve its management of flood risk, however much more is needed. The Council needs access to recent and comprehensive flood studies in order to progress. Without them, there cannot be certainty that the controls in place for town planning and building codes will be sufficient. We found that there is opportunity for the Council to be more active in community engagement and education activities about disaster management and to improve the sharing of risk information.²² Detailed discussion on flood risk mitigation components may be found in the Planning, Public Engagement and Communications, Operational Information and Intelligence, Warnings and Evacuations sections of this report.

Finding 2

Improved policy coordination of flood risk management would support councils to develop better flood risk management and town planning.

Recommendation 2

Banana Shire Council investigate means to prioritise the commissioning of a fit-for-purpose flood study for high-risk areas across the Banana Shire to better inform flood risk management, including improved town planning. The outcomes of such a study should be available to the public and inform flood awareness campaigns, flood warnings, and building approvals.

Floods as disasters

disaster

*'is a serious disruption in a community, caused by the impact of an event, that requires a significant coordinated response by the State and other entities to help the community recover from the disruption.'*²³

The Queensland approach to managing disasters

Disaster management means arrangements about managing the potential adverse effects of an event, including, for example, arrangements for mitigating, preventing, preparing for, responding to and recovering from a disaster.²⁴ Every state and territory in Australia has a different set of arrangements for disaster management. In Queensland, the following key documents explain how disasters should be managed:

- *Disaster Management Act 2003* (Qld)
- *Emergency Management Assurance Framework*²⁵
- *State Disaster Management Plan*²⁶
- *Disaster Management Strategic Policy Framework*.²⁷

Floods are one of the multiple hazards that local governments are required by law to manage in their local government area.²⁸ Many other entities share responsibility for different parts of disaster management.²⁹

The main entities with roles or interests in local disaster management form a group to assist each local government to coordinate its efforts. This is the Local Disaster Management Group (LDMG).³⁰ The LDMG meets throughout the year, and more regularly when a disaster happens. Members of the LDMG should help the Council write the Local Disaster Management Plan (LDMP) to develop a shared understanding of roles and responsibilities, as well as the capabilities of group members.³¹

Even with the combined efforts of the LDMG members, at times the capacity of the LDMG is exceeded by the demands of an event. A request for assistance is then made to the district level, which is the next level of the disaster management arrangements.³² The District Disaster Management Group (DDMG) is chaired by a senior police officer.³³ Membership of the DDMG is predominantly from state government agencies but includes representatives of local governments within the disaster district and some utility providers.³⁴ The resources the DDMG coordinates are generally at the regional level, but sometimes from other local government areas. At times, the DDMG's capacity is also surpassed and so a request for assistance would be escalated to the state level.³⁵ The state can request assistance from the Commonwealth in extreme cases.³⁶

disaster operations

*'...means activities undertaken before, during or after an event happens to help reduce loss of human life, illness or injury to humans, property loss or damage, or damage to the environment, including, for example, activities to mitigate the adverse effects of the event.'*³⁷

Disaster operations

Disaster operations covered in this review are limited to those in the Terms of Reference. Due to the importance and complexity of each of the areas covered, we focus on each in turn:

- Disaster Management Planning and Preparedness
 - > planning, including hazard identification and risk management
 - > public engagement and communications
- Disaster Management Response
 - > operational information and intelligence
 - > warnings
 - > evacuations
 - > telecommunications infrastructure.

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Disaster management planning and preparedness

Planning

planning process

*'The collective and collaborative efforts by which agreements are reached and documented between people and organisations to meet their communities' emergency management needs; a sequence of steps that allow emergency management to take place.'*¹

Effective planning

Hazard identification and risk assessment are fundamental to effective disaster management and are the basis for planning and programs.² Identification of hazards and assessment of risks should occur regularly and build upon lessons learned, experience, training and exercises.³ Planning must be based on the best available information and up-to-date data, including risk assessments.⁴ Effective risk assessments will identify specific roles for all phases of disaster management, and consider all types of events,⁵ including those hazards caused by human intervention and naturally occurring events.⁶

Disaster management planning is effective when all entities work conjointly.⁷ Many different types of entities, including councils, emergency services, community groups, critical infrastructure owners, and the community need to be involved in deciding how to manage risks, and how responsibility will be shared when responding to disaster events.⁸ This requires agreement about how the entities can eliminate, avoid or substitute risks, or transfer residual risk.⁹ Collaborative planning supports effective response where duplication of effort or gaps in service to the community are minimised.¹⁰

A thorough risk-based planning approach will consider unintended consequences, inform and prioritise risk reduction activities and hazard mitigation strategies.¹¹ For example, land use planning is a fundamental flood mitigation strategy that must be based on risk assessments, and in particular, flood risk studies, to be effective.¹² The diagram below shows how land can be zoned based on flood risk to reduce the impact of flood on communities.¹³



Left: Land use zoning based on flood risk can reduce the community impact of flood.

Illustration courtesy of WMAWater

All entities, including the community, must be clear on their responsibilities to minimise risks, or to reduce the impact of disaster events.¹⁴ To do this, everyone must understand the risks and options for risk reduction.¹⁵ Communities and other stakeholders rely on risk assessments and hazard identification products to be readily accessible.¹⁶ Plain language explanations of the risks and clear expectations of different responsibilities are necessary.¹⁷

The strategies used to deal with risks will inform the disaster operations of the entity, including provision of public information and warnings.¹⁸ In order to achieve risk-informed disaster operations, effective planning must:

- communicate disaster management priorities (e.g. identify vulnerable people and mechanisms for their protection)¹⁹
- ensure agencies work together to develop the plan; planning must be a process and not just a product²⁰
- provide linkages between the plan and the entity's core business, with clear identification as to who will complete a certain function (e.g. evacuation)²¹
- clearly articulate an entity's capability and escalation points (e.g. the plan identifies when further assistance may be required)²²
- encompass exercises and training²³
- identify what needs to be done and allocate responsibility to people or groups.²⁴

Banana Shire Council

Local Disaster Management Plan

We found that the Banana Shire Council's (the Council) Local Disaster Management Plan (LDMP) could be improved through an integrated risk-based planning process. Increased stakeholder engagement in the planning process would reduce the likelihood of omissions and identify circumstances where the disaster response capacity of the Local Disaster Management Group (LDMG) would be exceeded.²⁵ Importantly, this process would allow for the identification of circumstances where a request for assistance would be generated.

While the LDMP outlines the roles and responsibilities of the agencies that are 'core members' of the LDMG, there is a need to expand the roles of 'advisory members'.²⁶ This includes SunWater, which has a support agency role for specific hazards in *Part II - Local Disaster Management Group* of the LDMP, but no clear responsibilities even though a number of its dams are identified as hazards in another part of the LDMP.²⁷ Advisory members are not involved in planning, nor do they agree to what role or responsibilities they offer.²⁸ Without agreement during the planning process, there is a risk that mismatched expectations will result in gaps or duplication of service to the community.

Hazard identification and risk assessment

Part III - Disaster Risk Assessment of the LDMP addresses hazard identification, risk assessment and risk treatment.²⁹ In 2012, the Council commissioned a *Natural Hazard Risk Assessment* report from private sector risk analysts.³⁰ This forms the basis of *Part III* of the LDMP.³¹

Part III – Disaster Risk Assessment of the LDMP identifies a total of 20 known hazards to the Banana Shire, including major hazards of cyclone, dam failure, East Coast Low pressure systems and flood.³² These hazards are discussed generally, which does not contribute to a comprehensive understanding of risk. For instance, cyclones are noted to be a high risk that ‘can cause flooding in any of the rivers’.³³

The LDMP identifies flood risk as medium to high, noting that sustained rainfall events can cause moderate to major flooding in different parts of the Banana Shire.³⁴ The ‘flood’ section of the LDMP is restricted to the Dawson and Fitzroy river systems and does not reference the numerous creek systems that also pose a flood risk to residents.³⁵ The LDMP also identifies risks of flooding from the Callide and Kroombit dams.³⁶ The generalised nature of the LDMP’s descriptions of hazards may not sufficiently articulate the risks to the community.

The LDMP is readily available on the Council website.³⁷ The publicly available version of *Part III – Disaster Risk Assessment* does not include:

- *Annexure A – Risk Register*,³⁸ which details projected impacts of natural disasters to the people, environment, economy, infrastructure, the community as a whole and the governance of the Banana Shire; or
- *Annexure B – Risk Treatment Plan*,³⁹ which outlines treatment strategies for identified risks.

Releasing these annexures publicly could promote greater community understanding of local risks. This is because these annexures provide more detailed information about discrete areas of risk throughout the Banana Shire.

Part IV – Capacity Building of the LDMP outlines that the Council, in conjunction with the LDMG and other agencies, will provide detailed explanations of particular hazards to the community.⁴⁰ *Part IV* also indicates that the community will be provided with information about practical measures residents can take to prepare for, or mitigate effects of, a disaster.⁴¹ We did not find evidence of either of these capacity building strategies occurring and think there is opportunity to better inform and prepare the community if these strategies are strengthened.

Flood modelling and mapping

Effective flood models and maps are an important tool to enable councils to identify, understand and mitigate risks associated with flooding.⁴² The Council’s efforts in respect of flood modelling and mapping have been limited.

The *Callide Valley Flood Risk Study* was completed in 2010.⁴³ The study includes general flood maps, but possible impacts from flooding to properties are not included. The objectives of this study were to:

- Assess flood inundation due to riverine flooding of the major creeks within the Callide Valley
- Determine flood hazards and vulnerabilities relating to infrastructure and communities
- Identify risk mitigation approaches.⁴⁴

Improving the *Catchment Management Plan* is one of the risk treatment strategies identified in the Council’s *Risk Treatment Plan*.⁴⁵ The purpose of the strategy was ‘to identify and prioritise actions to reduce potential adverse impacts of flooding’.⁴⁶ This project was identified as being beyond the Council’s capacity and budget, so further study was not undertaken.⁴⁷

The Council also attempted to undertake a flood study for the Dawson River.⁴⁸ The Council obtained state government funding for the project in 2010/2011.⁴⁹ In November 2013, the Council sought an extension of time from 31 January 2014 to 31 December 2014 to complete the project.⁵⁰ At this point, the Council had not actually put out a tender for the project.⁵¹ An extension was granted, but only until 30 June 2014.⁵² Consequently, the Council only partially completed the project.⁵³

The Council has cited '*budget restraints*' as an underlying factor that affects its prioritisation of mitigation and planning activities.⁵⁴ While this is, of course, a fundamental concern for the Council, it does not explain why projects partially funded from sources external to the Council, such as state government, were not completed.

The Council has told us that a new flood study was approved in February 2015 after protracted negotiations.⁵⁵ A fit-for-purpose flood study will enable the Council to more effectively identify and prioritise actions to reduce potential adverse impacts of flooding.⁵⁶ This includes an opportunity for the Council to produce more information for the community about the risks of floods.

We suggest that the excellent materials about flood risks produced by other councils be examined and leveraged by the Banana Shire. For instance, the Southern Downs Regional Council has three *Emergency Action Guides* available for Warwick,⁵⁷ Stanthorpe⁵⁸ and Killarney.⁵⁹ These are available online and provide good information about flooding, flood history for the area, how to prepare and respond, the Bureau of Meteorology (BoM) warnings, and explanation of the flood severity classifications for the area.⁶⁰ They also include flood evacuation maps showing the flood extent linked to different river gauge heights.⁶¹ Further, they identify which properties will have yard flooding or flooding above floor level, depending on the river gauge height.⁶² These publications are a good example of how detailed flood studies can be transformed into accessible, cost-effective and easily understood public information.

Another example comes from the Bundaberg Regional Council, which has developed a sophisticated interactive mapping system that is linked to river gauge heights for the Burnett River.⁶³ The Bundaberg Regional Council also offers static maps⁶⁴ with versions available to the public that are easy to use and interpret. Users of the interactive site can select different stream gauges along the river, choose a gauge height and see the likely flood extent in relation to their property.⁶⁵

Town planning

As a primarily rural local government area, the Council has basic controls for town planning. The *Natural Hazard Risk Assessment* report prepared for the Council in 2012 outlines existing preventative and preparedness controls for flood risks.⁶⁶ Controls include: land use and building restrictions, such as zoning, removal of existing buildings, establishing minimum floor levels, and raising buildings.⁶⁷ Lessons identified from previous events, along with information available in the *Natural Hazard Risk Assessment* report appear to have informed town planning for Taroom and Theodore, where minimum floor heights are set for new developments.⁶⁸ Elsewhere, rural zoning allows for self-assessment and private certification, which may limit the contact a property owner has with the Council.⁶⁹

Under the existing planning scheme, the Queensland Reconstruction Authority maps are the main source of information on past flood areas (in the form of a map overlay).⁷⁰ The Council adopted the use of these maps in December 2011.⁷¹ We have been told though, that these maps are not available in high enough resolution to enable the identification of flood levels expected for particular properties.⁷² All flood maps to inform town planning are available to the public via the Queensland Reconstruction Authority website. The Council provides a free planning enquiry and pre-lodgement service to property owners that would connect people with available flood maps, should they seek this assistance.⁷³

The Council is presently pursuing amendments to its planning scheme, to align with the *Sustainable Planning Act 2009* (Qld). This is done through the Department of Infrastructure, Local Government and Planning (DILGP). The Council's proposed plan has been in draft form for nearly two years, although this is not unusual for local government planning schemes.⁷⁴ While it is for the DILGP to assess the appropriateness of the Council's proposed revisions, we note that the Council's proposal appears to include some improvements on its existing land use planning arrangements, including:

- Flooding is more prominently highlighted
- Floor heights are based on either being (a) above 1% Annual Exceedance Probability (AEP) flood height (i.e. a 1 in 100 year flood), or (b) the highest part of the site (if the 1% AEP flood height is unknown).⁷⁵

The absence of flood modelling will still impact the proposed plan, as there will continue to be a reliance on local knowledge about previous flood heights rather than the ability to use more accurate data to inform planning decisions.

Other strategies

A register of people at high-risk of impact from a disaster was suggested as a risk treatment strategy, but the Council did not pursue this due to concerns about privacy laws.⁷⁶ We found no evidence to suggest that this decision was based on legal advice. The Council's view is that the State should pursue such legal advice on a state-wide basis.⁷⁷ Engagement with the Privacy Commissioner could have provided information regarding flexibility to use personal information in an emergency to prevent serious threats to life, safety and welfare of persons.⁷⁸ Seeking consent from individuals to collect and use their information in the event of an emergency may also be explored and is a method used by the Cairns Regional Council.⁷⁹

Impact of Council's planning on its ability to respond

The LDMG and the Local Disaster Coordination Centre (LDCC) are housed in the Council Chambers. This building is in a flood prone area and the main access route has been cut during previous flood events.⁸⁰ The photo below shows the Council Chambers during the 2015 event:

Right: Aerial view of the Banana Shire Council Chambers complex during the 2015 flood.
Banana Shire Council



The Council has also experienced problems with communications to and from this building in past events.⁸¹ In this instance, the Council's satellite phones were unavailable and we were advised that the CB radio network identified in the *Risk Treatment Plan*⁸² could have been much better utilised to overcome communication problems.⁸³ Telstra and the Local Government Association of Queensland told the Council about telecommunications options that would have reduced communications issues to a degree, but the Council declined the free service (DISPLAN) on the basis it was perceived to be of no value (see also Telecommunications Infrastructure).⁸⁴

Business continuity planning is identified as a risk treatment strategy for some of the risks outlined in the Council's *Risk Treatment Plan*, including East Coast Low pressure systems and severe thunderstorms and electrical storms.⁸⁵ For these risks, the *Risk Treatment Plan* recommends that further study be undertaken on cost and funding implications.⁸⁶ To date, no further study has been completed.⁸⁷ However, for flood and cyclone risks, business continuity planning is not listed as a risk treatment strategy. The Council does not appear to have prioritised the completion of its business continuity planning. Completion of the plan would focus attention on a range of issues and potentially enhance or prioritise other work needed to strengthen local disaster management arrangements.

There is a council depot that is spoken about as a redundancy site for use in the event that the Council Chambers is not accessible.⁸⁸ There is some uncertainty amongst Council staff, LDMG members and District Disaster Management Group (DDMG) members as to whether this site can actually be used, as it is not in the LDMP and has not been tested.⁸⁹ Had a business continuity plan been prepared and the site tested, an informed decision could have been made whether to move to the backup location. This may also have avoided the communications issues experienced within the LDCC on Saturday 21 February.

2013 Review of Callide Dam Gate Operations in the January 2013 Flood Event

The Terms of Reference require consideration of the recommendations arising from a review of the Callide Dam in the January 2013 flood event. The independent hydrologist report commissioned for this review (Appendix G) deals with the recommendations made to SunWater in the 2013 report. While the 2013 review focused on SunWater's gate operations, there were a number of minor recommendations relating to the Council.⁹⁰ These recommendations included:⁹¹

- *'... investigation to identify damaging flow levels in Callide Creek, perhaps including some flood mapping to assist in identifying impacted properties and escape routes'*
- *'... given the long history without flooding in Callide Creek, Council may wish to consider some community education on flood behaviour in Callide Creek, which would assist in improving the resilience of the local community to flooding'*
- *'The LDMG may wish to improve the information and resources available to it, such as damage-stage tables or pre-modelled event surfaces, to enable the consequences of Callide Dam gate releases to be assessed in conjunction with downstream flows'*
- *'There may be some improvements that either SunWater, the LDMG, or other parties may be able to take to improve advice to residents'*
- *'... with some improved modelling and/or instrumentation, better estimates of future conditions may be made, providing longer lead times for advice to residents.'*

The Council disputes having received a copy of the report.⁹² We did not find evidence of the report being discussed at LDMG meetings. Had these recommendations been made available to, and effectively implemented by, the Council or the LDMG, each improvement had the potential to reduce the impact to the community from the flood event in February 2015.

Gladstone District Disaster Management Group

District Disaster Management Plan

The Banana Shire is assisted by the Gladstone DDMG.⁹³ The DDMG has a legislative responsibility to review and assess the disaster management of the relevant LDMGs in its district.⁹⁴ This involves the consideration of *'the capabilities and capacities of each of the LDMG's and includes the likely actions the district group may need to take to support those respective areas'*.⁹⁵ The performance of the LDMG should also be assessed in real events and exercises.

The Gladstone DDMG prepares a District Disaster Management Plan (DDMP).⁹⁶ The Gladstone DDMP identifies a number of hazards that can impact upon the district through direct, indirect or intangible means. The top three identified direct threats to the district are:

1. Inadequate disaster management
2. Flood
3. Cyclone.⁹⁷

The Gladstone DDMP rates both cyclone and flood as extreme risks, while the risk level for inadequate disaster management by local government is rated as high.⁹⁸ The DDMP identifies that inadequate disaster management can lead to inefficient and inadequate responses to disasters.⁹⁹

The Gladstone DDMP states that, for flood hazard, the BoM issues relevant warnings to affected residents who may be at risk of localised flooding.¹⁰⁰ This does not recognise the responsibilities of local government to warn residents.

Risk Register and Risk Treatment Plan

There are two annexed documents to the DDMP: *Annexure C: Gladstone District Risk Register*¹⁰¹ and *Annexure D: Gladstone District Risk Treatment Plan*.¹⁰² Both of these documents provide detail that is not available in the DDMP and both are restricted documents. As with the Council LDMP, the restriction of these detailed documents may limit community understanding of risks and how to prepare for them.

The *District Risk Register* comprehensively outlines identified risks in 22 categories, each with several sub-categories examining the area of impact (i.e. human, social, transport, etc.) and outlining controls.¹⁰³ The DDMP identifies relevant stakeholders and other government departments that would need to be engaged in each risk category.¹⁰⁴

Control mechanisms for the risk of inadequate disaster management in the *District Risk Register* include: reviewing local and district disaster management plans; regular LDMG and DDMG meetings; engaging with the LDMG regarding selection, induction and training of LDMG members and outlining their roles; testing communications systems and more.¹⁰⁵ As a business continuity plan is a key control mechanism identified in the DDMP, the DDMG should have identified that when the business continuity plan was spoken about by the Council, this was not a reference to a documented or robust plan.¹⁰⁶

In the *District Risk Register*, flood risk is divided into several sub-categories, with each category exploring slightly different risks and impacts. One of the identified flood categories relates to an extreme rainfall event resulting in flooding and having a major impact upon residents.¹⁰⁷ Relevant controls include:

- The LDMG to develop flood mapping
- Develop community awareness
- Building regulations
- Audit business continuity plans
- Evacuation arrangements, including local sub-plans, identifying at-risk groups and persons, identifying evacuation centres and shelters, considering evacuation timelines, trigger points and routes
- Emergency Alert
- Test and review plans
- Identification of other agencies and organisations to assist in response and recovery.¹⁰⁸

Tropical cyclones are also examined in several sub-categories, with suggested control mechanisms similar to those for flood risk.¹⁰⁹

The *District Risk Treatment Plan* outlines the risk treatment plan for each sub-category.¹¹⁰

District Plan in operation

The DDMP supports operations of the DDMG during an event, including DDMG support to the LDMG when their capabilities and limitations are reached.¹¹¹ In order to anticipate and prepare for the support that may be requested from LDMGs, the DDMG must have a good understanding of the LDMG's capabilities and limitations.¹¹²

As the DDMG is there to support and oversee the LDMG, it is not directly responsible for the functioning of the LDMG and the local council's response to an event.¹¹³ From our interviews with DDMG members, LDMG members and Council staff, and observations from reviewing LDMG minutes, we note the DDMG attempts to fulfil its role primarily through support and guidance in the preparation and response phase, prompting the prioritisation of disaster management by the Council.

Members of the DDMG highlighted that action items are regularly not followed through by the Council or the LDMG and cited the funding provided for the flood mapping study as an example.¹¹⁴ Other examples we have identified include:

- The *Natural Hazard Risk Assessment* report, which was finalised in November 2012, but was not referred to the Council for adoption until November 2013.¹¹⁵
- The *LDMG Improvement Action Plan*, which was developed following the January 2013 flood event and identified 29 action items.¹¹⁶ At the 4 November 2013 LDMG meeting, the DDMG representative stated that *'the District Disaster Coordinator ... has expressed some concerns in relation to the number of items that remain outstanding and not actioned, especially considering that the action plan was developed in about February 2013 as a result of relevant LDMG debriefs and there has been substantial time to implement any corrective issues'*.¹¹⁷ The *Improvement Action Plan* was not finalised until 5 May 2014.¹¹⁸
- A review of LDMG meeting minutes from 2010 to 2015¹¹⁹ showed that timelines were rarely set for action items, and record-keeping processes did not clearly or consistently highlight if action items had been completed.

SunWater

Emergency Action Plan requirements

SunWater is required to prepare and maintain an Emergency Action Plan (EAP) for its referable dams, in accordance with the *Water Supply (Safety and Reliability) Act 2008* (Qld).¹²⁰ The EAP outlines foreseeable emergency events and what to do during an emergency.¹²¹

The Department of Energy and Water Supply (DEWS) is the dam regulator and has legislative responsibility for approving EAPs.¹²² An EAP can be approved if the Chief Executive, DEWS is satisfied the plan complies with all legislative requirements and effectively deals with each emergency condition for the dam.¹²³

The dam owner is required to provide a copy of the proposed EAP to the chairperson of the LDMG before it is submitted to the DEWS.¹²⁴ The LDMG can elect to provide feedback.¹²⁵ This can help ensure the EAP is not planned in isolation from the LDMP and that the LDMG understands the EAP.

The Callide Dam EAP has been provided to the Council and the LDMG previously.¹²⁶ Each year, the EAP must be reviewed prior to 1 October.¹²⁷ In accordance with the *Water Supply (Safety and Reliability) Act 2008* (Qld), the Council is given 10 days to provide written comment on the EAP.¹²⁸ The Council and the DEWS have both told us that 10 days is not long enough to properly consider the document.¹²⁹

The Council's most recent feedback on the EAP in October 2014 included format changes, updates to contact details for LDMG members listed in the EAP, changing the content of the warning messages and adding explanatory notes for the inundation maps for the lay reader.¹³⁰ The Council did not receive a response from SunWater in relation to its feedback, although such feedback is not required.¹³¹ The LDMG received a copy of the approved EAP. The DEWS' *Provisional Guidelines for Emergency Action Planning for Referable Dams* would suggest that further engagement should occur, but is silent on the benefits.¹³² The development and revision of the EAP is an opportunity for stakeholders to ensure there is clarity on roles and responsibilities.

Emergency Action Plans roles and responsibilities

SunWater's EAPs for Callide and Kroombit dams clearly outline the internal roles and responsibilities for emergency management at the dams, but do not deal with wider disaster management response. In practice, disaster management arrangements are a shared responsibility.¹³³ The EAP does not need to outline the response expected of the LDMG, but it cannot be designed, planned and viewed in isolation only.

The legislative responsibilities of the dam owner in an EAP can be broken into three main areas:

- what will be done in response to an identified type of emergency
- the area that will likely be affected
- notification of people in that area likely to be affected, and relevant authorities.¹³⁴

The DEWS has informed the review that *'there are no current requirements for dam owners to explicitly comply with an EAP during an event'*.¹³⁵ SunWater relies upon section 356A of the *Water Supply (Safety and Reliability) Act 2008* (Qld) for its adherence to the EAP, which states that dam owners must not contravene a dam safety condition.¹³⁶ SunWater's actions in regard to EAP compliance is discussed in more detail in the Warnings section of this report.

Hazard Identification and Risk Management

SunWater has identified five major risks to the dam, one of which is flood.¹³⁷ In this context, the flood risk relates to the chance that inflows into the dam overtop the dam walls, causing dam failure. The EAP identifies how the dam owner will respond if an emergency or a related event occurs.

The flood operations component of the EAP identifies a staged approach to managing the flood risk to the dam, ranging from preparing for a flood risk through to a 'Stage 5' event where overtopping of the dam wall is likely.¹³⁸ The triggers for each stage are clearly identified. The EAP also identifies contingency plans for emergency pump or gate failure.

Section 3 of the EAP contains the emergency contact plan, which identifies who to contact and when to contact them in the event of an emergency.¹³⁹ The communications plan is a staged contact list, whereby the classes of people to be contacted relate to the stage of the flood event and relevant trigger level. The list of people to contact includes the LDMG, other disaster management personnel, the dam owner, and downstream residents.¹⁴⁰

The 2013 Water Solutions review made several recommendations for improvement to the operation of the Callide Dam by SunWater.¹⁴¹ On 9 April 2013, SunWater responded to these recommendations, accepting several of them.¹⁴² SunWater took steps to reduce the risk of identified issues re-occurring, such as pump failure and gate oscillation. These changes came at significant expense to SunWater.¹⁴³

SunWater advised in 2013 that a recommendation relating to improved instrumentation and modelling of the catchment would be considered by SunWater if the reduced full supply level was '*maintained for an extended period of time*'.¹⁴⁴ Inflow modelling was underway prior to the 2015 event. SunWater advised that the models were not effective due to limited rainfall data for the area.¹⁴⁵

SunWater has undertaken its own internal review of the operations of Callide Dam during the February 2015 event, as required by legislation.¹⁴⁶ SunWater is considering expanding the network of rainfall gauges, upgrading the tailwater gauge and introducing redundancies for communications at Callide Dam.¹⁴⁷ These upgrades are from lessons identified in the 2015 event, and demonstrate a commitment to continued risk assessment and hazard mitigation.

SunWater told us that Callide Dam (like many other SunWater dams) is excluded from the flood mapping coverage provided by SunWater's Flood Operations Centre.¹⁴⁸ This is a result of a risk assessment that had been completed previously on all dams.¹⁴⁹

The EAP is comprehensive, but it is designed to be used by dam operators. A separate simplified explanatory document could be considered for community education purposes. This may achieve an incidental purpose for SunWater by enhancing community understanding of the capabilities and limitations of the Callide Dam, and improving confidence in its operation.

Emergency Action Plan review process

It is a requirement that each time the EAP is activated it is examined.¹⁵⁰ This examination is in the form of a comprehensive *Emergency Event Report* that is submitted to the DEWS. SunWater also conducts exercises as another method of review.¹⁵¹ Exercise participants are internal to SunWater only.¹⁵² The existing review processes used by SunWater for the EAP meet legislative requirements.

By doing no more than simply meeting the minimum legislative requirements, we consider that SunWater misses opportunities to improve engagement with the LDMG, and develop a mutual understanding of how responsibility for disasters involving referable dams can be shared. Internally-focused exercises do not allow the LDMG to be involved and obtain a practical understanding of the EAP. The DEWS has indicated that this is not the intention of its *Provisional EAP Guidelines*.¹⁵³ Increasing coordination between the LDMG and SunWater could also provide the LDMG members with familiarity with gate operations.¹⁵⁴

Department of Energy and Water Supply

The role of the DEWS as dam safety regulator¹⁵⁵ necessarily entails a risk management approach. The regulator ensures dam owners protect the structural integrity of referable dams through various mechanisms, such as dam owners undertaking inspections, and conducting reviews of an emergency event.¹⁵⁶

In order to do this, the DEWS undertakes programs to assess whether the dam owners have processes and procedures in place for dam inspections, review the safety of dams against current standards, and ensure monitoring and maintenance programs are maintained.¹⁵⁷

Whilst the DEWS approves the EAP, it is the responsibility of the dam owner to operate the dam, including in emergent situations.¹⁵⁸ The DEWS does not have an operational role in the management of dams.¹⁵⁹ In emergency events, the DEWS will maintain awareness of the event and the risks for the particular dam.¹⁶⁰ In the event that an owner cannot obtain their own expert advice, the DEWS is available to provide advice.¹⁶¹

The DEWS told us that dam owners are *'free to undertake any actions they consider necessary to preserve the safety of the dam and subsequently the safety of people downstream during an emergency event'*.¹⁶² This interpretation is at odds with SunWater's understanding and legislative interpretation, which is that it must adhere rigidly to the EAP.¹⁶³

In relation to Callide Dam, the DEWS was made aware of safety concerns by SunWater in relation to the stability of the embankment prior to the 2013 flood event.¹⁶⁴ The DEWS was kept informed of the treatment strategies, including the implementation of a temporary full supply level and the subsequent gradual increasing of this level.¹⁶⁵ The DEWS concluded this was a prudent course of action to manage the risk to the safety of the dam.¹⁶⁶

Whilst the DEWS does not take an active role in the management of referable dams, it does take steps as the regulator to ensure that risks are being identified, managed and mitigated where necessary. After the 2013 flood event, and associated concerns with the operation of the Callide Dam, the DEWS engaged Water Solutions to independently review the operation of the dam.¹⁶⁷ After the finalisation of the report, the DEWS maintained contact with SunWater to ensure progress was made in implementing the recommendations.¹⁶⁸ This contact was via correspondence and attendance by the DEWS at a SunWater workshop to discuss rectification issues.¹⁶⁹

The specific details of the Callide Dam EAP have been outlined in the risk management approach of SunWater. The role of the DEWS in approving the EAP is to ensure that it contains:

- the emergency situations applicable to the dam
- what actions the owner must take to respond to each emergency
- the area likely to be impacted downstream
- which entities (including residents) are to be contacted during emergency situations.¹⁷⁰

In order to assess if the EAP meets the conditions, the DEWS must undertake an assessment of the hazards likely to be present in a dam of Callide's design, and to assess whether the EAP adequately deals with them.¹⁷¹

The DEWS provided a significant amount of information to assist in this review. This information indicated that the DEWS undertakes assessments and audits of the documentation dam owners must compile and also conducts site visits to referable dams.¹⁷² These audits are carried out on a rolling basis to ensure that all referable dams are visited in the order of priority, based upon parameters such as age of the dam, dam owner compliance history, dam structure and the associated risks and time since last audit.

The DEWS applies its published *Guidelines on Acceptable Flood Capacity for Water Dams*¹⁷³ to conduct quantitative risk assessments for assessing the risk of dam failure.¹⁷⁴

The DEWS, therefore, applies a comprehensive risk analysis and management approach to its role as dam safety regulator.

Public engagement and communications

Effective public engagement should empower communities. Public engagement should be a two-way process, where entities and the community work together to understand, prepare for, respond to and recover from disasters.¹⁷⁵

Key elements of effective public engagement include:

- Entities have a good understanding of the community profile, and how best to communicate with the community
- Community messages and education programs are delivered in plain language and use multiple modes of delivery
- Information is accurate, reliable, timely and relevant
- Systems are in place to address public enquiries and dispel myths
- Feedback is sought on public information and education activities.¹⁷⁶

While the Council and SunWater both undertake some public engagement activities, there is room to improve these activities to better prepare the community for potential events and to build an understanding of risk.

Banana Shire Council

We found that there was significant scope for enhancing the Council's engagement with the community about disaster management. To improve, the Council could target specific communities or areas known to be at risk, such as areas prone to flooding. Engaging directly with these areas could assist residents to understand their risks, become better prepared, and enhance their disaster resilience. Prior to the 2015 event, some residents were completely unaware of their risks, such as that their properties were located on a floodplain.¹⁷⁷

We were told of a disconnect between some residents' perceptions of risk and their expectations as to what will happen in an event.¹⁷⁸ For instance, during the event some residents took no action because they had not received any warning from the Council telling them that they were at risk.¹⁷⁹ This was despite being in close proximity to the Callide Dam and watercourses known (to the Council) to flood. Targeted public engagement prior to the event would have equipped these residents with the knowledge required to make informed decisions to better protect themselves and their property.



Above: Banana Shire Council disaster management preparedness information, 2014.

Banana Shire Council

Our survey of Callide Valley residents showed that 39% (n=158) of respondents had enquired about flood risk.¹⁸¹ Of those who had sought flood risk information, only 10% (n=16) enquired with the Council.¹⁸²

Brochures and information about disaster preparedness and mitigation are provided at the Council's customer outlets. The information within these materials is largely generic and is not tailored to different groups within the community, such as culturally and linguistically diverse populations, or people with a hearing impairment.

Before the 2014/15 storm season, the Council distributed a 'community information and preparedness satchel to assist residents in preparing for an emergency or disaster event'.¹⁸⁰



Above: Disaster management preparedness information (state and federal agency resources), available from Council outlets, 2015.

Inspector-General Emergency Management

Our interviews with various Council staff led us to believe that there is varying commitment to producing disaster management education materials.¹⁸³ While not everyone within the Council may share this view, to ensure that public engagement is effective, its value needs to be recognised by those with responsibility to prepare and disseminate materials to the community.

While it is a function of the LDMG to ensure the community is aware of ways of mitigating the adverse effects of an event, and preparing for, responding to, and recovering from a disaster,¹⁸⁴ the community also needs to inform itself about risks and to take action based on the range of information available.

SunWater

SunWater uses several mediums to engage the community, from its online presence, including social media, to more traditional modes of information sharing. SunWater engages with the community through representation at interest group meetings, such as Irrigators' Advisory Committees, sponsorship and water safety education campaigns.¹⁸⁵

The 2012/13 Annual Report showed that one of SunWater's 'Key Result Areas' was 'External stakeholder relations – improving the confidence of external stakeholders, including customers and the community, in SunWater's ability to deliver on business operations'.¹⁸⁶ The 2013/14 Annual Report has seven outcomes, one of which is 'work collaboratively with key stakeholders to deliver government policy'.¹⁸⁷

A March 2015 publication, *Dam Management During Floods*, and website update provide basic information in response to 'public interest in the flood attenuation capabilities and safety of SunWater's 19 dams'.¹⁸⁸ This is commendable, however there remains opportunity for SunWater to better convey its knowledge about risks to people downstream from its dams. For instance, there should be information on how or when the 'comprehensive communication protocols'¹⁸⁹ operate and who will be given information during a flood event.

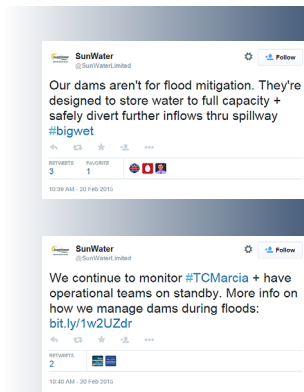
Engagement with the community on dams during floods is reflective of SunWater's position that the organisation has 'a limited role ... in emergency management'.¹⁹⁰ This appears to be supported by the information provided in the SunWater publication *Dam Management During Floods*. The brochure does not mention that residents are 'relevant stakeholders' and instead says SunWater provides updates to 'council, police, emergency services and counter disaster groups ... to ensure those agencies can fulfil their role of advising downstream residents'.¹⁹¹

In the lead up to the February 2015 event, SunWater could have provided considerably more information and better engaged the community or local media about what was occurring at its dams, including the likelihood that the dams would spill. We found limited evidence of media releases and information on Facebook and Twitter.¹⁹² The information provides the community with some understanding of the risks or likelihood of a risk occurring at its dams, but leaves room for improvement.

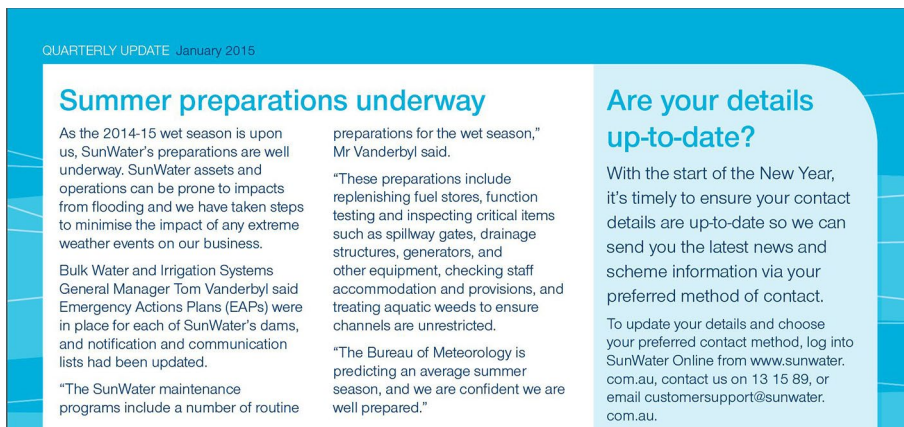
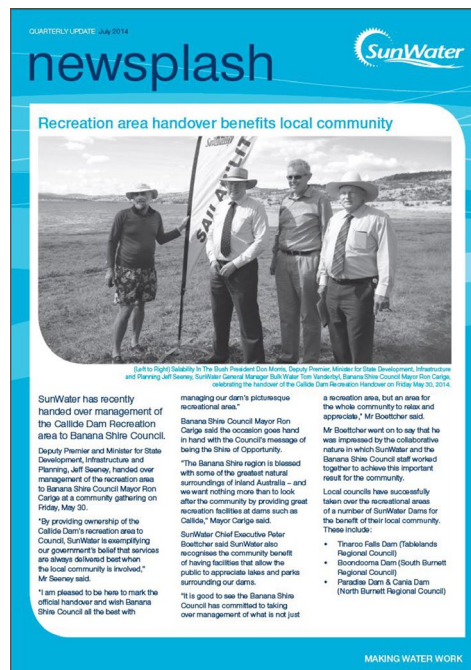
Early public engagement and an open dialogue about how the situation at the Callide and Kroombit dams was developing would have enabled the community to assess and respond to their personal risk. Had SunWater clarified common misconceptions, such as the belief among parts of the community that SunWater could pre-emptively release water at its discretion, or that the Council could order it to, much anxiety among the community may have been allayed.

Following criticism that SunWater had not engaged well with the Irrigators' Advisory Committee, we sought minutes of meetings with the group. SunWater told us that the group did not regularly meet but when it did, SunWater was represented.¹⁹³ Minutes from a 2014 meeting show four SunWater representatives and six advisory committee members in attendance.¹⁹⁴ SunWater was challenged on dam operations in circumstances of potential flooding rain and responded '[it] has been fully investigated by an independent reviewer ... the dam was not designed for flood mitigation'.¹⁹⁵

SunWater's regular newsletter, *Newsplash*, is a good representation of the organisation's approach to public information and engagement. Dam safety messages to the public are often conveyed in the newsletter, but are generally about the recreational use of dams and weirs rather than residing downstream from a dam.¹⁹⁶ SunWater's preparations for wet weather and potential spilling are included, but no information is provided on what the community can do to prepare.¹⁹⁷



Above: SunWater tweets, 20 February 2015. SunWater Limited



Examples of SunWater's Newsplash July 2014 (above) edition and (left) items from the January 2015 edition. SunWater

Finding 3

Improvements to Banana Shire Council's approach to flood risk management, including town planning, are dependent upon the Council having access to fit-for-purpose flood studies.

Finding 4

Of those surveyed, 55% indicated they had limited or no knowledge of disaster management arrangements.

Finding 5

It is difficult for residents to easily understand the implications of an Emergency Action Plan activation.

Finding 6

Believing there to be no legal option, SunWater followed the Emergency Action Plan, despite having information regarding emerging risks to downstream residents.

Finding 7

In relation to warnings, SunWater's understanding of Emergency Action Plan compliance requirements is divergent to that of the Department of Energy and Water Supply, which supports the notion of flexibility to deal with emergent conditions.

Recommendation 3

Banana Shire Council coordinates the development of a strategy to significantly enhance public education regarding local disaster management arrangements within the Banana Shire, focusing on key identified risks.

Recommendation 4

SunWater provide downstream residents with easily understood information regarding operation of the dam, and the impacts that various outflows may have for them, in accordance with mapping prepared for the Emergency Action Plan. This information should be complementary to any information from the Banana Shire Council.

Recommendation 5

The Department of Energy and Water Supply, in conjunction with SunWater, seek clarification of the dam owners' legal obligation to comply with Emergency Action Plans and, if required, investigate how a more flexible approach may be adopted.

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Disaster management response

Operational information and intelligence

Many disaster management entities will not have a formal intelligence unit, but will still have an intelligence function to manage. With the growing cooperation among disaster management groups, levels and the shared responsibility for disaster management, all entities could add value by developing some type of intelligence capacity. Intelligence capacity may be a full-scale unit or one person who serves part-time as an agency's point of contact to receive and disseminate critical information.¹ According to the Standard for Disaster Management in Queensland (the Standard), the two key outcomes to achieve are:

- Decision making, tasking, communications and messaging are informed by accurate and current intelligence.
- Common situational awareness is created at all levels through a process for sharing operational information and intelligence products, across all entities.²

The flow of credible information is often a challenge when coordinating a multi-faceted response to a disaster event. Decision-making needs to be based on a shared understanding of the current and pending situation.³ That understanding should be based on intelligence that is accurate, up-to-date and from credible sources.⁴

Banana Shire Council and Local Disaster Management Group

Local Disaster Management Group

The Local Disaster Management Group (LDMG) held its first meeting on Wednesday 18 February 2015 at 4.00pm.⁵ This activation was timelier than had occurred during the 2013 event,⁶ and should have provided the Banana Shire Council (the Council) with some lead-time to make preparations for Tropical Cyclone Marcia.

The LDMG met regularly and there was representation from the majority of key agencies.⁷ The LDMG consistently discussed the current weather situation and how Tropical Cyclone Marcia was developing and tracking.⁸ The LDMG was aware of forecast rainfall and wind speeds, including the predicted impact on the Biloela area.⁹ Having ready access to this key information and having discussed the issues, there was opportunity to use this information more meaningfully. Decisions to inform the public sooner, and with greater detail, would have been beneficial to community preparations.

From the review of meeting proceedings, the potential significance of the event did not seem to be fully appreciated during LDMG meetings.¹⁰ It is noted that this review is with the benefit of hindsight and is not subject to the operational pressures being experienced at the time. The LDMG's last meeting before the cyclone was predicted to hit Biloela was at 5.00pm on Friday.¹¹

The meeting ended with no key decisions being made on trigger points for Emergency Alert warnings for the Callide Dam, how the Local Disaster Coordination Centre (LDCC) intended to warn the rest of the Banana Shire, what those messages would say, or whether shelters should be opened.¹² The LDMG also scheduled its next meeting for 9.00pm that night. This was immediately after the cyclone was expected to reach Biloela, and was arguably too late for these key decisions to be made.¹³

Many in the LDMG had experienced the past flood events that had affected Biloela and understood the risks of power and communication loss.¹⁴ Yet the group did not discuss what its contingencies were if critical infrastructure failed. After the 2013 events, the LDMG acknowledged the possibility that all communications could be lost in future disaster events, so this scenario needed to be prepared for.¹⁵ During this most recent event, there was only one wireless dongle in the LDCC on the night, a UHF radio was available but not used, and the Council's satellite phone was inaccessible due to flood water.¹⁶ This proved problematic during the event, as communication issues hampered the operational capability of the LDCC.

In the days leading up to the cyclone, agencies represented on the LDMG discussed the preparatory work they were undertaking.¹⁷ This included the Queensland Police Service (QPS) checking on evacuation centres, Queensland Fire and Emergency Service pre-positioning swift water rescue crews, Queensland Ambulance Service checking on nursing homes, the hospital discharging patients that did not need to be at the hospital, the State Emergency Service (SES) filling sandbags, and the Department of Agriculture and Fisheries closing its Biloela offices and liaising with landowners about their livestock.¹⁸

Many LDMGs receive advice from Local Emergency Coordination Committees (LECC) about what is happening in particular parts of the local government area, such as those areas that may be susceptible to flood or severe weather events. Some other councils use Emergency Liaison Officers or Flood Wardens to provide an information conduit between the community and LDMGs.¹⁹

Five LECCs are in place in the Banana Shire: Baralaba/Rannes, Wowan/Dululu, Jambin/Goovigen, Moura/Baralaba, and Taroom/Theodore. LECCs are a valuable means of gathering and sharing vital information.²⁰ Engagement with the LECCs was variable in the lead up to the flood event.²¹ Some areas called consistently to provide information about their areas, while others were not in contact at all. The LDMG however could have used the LECCs more effectively as an information source for developing intelligence for event planning. It appears LECCs were not given sufficient guidance as to what information might assist the LDMG for its next meeting. For example, the heights of watercourses in the area or any key risks for that location could have provided the LDMG with intelligence it should have been considering. This was a missed opportunity, particularly as the areas the LECCs represent are all prone to flooding and valuable intelligence may have been provided to inform operations.

Local Disaster Coordination Centre

The LDCC is established to operationalise the decisions of the LDMG, as well as plan and implement disaster operations activities.²²

The LDCC had information about the predicted path and impact of Tropical Cyclone Marcia that could have been more proactively used to develop intelligence for operational activities or strategic direction. From our analysis of evidence gathered, decision-making appears to have been more reactive in nature. For example:

- After attempting to send its first Emergency Alert message (see Warnings section) the GIS officer was sent home.²³ It was reasonable to expect that further alerts would be required and that the mapping issues with the Emergency Alert system had not been resolved.
- Having advised the State Disaster Coordination Centre (SDCC) at 6.18pm that a further Emergency Alert would soon be requested, it appears no further preparation was made for the message requested at 8.48pm.²⁴
- The Planning and Logistics Cell was not rostered on until 1.30am on Saturday 21 February 2015, and staff were not called in earlier, despite the event escalating.²⁵
- Shift changeovers were not planned or executed well, including handover briefings and consideration being given to the ability of staff to get to and from the LDCC safely.²⁶
- Due to a lack of predefined Emergency Alert materials, the map for the Emergency Alert needed to be 'guessed', with the 2013 event used as a guide.²⁷
- Evacuation centres were opened after the cyclone had passed over Biloela and many parts of the Banana Shire were flood affected.²⁸

The Council had no recent flood study and there was minimal reliance on the 2010 *Callide Valley Flood Risk Study*²⁹ that was available. This hampered the LDCC's operational effectiveness.

The LDCC is comprised of Council staff and liaison officers from local entities with disaster management responsibilities. Often LDCC's group people together in cells with particular functions, such as intelligence or planning. We have been told that during the event, there were deficiencies in control and coordination of the LDCC's functions.³⁰ It appears that officers were operating in silos, with limited direction and poor information sharing between the different cells.³¹ Situational briefings (where the person in charge of the LDCC gives staff an overview of the situation) were not conducted within the LDCC as would be expected under an incident management system.³² We were informed by the Council that a number of staff were new to their roles, which may have contributed to some of the issues experienced.³³

There appears to be limited record keeping of LDCC activity, including logs of phone calls, activities, messages and decisions.³⁴ This recording of key activities is critical to support situational awareness within the LDCC and would have decreased the risk of oversights by staff. Duplication of effort was also a risk as new officers coming in to commence their shifts may not have been able to identify actions that had already been undertaken.

District Disaster Management Group

The role of the District Disaster Management Group (DDMG) is to support the LDMG in its response to an event.³⁵ The DDMG must have good situational awareness to enable it to fulfil this function. Local level situational awareness predominately comes from situation reports from local councils and LDMGs³⁶ and through attendance at LDMG meetings by DDMG representatives.

The LDMG provided the DDMG with five situation reports between the evening of 19 February 2015 and the early hours of the morning of 21 February 2015.³⁷ The information contained within these reports was often largely repeated

from one report to the next.³⁸ These reports also had limited information about planned activities for the intervening period before the next report was submitted.³⁹ For example, items such as *'monitor progress of Cyclone Marcia'* were consistently repeated throughout the various situation reports.⁴⁰ What was actually being undertaken by the LDMG was not clearly articulated to the DDMG.

In its third situation report (which was for the period 4.00am to 2.00pm on Friday 20 February 2015) the LDMG mentioned a preliminary risk assessment for the event.⁴¹ The LDMG discussed its main areas of concern, which included heavy rainfall, the effects of damaging winds, and localised flooding.⁴² This information was generic in nature and did not consider particular parts of the Banana Shire that would be at the greatest risk.

The situation reports did provide information on preparation activities that were being undertaken, including media releases,⁴³ draft emergency alerts,⁴⁴ and trigger points for dam release.⁴⁵ This information may have provided the DDMG with the perception that the LDMG had sufficient capacity to manage its disaster operations and did not need DDMG intervention.

The DDMG was invited to attend LDMG meetings, but is not required to, and does not appear to have attended any of the LDMG's meetings in the lead up to the event.⁴⁶ It is noted that there were clashes with meetings at the different disaster management levels, which precluded district representation at some of the LDMG meetings.⁴⁷ The DDMG was still able to maintain constant communication with the QPS Liaison Officer prior to, and after, each meeting to receive updates.⁴⁸ The DDMG was also provided with copies of the LDMG's meeting minutes.⁴⁹ Although meeting minutes are not relied upon as a point of truth for disaster operations, had the DDMG had the opportunity to scrutinise these minutes during the event, it may have become apparent that planning and critical decision making by the LDMG was not optimal.

It is noted that information the DDMG had at the time did not raise concerns or cause the DDMG to question what was being provided by the LDMG. While it is not the role of the DDMG to coordinate a disaster event for the Council, with a fuller appreciation of the situation in the Banana Shire, the DDMG may have been able to offer advice, guidance and direction to support the LDMG's effectiveness.

State Disaster Coordination Centre

The SDCC supports the State Disaster Coordinator through:

'... the coordination of a State level whole-of-government operational capability during disaster response operations. The SDCC also ensures information about an event and associated disaster response operations is disseminated to all levels, including to the Australian Government.

The State Disaster Coordination Group (SDCG) coordinates the operational delivery of the [Queensland Disaster Management Committee] QDMC's legislative responsibilities to facilitate response operations for Queensland communities. The Chair of the SDCG reports to the State Disaster Coordinator (SDC), who is accountable to the QDMC.

Agency and organisation representatives attending the SDCG will be of sufficient seniority to allocate resources from their agencies and provide agency coordination.⁵⁰

The SDCC relies on consistent and up-to-date information being submitted by local and district groups as well as state agencies and other disaster

management entities. This enables appropriate prioritisation and planning of state assistance and support to the district and local disaster management groups.

As a member of the SDCG, the Department of Energy and Water Supply's (DEWS) role is to represent the energy and water suppliers it regulates, including SunWater.⁵¹ The DEWS provided written situation reports to the SDCC over the course of the event. The DEWS advised us that these reports were intended to highlight and summarise issues about water supply and energy that have state-wide importance.⁵² The DEWS attached situation reports from the agencies it regulates to its situation reports.⁵³ This was intended to provide the SDCC with more detailed information about entities, such as SunWater.⁵⁴

The DEWS' situation reports did not provide detail about what was occurring at the Callide or Kroombit dams,⁵⁵ relying on the email recipient to open all attachments for a complete picture. From Wednesday 18 February 2015, SunWater's situation reports to the DEWS advised that there was a high likelihood of Emergency Action Plan (EAP) activation at these dams.⁵⁶ The DEWS did not extract this information and include it in its own report to the SDCC.⁵⁷

SunWater also emailed its situation reports directly to the SDCC, but did not highlight in the body of the email that EAP activation was likely. Rather, SunWater's emails simply advised that no EAPs had been activated.⁵⁸ With a widespread event like Tropical Cyclone Marcia, the SDCC receives large volumes of information. Without the entity overtly drawing attention to an issue, the SDCC may overlook the information. The lack of information about likely EAP activation in any of the SDCC's 'State Update' intelligence summaries illustrates this point.⁵⁹ For the SDCC to have appropriate situational awareness, it requires a clear and up-to-date picture of what is occurring in local areas.

The Gladstone DDMG was providing the Banana LDMG's situation reports to the SDCC according to protocol.⁶⁰ Due to the limited information contained in the LDMG's reports,⁶¹ the state level did not have a clear picture of the situation in the Banana Shire. This further undermined the SDCC's situational awareness.

SunWater

For Callide Dam, SunWater's information sources are few and collection methods basic.⁶² Generally, this would pose no issue to the management of the dam. During a cyclone, though, reliance on physical observations of the dam gates for timing and height of opening meant there were no recordings for a period, including at the time the gates opened.⁶³ In the flash flood situation that occurred, having only one inflow gauge that was not designed for high flow may have resulted in less accurate predictions about when the gates would open, or the amount of flow through them.⁶⁴ SunWater also told us that high winds during the event 'impacted the accuracy of the recorder',⁶⁵ and that there was a delay of up to half an hour in receiving information from the gauges.⁶⁶ In the period when SunWater was most reliant on information on the operation of the dam, data was scarce, unreliable and delayed.

To verify the accuracy of modelling, physical observation of the gate openings provides data that can be cross referenced with calculations from the upstream and headwater gauges.⁶⁷ Manual observations also occur for the instruments (piezometers) that take measurements of the embankment and signal whether the stability of the dam is compromised.⁶⁸ Handwritten logs accompany all manual observations, which potentially further delayed the transfer of information to SunWater technical staff (who were at another location) for modelling and decision-making.

SunWater has already identified these and other issues in its internal review of the dam, undertaken after this event.⁶⁹ SunWater has identified that the installation of a remote sensing system for gate operations, re-designed gauges, improved data feeds from the dam and other improvements could be made, and are being investigated.⁷⁰



Right: Manual monitoring of the Callide Dam.
SunWater, 2015

The Stepanoff gauge was located downstream from the Callide Dam and was used to validate calculations of spillway discharge.⁷¹ This is the only role this gauge played in the management of the Callide Dam.⁷² This gauge became inoperable after the 2013 floods.⁷³ Until recently, SunWater had been unable to find a stable location to reinstate the Stepanoff gauge, due to changes in the watercourse following the 2013 event.⁷⁴ In the absence of the Stepanoff gauge, SunWater had been using the Callide Dam tailwater gauge (near the gates) to monitor flows released from the dam's outlet valves.⁷⁵

SunWater's upstream gauge (known as the '96 kilometre gauge') helps with monitoring water coming into the dam.⁷⁶ Its primary purpose is to monitor the flows from the Awoonga Pipeline into the dam for the power station supply.⁷⁷ The gauge was designed to monitor low flows. In 2013, the '96 kilometre gauge' received water levels that exceeded the gauge rating curve, and for which flows were unable to be calculated during this peak flow period.⁷⁸ The same thing occurred during the 2015 event, with the gauge becoming completely inundated by 7.45pm on Friday 20 February 2015.⁷⁹ It last read 10.231m.⁸⁰ Debris around the gauging station suggested that the water peaked above 11m at the '96 kilometre gauge'.⁸¹ For the period the gauge was inoperable SunWater could only estimate how much water would be flowing into the Callide Dam.

The LDMG and some members of the downstream community specifically requested information on gate opening predictions.⁸² The LDMG received SunWater's best estimates, but the community messaging in the lead up to the event was a tweet: '*Our dams aren't for flood mitigation.*'⁸³ During this event, SunWater had very little information on which to base its assessment of imminent gate openings that it relied on to provide warnings to the subscribed residents downstream from the dam. While no legislation requires SunWater to provide modelling intelligence or gate opening predictions to the public, more importantly, no legislation prevents it.

Bureau of Meteorology

The Bureau of Meteorology (BoM) provides information and forecast weather predictions to assist planning and response activities in extreme weather events. The BoM also provides a dedicated liaison officer to the SDCC.

The BoM's ability to provide flooding predictions is limited by a range of conditions that influence the reliability of forecasts in different locations.⁸⁴ To forecast and predict flooding, the BoM uses rainfall and river height stations (among other sources), which are owned and operated by various agencies, including the BoM, SunWater, the Department of Natural Resources and Mines (DNRM) and the Council.⁸⁵

In addition, rainfall radar, forecast rainfall, flood forecasting techniques (rainfall runoff models and peak stage relationships), and estimates of antecedent catchment conditions all contribute to the assessment of flood potential.⁸⁶ The reliability of forecasts is affected by the quality of the data informing them and, in the case of gauges, this can be highly variable and not influenced by the BoM.⁸⁷ All data from these river and rain gauging stations is provided publicly via the BoM website.

River and rainfall gauges have different methods of providing data to the BoM. Manual gauges and telecommunications outages at automatic stations may contribute to delays in the BoM's situational awareness.⁸⁸ This occurred during Tropical Cyclone Marcia. Due to the inoperability of SunWater's Stepanoff gauge since 2013, the only flood monitoring station available downstream of the Callide Dam is the river gauge at Goovigen.⁸⁹

Just after midnight, the data logger stopped transmitting data to the DNRM (the gauge owner). The DNRM provides the data to the BoM. The DNRM told us that the BoM did not have the data from this gauge from 12.20am to 11.00am on Saturday 21 February 2015.⁹⁰ The gauge was still functioning, but the data was not available at the time it was needed to assist with flood predictions. The data issues with the rain gauges above Callide Dam became apparent several hours before midnight.⁹¹

The BoM provided us with a map of the Flood Warning Network for the Dawson Catchment.⁹² This shows that there are no forecast sites in the Callide Valley. The *quantitative* forecast sites in the Dawson Catchment are at Baralaba, Moura, Theodore and Taroom.⁹³ There are no *qualitative* forecast sites in the network.

The current documented and endorsed BoM *Flood Forecasting and Warning Service Level Specification* outlines the service levels provided for the various catchments around Queensland.⁹⁴ The current service requirements are quantitative predictions for four locations on the Dawson River.⁹⁵ The BoM has a catchment-scale model of the Don catchment (which includes the Callide Creek catchment) for providing inflows to the Dawson flood forecasting model to ensure inflows from the Don catchment are accounted for.⁹⁶ This model does not explicitly represent either Callide Dam or Kroombit Dam.⁹⁷ The current documented and endorsed service levels do not require a detailed hydrological model for Callide Creek.⁹⁸

Information sources that may contribute to flood modelling, and therefore forecasts, are high-resolution digital elevation models, river cross-sectional information, and detailed maps of land use and soil types.⁹⁹ All these sources, including river and rain gauges, are generally developed by local government, state government agencies, industry or infrastructure operators.

Few information sources of any type are available for the Callide Valley, but improvements are being considered. The DNRM is currently undertaking a review of the gauge network in Queensland.¹⁰⁰ SunWater is considering additional rainfall gauges and upgrades to the existing river gauge upstream of the Callide Dam.¹⁰¹

With current technology and data sources available for the Callide Valley, predicting the timing and exact locations of flash flooding is unlikely.¹⁰² The BoM told us that while they can estimate the amount of rain, predicting the intensity and period over which it will fall is difficult.¹⁰³ This affects the viability of releasing water from the Callide Dam in anticipation of a rain event for flood mitigation purposes. The BoM provided us with a 2006 letter addressing this very concept, which said, *'the capability of the science to provide sufficiently reliable 24 to 48 hour advance predictions of high catchment average rainfalls is limited'*.¹⁰⁴ The BoM letter also said that while it is possible to forecast a rain event, *'it is difficult (if not impossible) to predict the actual location of the heaviest rain, even with only a few hours notice'*.¹⁰⁵

Warnings

emergency warning

*'An emergency warning is a message signalling an imminent hazard, which may include advice on protective measures.'*¹⁰⁶

Effective emergency warnings

Effective emergency warnings are a key element of shared disaster management responsibility. Effective warnings empower the community to take action to protect life or property.¹⁰⁷

A key focus of the *Disaster Management Act 2003* (Qld) is helping communities minimise the negative effects of a disaster event; to be prepared to manage the effects of an event; and effectively respond to, and recover from, a disaster.¹⁰⁸ The right information at the right time enables people to make choices about how to respond to a disaster, and take steps to minimise the impacts.

Warnings are most effective when they are sent to communities that already have a good understanding of the different risks in their area,¹⁰⁹ what to do in an emergency, and what a warning message means.¹¹⁰ Our survey showed that there are high levels of confidence in understanding flood risk (91%, n=369)¹¹¹ and knowing how to prepare and respond to future flooding events (89%, n=361)¹¹² among the surveyed Callide Valley population.

Emergency warnings cannot be considered as an isolated part of disaster management. The entities responsible for warning the public should have effective risk management and planning processes to know who might need to be warned, what circumstances might necessitate a warning, and what information the public would need to know.¹¹³

Warnings can be issued in many different ways. Radio and television broadcasts are traditional information sources for disasters and emergencies.¹¹⁴ Increasingly, entities with responsibility to issue warnings are using social media, such as Facebook and Twitter, to distribute information to the public.¹¹⁵ Using a variety of approaches can help increase the number of people that will receive and understand warnings about an event.¹¹⁶ This is supported by our Callide Valley community survey results, which showed that during the event

most people relied on family and friends (71%, n=288), the BoM (46%, n=187) or ABC News (40%, n=162).¹¹⁷

Telecommunications-based warning systems are also used to issue warnings. These systems can be grouped into subscription-based services (i.e. where a person registers to receive information or alerts) or automatic emergency alert services (i.e. where anyone in a particular area who has a landline or mobile phone will receive a warning or alert about an event affecting that location).

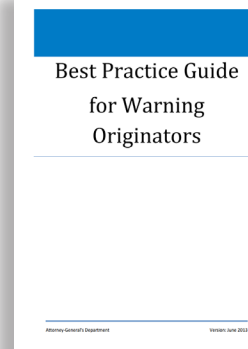
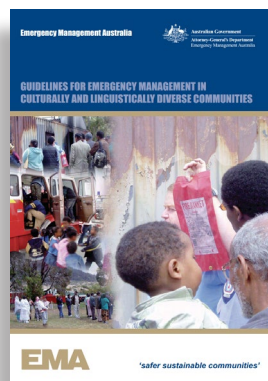
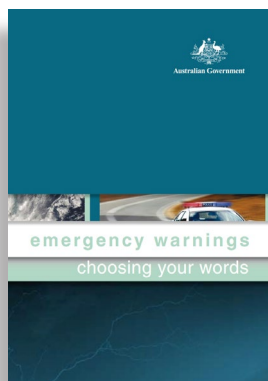
It is important to remember that:

*'No warning mechanism is guaranteed to deliver warnings to all people in a given area at a given point in time. Thus, it is critical that no single mode of communication is relied upon solely, in times of emergency – either by the public to receive warnings, or by warning agencies to disseminate them.'*¹¹⁸

Many different parties have responsibilities under legislation to issue warnings in an emergency. Research suggests that warnings are more effective if they come from a trusted source and can be verified with another source.¹¹⁹ That is why warnings often refer to a government website, like the BoM.

Guidelines and procedures have been developed to explain in more detail what the legislative obligations mean for entities with responsibility to warn.¹²⁰

The Standard also sets out performance expectations for the different parties involved in disaster management.¹²¹ Two key outcomes reflect good practice in terms of warnings.¹²² Different indicators help show if these key outcomes are likely to be achieved.¹²³ We acknowledge that the Standard is relatively new, however the fundamentals of effective warnings are covered in a number of well-established publications by the Australian Government.



From left to right:

Emergency Warnings: Choosing Your Words (2008)

Guidelines for Emergency Management in Culturally and Linguistically Diverse Communities (2007)

Best Practice Guide for Warning Originators (2013)

The general expectations for effective warnings are that the responsible entity:

- knows in advance who is likely to be at risk of impact from a disaster
- targets the people at risk of impact from a disaster with warnings that give the local context (e.g. evacuate to a particular place or avoid a route that is likely to flood)
- ensures warnings are consistent with other public information, are relevant to the people who need them, and provide accurate information in a way that is easily understood by the recipient.¹²⁴

Local governments are primarily responsible for managing disaster events in their local government area.¹²⁵

A local government needs to ensure it has a disaster response capability.¹²⁶ This means that local government needs to be able to provide things like equipment and people to effectively deal with, or help another entity deal with, an emergency situation or a disaster that occurs in the local government's area.¹²⁷ The LDMG supports the Council by coordinating the resources of other local entities like emergency services and community groups.

Responding to a disaster also includes issuing warnings of a disaster.¹²⁸ The responsibilities of local government to issue warnings are also emphasised in the *State Disaster Management Plan 2014-15*¹²⁹ and the *Queensland Local Disaster Management Guidelines*.¹³⁰

The Banana *Local Disaster Management Plan* (LDMP) states that:

'At a local level, the release of information to the community regarding the emergency, and associated threats, will be the responsibility of the Local Disaster Management Group. This will generally be done by the Chairperson of the LDMG or in conjunction with representatives of lead agencies and/or support agencies.

*The process for the notification and dissemination of warning products is not a function dependent upon the activation of the LDMG; rather it should be automatically implemented where necessary regardless of the status of activation of the LDMG.'*¹³¹

Banana Shire Council and Local Disaster Management Group

In the days preceding the flood event, the Council issued information to assist the community to prepare (e.g. have an emergency kit ready etc). This included media releases and Facebook posts, as well as interviews with local media.¹³² These were positive steps by the Council to give the community some basic information and direct them to other sources, such as the BoM, ABC radio and the Queensland Disaster Management website. Not all of the information disseminated by the Council in the lead up to the event is discussed or referenced within this section.

Below: The national Emergency Alert system provides information and warnings.
Commonwealth of Australia

While the Council's efforts to warn the community in the days leading up to the event were satisfactory, we found there was significant opportunity to improve their emergency warnings response to the event. Emergency warnings were issued primarily via Facebook and Emergency Alert.¹³³



EMERGENCY ALERT. BE WARNED. BE INFORMED.



What is Emergency Alert?

Emergency Alert is a national telephone-based warning system that can be used to warn a community about a disaster or emergency, such as flood, fire or an extreme weather event.



How does the Emergency Alert system work?

The system sends voice messages to landlines and text messages to mobiles that are within a particular area that is specified by the disaster management group or agency sending the warning.



Are Emergency Alerts sent for every emergency or disaster?

The system is not used in every emergency. For this reason, it is important that people don't wait for an Emergency Alert before taking action. Instead, many sources of information should be used to help decide what to do in an emergency.



What does the Local Disaster Management Group need to do to send an Emergency Alert?

The Local Disaster Management Group sends a request to the State Disaster Coordination Centre which must include message content and where to send the warning (in practice, this is a shape - called a polygon - drawn on a map).

The Council building and LDCC experienced telecommunications issues throughout the evening, including unreliable access to internet and email.¹³⁴ This made its reliance on Emergency Alert and Facebook problematic. Intermittent phone and internet services caused delays in issuing warnings, and the Council could not be confident that residents would receive its warnings (see Telecommunications Infrastructure section for more detail).

The LDMG relied on SunWater and the Callide Dam as its 'triggers' for deciding if, and when, to issue Emergency Alert warnings.¹³⁵ This saw the LDMG narrow its focus to exclude other hazards and risks that warranted warnings to the community. While information about dam levels and the likelihood of spilling was important for painting the picture of a flood event, it was only one component of the range of information the LDMG needed to consider, and only one part of a larger flood event.

Cancelled Emergency Alert

The LDCC experienced significant difficulties using the Emergency Alert system. At 4.51pm on 20 February 2015, the LDCC attempted to send the following advice message:¹³⁶



Emergency Alert SMS Message¹³⁷

CALLIDE DAM CAPACITY RISING. MAY REQUIRE RELEASE OF WATER FROM DAM- PREPARE NOW. LISTEN TO RADIO OR VISIT WWW DOT BANANA DOT QLD DOT GOV DOT AU



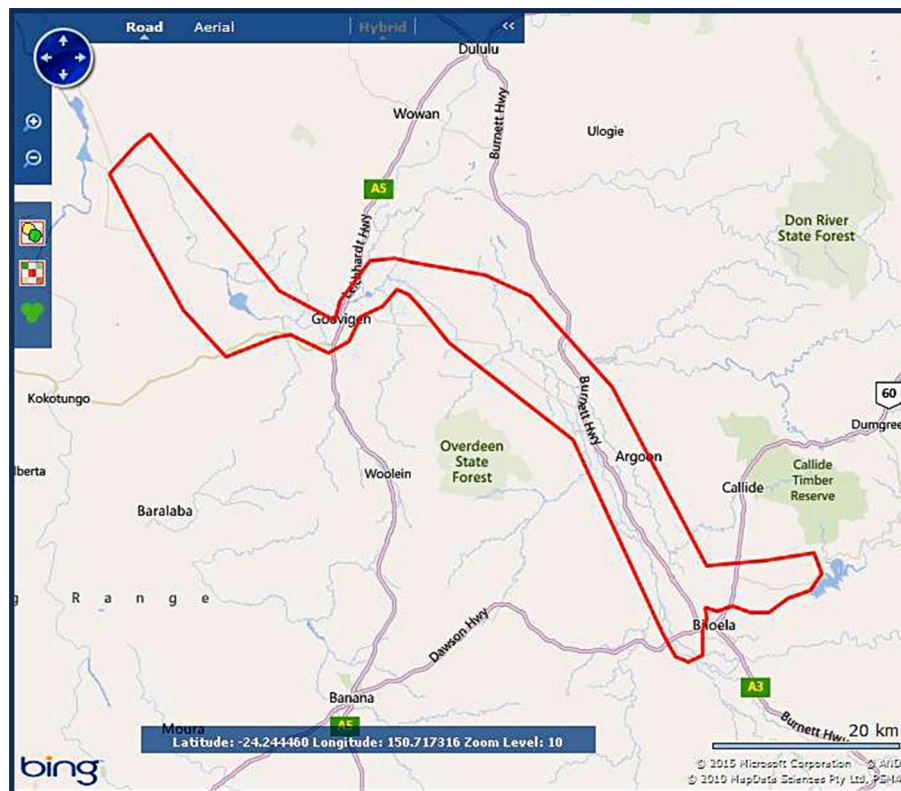
Emergency Alert Voice Message¹³⁸

This is a flood advice message from local disaster management group. Callide Dam capacity rising. May require release of water from dam. Areas in jambin and goovigen may be affected if this occurs. You should prepare now in case release of water is required. For more information listen to local radio or visit [www dot banana dot qld dot gov dot au](http://www.dot.banana.qld.gov.au). For flood assistance contact state emergency service on 132500

The LDCC then cancelled the advice message at 6.18pm before anything was sent to the public.¹³⁹ The cancellation was partly due to issues with the map showing the area to be warned (known as the polygon) that the LDCC had sent to the SDCC.¹⁴⁰ Despite multiple attempts, the file types the LDCC provided were unable to be uploaded into the Emergency Alert system.¹⁴¹

The SDCC eventually prepared the polygon for the LDCC by free-drawing the shape into the Emergency Alert system.¹⁴² This was completed at around 8.30pm and was done on the initiative of a SDCC staff member. This avoided a repeat of the same issues in the LDCC's later warning message.

Right: Emergency Alert polygon depicting the warning area of the Emergency Alert campaign within the Callide Valley. Emergency Management Victoria



During Tropical Cyclone Marcia, 47% of all the Emergency Alert requests sent to the SDCC by local and district disaster management groups required amendment,¹⁴³ suggesting that the Banana LDCC was not alone in experiencing difficulties utilising the system. The Queensland Floods Commission of Inquiry (QFCOI) recommended that local governments pre-plan SMS alert templates for warnings.¹⁴⁴ Despite this, a recent review found only a small proportion of councils have pre-prepared and obtained pre-approval of their warning materials for Emergency Alert.¹⁴⁵

If the LDMG had pre-prepared its warning materials, it may have avoided the issues with its polygon. This preparatory work was suggested by a core member of the LDMG at their 6.00am meeting on 20 February 2015.¹⁴⁶ The member raised the Emergency Alert delays experienced in the 2013 event as the rationale for being more prepared this time.¹⁴⁷ The LDMG did not resolve to pre-prepare its warning materials at the 6.00am meeting, but did agree to develop draft trigger points for the Callide Dam.¹⁴⁸

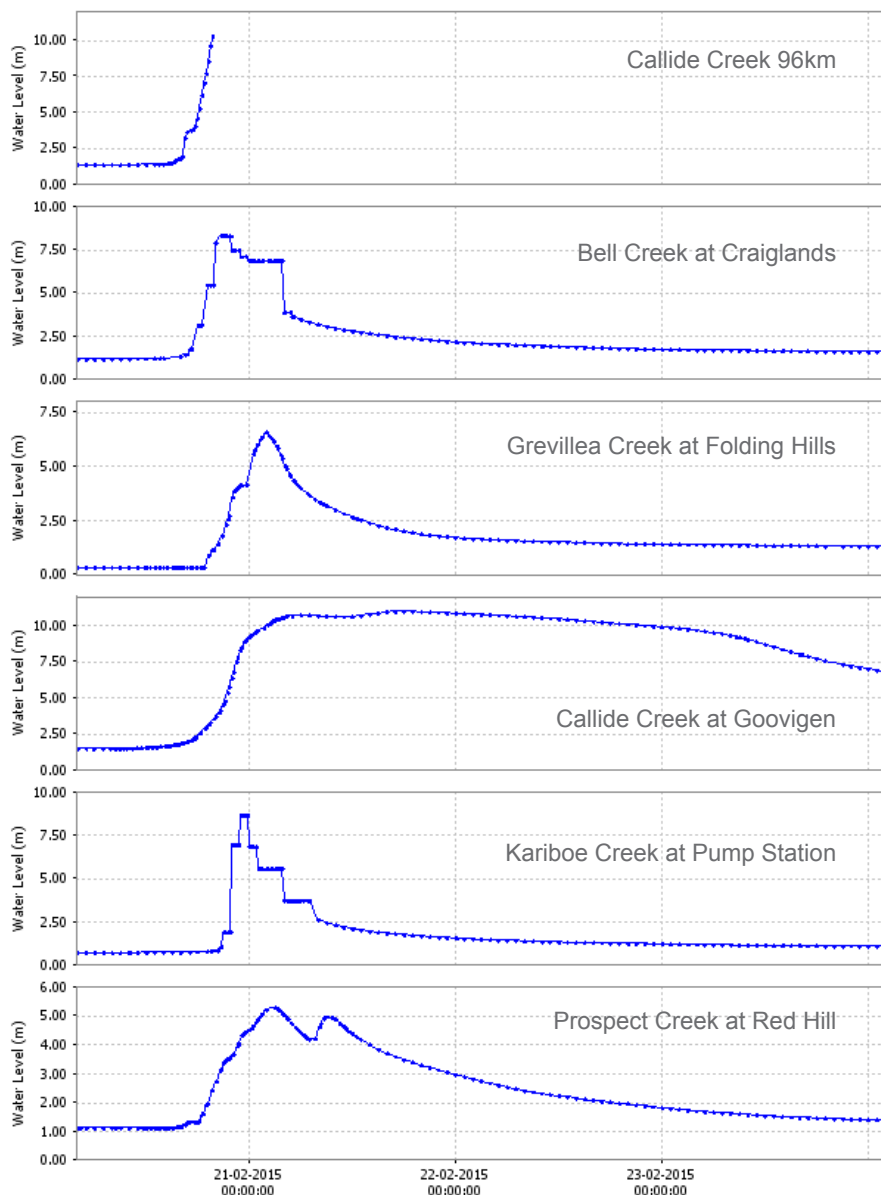
When cancelling the advice message at 6.18pm, the LDCC staff told the SDCC that a warning message would be issued shortly.¹⁴⁹ It was two and a half hours before the LDCC provided the content for the Emergency Alert warning.¹⁵⁰ The LDCC had attempted to send a new map at 8.09pm, however this was still not compatible with the Emergency Alert system¹⁵¹ and, as discussed above, it was the SDCC that eventually prepared the map for the Council.

The LDCC issued a media release sometime after 6.20pm that did not mirror the information contained in the advice message and did not include the extent of the LDCC's knowledge of the likelihood that Callide and Kroombit dams would spill, nor that river and rain gauges had been showing rises for some time:

*'The Coordination Centre continues to work with SunWater monitoring levels at the Callide Dam. The situation will continue to be monitored and advices issued to affected residents by media release and text message as appropriate.'*¹⁵²

Issued Emergency Alert

The timing of the request for the warning message needs to be considered in the context of what the LDCC and LDMG knew during the late afternoon and early evening of 20 February 2015. Rain gauges showed rainfall increasing from around lunchtime,¹⁵³ which was publicly available information via the BoM website.¹⁵⁴ The river height gauges, also available via the BoM website, showed the impact of heavy rainfall from early evening:



Left: River gauge plots.
Independent BMT WBM
hydrologist report

At the LDMG meeting at 5.00pm on the 20 February 2015, SunWater said that it expected that the Callide Dam would reach its temporary full supply level within the next 24 hours, which would result in water being released.¹⁵⁵ At this point, the LDCC had already requested the Emergency Alert advice message.

Banana Shire Local Disaster Coordination Centre / Local Disaster Management Group:

Selected telephone calls / warnings related to Callide Dam release, 5.00pm to midnight, 20 February 2015.

Red shaded cells represent warnings issued.

Time	From	To	Call duration	Details
5.08pm	SunWater	LDMG	26 mins	Teleconference LDMG meeting: 'updated gate status and levels. Callide Ck showing a flow at 96km. 91mm of rain today and possible that the dam may spill within 24hrs. Manual GB read to be checked'. ¹⁵⁶
6.18pm	LDCC	Watchdesk	Email	Cancelled Emergency Alert 'advice' message requested at 4.52pm ... 'as we will more than likely be looking at a request in the near future for an EA [Emergency Warning]. I will try to ensure that the mapping issue is sorted at our end before we got to that point.' ¹⁵⁷
6.49pm	SDCC Watchdesk	LDCC	14 secs	No detail available, call not recorded ¹⁵⁸
6.52pm	Watchdesk	LDCC	2 mins	No detail available, call not recorded ¹⁵⁹
6.59pm	Watchdesk	LDCC	1 min	No detail available, call not recorded ¹⁶⁰
7.03pm	SunWater	LDCC	3 mins	'Advised that we may reach the reduced FSL trigger tonight. Inflows are still rising but need to monitor rainfall. He asked if we can add height and flows to the SMS messages.' ¹⁶¹
7.07pm	LDCC	Watchdesk	3 mins	No detail available, call not recorded ¹⁶²
7.52pm	LDCC	SunWater	7 mins	'Advised [LDCC] that we will reach the 215.4 trigger shortly. Won't be able to open the gates manually – too dangerous. Expect auto gate operation within hours. 96k 120,000 and rising. Kroombit 266.4.' ¹⁶³
8.09pm	LDCC	SDCC	Email	Alternative map files sent to SDCC, but these were still incompatible with Emergency Alert system. ¹⁶⁴
8.18pm	LDCC	SunWater	4 mins	'[LDCC] called. Asked about automatic gate operation. Advised they would open to route flow and match inflows. Callide is now above reduced FSL and still rising. Inflows are now beyond 2013 records. Expect auto-operation is imminent and we will need to notify our DS residents and activate EAP' ¹⁶⁵
8.18pm	LDCC	Watchdesk	2 mins	No detail available, call not recorded ¹⁶⁶

Time	From	To	Call duration	Details
8.30pm	Watchdesk	LDCC	Email	SDCC had prepared polygon for LDCC and emailed it for approval. Appears not to have been received by LDCC due to communication issues. ¹⁶⁷
8.34pm	SunWater	LDCC	2 mins	'Gave an update on levels. Believe gates will open.' ¹⁶⁸
8.37pm	LDCC	LECC (Jambin Chair)	Unknown	Notify residents to evacuate to the school, expect water to be released soon. ¹⁶⁹
8.39pm	SunWater	Subscribed Downstream Residents	SMS	Dam: CALLIDE EVENT: FLOOD ALERT: D/S FLOODING EXPECTED - RAPID RISES REFER: www.bom.gov.au and Local Emergency Mgt Groups for more details. ¹⁷⁰
8.39pm to 9.02pm	SunWater	Immediately Downstream Residents	Unknown	Advised to expect rapid rises in Callide Creek and that the event was going to be larger than 2013, although SunWater could not confirm how high the water would be as the upstream gauge had not peaked. ¹⁷¹
Around 8.40pm onwards	LDCC	Contacts	Unknown	LDCC staff began ringing their contacts to advise them that the dam gates were open. LDMG Chairperson notified media outlets. ¹⁷²
8.41pm	LDCC	LECC (Jambin Chair)	Unknown	The gates had automatically opened and reports were that the water may be higher than 2013. ¹⁷³
8.43pm	QFES Rep	Watchdesk (staff)	1min 45secs	Called on behalf of LDCC as they're having communications issues and can't send a polygon. Understood an Emergency Alert was being prepared. Please call LDCC to arrange Emergency Alert over the phone. ¹⁷⁴
8.44pm	SunWater	LDCC	31 secs	No detail available, call not recorded ¹⁷⁵
8.45pm	LDCC	Public	NA	Banana Shire Disaster Management Information Facebook post: 'SunWater has advised to expect water to be released from the dam in the very near future. Urges residents to evacuate to Jambin School.' ¹⁷⁶
8.46pm	QFES Rep	Watchdesk (supervisor)	1min 28secs	Called on behalf of LDCC as they're having communications issues and can't send a polygon. Please call LDCC to arrange Emergency Alert over the phone. ¹⁷⁷

Time	From	To	Call duration	Details
8.48pm	Watchdesk	LDCC	1min 38secs	<p>Watchdesk: 'I believe you want us to get a EA prepared?...'</p> <p>...</p> <p>Watchdesk: 'Have you got it [message] prepared already?'</p> <p>LDCC: 'Ah, got a draft, just have to finalise the message and sort...that out so I'll do that with um the senior people here while I'm waiting for you...to get back to me.'¹⁷⁸</p>
8.50pm	Watchdesk	LDCC	2min 39secs	<p>Watchdesk advised they had hand drawn the map into the Emergency Alert system. Watchdesk requested message content and LDCC staff member replied:</p> <p>'I'm just waiting on the draft we did up, and other people here to advise it so, do you want us to do that and get back to you with that message?'¹⁷⁹</p>
8.52pm	SunWater	LDCC	1 min	'Updated levels Callide and Kroombit' ¹⁸⁰
8.56pm	LDCC	Watchdesk	7min 44secs	<p>LDCC contacted Watchdesk with the approved message for use in the Emergency Alert:</p> <p>'We will do the voice first... This is a flood warning message from Banana Local Disaster Management Group. SunWater advise of extensive outflow of water occurring from Callide Dam. Areas in Jambin and Goovigen... are likely to experience rapidly rising water levels, over the next two to three hours, posing a danger to residents. You should move to high ground now, for more info listen to local radio, or visit w, w, dot, banana, dot, q, l, d, dot, gov ,a, u'.</p> <p>'Ok and the text... Flood warning message from Banana Local Disaster Management Group. Stop. Water release from Callide Dam occurring Stop? Threat to life and property, stop. Jambin and Goovigin leave area now or seek higher ground. Stop. Listen to radio'</p> <p>Watchdesk staff member:</p> <p>'OK. All good, we'll set it up and we'll find someone to approve it here'¹⁸¹</p>
9.09pm	SunWater	LDMG	SMS	'Callide Dam ht 216.33m, 96k gauge 10.23 last read at 7:45pm. Kroombit 267.24m 78,462ML/d flow.' ¹⁸²

Time	From	To	Call duration	Details
9.15pm	SunWater	LDCC	1 min	'Asked if we had spillway ratings for Kroombit and historical levels for comparison. Wanted info to assist with determining where they might move people.' ¹⁸³
9.16pm	Watchdesk	LDCC	1 min	No detail available, call not recorded ¹⁸⁴
9.24pm	Watchdesk	LDCC	3 mins	No detail available, call not recorded ¹⁸⁵
9.34pm	SunWater	LDCC	2 mins	'Advised 2013 peak at Kroombit was 267.47m. Will confirm flows when I have rating table.' ¹⁸⁶
9.40pm to 10.41pm	LDCC	Public within polygon	SMS	Emergency Alert warning from Banana LDMG (exact content included with discussion below)
9.40pm to 10.41pm	LDCC	Public within polygon	Recorded Voice Message	Emergency Alert warning from Banana LDMG (exact content included with discussion below)
10.04pm	SunWater	LDCC	1 min	'Advised level 217.16m and flow 298,000ML/day. HW may be slowing. 2013 peak was 2000cumecs, now well over previous record. At 3460cumecs.' ¹⁸⁷
10.07pm	SunWater	LDCC	3 mins	'Checked ratings for Kroombit. 268.19m = 175,000NL/d. 2013 267.47m = 98,000ML/d.' ¹⁸⁸
10.35pm	SunWater	LDCC	Nil	'No answer' ¹⁸⁹
10.36pm	SunWater	LDCC	1 min	'Callide HW may have peaked, gates may close slightly from now.' ¹⁹⁰
10.37pm	SunWater	Subscribed Downstream Residents	SMS	Dam: CALLIDE EVENT: FLOOD ALERT: FLOOD STAGE 4 Current Flow: 298000ML/day REFER: www.bom.gov.au and Local Emergency Mgt Groups for more details. ¹⁹¹
11.03pm	SunWater	LDCC	Nil	'No answer' ¹⁹²
11.41pm	SunWater	LDCC	22 secs	'Gave update. Gates openings reduced. HW 216.88. Kroombit 268.03m and falling. Will have an EEC handover from midnight' ¹⁹³

The LDCC's delay in taking action to send a warning message, despite knowing that the dam would almost certainly spill, is a significant issue. The cancellation of the advice message compounds this issue, as the community was not provided with important information needed to take action early.

The Emergency Alert warning message the Council requested is as follows:



Emergency Alert SMS Message ¹⁹⁴

Flood Warning from Banana LDMG. Water releasing Callide Dam. Threat to Life and Property. Jambin & Goovigen leave area now or seek higher ground. Listen to radio.



Emergency Alert Voice Message ¹⁹⁵

Emergency Emergency. This is a flood warning message from Banana Local Disaster Management Group. Sun Water advise of extensive outflow of water occurring from Callide Dam. Areas in Jambin and Goovigen are likely to experience rapidly rising water levels over the next 2 to 3 hours posing a danger to residence. You should move to high ground now. For more information listen to local radio.

This information was not posted on the Banana Shire Disaster Management Information Facebook page (Banana DM Facebook page).

There were issues with the message content, including that Goovigen could not be pronounced by the Emergency Alert system, and the content needed to be approved over the phone, rather than via email due to the LDCC's communications issues.¹⁹⁶ Addressing these issues took approximately eight minutes.¹⁹⁷

It then took 43 minutes to send the warning.¹⁹⁸ This was because the message content and the polygon needed to be loaded into the Emergency Alert system, which takes time. On the night of 20 February 2015, it took an average of one hour and 23 minutes to send an Emergency Alert.¹⁹⁹ Again, pre-planning of warning materials by the LDMG may have enabled the message to be sent more rapidly, as the material would already have been in the Emergency Alert system.

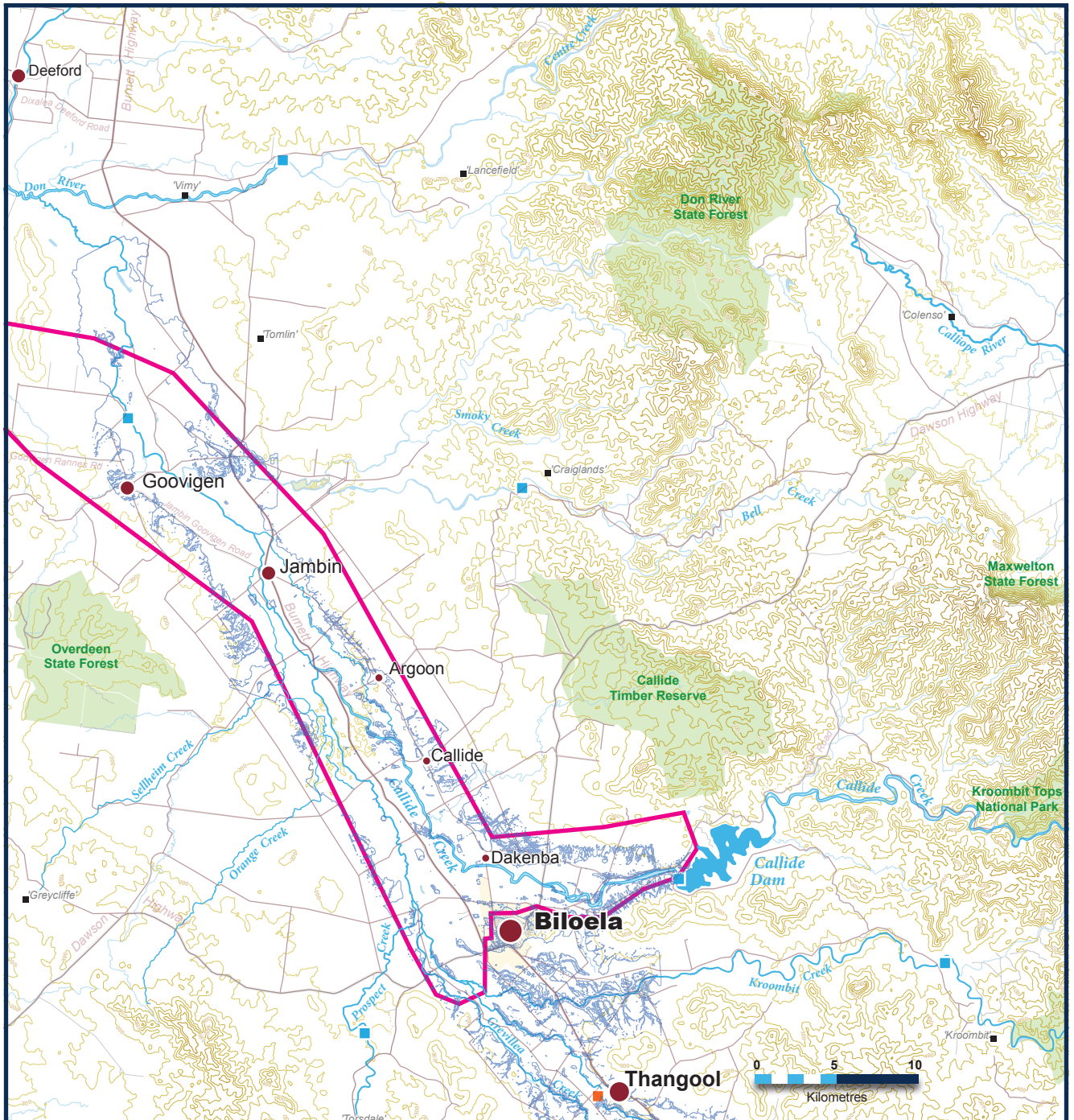
The Emergency Alert campaign started at 9.40pm (i.e. when the Emergency Alert system started sending the warning to phones within the polygon).²⁰⁰ The campaign ended at 10.41pm. The gates of the Callide Dam had been open since approximately 8.30pm.²⁰¹

The Emergency Alert warning only mentioned risks to Jambin and Goovigen, and did not specifically warn other downstream residents. Some residents who received this notification interpreted the warning as meaning only Jambin and Goovigen were at risk, so they incorrectly assumed the flood event would not affect them.²⁰² The confusion caused by referring to Jambin and Goovigen is evidenced by the following resident comments in response to our community survey:

- *'although [we were] in the direct path of the water releases [we] didn't know it applied to us, so [we] didn't know what it meant for us'*
- *'It didn't refer to our area, we were already flooded'*
- *'[the] Message was not clear as it didn't refer to my local area so I had to guess if it really meant us or really just the areas mentioned.'*²⁰³

According to our community survey, most people found the message easy to understand, but a small proportion rated it as difficult because:

- *'It didn't indicate the area that we were in - our house was flooded.'*
- *'It didn't refer to our area, we were already flooded.'*
- *'Did not tell me where to go, just to get out.'*
- *'They told us to evacuate to Jambin which is ridiculous because it's downstream. By the time we got the message we were already flooded in.'*²⁰⁴



As it is the Council's responsibility to issue warnings within the local government area, all communities within the Banana Shire that were likely to be impacted by the flood event should have received warnings. Although the LDMG knew that SunWater had notified its subscribed residents who were within 10km downstream from the Kroombit Dam, the LDMG did not take any action to warn residents susceptible to flows from that catchment area.²⁰⁵ Resident reports of flooding, the BoM forecasts and rainfall or river gauge readings indicated widespread flooding and rapid river rises. Despite developing a risk assessment²⁰⁶ for Tropical Cyclone Marcia that identified flooding in all local watercourses, the LDMG did not warn of flooding other than for Callide Creek. The Council did issue some media releases in the lead up to the event that contained some generic information, such as risks associated with destructive winds, localised flooding and rainfall around the Banana Shire.²⁰⁷

Above: Extent of flood compared to warning area.
BMT WBM flood mapping overlaid with polygon from Emergency Alert campaign from Emergency Management Victoria

Effectiveness of Emergency Alert

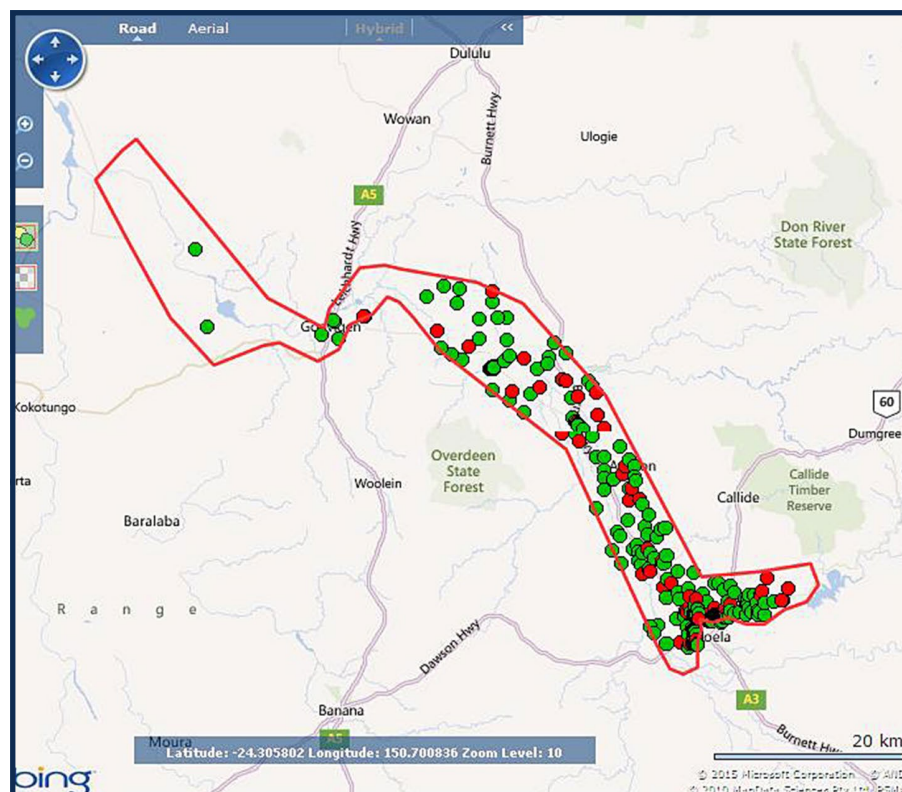
Some people within the target area for the Emergency Alert campaign may not have received a warning. A review of the Emergency Alert campaign statistics indicates that while the system attempted to contact all the telephones in the campaign area, a significant number of both voice calls to landlines (51%) and SMS messages to mobile phones (15%) were not received by individuals for a variety of reasons.²⁰⁸ Emergency Management Victoria told us that these statistics are not uncommon.²⁰⁹ This is concerning because of the importance placed on the Emergency Alert system in providing warnings to people in this event.

Of the total 601 voice messages attempted, 308 were not answered (51%), however all numbers were dialled.²¹⁰ There are numerous reasons why these messages were not answered. Emergency Alert's effectiveness in reaching everyone within a target area depends on a number of factors that are not within the LDMG's control. Reasons for landline voice messages not being answered include:

- power outages affecting landline or cordless phones
- landlines were busy on another call at the time
- no answer was made on the line (calls rang out)
- disconnected numbers, fax lines or Private Automatic Branch Exchange (PABX) being attempted.²¹¹

Of the 308 voice calls that were not answered, 10 dialled numbers were busy, 91 were not answered, 195 were not valid numbers (e.g. PABX) and 12 were to fax lines.²¹² We note that the Emergency Alert system will make several attempts to reach a telephone.²¹³ Of the total 5,820 devices detected in the target area 902 SMS messages were not delivered to a device (15%)²¹⁴ due to mobile network failures affected by the flooding, plus SIM enabled devices, such as vending machines, incapable of receiving SMS.²¹⁵ The following map shows a section of the warning area depicting alerts received on landlines with green dots, and unsuccessful attempts with red dots:

Right: Map of the final
Emergency Alert Campaign
– landlines only
Emergency Management Victoria



The reasons why mobile phone SMS failures occur are more complex, and difficult to qualify on a case-by-case basis, than landlines. A specific breakdown of the number of failures per cause is not possible.²¹⁶ Reasons for failure include:

- mobile phones were switched off or not in a coverage area
- power outages affecting the area and mobile phones not being charged
- general reception issues in the area effecting the receipt of phone calls or SMS
- delays in phones connecting to towers as the phone moves between towers (can impact up to an hour after relocating)
- carrier-specific 4G technology issues (discussed in detail on the Emergency Alert website).²¹⁷

Generally speaking, the Emergency Alert system will alert slightly more mobile phones than are actually in the target area.²¹⁸ This is due to the method by which towers recognise phone locations. The three network providers in Australia (Telstra, Optus and Vodafone) all operate independent networks. Only Telstra's 4G network is completely compatible with the Emergency Alert system.²¹⁹ All Telstra mobile phones within the defined Emergency Alert warning area should receive an alert, pending other causes of non-receipt outlined above.²²⁰ Subscribers on the Optus or Vodafone networks who have moved between towers, or have not made or received a call or SMS in the preceding hour, may not be recognised as being in the warning area.²²¹

A full explanation of the Emergency Alert system, and frequently asked questions (including issues about receipt of messages), can be located at <http://www.emergencyalert.gov.au/>. This site provides detailed explanations of the technical reasons why some mobile phones will not receive an alert.

These issues highlight the need for both LDMGs and the community to use multiple mediums for sending and receiving emergency warnings aside from the Emergency Alert system. Emergency Alert does not replace the use of other media, such as radio, television and internet services, to keep people informed.

Facebook and other warning methods

The LDCC used Facebook and media releases in the lead up to, and during the event. The LDCC posted a mix of general information (e.g. preparedness information) and warnings, and also used Facebook's private messaging function to communicate directly with residents.

Information posted on the public Banana DM Facebook page and sent via private messages was inconsistent. There were also delays in communicating key information. One LDCC staff member recalled an LDMG member coming into the centre at 8.41pm and instructing everyone to call as many people as possible, and post on the Banana DM Facebook page that the dam gates were open, as there were problems with the SMS alert.²²² The LDCC staff member then telephoned a representative from the Jambin LECC, saying that the dam gates had automatically opened and that water may be higher than 2013.²²³

Other staff in the LDCC began ringing their contacts and local residents to advise them of the situation and to ask them to contact others in their area.²²⁴ This informal 'phone-tree' approach took staff away from their core responsibilities, such as posting advice to Facebook or managing the LDCC. It is also likely that this approach resulted in inconsistent information being conveyed to the community, given the lack of shared situational awareness within the LDCC (see Operational Information and Intelligence section).

The informal nature of the communications means there are few records or recollections of the content of the conversations for our analysis.

At 8.45pm the LDCC posted its first warning related to the Callide Dam, which said:

Facebook Message (public)²²⁵



URGENT – All Jambin residents are urged to evacuate to the Jambin State School due to high water levels coming into the Callide Dam. **SunWater has advised to expect water to be released from the dam in the very near future.** Please tag and share to all your friends as there are current difficulties with the SMS alert system. *[emphasis added]*

This was posted nine minutes before the LDCC sent the request to the SDCC for an Emergency Alert warning message. Despite the content of the message indicating the gates would open soon, we believe senior staff in the LDCC knew the Callide Dam gates were open and this Facebook post was the result of the 8.41pm instruction. At 8.48pm there was a discussion in the LDCC about the gates being open.²²⁶ The LDMG Chair telephoned media outlets,²²⁷ relaying the same message that had been given to the LDCC at 8.41pm, that the gates had opened and there were problems with the SMS warnings:

Right: Media article Nine News, 21 February 2015

Emergency evacuation for Jambin after floodgates open at Callide Dam



An emergency evacuation has been ordered for the central Queensland towns of Jambin and Goovigen after automatic floodgates opened at the nearby Callide Dam in the wake of Cyclone Marcia.

Banana Shire Mayor Ron Carige has urged residents in low-lying areas, including the local school, to evacuate and seek higher ground.

It is believed up to 100 people in the area could be affected by flooding, which is about 40km from the dam.

"Areas in Jambin and Goovigen are likely to experience rapidly rising water levels over the next two to three hours posing a danger to residents," an emergency alert said.

"You should move to higher ground now. For more information listen to local radio."



It is understood an SMS alert system failed, but residents have been contacted via landline phones and through social media, Cr Carige said.

"We've gone on Facebook and we're phoning as many people as we can," he told the Courier Mail.

"We can't make them go but we're appealing to them to go and from past experience they're well geared for this operation... they're pretty resilient."

The town last flooded in 2013, but water levels at the dam are believed to be higher now than that event.

© ninemsn 2015

At 9.04pm, a resident who lives close to the Callide Dam sent a private message to the Banana DM Facebook page asking how to get on the list to be notified if the dam gates opened.²²⁸ At 9.21pm the LDCC responded, stating:



Facebook Message (private)²²⁹

The gates have automatically opened. Please self-evacuate. We have limited communication lines.

At 9.19pm another resident sent a private Facebook message asking if it would be necessary to evacuate the Tognolini-Baldwin end of State Farm Road that night.²³⁰ At 9.36pm the LDCC responded advising the resident to self-evacuate as the gates had automatically opened.²³¹ At 9.19pm, the LDCC posted the following to its Facebook page:



Facebook Message (public)²³²

URGENT – Tognolini-Baldwin Road residents are urged to self-evacuate to relatives or friends. If unable to do so, please contact the disaster call centre on 49923511 or 49924027 to arrange emergency shelter.

This public message said nothing about the gates being open. It was not until 9.58pm (around an hour and a half after the gates had opened) that the following was posted:



Facebook Message (public)²³³

Banana LDCC having difficulties with internet and phone connections. **We can confirm that the gates to Callide Dam have automatically opened** and SunWater have predicted water levels to be higher than 2013. If in low lying area, urge to self-evacuate. *[emphasis added]*

Warning messages should provide the public with consistent information and advice, and warning systems should support the timely flow of critical information.²³⁴ During the event, there were considerable delays between when senior staff in the LDCC became aware of information and when this information was posted on Facebook. It was also problematic that information about the Callide Dam gates being open was communicated via private messages well before it was posted to the public Facebook page. We acknowledge that the social media officer was performing multiple roles, and some staff felt pressure from the demands of the unfolding situation, all the while experiencing telecommunication difficulties.²³⁵ This only highlights the value of thorough planning processes embedded through live exercises, and ensuring staffing levels are appropriate for the scale of the event.

The Council had not finalised procedures or guidelines as to how Facebook should be used during an emergency, including when warnings should be posted and what information should be provided to the community.²³⁶ The social media officer had participated in Facebook training run by the Local Government Association of Queensland, and had some knowledge about information that should and should not be posted.²³⁷

Using Facebook in a disaster may intimate to the community that information is being posted in real-time. If this expectation is created, the Council must ensure it has capacity to meet that expectation. As Facebook was one of the LDCC's key platforms for issuing public information and warnings, tasking one officer to manage Facebook (plus other functions in the LDCC) did not enable the LDCC to use Facebook to its full potential. Senior staff in the LDCC were approving every post, and missed opportunities to connect the community with vital information as it came to hand.²³⁸

SunWater

SunWater has limited responsibility for issuing warnings. Those warnings though are critical for people immediately below the dam. It is vital that SunWater's messages are as effective as possible given recipients may have little time to comprehend the contents of the warning and decide what action to take. There were issues with both the content and timing of SunWater's warnings in this event.

The QFCOI noted:

*'The need for warnings is acute for those residing below dams with gates, because the water flow may increase rapidly when the gates open. Water levels can threaten before the local disaster management group can properly process the dam information and issue a warning. This leads to a confined exception to the general rule that dam operators are not responsible for providing warnings directly to the community.'*²³⁹

In response to the February 2015 event, SunWater published answers to frequently asked questions on its website.²⁴⁰ SunWater stated that downstream residents were warned 'as soon as it became clear that water releases were likely'.²⁴¹ SunWater contended it 'followed the legislated Emergency Action Plan'.²⁴² We do not believe either of those statements to be acceptable in the circumstances of this event.

Timeliness

SunWater 'activated' the EAP at 8.18pm²⁴³ when the LDCC was told that automatic operation of the dam gates was expected 'imminently'. Prior to this time there had been at least eight consecutive readings (every 15 minutes) or two hours of significant water level rises at the '96 kilometre gauge' apparent at the time (accounting for a 30 minute delay in the data being available to SunWater).²⁴⁴ By 7.15pm, SunWater would likely have seen four consecutive readings of water levels rising significantly. High intensity rain was still falling.²⁴⁵ At 8.00pm, the gauge near the dam gates showed the lake level had reached 215.59m, which was just over the trigger for activating the EAP. SunWater's first recording of this level was at 8.09pm when a dam operator logged the 8.00pm reading.²⁴⁶ Yet, SunWater's first warning to downstream residents was not until 8.39pm.²⁴⁷ As a result, residents within the 10 km downstream zone from the Callide Dam received little warning of the large flows heading their way.

The *Water Supply (Safety and Reliability) Act 2008* (Qld) states that dam owners must not contravene a dam safety condition.²⁴⁸ Of relevance, dam safety condition 13 for the Callide Dam outlines that '*In all emergencies, the dam owner must respond in accordance with the Emergency Action Plan*'.²⁴⁹

The DEWS told us that:

*'Given the uncertainty in predicting the exact circumstances in which these catastrophic failures may be caused, EAPs are intended to guide planning and emergency responses and not be rigid operational documents during emergency events ...'*²⁵⁰

'Referable dam owners are free to undertake any actions they consider necessary to preserve the safety of the dam and subsequently the safety of people downstream during an emergency event. There are no current requirements for the dam owner to explicitly comply with an EAP during an event. This is due to a need to maintain some flexibility to be able to adapt to emergent situations that cannot always be predicted during emergency events. The only directly relevant dam owner compliance

requirements are to have an approved EAP in place and to produce an emergency event report after each emergency event.’²⁵¹

The DEWS’ *Provisional Guidelines for Emergency Action Planning for Referable Dams* states that:

‘The main function of an EAP is to specify what the dam owner will do in an emergency in order to:

- (a) Provide timely notification to people who are or may be at immediate risk during an emergency event so that they can take appropriate measures for their own safety...²⁵²*

These Guidelines also note that examples of ‘trigger events’ for activation of the EAP might include ‘*dam lake levels that may be rising much more rapidly than is usually experienced*’.²⁵³

A particular event may warrant a common sense deviation from the EAP. Provided that departure is aimed at achieving the purposes of the EAP (i.e. preservation of the safety of the dam or those downstream), it is appropriate and within the discretion of the dam operator. SunWater’s *Callide Dam Operation and Maintenance Manual* states that ‘*operating personnel must know the EAPs contents and follow its procedures*’.²⁵⁴ The Manual does support flexibility in activating the EAP ‘*when a problem develops that has the potential to endanger downstream life and property*’.²⁵⁵

SunWater participates in the LDMG meetings to provide advice on dam levels at the Callide and Kroombit dams, and to discuss any issues. At the 1.00pm LDMG meeting on 19 February 2015, a SunWater representative said:

‘... if we think that we might need to do a release overnight we would activate early and advise you and our downstream people in our list even though the release may not be until one, two or four in the morning. At least that way people are advised in daylight hours.

‘... There would still be the actual formal notification through you guys and then the relevant people as well when the actual release occurred as well that would be our best guess forecast so that people had sufficient warning of an intention to do that’.²⁵⁶

At the LDMG meeting on Friday 20 February 2015 at 6.00am the SunWater representative re-emphasised that downstream residents would be warned in daylight hours.²⁵⁷ This advice suggested that SunWater would deviate from its EAP and issue warnings early, which was inconsistent with the intention of the dam’s decision-makers.

SunWater’s downstream residents

EAPs for referable dams must include arrangements for warning downstream residents.²⁵⁸ For each flood alert level, the EAP sets out who needs to be notified, how they are to be notified and what message is to be sent to them.²⁵⁹

SunWater uses a combination of SMS notifications and phone calls to notify downstream residents when water is released from one of its referable dams.

A ‘downstream resident’ is not defined in SunWater’s EAPs or in legislation. SunWater only notifies residents within 10km downstream of a dam, as these are the people likely to be affected within one hour of water being released.²⁶⁰ The basis of this assessment is that as flood waters are typically up to 3m³/s, a flood wave would travel up to approximately 10km in one hour.²⁶¹ SunWater believes that this one hour window should give the LDMG time to prepare and send its warnings to communities at risk.²⁶²

If you live by a dam, sign up for alerts

RESIDENTS and landholders who are downstream from SunWater dams are being asked to sign up to receive emergency alerts from the water supplier.

SunWater's notification system has been designed to ensure Queenslanders living immediately downstream of its dams have as much notice as possible to prepare should an emergency arise.

Water Minister Mark McArdle said residents can select to be notified of alerts via their preferred method of communication including email, telephone or SMS.

"With summer fast approaching, now is the time to start thinking about what actions people can take to get ready for severe weather events," Mr McArdle said.

"People living up to 10km downstream of SunWater dams should register to be included on SunWater's Emergency Action Plan (EAP) Notification List."

Residents who have registered previously do not need to register again.

Mr McArdle said the Queensland Government's strong plan for the water sector – WaterQ – recognised that natural disasters and climate variability present unique challenges.

Registrations can be lodged on the SunWater website at www.sunwater.com.au or by calling SunWater's Customer Support Team on 131 589 by Friday, August 29.

SunWater dams include:
 ■ Callide and Kroombit Dams (Biloela)
 ■ Cania Dam (Monto)

TELL US YOUR NEWS

editor@centraltelegraph.com.au

SunWater obtains contact details for residents within the 10km zone by:

- Conducting property searches, and sending letters to confirm contact details
- Placing annual advertisements in local newspapers inviting residents to register
- Advertising the subscription service via Twitter
- Providing an online registration form on its website
- Contacting every resident already in the EAP to check their contact details are still accurate.²⁶³



SunWater told us that at the commencement of the February 2015 event, there were a total of 58 residents on its contact list.²⁶⁴ There were 51 mobile phone numbers and seven landline numbers.²⁶⁵ SunWater advise that the 10 km downstream zone contains 66 properties.²⁶⁶ It is not known how many of those properties are occupied.

Not all dams impose a 10 km downstream zone for notifications. Seqwater, which operates 26 dams in south-east Queensland, allows anyone to register to receive notifications via its Early Warning Network service.²⁶⁷ These people do not need to live within the 10 kilometre downstream zone, enabling Seqwater to capture a broader pool of people (e.g. people who frequent the area for recreational purposes). There is still a reliance on people registering their details.

Warnings for Callide and Kroombit dams

On the night of 20 February 2015, SunWater issued two warnings for the Callide Dam, at 8.39pm and 10.37pm.²⁶⁸ SunWater also issued two warnings for the Kroombit Dam, one at 6.28pm (an SMS spilling alert notification) and another at 7.45pm (a Stage 2 alert).²⁶⁹

8.39pm warning for the Callide Dam

The SMS alert sent by SunWater at 8.39pm on 20 February 2015 stated:

SUNWATER ALERT NOTIFICATION²⁷⁰



Dam: CALLIDE
 EVENT: FLOOD
 ALERT: D/S FLOODING EXPECTED - RAPID RISES
 REFER: www.bom.gov.au and Local Emergency Mgt Groups for more details.

Fifty SMS messages were successfully submitted to the SMS service provider.²⁷¹ Of these 50 messages, 48 numbers were successfully submitted on the first attempt at 8.39pm, with the remaining two numbers successfully submitted at 8.42pm.²⁷²

Above: Newspaper article, 8 August 2014, p. 3. Central Telegraph, Biloela
 Top right: Tweet, 30 July 2013 SunWater Limited.

Between 8.39pm and 9.02pm, SunWater attempted to phone 13 downstream residents.²⁷³ Eight were spoken to and advised to expect rapid rises in Callide Creek and that the event was going to be larger than 2013, although SunWater could not confirm how high the water would be as the upstream gauge had not peaked.²⁷⁴ One message was left on an answering machine.²⁷⁵ The nine contacted included six who were not able to be sent an SMS.²⁷⁶

10.37pm warning

SunWater sent its second warning to residents within the 10km zone downstream from the Callide Dam at 10.37pm:²⁷⁷



SUNWATER ALERT NOTIFICATION²⁷⁸

Dam: CALLIDE
 EVENT: FLOOD
 ALERT: FLOOD STAGE 4
 Current Flow: 298000ML/day
 REFER: www.bom.gov.au and Local Emergency Mgt Groups for more details.

Fifty-one messages were successfully submitted to the SMS service provider on the first attempt.²⁷⁹

In contrast to the 8.39pm message, this SMS alert was not followed up with phone calls to downstream residents.²⁸⁰ This is of concern, as there are seven landline numbers in SunWater's notification list that would not have received any warning. SunWater provided no explanation as to why these residents were not contacted.

Message content

An effective warning is understandable, perceived to be authoritative, and is clear on what action the recipient needs to take.²⁸¹ Assessed against these criteria, the text messages from SunWater were not effective warnings. Some residents told us that they did not understand SunWater's message, that the message was too technical, and that it did not make it clear how severe the situation was, particularly as it was sent after the dam gates were already open:

- *'Unless you understood what the technical specs meant you had no concept of the severity of it.'*
- *'Wasn't clear as to what was happening. Didn't seem to include my area and I wasn't sure the information was relevant.'*
- *'[The message came] 5 minutes until [we had to] immediately evacuate premises. Where do I go? How do I get there? [It] wouldn't have mattered even if we up and ran, [the] water would have got you if (you were) outside in the open. Sending a message like that – it was like dropping a bomb on someone who didn't know what was going on. ([I] thought message was for Jambin people – I'm in Biloela – some people got it some people didn't – not all the right people got it. The message just wasn't clear in its direction [and there was] not enough time to act on message'.²⁸²*

The message did not explain what 'Flood Stage 4' meant, and was generally unclear about what was happening, what the risk was, who was at risk, and what the recipient should do. The only action the message recommended was to go to the BoM website or the LDMG for more details.

Residents said:

- *'[I] didn't understand what stage 4 meant. I didn't have the number for the Local Emergency Management Group. [The message] referred to [a] website and if you haven't got a computer you can't find further information.'*
- *'When I received the message you were already surrounded by water and could not get out as we were flooded in. [I] tried to get the family out but could not get them out as each road we tried to take was covered with water.'*
- *'I tried to get onto the [web]site that they had sent through with the message but could not get on, none of us could get on (to the website) from around here.'*
- *'It didn't specifically say gates had opened. It didn't say to evacuate. I had to refer to the BOM website to see what it meant and there was no information. It didn't refer to our area – we were already flooded.'*²⁸³

The BoM website does not have additional information about what is happening at a dam. General weather conditions may be found, and savvy users may find river and rain gauge data for their own interpretation.²⁸⁴ The 'more details' was confusing to some who looked for local disaster management information on the BoM website.²⁸⁵

The 'Local Emergency Mgt Groups' was a reference to the LDMGs. LDMGs are dispersed groups of people that periodically meet. It is not a group readily contactable and not the same as the LDCC, which has a contact number and may have more information for the message recipient. Some residents contacted the LDCC after receiving the SunWater message, only to be told that SunWater was responsible for issuing warnings within the 10 km downstream zone.²⁸⁶ After the event, several residents contacted SunWater to raise their concerns about the quality of the message.

At its 2 February 2015 meeting, the LDMG raised with SunWater the reference to 'Local Emergency Mgt Groups' in its messages.²⁸⁷ The LDMG was also concerned that the LDCC would not always be operating when alerts were sent for dam releases.²⁸⁸

Our community survey showed that 39% (n=158) of respondents had not heard of LDMGs before and 67% (n=272) would not know how to contact them.²⁸⁹

Social media

SunWater has a presence on Facebook and Twitter. SunWater tweeted at 9.22pm on Friday 20 February 2015 that the Callide Dam gates were open.²⁹⁰ It had sent its SMS alert to downstream residents at 8.39pm. As per the discussion about the Council's use of Facebook if an entity has a social media presence, this may intimate to followers that the information being posted is real-time information.

Misunderstanding SunWater's notification system

Following the flood event, it became clear that the LDMG did not understand SunWater's warning arrangements. A core member of the LDMG expressed concern that some residents within 10 km downstream of the Callide Dam had not been notified of releases by SunWater.²⁹¹ At a meeting on 2 March 2015 the LDMG resolved to:

1. *'Inform SunWater that reports received by LDMG have shown that their emergency alert system have not been received by people who reside within the 10km radius'.*
2. *'Ensure their contact procedures are up to date to ensure delivery of the emergency alert text messages is dispersed to all residences residing within the 10km radius'.*²⁹²

On 4 March 2015, a SunWater representative explained to a LDMG meeting that SunWater's alert system was not like Emergency Alert.²⁹³ Rather, people could register their details with SunWater. In response to this advice, the Chairperson of the LDMG remarked:

*'At least we know now that our message is the only message getting to some people ... I wasn't aware of that before. I thought it must have been compulsory that they all had to have their numbers 10km down'.*²⁹⁴

Effective disaster management requires all key entities to understand their roles and responsibilities, and those of other entities they interact with and rely upon. When long-standing LDMG members do not realise that SunWater's warning arrangements do not include all residents 10 km downstream, it is apparent that more could be done by SunWater to ensure its roles and responsibilities are understood.

Emergency Alert

SunWater does not currently use the Emergency Alert system to send warning messages for the Callide or Kroombit dams.²⁹⁵ The use of Emergency Alert was not contemplated for this event, as SunWater believed it could use the system only for events of a 'catastrophic nature' (e.g. imminent dam failure).²⁹⁶

It is SunWater's intention to incorporate the use of Emergency Alert into its EAPs later in 2015.²⁹⁷ This will correspond with scheduled amendments to its EAP.

If the Emergency Alert system had been available to SunWater during the flood event, a higher proportion of residents within the 10 km zone downstream from the dam may have received the alert. Also, anyone else in the area at the time would likely have been notified. Although, the limitations of the Emergency Alert system, as discussed previously in this section, must also be recognised.

Bureau of Meteorology

The BoM issues warnings of gales, storms and other weather conditions likely to endanger life or property.²⁹⁸ This includes weather conditions likely to give rise to floods or bushfires.²⁹⁸ The BoM's flood warning service is documented in the *Service Level Specification* that has been endorsed the Queensland Flood Warning Consultative Committee.³⁰⁰

The BoM issues warnings via local radio, television, and through a telephone service.³⁰¹ The BoM also uses social media – particularly Twitter – to communicate information about weather events.³⁰² All the BoM's messaging refers the recipient back to the BoM website, which is the central source of truth for warning information.

Flood warnings

The following table outlines flood watches and warnings issued by the BoM in the lead up to and during the event. The focus is on material relating to the Banana Shire. Warnings or information issued in the days following the event are not discussed.

Watches and Warnings issued by the Bureau of Meteorology ³⁰³			
Date	Time	Type	Key message content
17 February 2015	3.47pm	Flood Watch	Dawson Catchment: between Thursday and Saturday, expecting widespread rainfall of 200-300mm with higher local rainfall, river level rises above minor flood level, and possible flash flooding.
18 February 2015	11.54am	Flood Watch	Dawson Catchment: between Thursday and Saturday, expecting widespread 200-400mm with higher local rainfall, river level rises above minor flood level, and possible flash flooding. A severe weather warning and tropical cyclone advice are current for parts of the Flood Watch area.
19 February 2015	11.46am	Flood Watch	Same key information as above.
20 February 2015	11.34am	Flood Watch	Dawson Catchment: on Friday and Saturday, expecting widespread rainfall of 200-300mm with higher local rainfall, and possible flash flooding. Severe weather warning and tropical cyclone advice are current.
20 February 2015	10.03pm	Minor Flood Warning	Heavy rainfall has been recorded over the Dawson and Don Rivers and the Callide Creek catchment area in the past 6 hours. This has caused rapid river level rises in the Don River and Callide Creek. Rapid river level rises are occurring on the Don and Dee Rivers and in Callide Creek. Moderate flood levels are rising in the Dee River at Wura. Major flood levels are rising at Kingsborough with rises expected downstream.
21 February 2015	5.55am	Minor Flood Warning	River levels are easing in the upper reaches of the Don and Dee Rivers and Callide Creek. Heavy rainfall has been recorded over the Dawson and Don Rivers and the Callide Creek catchment area overnight with isolated falls to 300 mm. River levels have peaked in the upper reaches of the Dee and Don Rivers and Callide Creek. Rises and moderate flood levels are expected downstream at Rannes Saturday.

Flood watches were issued well in advance of the flood event. Flood warnings did not commence until 10.03pm on Friday 20 February 2015.³⁰⁴ By this time, there was already flooding in many parts of the Banana Shire. The water had been rising significantly at the 96km gauge site since approximately 5.45pm.³⁰⁵ Data source issues that obscured the BoM's situational awareness are discussed in the Operational Information and Intelligence section.

The warnings that were issued were part of a multi watercourse bulletin that was titled 'minor flood warning'. The BoM advised us that often, flood warnings for agreed catchments and locations include reference to some observed local flooding, in accordance with the QFCOI recommendations.³⁰⁶ Although the 'minor flood warnings' issued in this event were consistent with the documented and endorsed *Service Level Specification*,³⁰⁷ they may have confused recipients and undermined their ability to assess the significance of the information. For instance, the 'minor' flood warning at 10.03pm on Friday 20 February 2015 mentioned both 'moderate' and 'major' flood levels:

*'Rapid river level rises are occurring on the Don and Dee Rivers and in the Callide Creek. Moderate flood levels are rising in the Dee River at Wura. Major flood levels are rising at Kingsborough with rises expected downstream.'*³⁰⁸

The BoM advised that flood warnings currently carry the title of the highest flood classification at the locations where a formal flood warning service exists.³⁰⁹ In the case of the Callide Valley catchment, this applies only to the Dawson River.³¹⁰ This message structure may also have been unclear to those relying on the warnings.

Consistent with their responsibilities, the BoM did not issue any site-specific warnings for flash flooding.³¹¹ The BoM did note heavy rain leading to risks of localised flash flooding in its flood watches, and also provided forecasts of heavy rain within tropical cyclone warnings and weather forecasts.³¹² The BoM can issue flash flood warnings if there is a risk to life or property, and it is in the public interest to warn. As noted by the QFCOI though, local councils should generally issue warnings about flash flooding.³¹³

The BoM told us that its flood watches and warnings were disseminated to councils, media and a range of other emergency response agencies.³¹⁴ The BOM_Qld Twitter feed and the information shared by QPS Media focused upon tropical cyclone warnings and not flood risks.

On the following page is a map of the Dawson Catchment area.³¹⁵



Above: Map of the flood warning network in the Fitzroy Basin and Dawson Catchment areas.
Bureau of Meteorology

Cyclone warnings

The BoM frequently posted tropical cyclone advice and warning information in the lead up to and during the flood event.³¹⁶ These warnings noted throughout the event that parts of Banana Shire were likely to be impacted, including Biloela, Taroom and Moura.³¹⁷

As per the standard information the BoM includes in its cyclone warnings, the focus was on destructive winds and gales, rather than rainfall predictions. For many areas, destructive winds were the greatest threat. For the Banana Shire, it was not just the risks from the strong winds and gales that needed to be understood, but also the implications of the rain that had already fallen in the area. The cyclone warnings may not have provided the community with the full picture of the risks it was facing from Tropical Cyclone Marcia.

Cyclone warnings were actively shared by entities, such as ABC Radio and QPS Media. The BoM conducted large numbers of radio broadcasts regarding the threat and the Premier also mentioned cyclone information and a specific threat of heavy rain and local rises during press conferences,³¹⁸ including referring to risks to Biloela. This enabled the information to reach a wider audience. It also ensured that the information in the public domain was consistent and had authority. Social media was an important tool in this regard, with #TCMarcia trending on Twitter. The BoM also made use of several hashtags for cyclone watches and warnings, including #QLDfloods, #SEQrain and #TCMarcia.³¹⁹ A similar arrangement for the flood watches and warnings would have helped this information reach a wider audience.

Evacuations

Banana Shire Council and Local Disaster Management Group

The management of evacuations in the Banana Shire during Tropical Cyclone Marcia was problematic. Evacuations were not planned for in advance by the LDMG. The issues previously discussed regarding warnings meant that residents did not have sufficient time to self-evacuate.

Depending on the nature of an event and its impacts on the community, evacuation of residents from an area may be required. To assist in planning for and responding to the need for evacuations, the *Queensland Evacuation Guidelines for Disaster Management Groups* (the Evacuation Guidelines) was published in 2011.³²⁰

Like many other aspects of disaster management, evacuations are a shared responsibility between the community and the disaster management groups. Communities must take responsibility for their own safety.³²¹ They must assess the risks to themselves and their family and determine whether to shelter in place or to self-evacuate. They must know what to do, be ready to leave, and have an emergency / evacuation kit ready.³²² Councils must ensure their community is aware of the risks facing it, the contents of the evacuation sub-plan, the warnings system to be used and where to go if evacuation is considered.³²³ The community can rightly expect that councils will provide some options for safer places during a disaster event.³²⁴

There are two types of evacuation: directed evacuation and self-evacuation. Directed evacuation is where residents are directed by police to evacuate.³²⁵ Self-evacuation is where residents evacuate by themselves or with assistance, but are not forcibly evacuated.³²⁶ A self-evacuation can be done on the initiative of the resident, or in response to warnings by the LDMG to consider evacuations.³²⁷ Shelter in place (at home or with family and friends) can be considered as an alternative to evacuation where the structure or location of available buildings is safer than attempting to leave.³²⁸ The LDMG is responsible for the management of all evacuations, except as legislated regarding directed evacuations.³²⁹ In this event, there were no directed evacuations.

The Evacuation Guidelines state '*an evacuation that has been planned prior to the onset of an event will minimise risks to both the community and disaster management personnel*'.³³⁰ Due to their local knowledge, experience and community understanding, the Council (in consultation with the LDMG) is best suited to conducting evacuation planning in the lead-up to an event.³³¹

There are five stages of evacuation: decision to evacuate, warning, withdrawal, shelter and return.³³² The LDMG's evacuation sub-plan (which is part of the LDMP) and its Standard Operating Procedures for evacuations align with the Evacuation Guidelines.³³³

Depending on the nature of the event, evacuation may be required pre or post impact. Warning notice may range from nil to a fully planned evacuation. The time critical stages are decision, warning and withdrawal.³³⁴ The Evacuation Guidelines advise LDMGs to consider areas susceptible to isolation, including the risk that the residents will become isolated by road and will not be able to reach a designated evacuation point. This is an important consideration in relation to the timeliness of decision-making.³³⁵

The Council knew Tropical Cyclone Marcia would impact parts of the Banana Shire, with the BoM cyclone warnings mentioning Biloela and Moura since 1.51pm on Thursday 19 February 2015.³³⁶ Heavy rainfall and possible flash flooding were also forecast for parts of the catchment.³³⁷ Given the recent history of flood events in the Banana Shire, this should have prompted the LDMG to activate its evacuation sub-plan. This would have required the LDMG to ensure residents were ready to be evacuated if necessary, and the LDCC would have needed to be well prepared to coordinate evacuations.

There was sufficient time to prepare. The LDCC had prepared a risk assessment that suggested evacuation preparations be conducted on Friday morning.³³⁸ This advice was not actioned.³³⁹

In 2012, the Council prepared timelines outlining the estimated time it takes to evacuate different towns in the Banana Shire.³⁴⁰ This information is included as Annexures to the *Evacuation Operational Plan*³⁴¹ and is also part of some of the *LECC Plans*.³⁴² This information is not included in the publicly available version of the LDMP. The timelines include the time it takes to make the evacuation decision, time to warn residents of the evacuation, time for residents to leave, travel time, and time for all residents to take shelter in a safe location.³⁴³ The total time required to prepare and execute evacuations for each of the towns is approximately seven hours.³⁴⁴ This time can increase if roads are blocked or disrupted.³⁴⁵ According to the *Evacuation Operational Plan*, the Council's evacuation strategies should be developed based on timeline criteria.³⁴⁶ As the cyclone was forecast to impact Biloela at approximately 8.00pm, evacuation decision-making should have commenced prior to 1.00pm on Friday 20 February 2015.

Sometime after 10.30am on Friday 20 February 2015, Banana Shire Council issued a media release warning residents of strong winds and heavy rainfall associated with Tropical Cyclone Marcia. The media release said:

*'The best time to prepare your home is now, in daylight hours and before the storms. Make sure you secure loose items in and around your property and have an emergency plan ... As the storm approaches stay indoors, stay off the roads, check on the elderly and make sure your animals are safe.'*³⁴⁷

On its own initiative, the Moura LECC opened the Kianga Hall place of refuge during the morning of Friday 20 February 2015, as Moura was in the direct path of the cyclone.³⁴⁸ During both the midday and 5.00pm LDMG meetings on 20 February 2015, the issue of opening shelters was discussed.³⁴⁹ At both meetings, it was noted that the shelters were ready, but remained closed (with the exception of Moura).³⁵⁰ It was determined there was no need to open them at that stage as no residents had asked for evacuation.³⁵¹ We were told that this reticence was related to the lack of bedding for the shelters.³⁵² The Banana Shire does not have any evacuation centres, but rather utilises places of refuge, and also does not have a cyclone shelter. This creates challenges for the Council in an event like Tropical Cyclone Marcia where it may be unsafe to evacuate people to facilities that are not designed to withstand a cyclone.

At 6.18pm on Thursday 19 February 2015, a resident sent a private message to the Banana DM Facebook page enquiring about shelters in the Banana Shire and asking whether residents should evacuate to them.³⁵³ The LDCC's response at 6.28pm was that no shelters had been opened, the situation was being monitored, and that if the resident was concerned they could consider self-evacuation to family or friends.³⁵⁴ Shelter in place is often an option for cyclones or when time does not allow safe withdrawal.³⁵⁵ Many of the residences in the Shire are pre-cyclone rating and time was available to withdraw (if a decision was made earlier) to safer places.³⁵⁶

The BoM issued a 5.59pm cyclone warning that said Tropical Cyclone Marcia was 45 km from Biloela.³⁵⁷ Around 6.20pm, the Council issued a media release:

*'The Shire is expected to continue to receive strong winds and moderate rainfall to reach Banana Shire later today or early this evening. Tropical Cyclone Marcia is expected to pass east of Biloela at around 8pm tonight ... At this stage, no shelters in the Shire have been opened. Residents are encouraged to seek shelter with friends and family first. If the need arises for shelters to become active in the Shire, the Local Disaster Coordination Centre will provide advice accordingly.'*³⁵⁸

This information was also posted to the Banana DM Facebook page at 6.19pm.³⁵⁹

At 8.45pm the LDCC urged Jambin residents to evacuate via a public post to the Banana DM Facebook page. The evacuation notice was silent on what action should be taken by residents living along the approximately 20 km of watercourses between the Callide Dam and Jambin. There was a similar lack of clarity within the Emergency Alert warning issued from 9.40pm that mentioned Jambin and Goovigen (see Warnings section).³⁶⁰

The LDMG received SunWater alerts for spilling at Kroombit, which started at 6.28pm on Friday 20 February 2015.³⁶¹ Without adequate flood maps, river gauges or known triggers, the Council did not know what the Kroombit spilling alert meant for downstream residents. The only evidence we found of enquiries into understanding the potential impact was a phone call to a resident at around 8.00pm.

The LDMG Chair telephoned a resident upstream from the dam to check conditions, and was on the phone when a flash flood inundated property there.³⁶² The next evidence we found was not until the LDMG telephoned SunWater at 9.15pm to enquire about flow and historical levels for evacuation planning.³⁶³

A resident sent a private message to the Banana DM Facebook page at 9.46pm on 20 February 2015 asking about evacuations for Biloela.³⁶⁴ We have been advised that the LDCC posted on the Banana DM Facebook page at 10.02pm that the Biloela Civic Centre was open.³⁶⁵ At 10.42pm the LDCC responded that the Biloela Civic Centre was open for those evacuating.³⁶⁶

The Council advise us that the LDCC posted at 12.04am on 21 February 2015 that the Mount Murchison State School was open for those needing to evacuate.³⁶⁷ Throughout the early hours of the morning of 21 February 2015 the LDCC posted information to the Banana DM Facebook page about emergency contact numbers and road closures, as well as advising followers that Ergon would be arriving in the morning and reminding motorists that *'if it's flooded, forget it'*.³⁶⁸ The Council issued a media release around 7.00am on 21 February 2015 noting that the Biloela Civic Centre, Jambin State School and Mt Murchison State School were open.³⁶⁹ The timing of the Facebook posts and media release were too late to be useful to many affected residents.

By the time centres were opened for those needing to evacuate, many evacuation routes were cut.³⁷⁰ Consistent with the content of the Evacuation Guidelines, the Callide Valley Flood Study outlined:

*'Many of the properties at risk of inundation during floods are rural and removed from the population centres. People from flood affected rural properties may require evacuation, however access may be restricted due to flooding of roads. Securing access for the evacuation of residents is one of the primary concerns for Banana Shire Council.'*³⁷¹

Throughout the late evening on Friday and into the early hours of Saturday morning, many residents asked to be evacuated, including some who were in life-threatening situations. The QPS fielded many of these calls on Triple Zero (000), possibly due to the life threatening nature of the situation and the communications issues at the LDCC. Some residents were told to call the SES by Triple Zero (000) operators, and the residents replied they had been told there was no SES presence in the area.³⁷² They were redirected by QPS to call the LDCC.

Calls were received from people who had evacuated onto rooftops or trucks.³⁷³ Some people had small children with them.³⁷⁴ Other residents were stuck in the upper level of their house with flood waters below.³⁷⁵ Still more had evacuated to neighbours or their sheds on higher land, only to be surrounded by water and unable to evacuate further.³⁷⁶

It was problematic to organise evacuations and respond during the night. The LDCC told the District Disaster Coordination Centre (DDCC) that the SES had sufficient resources and swift water rescue boats available, but the conditions hampered deployment.³⁷⁷ The SES attempted to reach residents requiring evacuation but, due to the inundated roads, they could not drive through the floodwaters to get the boat to where it was needed.³⁷⁸ An attempted helicopter evacuation of residents stuck on their roof had to be abandoned due to weather conditions hampering the safe operation of the helicopter.³⁷⁹ There were also widespread power outages and unknown water levels and road damage, which impacted the ability to evacuate residents.

Some residents have publicly stated that they should have been advised to evacuate earlier; the worst that would have resulted was inconvenience if the evacuation was subsequently not required.³⁸⁰ Had the LDMG implemented the evacuation strategies suggested in the risk assessment it had developed for Tropical Cyclone Marcia, taking into account timelines required to evacuate as outlined in its evacuation sub-plan, notifications could have been issued earlier and provided residents with more time to prepare or to self-evacuate.

With all the information known to the LDMG throughout Friday 20 February 2015 about the predicted weather and likelihood of the dam spilling, it should have been foreseen that evacuations, or at least the approximately seven hour warning lead time, may need to be commenced during the night. Proactively dealing with evacuation planning during the day on Friday may have avoided some evening evacuations and ensured a more coordinated response.

Telecommunications infrastructure

During our visits to Banana Shire, a number of residents made comments about telecommunications problems during and after Tropical Cyclone Marcia. Both residents and the Council told us about communication difficulties involving the LDCC. We explored the issues with Telstra and Optus.

Telecommunications infrastructure available in the Banana Shire

Telstra

The following information was obtained from either documents provided by Telstra or in meetings with Telstra staff. Where the material is not otherwise referenced, this information was provided during a meeting with Telstra staff on 15 April 2015.

The town of Biloela is located on the Telstra main Queensland north / south fibre optic cable route.

Telstra has several redundancies built into the fibre optic network. Prior to the flood event of 2013 caused by Ex Tropical Cyclone Oswald, Telstra had two fibre optic cables heading north / south through Queensland. In that event, both cables were damaged, despite running parallel at approximately 300 km apart.

As a result of lessons identified from that event, Telstra installed an extra cable and there are now three fibre optic cable lines that head north / south through Queensland. These are located a significant distance from each other, with looping joins located at various points to provide redundancies. If one section of fibre optic cable is damaged, Telstra has the ability to re-route calls past the breakage by using these paths where possible.

There is one main mobile phone tower in Biloela and several others located in nearby towns or on ridgelines around Biloela to provide coverage. The towers are connected via fibre optic cable and are ordinarily powered through mains electricity. The tower in Biloela is fitted with battery and generator backup. The surrounding towers are fitted with battery backup only.

Telstra has the ability to deploy generators to be connected to the mobile phone towers that do not have an on-site generator. In this event, Telstra had approximately 110 sites that lost power across the area affected by Tropical Cyclone Marcia.

Telstra was able to deploy approximately 80 generators to these sites and restore power. Having this number of generators spread across a large area can cause problems in the refuelling cycle, particularly with numerous roads damaged or cut by floodwater or debris. In some instances, power was restored to the service and lost again for a short period until the refuelling cycle was completed.

In Thangool, Telstra was aware its tower had run out of backup battery power. Impassable roads prevented supply of a generator to Thangool. Telstra arranged for delivery of the generator by air at the priority request of the SDCC (the only request of the event). By the time crews had finished connecting the generator to the tower, the mains power was restored and the generator was not required.

When power was restored, these sites generally recovered automatically. An issue that became apparent was the reliance of many members of the community on cordless phone handsets that require mains power to operate. Some mains powered cordless phones become inoperable during power loss regardless of the telecommunications network. However, phones that are physically connected continue to operate for some time from the telephone exchange battery when mains power has failed.

The fixed line network in Biloela is a mixture of fibre optic and older style copper wire phone lines. Some services are on the Public Switched Telephone Network (PSTN) systems. Other services are provided through Integrated Services Digital Network (ISDN) technology over the PSTN systems.

The PSTN systems cater for single phone lines with single numbers, such as those used by residences and small businesses. The ISDN systems allow both voice and data to be carried at the same time. Multiple phone calls can occur on the one line simultaneously. Business offices with several phone lines usually use the ISDN services through a Private Branch Exchange (PBX) system.

It is important to understand the difference between these network operations in order to understand why some calls could be made and not others. A remote computer operates the ISDN network exchanges. These use the fibre optic network to provide the exchanges with operating information and are also reliant upon a power source. The PSTN network is older technology and does not need the remote 'brain' for instructions. The PSTN exchanges can create their own power source for phones connected to the copper network. This is why during a power outage an older style telephone handset connected to the PSTN fixed line network will continue to operate while a cordless phone on the same network will not. The older fixed handset utilises power produced from the PSTN exchange, whereas the newer cordless handset relies on normal mains power to operate.

Optus

Optus told us that it does not own any fibre optic or fixed line infrastructure in the Banana Shire. Optus offers mobile phone services in the Banana Shire and operate its own towers in four locations. Optus did not suffer any damage to these assets. The links between Optus towers are either via fibre optic leased from other providers or Optus microwave facilities. Where the leased links suffered outages, such as the Telstra fibre optic cable, Optus towers relying on the links will also fail.³⁸¹

Telstra planning and preparations

Telstra advise that in preparation for weather events, they determine the geographical area at risk based on the BoM forecasts. If time permits, Telstra undertakes activities such as reviewing the field staff and resource placement, protecting sites from flood risks by sandbagging, and reviewing outstanding repairs or other actions that can be resolved prior to the weather event. Telstra also engage their Major Incident Management unit to prepare cross-company internal support mechanisms. Telstra's Emergency Services Liaison Officers are engaged in the relevant LDMG and DDMG meetings pre-event and a representative is made available to the LDMG when impact occurs.³⁸² During 2014, a Telstra representative attended four of five LDMG regular meetings, and on 2 February 2015, presented Telstra capabilities to a regular meeting.³⁸³ In the lead up to, during and after the flood event, Telstra representatives generally attended LDMG meetings by telephone or in person.³⁸⁴

Telstra also has the ability to provide replacement exchanges or mobile phone towers on wheels. These can be airlifted or driven into an area post-event if the service problems cannot be readily rectified and road access is available. Pre-placement of this equipment usually occurs as part of the preparation works discussed above.

Telecommunications issues

Telstra

At 7.22pm on 20 February 2015, Telstra's network alarms indicated the main cable line that passes near Biloela was damaged.³⁸⁵ Prior to the dam releases, water flowing along Old Callide Creek washed away a section of fibre optic cable to the north of the Argoon and Jambin Dakenba Road intersection.³⁸⁶ Once conditions were suitable for flying (21 February 2015), a Telstra technician was flown in by an emergency services helicopter to near the site of the cable washout. The site of the damage was still underwater however testing of the damaged cable at the nearest access point allowed for a significant reduction in the restoration time.

Due to the redundancy capability of the Telstra network, services were re-routed and service continued to Biloela and the surrounding Banana Shire. As the event progressed and significant power outages occurred, Telstra told us that the majority of services in and around Biloela continued working due to the network redundancy. Some services were unable to work due to the concurrent power outages suffered by local exchanges as they do not have the same network redundancy. The services impacted by the loss of the fibre optic only (not including related mains power issues) were:³⁸⁷

- 89 fixed line voice services
- 1212 ADSL services
- Four business data services
- Seven mobile base stations with coverage loss.

Due to the extensive power outages caused by Tropical Cyclone Marcia, the mobile phone towers and exchanges all moved to backup power capability. The battery backup systems for the mobile phone towers are designed to last between three to eight hours in remote areas. High demand from mobile devices can reduce battery life. In this event, significant load was placed on the network.

Anecdotally, this is supported, with many residents telling us they relied on internet access via mobile devices for situational awareness from the BoM and social media. Our community survey showed 51% (n=207) of respondents experienced telecommunications 'outages' related to the flooding event.³⁸⁸

Congestion on the services may have led some people to conclude that all services were lost. Telstra was able to contact staff in the field throughout the event, though at times they had to make two or three attempts to contact staff with mobile phones. Telstra told us that the GSM or 2G network continued to operate throughout the event in Biloela, which would have maintained the ability to make or receive calls for mobile phones that operate on the 2G network. Emergency Alert would still reach Telstra mobile telephones on the 2G network, and the user can call Triple Zero (000) on any carrier network, even where 3G and 4G networks are not available. During this event, the 3G and 4G networks may not have been functional, since they rely on different technology.

Several people told us that the council chambers experienced communications difficulties during this event. The LDMG and LDCC were housed in this building. During this event, the ISDN lines into the council chambers were not working due to the wider ISDN faults caused by the loss of power to the exchanges. Council PSTN numbers (which were still working) had been diverted to the ISDN numbers (which were not working), calls were reaching the PSTN numbers until such time as the diversion took place and they were unable to be answered on the ISDN numbers. Telstra confirmed that it had removed diversions on phone lines connected to the Council's phone system to allow them to operate. Telstra also installed two additional emergency (DISPLAN) phone lines on site.

Telstra technicians were able to access the damaged cable at approximately 7.00pm on 22 February 2015 by driving to the site. They worked through the night and restored the cable at 12.44pm the following day, 23 February 2015. Issues not resolved at that time were reliant upon power being restored.

On 2 February 2015, Telstra attended the LDMG meeting and provided a presentation on a service they offer local councils known as 'DISPLAN'. This is a disaster management voice service for councils and emergency services that can provide priority tone for outgoing calls in exchanges that are experiencing congestion. The services for fixed line are sponsored (provided free of charge) by Telstra. Mobile network voice priority services used by other councils in Queensland was also discussed. This service is managed by the Federal Attorney-General's Department, at a nominal cost to councils. We understand that neither offer was taken up.³⁸⁹

Telstra also offers an SMS alert system to councils known as 'Whispir'. This product is a pay-for service, allowing councils to send out bulk warning SMS messages independently of the Emergency Alert system (though it should not replace the use of Emergency Alert). We understand that the Council has purchased Whispir since this event occurred.

Optus

Optus suffered outages to all four mobiles phone towers it operates in the Banana Shire. The towers lost mains power as a result of cyclone damage to electricity infrastructure. Optus towers have battery backup capacity of approximately four hours, depending on the use of the tower. Optus told us that all their services were restored by the evening of 23 February 2015 when damage to other providers' infrastructure was rectified (both Telstra cables and electrical supply).³⁹⁰

Finding 8

For flood events, there are significant gaps in the availability of operational information sources (such as real-time river and rainfall gauges) for the Banana Shire Local Disaster Management Group to utilise. This limits its ability to produce actionable intelligence and plan effectively for these events.

Finding 9

SunWater's reliance on rudimentary gauges and manual monitoring systems did not enable effective situational awareness and delayed warnings to downstream residents in this event.

Finding 10

The Bureau of Meteorology's ability to accurately forecast flood events in the Callide Valley is significantly limited by the quality and quantity of data sources.

Finding 11

Although the Banana Shire Council and SunWater communicated regularly during the event, this collaboration did not result in consistent and timely warnings being delivered to the community.

Finding 12

The prepared warning messages within the Local Disaster Coordination Centre were not adequate to enable rapid and efficient processing through the State Disaster Coordination Centre and into the Emergency Alert system.

Finding 13

The community was not provided with all the available risk information relevant to this event.

Finding 14

There is opportunity for improvement in the operation of the Local Disaster Coordination Centre across the full range of incident management functions that will particularly enhance planning, decision making and warning processes in the future.

Finding 15

Issues related to telecommunications difficulties within the Local Disaster Coordination Centre may have been identified prior to the event if a business continuity plan had been completed and tested.

Finding 16

The event has highlighted opportunities for improvement in activation of the evacuation sub-plan and associated activities.

Finding 17

State Disaster Coordination Centre situational awareness would be improved through direct access to representatives of critical infrastructure owners.

Recommendation 6

In accordance with recommendations of the BMT WBM report, the Banana Shire Council, SunWater, and the Bureau of Meteorology, under the stewardship of the Department of Natural Resources and Mines, jointly identify the requirements for a suitable gauge network for the Callide Valley to allow meaningful and timely flood warnings. The review should identify key stakeholders, examine potential funding sources and include a cost benefit analysis.

Recommendation 7

Prior to September 2015, the Banana Shire Council develops a multi-channel warning strategy and associated public information campaign, including common language and consistent messaging, for the Banana Shire.

Recommendation 8

Prior to September 2015, SunWater and the Banana Shire Council jointly develop a multi-channel, common warning strategy, including common language and consistent messaging, for residents downstream of SunWater assets within the Banana Shire Council, and clearly articulate procedures for dissemination.

Recommendation 9

As part of the above, both the Banana Shire Council and SunWater ensure Emergency Alert messages are pre-formatted, consistent, polygons are identified according to risk, and that they are tested and practiced with the State Disaster Coordination Centre.

Recommendation 10

Local Disaster Coordination Centre capability and capacity should be reviewed to ensure adequate staffing arrangements are in place to fill key positions and that operational protocols are known and practiced across all functions to provide redundancy. Assistance for review and necessary training should be sought from key Local Disaster Management Group member agencies.

Recommendation 11

Banana Shire Council completes business continuity planning as a matter of priority, including documentation and testing of the plan.

Recommendation 12

The evacuation sub-plan component of the Local Disaster Management Plan should be reviewed, including any identified triggers for activation. Ideally, the plan should be tested in a live, multi-agency exercise prior to next summer.

Recommendation 13

State Disaster Coordination Centre considers requesting a representative from the critical infrastructure owner be present as a liaison officer in the State Disaster Coordination Centre during activations for events that may impact on their assets.

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Glossary

Activate: to set up or formally institute (as a military unit) with the necessary personnel and equipment. *(Merriam-Webster Dictionary)*

Airspace: the space lying above the earth or above a certain area of land or water; especially: the space lying above a nation and coming under its jurisdiction. *(Merriam-Webster Dictionary)*

Alert: A heightened level of vigilance due to the possibility of an event in the area of responsibility. No action is required however the situation should be monitored by someone capable of assessing the potential of the threat. *(Draft State Disaster Management Plan 2014-15)*

Attenuate: to make (something) weaker or less in amount, effect, or force. *(Merriam-Webster Dictionary)*

Business Continuity Plan: Business continuity planning involves developing a practical plan for how your business can prepare for, and continue to operate, after an incident or crisis. *(<https://www.business.qld.gov.au/business/running/risk-management/business-continuity-planning>)*

Congest: to concentrate in a small or narrow space. *(Merriam-Webster Dictionary)*

Cyclone: A large-scale, closed circulation system in the atmosphere with low barometric pressure and strong winds that rotate counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere. *(Australian Institute of Emergency Management Glossary)*

Disaster: is a serious disruption in a community, caused by the impact of an event, that requires a significant coordinated response by the State and other entities to help the community recover from the disruption. *(Disaster Management Act 2003 (Qld))*

Disaster Management: means arrangements about managing the potential adverse effects of an event, including, for example, arrangements for mitigating, preventing, preparing for, responding to and recovering from a disaster. *(Disaster Management Act 2003 (Qld))*

Disaster Operations: means activities undertaken before, during or after an event happens to help reduce loss of human life, illness or injury to humans, property loss or damage, or damage to the environment, including, for example, activities to mitigate the adverse effects of the event. *(Disaster Management Act 2003 (Qld))*

District Disaster Management Group: provide whole-of-government planning and coordination capacity to support local government in disaster operations and disaster management. *(Queensland District Disaster Management Guidelines)*

District Disaster Management Plan:

- (1) A district group must prepare a plan (a district disaster management plan) for disaster management in the disaster district for the group.
- (2) The plan must include provision for the following—
 - a. the State group's strategic policy framework for disaster management for the State;
 - b. the roles and responsibilities of entities involved in disaster operations and disaster management in the district;
 - c. the coordination of disaster operations and activities relating to disaster management performed by the entities mentioned in paragraph (b);
 - d. events that are likely to happen in the district;
 - e. priorities for disaster management for the district;
 - f. the matters stated in the disaster management guidelines as matters to be included in the plan;
 - g. other matters about disaster management in the disaster district the group considers appropriate.

(Disaster Management Act 2003 (Qld))

East Coast Low: East Coast Lows are intense low-pressure systems which occur on average several times each year off the eastern coast of Australia, in particular southern Queensland, New South Wales and eastern Victoria. (<http://www.bom.gov.au/nsw/sevwx/facts/ecl.shtml>)

Emergency Alert: Emergency Alert is the national telephone warning system used by emergency services to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies. (<http://www.emergencyalert.gov.au/>)

Emergency Warning: An emergency warning is a message signalling an imminent hazard, which may include advice on protective measures. (*Australian Institute of Emergency Management Glossary*)

Evacuation: The planned relocation of persons from dangerous or potentially dangerous areas to safer areas and eventual return. (*Australian Institute of Emergency Management Glossary*)

Evacuation Centre: A centre that provides affected people with basic human needs including accommodation, food and water. In addition, to enhance the recovery process, other welfare/recovery services should also be provided. (*Australian Institute of Emergency Management Glossary*)

Flash Flood: A flood that rises quite rapidly with little or no advance warning, usually as a result of an intense rainfall over a small area or, possibly, an ice jam, or after a dam failure. (*Australian Institute of Emergency Management Glossary*)

Flood: The overflowing by water of the normal confines of a stream or other body of water, or the accumulation of water by drainage over areas which are not normally submerged. (*Australian Institute of Emergency Management Glossary*)

Flood Mitigation Dam: A dam that is designed to temporarily store or control flood runoff in addition to providing water supply. (*Australian Institute of Emergency Management Glossary*)

Floodplain Management: Management of flood risk is essential to limiting the impacts of flooding on the community in balance with maintaining the benefits of occupying the floodplain to society, and the benefits of flooding to the environment. *(Australian Institute of Emergency Management Glossary)*

Flood Stage 4: Refers to the Storage Level in the Callide Dam being above EL 217.11m and approaching EL 218.09m. *(Callide Dam Emergency Action Plan)*

Full Supply Level: The maximum operating water surface level of a reservoir when not affected by floods. *(Australian Institute of Emergency Management Glossary)*

Government Owned Corporation: A government entity that is established as a body corporate under an Act or the *Corporations Act 2001* (Cth) and declared by regulation to be a Government Owned Corporation. *(Government Owned Corporations Act 1993 (Qld))*

Hazard Identification: The process of recognising that a hazard exists and defining its characteristics. *(Australian Institute of Emergency Management Glossary)*

Inflow: A flow or movement of something into a place. *(Merriam-Webster Dictionary)*

Intelligence: The ability to learn or understand or to deal with new or trying situations; the skilled use of reason; the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria. *(Merriam-Webster Dictionary)*

Lean Forward: An operational state prior to 'stand up' characterised by a heightened level of situational awareness of a disaster event (either current or impending) and a state of operational readiness. Disaster Coordination Centres are on stand by; prepared but not activated. *(Draft State Disaster Management Plan 2014-15)*

Lessons Learned: A full iteration of a Lessons Learned cycle would involve the identification of a lesson, an action proposed and agreed, and the solution implemented and tested/validated to ensure the desired behaviour is sustained across the organisation. *(Handbook 8 – Lessons Management, Australian Emergency Management Handbook Series)*

Local Disaster Management Group: The group established under the *Disaster Management Act 2003* (Qld) to manage disaster planning and operations on behalf of the local government. *(Queensland Local Disaster Management Guidelines)*

Local Disaster Management Plan:

- (1) A local government must prepare a plan (a local disaster management plan) for disaster management in the local government's area.
- (2) The plan must include provision for the following–
 - a. the State group's strategic policy framework for disaster management for the State, and the local government's policies for disaster management;
 - b. the roles and responsibilities of entities involved in disaster operations and disaster management in the area;
 - c. the coordination of disaster operations and activities relating to disaster management performed by the entities mentioned in paragraph (b);

- d. events that are likely to happen in the area;
- e. strategies and priorities for disaster management for the area;
- f. the matters stated in the disaster management guidelines as matters to be included in the plan;
- g. other matters about disaster management in the area the local government considers appropriate.

(Disaster Management Act 2003 (Qld))

Local Emergency Coordination Committees: The purpose of LECCs is to establish a core group of people within the local community who possess the local knowledge and expertise to inform the Local Disaster Management Group (LDMG) and Local Disaster Coordinator (LDC) on local matters and to provide a conduit for the dissemination of authorised information to the community. (<http://www.gladstone.qld.gov.au/local-emergency-coordination-committees>)

Local Government: An elected body that is responsible for the good rule and local government of a part of Queensland. (*Local Government Act 2009 (Qld)*)

Local Government Area: A part of Queensland that is governed by a local government. (*Local Government Act 2009 (Qld)*)

Mitigation: Measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and the environment. (*Australian Institute of Emergency Management Glossary*)

Overtop: Rise above the top of. (*Merriam-Webster Dictionary*)

Piezometer: An instrument for measuring pressure or compressibility, especially, one for measuring the change of pressure of a material subjected to hydrostatic pressure. (*Merriam-Webster Dictionary*)

Planning Process: The collective and collaborative efforts by which agreements are reached and documented between people and organisations to meet their communities' emergency management needs; a sequence of steps that allow emergency management to take place. (*AIEM Glossary*)

Polygon: A polygon is a two-dimensional shape made up of straight lines. The shape is considered 'closed', as all the lines connect up around an area. (*Queensland Emergency Alert Guidelines*)

Referable Dam:

- (1) A dam is, or a proposed dam after its construction will be, a referable dam if—
 - a. a failure impact assessment of the dam, or the proposed dam, is required to be carried out under this part; and
 - b. the assessment states the dam has, or the proposed dam after its construction will have, a category 1 or category 2 failure impact rating; and
 - c. the chief executive has, under section 349, accepted the assessment.
- (2) The following are not referable dams—
 - a. a hazardous waste dam;
 - b. a weir, unless the weir has a variable flow control structure on the crest of the weir.

(Water Supply [Safety and Reliability] Act 2008 (Qld))

Risk Assessment: The process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria. (*Australian Institute of Emergency Management Glossary*)

Serious Disruption: Means

- (a) loss of human life, or illness or injury to humans; or
- (b) widespread or severe property loss or damage; or
- (c) widespread or severe damage to the environment.

(*Disaster Management Act 2003 (Qld)*)

Stand Up: The operational state following 'lean forward' whereby resources are mobilised, personnel are activated and operational activities commenced. Disaster Coordination Centres are activated.

(*Draft State Disaster Management Plan 2014-15*)

Stand Down: Transition from responding to an event back to normal core business and/or recovery operations. There is no longer a requirement to respond to the event and the threat is no longer present.

(*Draft State Disaster Management Plan 2014-15*)

State Disaster Management Plan:

- (1) The State group must prepare a plan (the State disaster management plan) for disaster management for the State.
- (2) The plan must include provision for the following—
 - a. the group's strategic policy framework for disaster management for the State;
 - b. the roles and responsibilities of entities involved in disaster operations and disaster management for the State;
 - c. the coordination of disaster operations and activities relating to disaster management performed by the entities mentioned in paragraph (b);
 - d. events that are likely to happen in the State;
 - e. priorities for disaster management for the State;
 - f. the matters stated in the disaster management guidelines as matters to be included in the plan;
 - g. other matters about disaster management the group considers appropriate or that are prescribed under a regulation.
- (3) The chairperson of the State group must give a copy of the plan to each district group and local group.

(*Disaster Management Act 2003 (Qld)*)

Abbreviations and acronyms

AHD	Australian Height Datum
ANCOLD	Australian National Committee on Large Dams Incorporated
Banana DM Facebook page	Banana Shire Disaster Management Information Facebook page
BoM	Bureau of Meteorology
Cumec	Cubic metres per second
DDMG	District Disaster Management Group
DDMP	District Disaster Management Plan
DEWS	Department of Energy and Water Supply
DisPlan	Disaster Management Telephone Plan
DMC	Disaster Management Coordinator
DNRM	Department of Natural Resources and Mines
EAP	Emergency Action Plan
IGEM	Inspector-General Emergency Management
ISDN	Integrated Services Digital Network
LDCC	Local Disaster Coordination Centre
LECC	Local Emergency Coordination Committee
LDMG	Local Disaster Management Group
LDMP	Local Disaster Management Plan
PBX	Private Branch Exchange
PSTN	Public Switched Telephone Network
QDMC	Queensland Disaster Management Committee
QFCOI	Queensland Flood Commission of Inquiry
QPS	Queensland Police Service
QRA	Queensland Reconstruction Authority
SDC	State Disaster Coordinator
SDCC	State Disaster Coordination Centre
SDCG	State Disaster Coordination Group
SES	State Emergency Service
the Council	the Banana Shire Council
the Standard	The Standard for Disaster Management in Queensland

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Office of the Inspector-General Emergency Management

Phone (07) 3227 6588

Email info@igem.qld.gov.au

Web www.igem.qld.gov.au

Postal address GPO Box 1425, Mail Cluster 15.7
Brisbane, Queensland 4001