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 LDMGs[36] 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 Message[137]

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 Message[138]

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. 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]

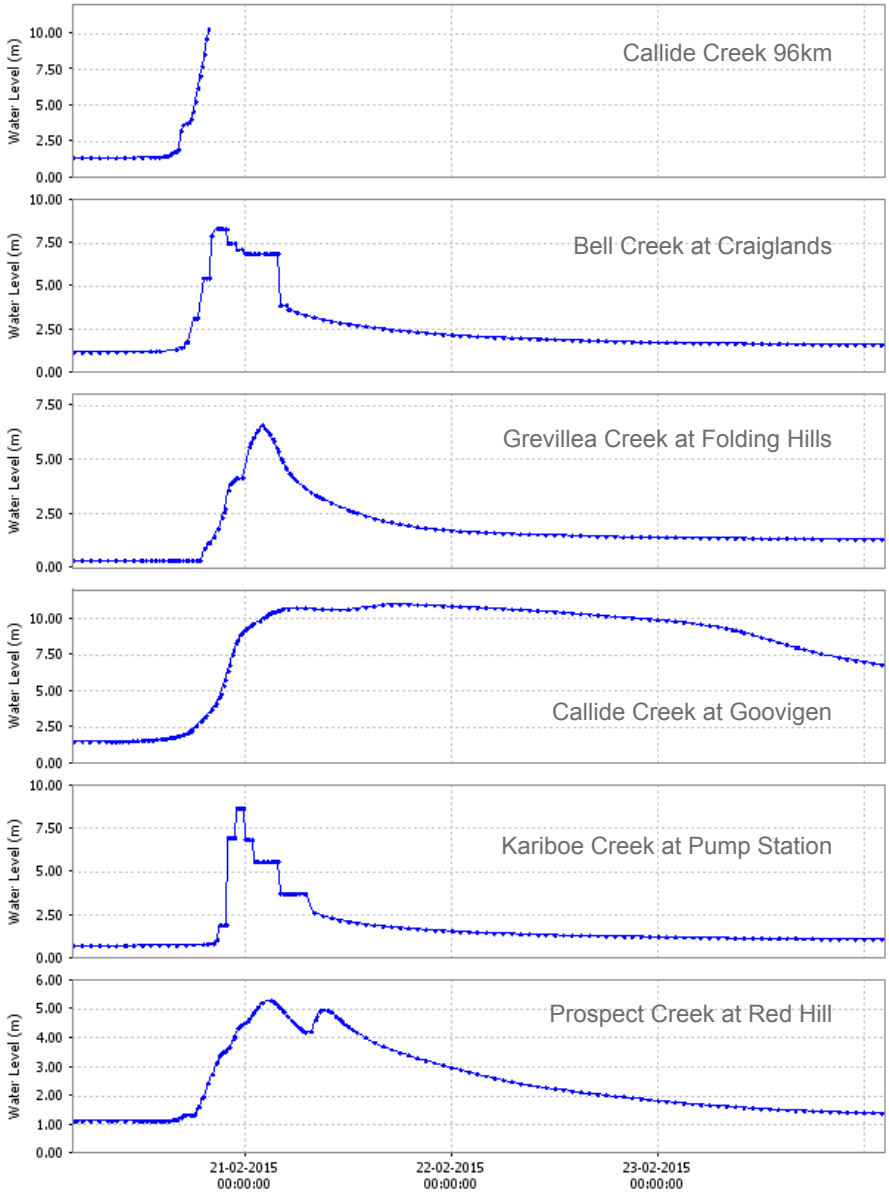
When cancelling the advice message at 6.18pm, the LDCC staff told the SDCC that a warning message would be issued shortly.[149] It was two and a half hours before the LDCC provided the content for the Emergency Alert warning.[150] The LDCC had attempted to send a new map at 8.09pm, however this was still not compatible with the Emergency Alert system[151] 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	Watchdesk: *'I believe you want us to get a EA prepared?...'* … Watchdesk: *'Have you got it [message] prepared already?'* 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]
8.50pm	Watchdesk	LDCC	2min 39secs	Watchdesk advised they had hand drawn the map into the Emergency Alert system. Watchdesk requested message content and LDCC staff member replied: *'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]
8.52pm	SunWater	LDCC	1 min	*'Updated levels Callide and Kroombit'*[180]
8.56pm	LDCC	Watchdesk	7min 44secs	LDCC contacted Watchdesk with the approved message for use in the Emergency Alert: *'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'.* *'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'* Watchdesk staff member: *'OK. All good, we'll set it up and we'll find someone to approve it here'*[181]
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 Goovigin 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.

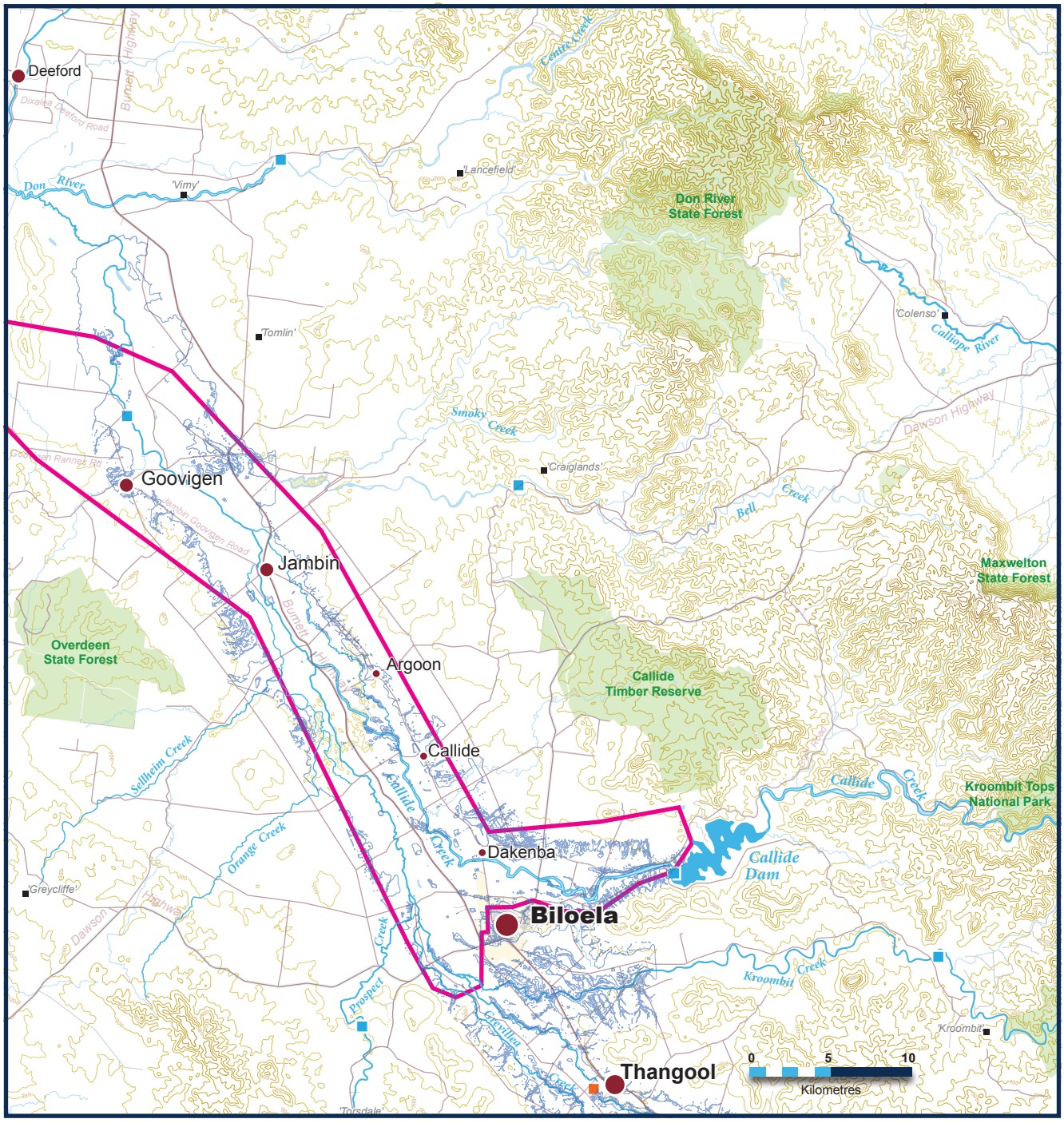
The Emergency Alert campaign started at 9.40pm (i.e. when the Emergency Alert system started sending the warning to phones within the polygon).[200] The campaign ended at 10.41pm. The gates of the Callide Dam had been open since approximately 8.30pm.[201]

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 were already flooded in.'* [204]



Above: Extent of flood compared to warning area.

BMT WBM flood mapping overlayed with polygon from Emergency Alert campaign from Emergency Management Victoria

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 assessment[206] 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]

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.

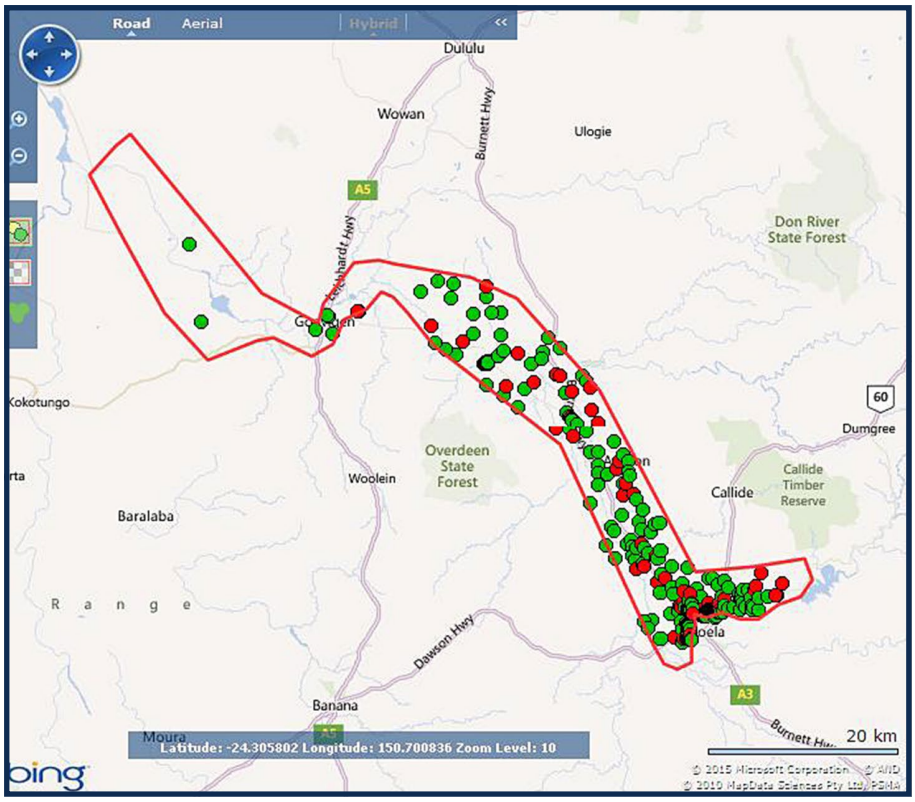
Of the total 601 voice messages attempted, 308 were not answered (51%), however all numbers were dialled.[210] There are numerous reasons why these messages were not answered. Emergency Alert's effectiveness in reaching everyone within a target area depends on a number of factors that are not within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

9NEWS

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."

> SunWater @SunWaterLimited
> SunWater is making releases through the gates at Callide Dam, however reports the gates have burst are not accurate. #TCMarcia *View on Twitter*
> Follow

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.

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 8.18pm[243] 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 $3m^3/s$, 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

Above: Newspaper article, 8 August 2014, p. 3. Central Telegraph, Biloela

Top right: Tweet, 30 July 2013 SunWater Limited.

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 NOTIFICATION[270]

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]

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 NOTIFICATION[278]

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. ([] 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 Kroomit 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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