Inspector-General Emergency Management

2015 Callide Creek Flood Review

Volume 2 : Appendices

Queensland Government

Front cover images

Upper: Callide Dam gates 21 February 2015.
Photo courtesy E. Clarke

Lower: Aerial view of Jambin area 21 February 2015.
Photo courtesy S. Wilkie

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Volume 2 : Appendices

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Lower: Aerial view of Jambin area 21 February 2015
Photo courtesy S. Wilkie

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Appendix A

Callide Creek catchment area community survey

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Callide Creek Catchment Area Survey

Report

PREPARED FOR • Inspector-General Emergency Management

Date • May 2015 **JOB #** • 151461

Market & Communications Research

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introduction

Background

MCR was commissioned by the Office of the Inspector-General Emergency Management (IGEM) in March 2015 to undertake a survey of Banana Shire residents. Results from the survey, and other investigations by IGEM, will inform the formal review into the February flooding of Callide Creek.

Objectives

The key objectives of the research were to:

- understand community engagement with general Disaster Management Arrangements, including:
  - awareness of arrangements, perceptions of the organisation(s) perceived to be responsible for disaster management and awareness and participation in community and public events about Disaster Management Arrangements;
- measure community awareness and understanding of flood risks, including:
  - the sources consulted for flood risk information and confidence in dealing with flooding events;
- understand the personal impacts experienced as a result of the recent event, including:
  - the proportion who needed to evacuate, perceptions about the potential impact that an early release of water from the Callide Dam would have had and observations about the difference between the recent and past flood events;
- understand the sources of information consulted by community members in the lead up to and during the recent event, including:
  - the warnings received, the perceived effectiveness of communication channels for distributing warnings and community suggestions for improving emergency warnings generally.

This report details the findings of the study.

summary

MCR was commissioned by the Office of the Inspector-General Emergency Management (IGEM) to undertake a telephone survey of n=406 residents living within the Callide Creek catchment area. The survey was undertaken between the 14th and 26th April 2015. A summary of results is presented below.

Community engagement

Knowledge of Disaster Management Arrangements

45% of respondents in our survey report having a good (36%) or extensive (9%) knowledge of the Disaster Management Arrangements in the Banana Shire. A similar proportion (47%) rates their knowledge as limited while 8% say they have no knowledge of such arrangements.

More than eight in ten respondents nominate the Banana Shire Council (85%) as being the entity responsible for disaster management generally. The State Emergency Service (46%) is the next most often mentioned group followed by Queensland Fire and Emergency Services (27%) or the Queensland Police Service (26%).

Six in ten respondents (61%) had heard of the Local Disaster Management Group (LDMG) prior to being surveyed. 33% of respondents believe they would know how to contact the LDMG if they needed to.

Perceptions of the role of the LDMG

The LDMG is primarily associated with coordination tasks in the lead-up to and during an event and secondarily with planning responsibilities:

- 33% (of all respondents) say the LDMG is responsible for coordinating and organising emergency services during an emergency
- 29% consider the LDMG's role to be related to coordinating and organising recovery or clean-up efforts after an emergency
- 26% nominate the broadcasting of warnings in the lead-up to and during emergencies as LDMG's role
- 17% consider the LDMG's role to be to plan for emergencies.

Public events related to Disaster Management Arrangements

Prior to our survey, four in ten respondents (40%) had heard about community events, public meetings or presentations about Disaster Management Arrangements in their local area. 5% of all respondents report attending a community event, public meeting or presentation about Disaster Management Arrangements in the past few years.

Flood risk

Enquiries made about flood risk

Four in ten (39%) respondents report they have enquired about the risks of flood to their property in the past few years. Most enquiries appear to have been informal in nature with 32% sourcing information from individuals such as family, friends or neighbours. After this, residents are most likely to have consulted Banana Shire Council (10%), SunWater (4%) or Queensland Fire and Emergency Services (4%).

57% of those who consulted Banana Shire Council about flood risk say they are satisfied with the information provided by the council (16% very satisfied, 41% quite satisfied). 10% of those who enquired with SunWater about flood risk consider the information provided to be satisfactory (all of whom were quite satisfied– this result should be treated with caution given the small sample size).

Confidence in one's understanding of flood risks

91% of respondents say they are confident in their understanding of the flood risk to them or their property (61% very confident, 30% quite confident). Reported confidence is lower than average (91%) among:

- those who had been impacted by a flood prior to the 2015 flood (84%)
- those living outside the Biloela township (86%) – particularly those in Valentine Plains (79%)
- those who reported being emotionally impacted by the February event (69%)
- those who had house/other property/agricultural property damaged or destroyed during the February event (82%)
- those who evacuated their home during the February event (57%)
- females (88%).

89% of survey respondents express confidence in regards to being prepared for and knowing how to respond to flooding events in the future (49% very confident, 40% quite confident).

39% of respondents say they are aware of how and where to seek information from river gauges within the Callide Valley.

Impact of February 2015 event

The majority of survey respondents (92%) report experiencing at least some personal impact as a result of the flooding event in February 2015. The most widespread impacts mentioned (without prompting) are power outages (68%) and telecommunications outages (51%). Common impacts mentioned in relation to property include:

- damage to property (other than home or agricultural property) (25%)
- fencing damage (21%)
- loss of fencing (19%)
- paddock quality impacts (14%)
- damage to home (13%)
- destruction or loss of other property (11%).

Impacts related to home/other property damage/agricultural property damage are more likely than average (47%) to be found among those:

- living outside the Biloela township (70%)
- who evacuated their home (96%)
- involved in primary production (88%).

8% of survey respondents report having had to evacuate their home as a result of the recent flood event.

Perceptions of the impact of an early release of water from the Callide Dam

23% of survey respondents believe an early release of water from the Callide Dam leading up to the flooding event would have improved the situation for them and their property. 1% of respondents consider an early release would have worsened their situation. 70% of respondents consider an early release would have made no difference in their situation, while 5% are unsure.

Those living outside the Biloela township (32%) are more likely than average (23%) to believe an early release would have improved their situation. This is especially the case among those living in the combined areas of Jambin/Argoon/ Goovigen/Orange Creek/Greycliffe (39%), Mt Murchison/Dakenba/Callide (52%) or Smoky Creek (56%).

Other sub-groups more likely than average (23%) to believe an early release from the Callide Dam would have improved their situation are those:

- who feel they have been emotionally impacted by the event (55%)
- who evacuated their home (76%)
- involved in primary production (32%).

By far the most commonly perceived difference an early release of water could have made is that the amount of water arriving at once would have been reduced and the damage therefore lessened (74%).

Being on high ground (35%) or living in a flood free zone (25%) are the main reasons for believing an early release from Callide Dam would not have made a difference to the impacts personally experienced during the February event. Not being impacted by Callide Dam waters is mentioned by 16%. 11% consider that there was so much water, an early release would not have made a difference.

Previous flood experience

39% of survey respondents report having been impacted by flood waters at their current address before the February event. Of those with prior flood experience, the majority (82%) believe there was a difference between the impact experienced as a result of February 2015 event and earlier floods.

The main difference perceived was that the volume of water, the speed with which it came and the amount of flooding was greater in February 2015 than during previous flooding events (50%). 14% say there was more damage to property or infrastructure this time compared to previous floods, 13% noticed more debris/damage to crops or land this time.

Positive differences noted include a perception that they were more prepared in February 2015 than in previous floods (10%), that there was less water or flooding this time (6%) or that there was less damage or debris left over this time (5%).

Information sources used in February 2015

Two key sources of information were relied upon in the lead-up to the February event; the Bureau of Meteorology website (73%) or family/friends/neighbours (67%). During the event reliance on family, friends or neighbours was maintained (71%) while use of the Bureau of Meteorology website decreased to 46%.

46% consulted ABC News prior to the event, with a similar proportion (40%) doing so during the event.

Other key information sources that were more commonly referred to in the lead-up to, rather than during the event are:

- Banana Shire Council/LDMG (43% lead-up, 26% during)
- Landline or mobile phone (38% lead-up, 22% during)
- Other radio station (18% lead-up, 12% during)
- Other website (18% lead-up, 5% during).

Text message warnings

23% of all survey respondents received (and retained) the text message: 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. Those living in Biloela township (23%) are equally as likely as those living outside this area (23%) to have received this message.

Other messages receiving 1% or fewer mentions are detailed under section 5.0 of this report.

Perceived effectiveness of communication channels for receiving warnings

Respondents were asked to rate the effectiveness of a range of communication channels in delivering warnings during times of disaster.

Calls to mobile telephone (81%), text messages to mobile telephone (79%) or radio broadcasts (77%) are the methods most likely to be considered effective. Seven in ten respondents rate a phone call to a landline (70%) or television broadcasts (70%) as effective. 58% consider Facebook to be effective while 56% rate the websites of relevant authorities as an effective way of delivering warnings during disasters. Twitter perceived as effective by 14% of respondents.

Respondent suggestions for improvement emergency warnings generally

When asked for suggestions about how to improve emergency warnings generally, the most common response given was to provide warnings to residents earlier (from any source or organisation) (25%). After this, residents called for more geographically specific warnings (14%), more text messages (13%) or more telephone calls to residents (10%).

method

Method	Computer assisted telephone interviewing (CATI), where trained interviewers read the pre-scripted survey from a computer screen and enter the responses directly into the computer at the time of interviewing.
Fieldwork partner	MCR's fieldwork partner Q&A Market Research conducted the fieldwork and data analysis tasks. Q&A Market Research has ISO 20252 quality accreditation.
Target respondent	Residents in the defined catchment area (one person (18+ years) per household).
Universe	The survey universe was made up of the following areas: • Argoon • Biloela (respondents self-selected as either living with the township or within areas surrounding the township) • Callide • Dakenba • Dululu • Goovigen • Greycliffe • Jambin • Mt/Mount Murchison • Orange Creek • Prospect • Smoky/Smoky Creek • Thangool • Valentine Plains • Wowan
Sample source	n=406 interviews were completed: n=182 within Biloela township and n=224 outside this area. See appendix B for a full sample composition.
Weighting	A two phased weighting approach was applied to take into account the age and gender profile of residents in the survey region and the number of households in the survey region.
Questionnaire	See appendix A for the questionnaire.
Fieldwork statistics	See appendix C for fieldwork statistics and dates.
Pilot	A survey pilot (a small number of interviews) and subsequent review was conducted to check for respondent comprehension and questionnaire flow.
Data analysis	MCR designed a detailed analysis specification for Q&A Market Research to produce data tables. The statistical processing software SurveyCraft was used to produce these data tables. Results were subject to significance testing to indicate if a result is statistically significant (i.e. if a result is statistically different from the average or from another sub-group).

Publication of Information

MCR is a member of AMSRO and abides by the AMSRS Code of Professional Behaviour. The Code of Professional Behaviour can be downloaded at www.amsrs.com.au. Under the Code of Professional Behaviour – information about Client's businesses, their commissioned market research data and findings remain confidential to the clients unless both clients and researchers agree the details of any publications.

MCR has ISO 20252 quality assurance accreditation.

Disclaimer

As is our normal practice, we emphasise that any market size estimates or marketing recommendations in this report can be influenced by a number of unforeseen events or by management decisions. Therefore no warranty can be given that the information included will be predictive of a desired outcome.

findings

1.0 Community engagement

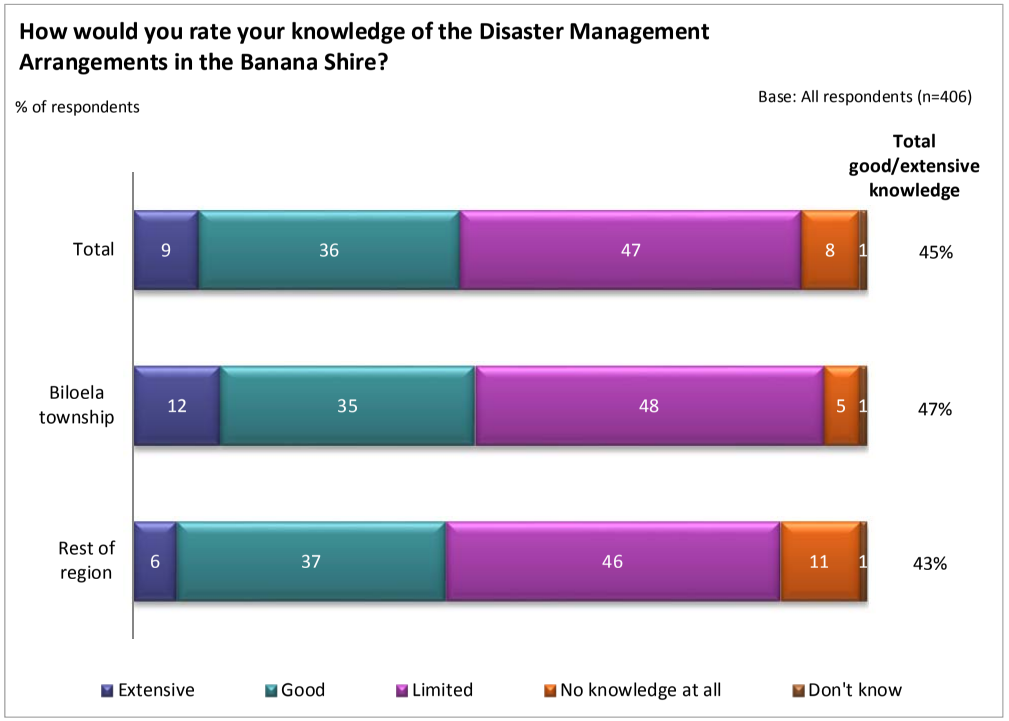
1.1 Knowledge of Disaster Management Arrangements

45% of respondents in our survey report having a good (36%) or extensive (9%) knowledge of the Disaster Management Arrangements in the Banana Shire. A similar proportion (47%) rates their knowledge as limited while 8% say they have no knowledge of such arrangements.

1.1.1 Sub-group differences

Extensive knowledge of the arrangements is more likely to be found among those living in the township of Biloela (12%), compared to those living outside this area (6%).

Those who evacuated their home during the February 2015 event (63%) are more likely than those who did not (45%) to consider their knowledge to be limited.



Q1 Firstly, how would you rate your knowledge of the Disaster Management Arrangements in the Banana Shire? Would it be…?

Table: Q1 Firstly, how would you rate your knowledge of the Disaster Management Arrangements in the Banana Shire? Would it be…?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Extensive/Good	45	47	43	33	46	40	48	50	**48**	42	32	46	44	45	39	51	50	39
Extensive	9	**12**	**6**	2	9		9	9	10	9	12	9	**3**	**11**	7	11	11	7
Good	36	35	37	31	36	40	39	**41**	38	33	20	37	41	34	31	41	39	32
Limited	47	48	46	60	45	58	41	44	**44**	41	**63**	**45**	46	47	52	41	45	48
Or do you have no knowledge at all	8	5	11	4	8	2	9	6	7	16	5	8	7	8	9	7	5	11
Don't know	1	1	1	3	1		2	1	1	1		1	3	1	1	1		2

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Extensive/Good	45	38	51	44	32	38	48	36	52	19	52	31	48	35	57	48	47
Extensive	9		9	4	5	7			13		8	8				11	**11**
Good	36	38	42	40	27	31	48	36	39	19	44	23	48	35	57	37	35
Limited	47	60	46	54	52	46	38	61	48	54	36	58	22	58	39	43	47
Or do you have no knowledge at all	8	2	3	3	16	16	13	3		27	12	11	26	7	4	8	5
Don't know	1						1						4			2	1

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

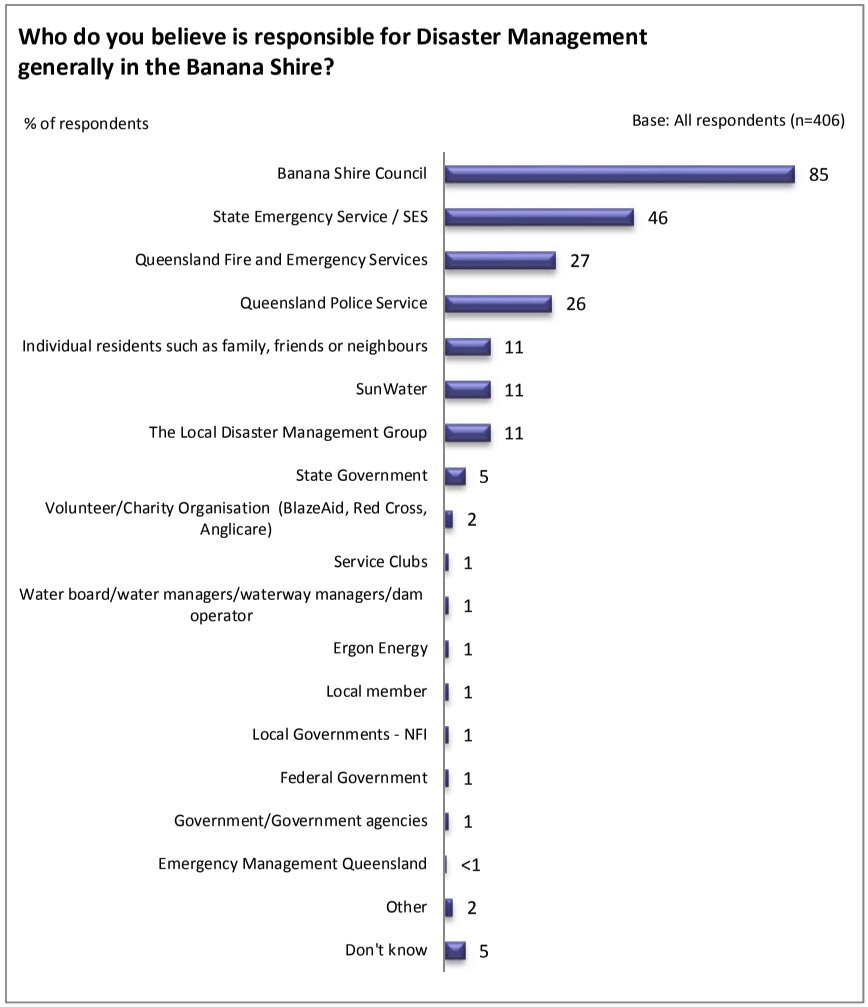
1.2 Organisation perceived to be responsible for Disaster Management Arrangements

More than eight in ten respondents nominate the Banana Shire Council (85%) as being the entity responsible for disaster management generally. The State Emergency Service (46%) is the next most often mentioned group followed by Queensland Fire and Emergency Services (27%) or the Queensland Police Service (26%).

The adjacent chart lists other organisations mentioned by respondents.

1.2.1 Sub-group differences

Primary producers (20%) are more likely than average (11%) to nominate individual residents such as family, friends or neighbours as being responsible for disaster management.



Q2 Who do you believe is responsible for disaster management generally in Banana Shire? [Unprompted MR]

Table: Q2 Who do you believe is responsible for disaster management generally in Banana Shire? [Unprompted MR]

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Banana Shire Council	85	**89**	**80**	82	85	94	87	81	84	83	93	84	84	85	82	88	87	83
State Emergency Service/SES	46	48	44	27	47	39	46	52	50	47	51	45	44	46	49	42	47	44
Queensland Fire and Emergency Services	27	**34**	**19**	26	27	15	**19**	28	28	33	24	27	**17**	**29**	27	26	31	22
Queensland Police Service	26	**34**	**19**	33	26	16	**16**	28	27	34	26	26	**17**	**29**	26	26	27	25
Individual residents such as family, friends or neighbours	11	10	13	6	12	18	14	11	12	15		**12**	**20**	**9**	16	7	10	13
SunWater	11	11	12	5	12	14	15	13	12	11	25	10	11	12	12	10	12	11
The Local Disaster Management Group	11	12	9	8	11	17	11	13	12	**30**	9	11	5	13	10	12	13	9
State Government	5	5	5	5	5	7	7	4	5	5	3	6	8	5	5	5	7	4
Volunteer/Charity Organisation (BlazeAid, Red Cross, Anglicare)	2	3	1		2		2	3	2	2		2	1	2	*	4	**3**	**1**
Service Clubs	1	2	*	5	1		1	2	1	1		1		2	*	2	2	1
Water board/water managers/waterway managers/dam operator - no specific brand	1	2	*	**10**	*		*	1	1	1		1	1	1	1	1	1	1
Ergon Energy	1	2			1		1	1	1			1		1	1	1	**2**	
Local member	1	2	*		1		1	*	1	1		1	1	1		2	2	1
Local Governments - NFI	1		2		1		2	2	2	1		1	**5**		2		2	*
Federal Government	1	1	1		1	**5**	1	*	*		3	*	2	*	*	1		1
Government/Government agencies	1		1		1		*	1	1	1		1	1	1	*	1	*	1
Emergency Management Queensland	*		1		*		*	*	1			*	1	*	*	*	*	*
Other	2	**3**	**1**		2	3	2	3	3	1		2	2	2	1	3	2	2
Don't know	5	**3**	**7**	9	4	2	3	4	4	5	2	5	4	5	4	6	3	7

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q2 Who do you believe is responsible for disaster management generally in Banana Shire? [Unprompted MR] (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Banana Shire Council	85	80	69	75	83	82	**70**	78	78	71	84	92	84	60	63	88	**89**
State Emergency Service/SES	46	71	30	53	63	44	40	88	30	66	39	42	56	40	25	34	45
Queensland Fire and Emergency Services	27	20		**11**	29	24	**10**	25		24	25	27	6	16	9	20	**31**
Queensland Police Service	26	7	17	11	17	20	**11**	9	11	24	34	15	4	9	19	28	**33**
Individual residents such as family, friends or neighbours	11	2	14	8	13	12	**26**		13	14	6	4	35	23	19	8	10
SunWater	11	5	20	11	11	13	8	6	28	5	14	15		12	13	13	12
The Local Disaster Management Group	11		3	1	6	11	**1**		4		20	6		5		20	14
State Government	5	5	5	5		3	13	6	7		8			7	30	5	5
Volunteer/Charity Organisation (BlazeAid, Red Cross, Anglicare)	2					1	2				2				6		3
Service Clubs	1						1							5			2
Water board/water managers/waterway managers/dam operator - no specific brand	1		3	1					4								2
Ergon Energy	1																2
Local member	1						1								4		1
Local Governments - NFI	1		5	2			9		7						26		
Federal Government	1					1					2					2	1
Government/Government agencies	1		6	3		1	**3**		8			2	4	5			
Emergency Management Queensland	*	5		3				6								2	*
Other	2	4		2			2						6				3
Don't know	5	2	20	**10**	6	4	9		13	10	6	3	10	12	7	6	**3**

^ Caution: small cell size.

* Indicates less than 1% of respondents.

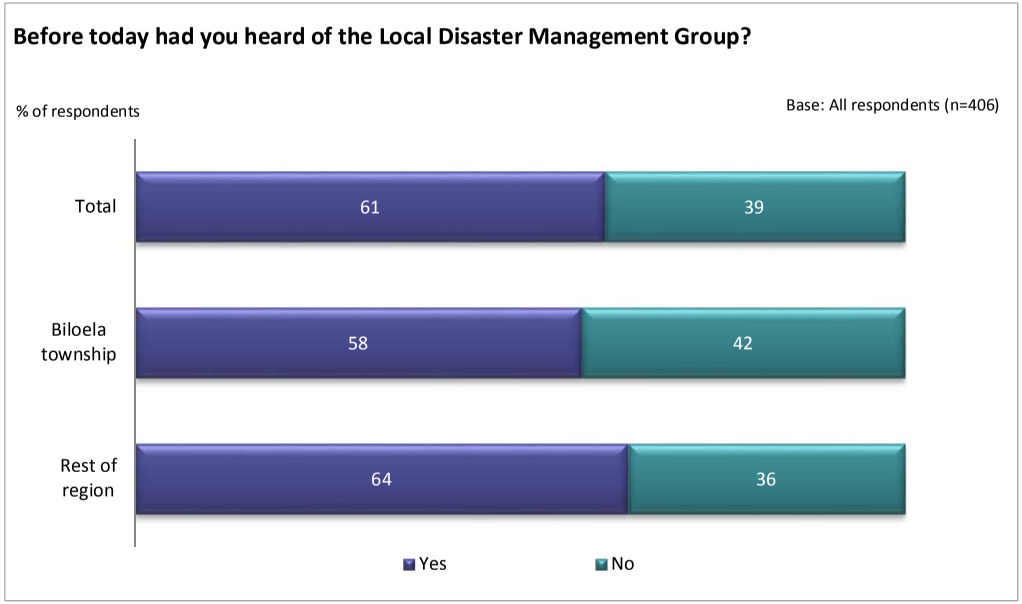
Bold figures are significantly different to the average at at least the 95% confidence level.

1.3 Awareness of the Local Disaster Management Group

Six in ten respondents (61%) had heard of the Local Disaster Management Group (LDMG) prior to being surveyed.

1.3.1 Sub-group differences

Primary producers (71%) are more likely than average (61%) to have prior awareness of the LDMG.



Q2a Before today had you heard of the Local Disaster Management Group? It may also be known as the Local Emergency Management Group?

Table: Q2a Before today had you heard of the Local Disaster Management Group? It may also be known as the Local Emergency Management Group?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	61	58	64	64	60	80	66	61	60	70	79	59	**71**	**58**	57	65	60	61
No	39	42	36	36	40	20	34	39	40	30	21	41	**29**	**42**	43	35	40	39

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	61	65	69	67	64	63	58	67	75	68	60	59	44	48	79	68	60
No	39	35	31	33	36	37	42	33	25	32	40	41	56	52	21	32	40

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

1.4 Awareness of responsibilities of Local Disaster or Emergency Management Group

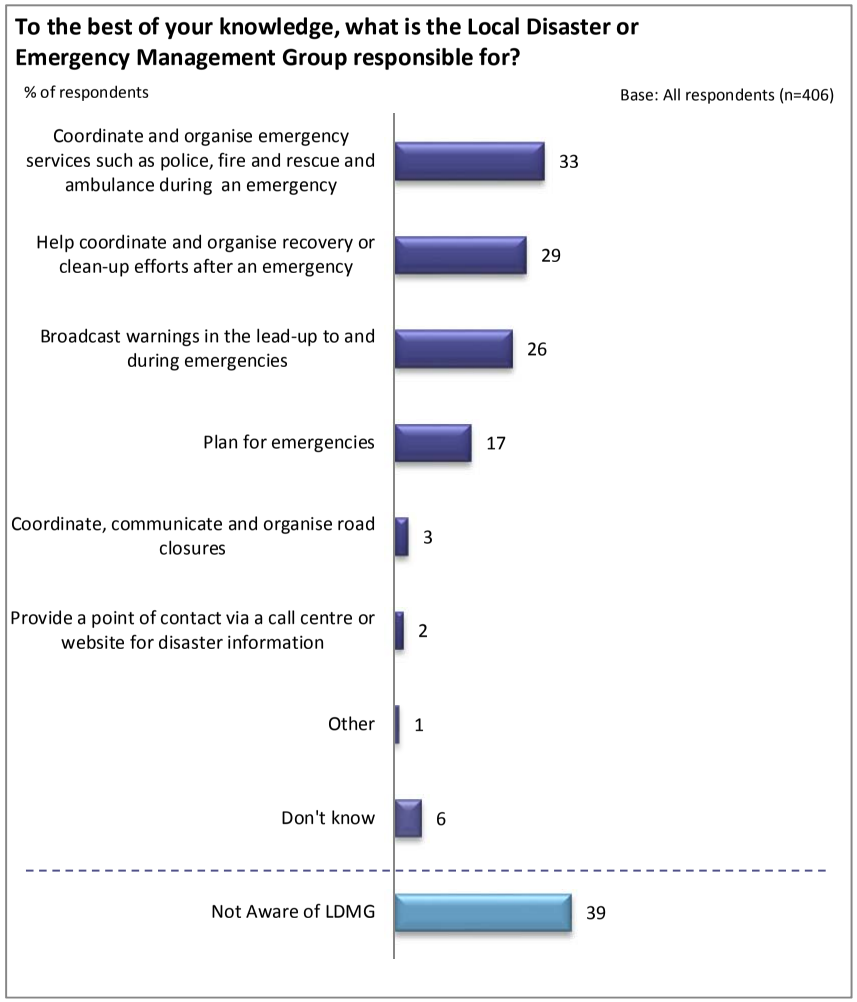
The LDMG is primarily associated with coordination tasks in the lead-up to and during an event and secondarily with planning responsibilities:

- 33% (of respondents) say the LDMG is responsible for coordinating and organising emergency services during an emergency
- 29% consider the LDMG's role to be related to coordinating and organising recovery or clean-up efforts after an emergency
- 26% nominate the broadcasting of warnings in the lead-up to and during emergencies as the LDMG's role
- 17% consider the LDMG's role to be to plan for emergencies.

1.4.1 Sub-group differences

Respondents living within the Biloela township (22%) are more likely than respondents elsewhere in the survey region (12%) to consider the LDMG is responsible for planning for emergencies.

Broadcasting warnings in the lead-up to and during emergencies is an area of responsibility more likely to be mentioned by those aged under 45 years (32%) than those aged 45 years or older (20%).



Q2b To the best of your knowledge, what is the Local Disaster or Emergency Management Group responsible for? What do they do? [Unprompted MR]

Table: Q2b To the best of your knowledge, what is the Local Disaster or Emergency Management Group responsible for? What do they do? [Unprompted MR]

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Coordinate and organise emergency services such as police, fire and rescue and ambulance during an emergency	33	30	36	27	33	42	35	34	32	39	47	32	38	31	32	34	32	33
Help coordinate and organise recovery or clean-up efforts after an emergency	29	26	32	31	29	42	32	31	32	35	48	27	34	28	25	34	31	27
Broadcast warnings in the lead-up to and during emergencies	26	28	24	27	26	**44**	31	28	27	39	40	25	21	27	22	30	**32**	**20**
Plan for emergencies	17	**22**	**12**	30	16	8	15	14	16	18	26	16	10	19	17	17	17	17
Coordinate, communicate and organise road closures	3	4	1	2	3	9	4	4	2	4		3	3	3	3	3	4	1
Provide a point of contact via a call centre or website for disaster information.	2	2	2		2		2	2	2	3		2	2	2	0	3	2	2
Other	1	2	1		2		2	1	2	1		2	1	2	1	2	1	2
Don't know	6	8	5	10	6	12	6	5	5	3	7	6	10	5	7	5	6	7
Not Aware of LDMG	39	42	36	36	40	20	34	39	40	30	21	41	**29**	**42**	43	35	40	39

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Coordinate and organise emergency services such as police, fire and rescue and ambulance during an emergency	33	32	37	34	33	35	32	33	46	26	51	32	34	16	42	41	32
Help coordinate and organise recovery or clean-up efforts after an emergency	29	7	49	25	41	**17**	36	3	60	43	19	15	30	34	44	**49**	31
Broadcast warnings in the lead-up to and during emergencies	26	36	14	27	25	27	13	39	13	18	14	31	7	9	22	25	27
Plan for emergencies	17	5	12	8	16	10	12	6	16	21	17	8	6	18	13	15	**21**
Coordinate, communicate and organise road closures	3				3	1				5						3	4
Provide a point of contact via a call centre or website for disaster information.	2					**6**					4	**7**					1
Other	1		6	3	5				8	8							2
Don't know	6	6		4		7	4	3			2	**11**		5	7	5	7
Not Aware of LDMG	39	35	31	33	36	37	42	33	25	32	40	41	56	52	21	32	40

^ Caution: small cell size.

* Indicates less than 1% of respondents.

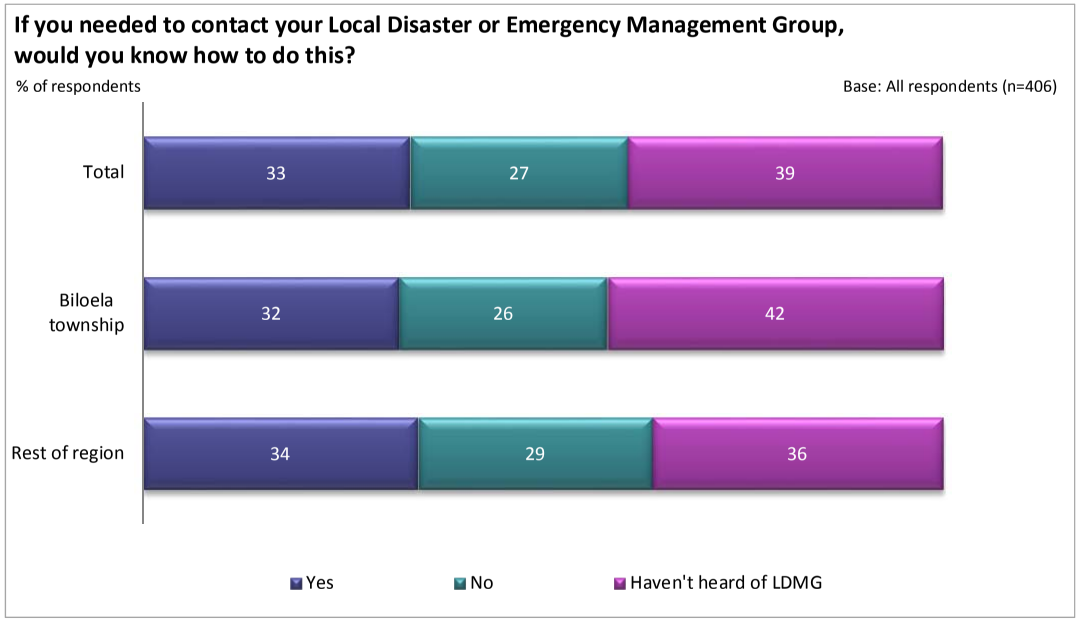
Bold figures are significantly different to the average at at least the 95% confidence level.

1.5 Awareness of how to contact Local Disaster or Emergency Management Group

33% of respondents believe they would know how to contact the LDMG if they needed to.

1.5.1 Sub-group differences

Females (42%) are more likely than males (25%) to say they know how to make contact with the LDMG.



Q2c If you needed to contact your Local Disaster or Emergency Management Group, would you know how to do this?

Table: Q2c If you needed to contact your Local Disaster or Emergency Management Group, would you know how to do this?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	33	32	34	29	34	45	**38**	**39**	34	39	40	33	38	32	**25**	**42**	34	32
No	27	26	29	35	27	35	27	22	26	31	39	26	33	26	31	23	26	29
Haven't heard of LDMG	39	42	36	36	40	20	34	39	40	30	21	41	**29**	**42**	43	35	40	39

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	33	14	43	27	45	37	31	9	52	54	39	37	17	14	59	36	33
No	27	51	26	40	19	26	27	58	24	14	20	22	26	34	20	31	27
Haven't heard of LDMG	39	35	31	33	36	37	42	33	25	32	40	41	56	52	21	32	40

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

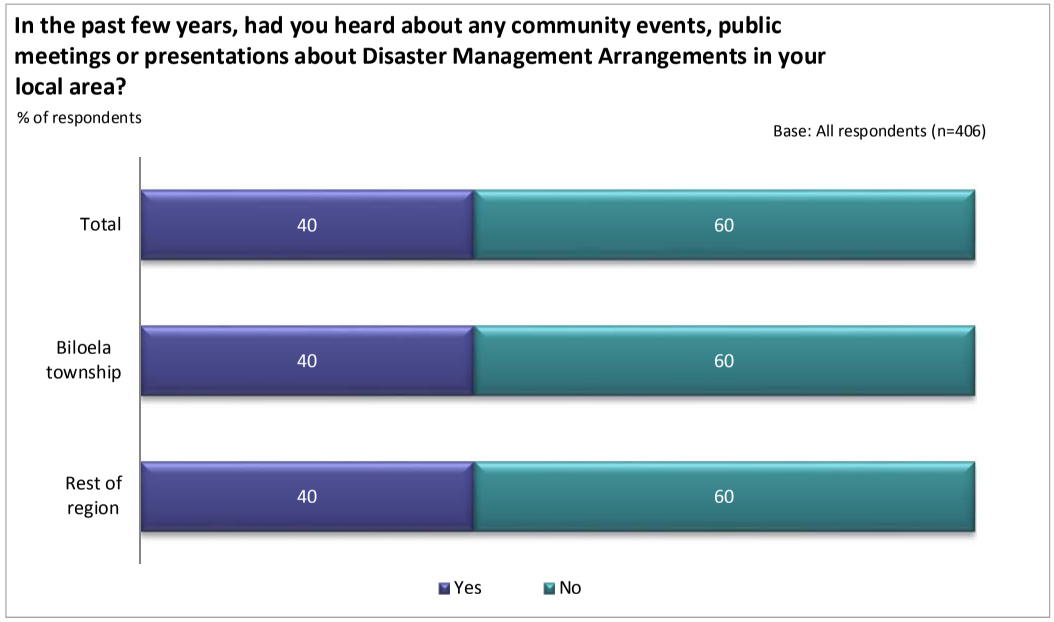
Where totals do not equal 100%, this is due to rounding.

1.6 Awareness of community events about disaster management

Prior to our survey, four in ten respondents (40%) had heard about community events, public meetings or presentations about Disaster Management Arrangements in their local area.

1.6.1 Sub-group differences

Those living in the combined area of Valentine Plains/Prospect/Thangool (31%) are significantly less likely to be aware of Disaster Management Arrangements compared with the average (40%).



Q3 In the past few years, had you heard about any community events, public meetings or presentations about Disaster Management Arrangements in your local area?

Table: Q3 In the past few years, had you heard about any community events, public meetings or presentations about Disaster Management arrangements in your local area?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	40	40	40	41	40	28	39	41	41	48	32	41	41	40	38	43	41	40
No	60	60	60	59	60	72	61	59	59	52	68	59	59	60	62	57	59	60

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	40	62	46	55	34	**31**	45	57	52	38	**23**	29	51	42	42	40	40
No	60	38	54	45	66	**69**	55	43	48	62	**77**	71	49	58	58	60	60

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

1.7 Attendance at community events

Across all survey respondents, 5% report attending a community event, public meeting or presentation about Disaster Management Arrangements in the past few years.

The adjacent chart illustrates the various organisations recalled as being present at these events, Banana Shire Council (4%) being the most common.

1.7.1 Sub-group differences

Those who evacuated their home in the February 2015 event (16%) are more likely than those who did not (5%) to have attended a community event.

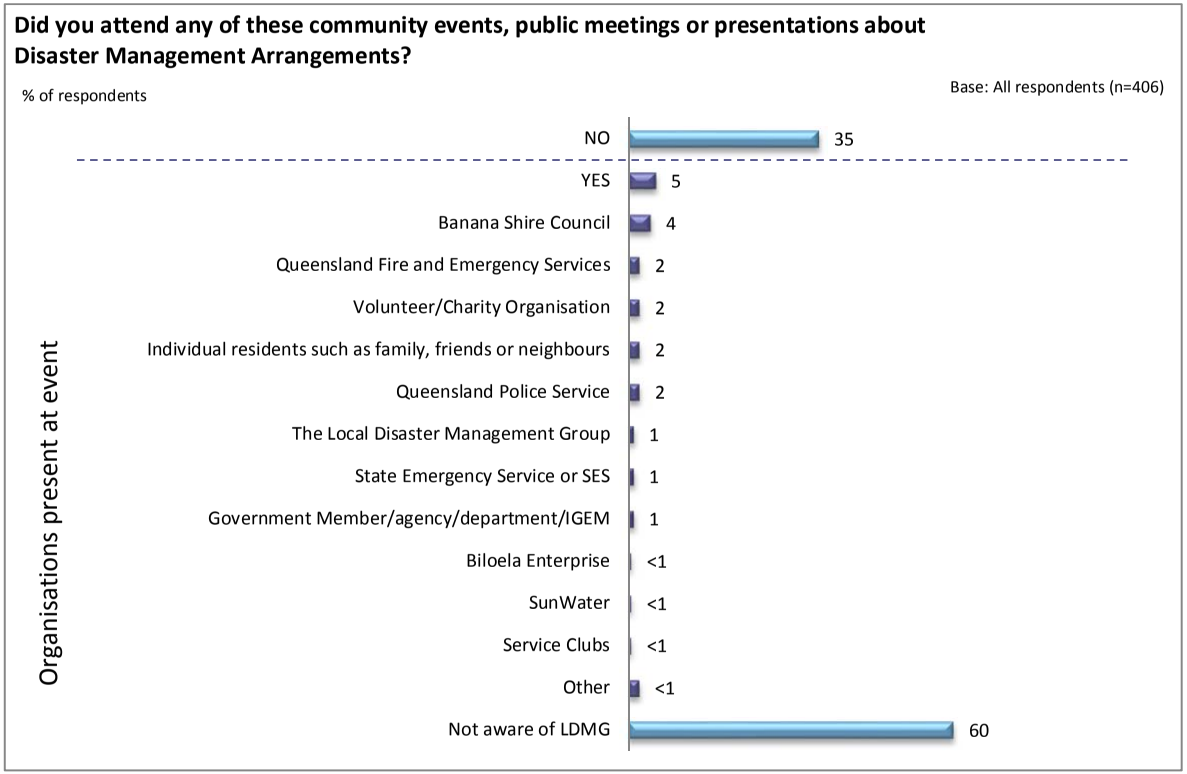


Table: Q4 Did you attend any of these community events, public meetings or presentations about Disaster Management arrangements? [Unprompted MR]

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Yes	5	3	8	7	5	3	6	5	5	5	**16**	**5**	6	5	4	7	5	6
Banana Shire Council	4	3	6	5	4	2	5	3	4	4	**14**	**3**	5	4	3	5	4	4
Queensland Fire and Emergency Services	2	2	3	5	2		1	3	3	3		2	1	3	2	3	**4**	*
Volunteer/Charity Organisation	2	2	2	5	1		1	1	1	3	3	2	1	2	2	2	2	1
Individual residents such as family, friends or neighbours	2	1	2	5	1	2	2	1	1		**6**	**1**	1	2	*	3	2	2
Queensland Police Service	2	1	2	5	1			2	1	4		2		2	2	1	2	1
The Local Disaster Management Group	1	1	2	5	1		1	1	1	1	3	1	1	2	1	2	1	2
State Emergency Service or SES	1	1	2	**7**	**1**		1	*	1			1	2	1	*	2	1	1
Government Member/agency/ department/IGEM	1		**2**		1	2	**2**	*	*	1	3	1	**3**	*		2	*	1
Biloela Enterprise	*	*	1		*		*	*	*	1	2	*		1	*	1		1
SunWater	*	1		**5**								*		1		1	1	
Service Clubs	*	*	*		*		1	*				*	1	*		1		1
Other	2	1	3		2	2	2	**4**	2	3		2	2	2	1	2	**3**	**1**
No	35	37	33	34	35	25	33	36	37	43	16	37	34	35	34	35	36	34
Not aware of disaster management events, meetings or presentations	60	60	60	59	60	72	61	59	59	52	68	59	59	60	62	57	59	60

* Indicates less than 1% of respondents.
Bold figures are significantly different to the average at at least the 95% confidence level.
Where totals do not equal 100%, this is due to rounding.

Table: Q4 Did you attend any of these community events, public meetings or presentations about Disaster Management arrangements? [Unprompted MR] (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Yes	5	11	12	11	6	4	9	6	16	11	10			12	16	9	5
Banana Shire Council	4	11	6	9	3	2	5	6	8	5	4			7	9	9	4
Queensland Fire and Emergency Services	2		6	3		2			8		4					8	3
Volunteer/Charity Organisation	2				3					5						7	3
Individual residents such as family, friends or neighbours	2		12	5	6	1			16	11	2					2	1
Queensland Police Service	2					1					4					**8**	2
The Local Disaster Management Group	1		6	3	3	1			8	5	4					3	1
State Emergency Service or SES	1					2	1				4			5		3	1
Government Member/agency/ department/IGEM	1	5		3	3	1	1	6		5	2				4	1	*
Biloela Enterprise	*				3	1				5	4						*
SunWater	*																1
Service Clubs	*															1	*
Other	2		6	3		1	2		8		2				7	6	2
No	35	51	34	44	28	**27**	36	52	35	28	**13**	29	51	30	26	31	36
Not aware of disaster management events, meetings or presentations	60	38	54	45	66	**69**	55	43	48	62	**77**	71	49	58	58	60	60

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

2.0 Flood Risk

2.1 Enquiries made about flood risk

Four in ten (39%) respondents report they have enquired about the risks of flood to their property in the past few years.

Most enquiries appear to have been informal in nature with 32% sourcing information from individuals such as family, friends or neighbours.

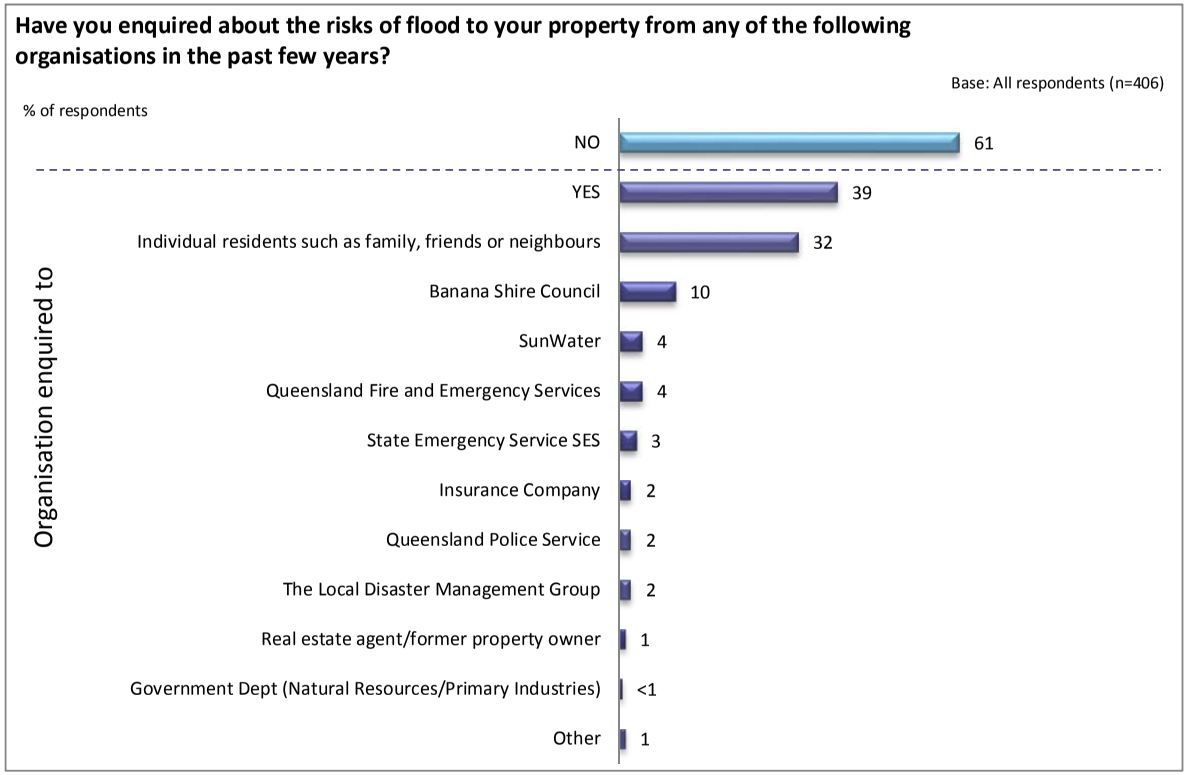
After this, residents are most likely to have consulted Banana Shire Council (10%), SunWater (4%) or Queensland Fire and Emergency Services (4%).

Other organisations respondents accessed for flood risk information are detailed in the adjacent chart.

2.1.1 Sub-group differences

Sub-groups more likely than average (39%) to have made enquiries about flood risk in the past few years are those:

- living outside the Biloela township (45%)
- who evacuated their home during the February event (72%)
- aged under 45 years (49%).



Q9 Have you enquired about the risks of floods to your property from any of the following organisations in the past few years? [Read out MR]

Table: Q9 Have you enquired about the risks of floods to your property from any of the following organisations in the past few years?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Yes	39	**34**	**45**	26	41	57	**49**	39	39	25	**72**	**37**	44	38	38	41	**49**	**30**
Individual residents such as family, friends or neighbours	32	**30**	**35**	23	33	38	**39**	33	31	21	56	30	34	32	32	33	**40**	**24**
Banana Shire Council	10	9	12	7	11	12	**16**	10	9	7	21	10	11	10	9	12	**14**	**7**
SunWater	4	3	4	2	4	14	6	3	3	1	13	3	5	4	4	4	4	4
Queensland Fire and Emergency Services	4	4	3		4	**9**	5	5	4	3	**22**	**2**	1	4	3	4	**6**	**2**
State Emergency Service SES	3	2	5		4	5	5	3	4		**13**	**3**	2	4	4	3	5	2
Insurance Company	2	**4**		3	2		*	2	2			2		3	2	2	3	1
The Local Disaster Management Group	2	2	2	5	2	2	2	1	1		4	2	3	2	1	3	2	1
Queensland Police Service	2	3	1	2	2	3	1	2	2		**5**	**2**	1	2	*	4	2	2
Real estate agent/former property owner	1	1	*		1	3	1	1	1		3	1	1	1		2	1	1
Government department (Dept Natural Resources/Primary Industries)	*		1		1		1	1	1	1		1	2	*		1	*	1
Other	1	1	1		1		1		*	1		1	1	1	1	1	1	1
None	61	**66**	**55**	74	59	43	**51**	61	61	75	**28**	**63**	56	62	62	59	**51**	**70**

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q9 Have you enquired about the risks of floods to your property from any of the following organisations in the past few years? (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Yes	39	61	34	49	37	41	38	70	46	39	48	46	59	40	15	**56**	38
Individual residents such as family, friends or neighbours	32	61	17	42	37	26	32	70	23	39	31	28	56	28	11	42	32
Banana Shire Council	10	12	17	14	3	14	3	11	23	5	11	19		7	4	16	11
SunWater	4	9		5	6	1		11		5	4					**10**	5
Queensland Fire and Emergency Services	4	2		1	3	2				5		3				9	5
State Emergency Service SES	3	18	6	13	3	2	2	22	8	5	4	2		7		6	3
Insurance Company	2																**3**
The Local Disaster Management Group	2	7		4		2		6			4	2				2	2
Queensland Police Service	2	2	6	4	3		1		8	5					4		2
Real estate agent/former property owner	1					2					4						1
Government department (Dept Natural Resources/Primary Industries)	*	5		3			1	6					4			1	*
Other	1						1							5		1	1
None	61	39	66	51	63	59	62	30	54	61	52	54	41	60	85	**44**	62

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

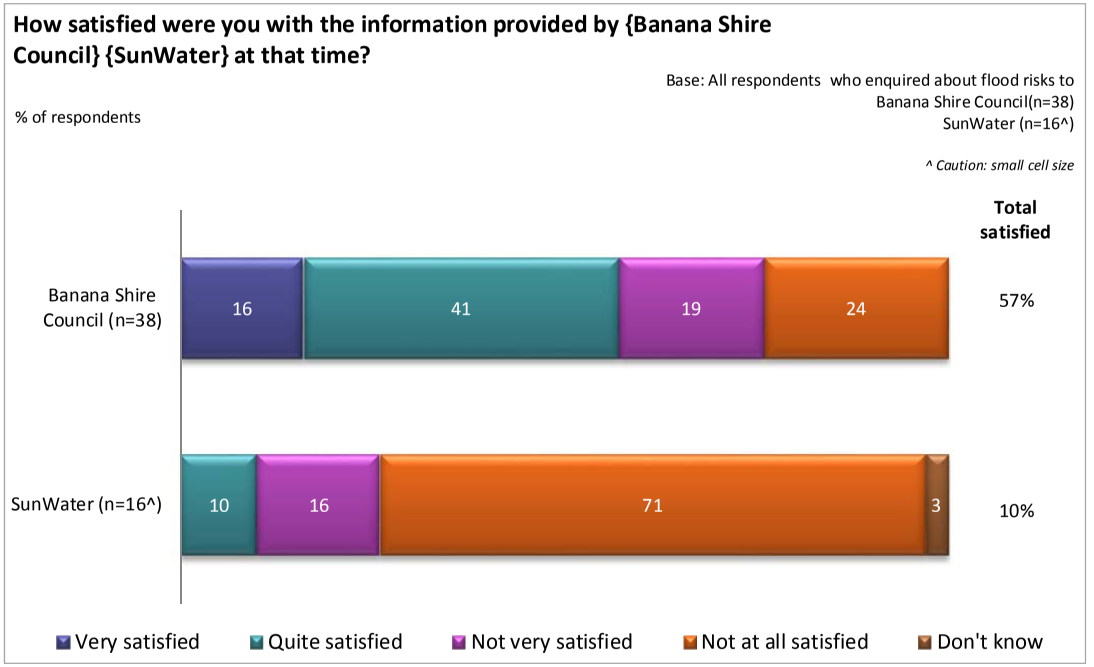
2.2 Satisfaction with flood risk information

57% of those who consulted Banana Shire Council about flood risk say they are satisfied with the information provided by the council (16% very satisfied, 41% quite satisfied).

10% of those who enquired with SunWater about flood risk consider the information provided to be satisfactory (all of whom were quite satisfied). Caution should be applied given the small cell size (n=16).

2.2.1 Sub-group differences

No significant sub-group differences are evident on this question.



Q10 How satisfied were you with the information provided by {Banana Shire Council} {SunWater} at that time?

*Table: Q10 How satisfied were you with the information provided by **{Banana Shire Council}** at that time?*

Base: Respondents enquiring about the risks of flood to their property to Banana Shire Council	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	38	15^	23^	2^	36	3^	25^	20^	25^	4^	6^	32	9^	29^	11^	27^	18^	20^
	% of respondents																	
SUB-TOTAL Satisfied	57	48	64		60	100	51	79	63	39	35	61	50	59	29	77	50	71
Very satisfied	16	11	19		17		10	23	23	11	14	16	13	17	15	17	6	36
Quite satisfied	41	37	44		43	100	41	55	40	29	21	45	37	42	15	61	44	35
Not very satisfied	19	20	19	100	15		17	5	21		13	20	45	12	24	16	21	16
Not at all satisfied	24	32	17		25		32	17	17	61	52	19	5	30	47	7	29	13

Base: Respondents enquiring about the risks of flood to their property to Banana Shire Council	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	38	3^	3^	6^	1^	8^	2^	2^	3^	1^	3^	5^	*	1^	1^	6^	21^
	% of respondents																
SUB-TOTAL Satisfied	57	61	100	81	100	54	100	50	100	100	79	44		100	100	56	50
Very satisfied	16		30	16		27	39		30			37			100	12	11
Quite satisfied	41	61	70	66	100	27	61	50	70	100	79	8		100		44	39
Not very satisfied	19	39		19		41		50				56					14
Not at all satisfied	24					6					21					44	36

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Where totals do not equal 100%, this is due to rounding.

*Table: Q10 How satisfied were you with the information provided by **{SunWater}** at that time?*

Base: Respondents enquiring about the risks of flood to their property to SunWater	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of Region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	16^	7^	9^	1^	15^	3^	10^	7^	11^	2^	3^	13^	6^	10^	5^	11^	4^	12^
	% of respondents																	
SUB-TOTAL Satisfied	10	9	11		11			18	6		14	9		14	11	9		20
Quite satisfied	10	9	11		11			18	6		14	9		14	11	9		20
Not very satisfied	16	23	11	100	12		16	18	10		21	14	21	14	11	21	12	20
Not at all satisfied	71	68	73		74	100	80	55	78	56	65	73	68	72	77	63	88	55
Don't know	3		6		3		4	9	5	44		4	11			7		6

Base: Respondents enquiring about the risks of flood to their property to SunWater	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	16^	2^	*	2^	2^	1^	*	2^	*	1^	1^	*	*	*	*	4^	11^
	% of respondents																
SUB-TOTAL Satisfied	10	*		*	*	*		*		*	*					19	13
Quite satisfied	10															19	13
Not very satisfied	16	50		50				50									13
Not at all satisfied	71	50		50	50	100		50		100	100					81	74
Don't know	3				50												

* Indicates less than 1% of respondents.
^ Caution: small cell size.
Where totals do not equal 100%, this is due to rounding.

2.3 Confidence in personal understanding of flood risk

91% of respondents say they are confident in their understanding of the flood risk to them or their property (61% very confident, 30% quite confident).

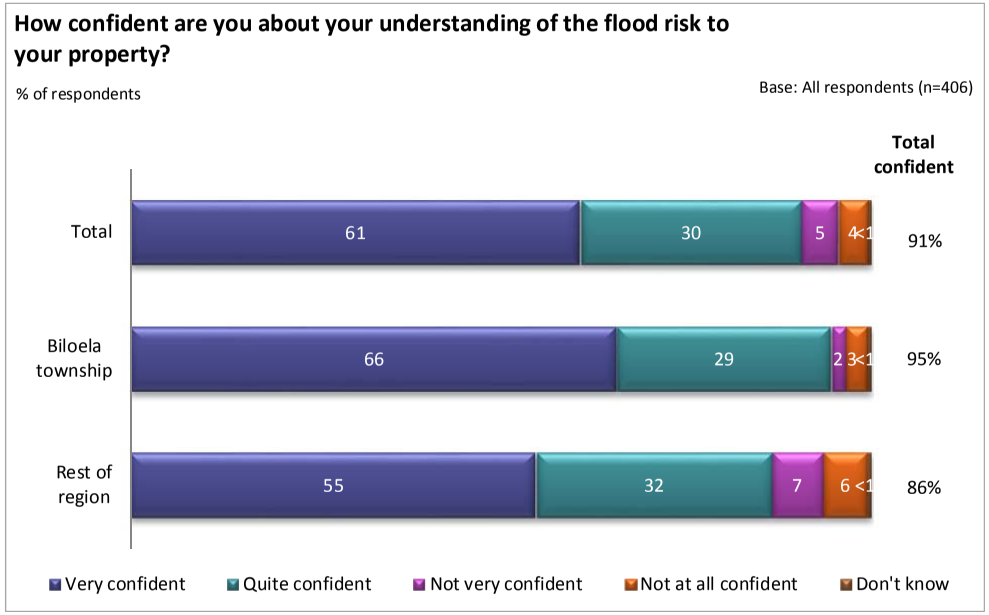
2.3.1 Sub-group differences

Confidence is higher than average (91%) among:

- those living within the Biloela township (95%)
- those who were not impacted by the February flood event (100%)
- those who did not evacuate their home during the February event (94%)
- males (94%).

Reported confidence is lower than average (91%) among:

- those who had been impacted by a flood prior to the 2015 flood (85%)
- those living outside the Biloela township (86%) – particularly those in Valentine Plains (79%)
- those who reported being emotionally impacted by the February event (69%)
- those who had house/other property/agricultural property damaged or destroyed during the February event (82%)
- those who evacuated their home during the February event (57%)
- females (88%).



Q11 How confident are you about your understanding of the flood risk to you and your property? Are you…?

Table: Q11 How confident are you about your understanding of the flood risk to you and your property? Are you…?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Confident	91	**95**	**86**	**100**	**90**	**69**	**82**	90	92	**99**	**57**	**94**	93	90	**94**	**88**	92	90
Very confident	61	66	55	56	61	47	56	62	64	68	**36**	**63**	**68**	**59**	**72**	**49**	61	61
Quite confident	30	29	32	**44**	**29**	21	27	28	28	31	21	31	24	32	**22**	**39**	31	29
Not very confident	5	**2**	**7**		5	**14**	**8**	**7**	4	1	**20**	**3**	4	5	**2**	**8**	3	6
Not at all confident	4	**3**	**6**		4	**16**	**9**	3	**3**		**21**	**3**	4	4	4	4	5	3
Don't know	*	*	*		*	**2**	1	*	*		**2**	*		*		1		1

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Confident	91	93	94	93	82	88	92	94	91	85	**79**	91	90	88	96	**77**	92
Very confident	61	56	73	64	59	47	63	62	64	74	52	46	66	51	70	52	63
Quite confident	30	37	20	30	23	42	29	32	28	11	27	45	24	37	27	26	28
Not very confident	5		6	3	9	9	5		9	10	11	9		12	4	11	4
Not at all confident	4	5		3	9	3	3	6		5	9		10			**12**	4
Don't know	*	2		1													*

^ Caution: small cell size.
* Indicates less than 1% of respondents.
Bold figures are significantly different to the average at at least the 95% confidence level.
Where totals do not equal 100%, this is due to rounding.

2.4 Confidence in being prepared for and knowing how to respond future flooding events

89% of survey respondents express confidence in regards to being prepared for and knowing how to respond to flooding events in the future (49% very confident, 40% quite confident).

2.4.1 Sub-group differences

Confidence levels are lower than average among those:

- who were emotionally impacted by the February event (74%)
- who evacuated their home during the February event (72%).

Q12 How confidents are you in regards to being prepared for and knowing how to respond to flooding events in the future? Are you…?

Table: Q12 How confidents are you in regards to being prepared for and knowing how to respond to flooding events in the future? Are you…?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Confident	89	89	88	86	89	**74**	89	89	**90**	86	**72**	**90**	89	88	90	87	92	85
Very confident	49	51	46	29	50	52	48	50	**55**	53	**21**	**51**	49	48	**55**	**41**	49	49
Quite confident	40	38	42	58	38	**22**	42	40	35	33	51	39	40	40	34	46	43	37
Not very confident	9	10	7	8	9	12	7	9	8	11	**18**	**8**	6	9	7	10	6	11
Not at all confident	1	*	1		1	2	1	1	*	1		1	1	1	*	1		2
Don't know	2	1	3	6	2	**12**	3	1	2	2	10	1	**4**	**2**	2	2	2	2

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Confident	89	91	94	92	78	93	95	91	91	79	83	97	100	88	96	78	87
Very confident	49	31	76	50	42	46	47	31	79	37	37	44	31	75	41	45	50
Quite confident	40	60	18	41	36	47	48	61	13	42	47	53	69	14	56	33	37
Not very confident	9	5	3	4	10	6	5	6	4	5	14	3		12	4	12	10
Not at all confident	1				3	1				5	2					**3**	1
Don't know	2	5	3	**4**	9			3	4	10						7	2

^ Caution: small cell size.
* Indicates less than 1% of respondents.
Bold figures are significantly different to the average at at least the 95% confidence level.
Where totals do not equal 100%, this is due to rounding.

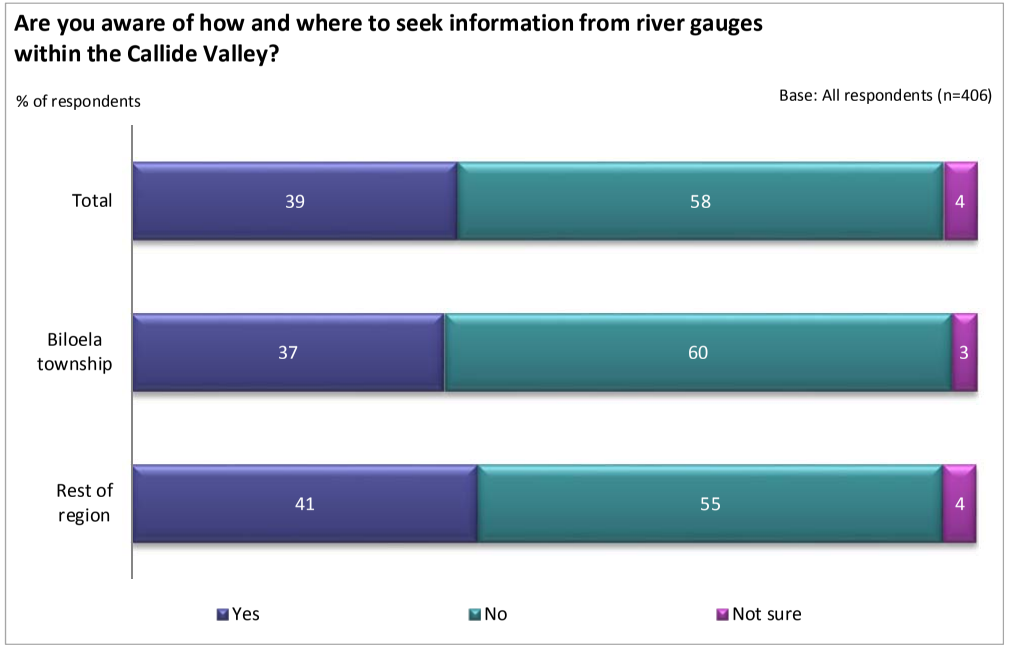
2.5 Awareness of how and where to seek information from river gauges

39% of respondents say they are aware of how and where to seek information from river gauges within the Callide Valley.

2.5.1 Sub-group differences

Awareness is higher than average (39%) among:

- those who experienced house/other property/agricultural property damage in the February event (47%)
- those involved in primary production (53%)
- males (45%)
- those from the combined areas of Jambin/Argoon/Goovigen/Orange Creek/Greycliffe (69%).



Q13 Are you aware of how and where to seek information from river gauges within the Callide Valley?

Table: Q13 Are you aware of how and where to seek information from river gauges within the Callide Valley?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	39	37	41	36	39	43	**47**	42	38	36	31	39	**53**	**35**	**45**	**32**	42	35
No	58	60	55	61	57	52	**49**	56	58	63	66	57	**42**	**62**	52	64	55	60
Not sure	4	3	4	3	4	5	**3**	2	4	1	3	4	5	3	3	4	3	5

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	39	60	80	**69**	23	38	47	58	87	20	40	28	58	19	58	24	35
No	58	40	20	**31**	71	55	52	42	13	70	60	59	42	77	42	69	62
Not sure	4				6	7	1			10		12		5		6	4

^ Caution: small cell size.
Bold figures are significantly different to the average at at least the 95% confidence level.
Where totals do not equal 100%, this is due to rounding.

3.0 Impact of event

3.1 Personal impact of flooding event

The majority of survey respondents (92%) report experiencing at least some personal impact as a result of the flooding event in February 2015.

The most widespread impacts mentioned (without prompting) are power outages (68%) and telecommunications outages (51%).

Common mentions related to property include:

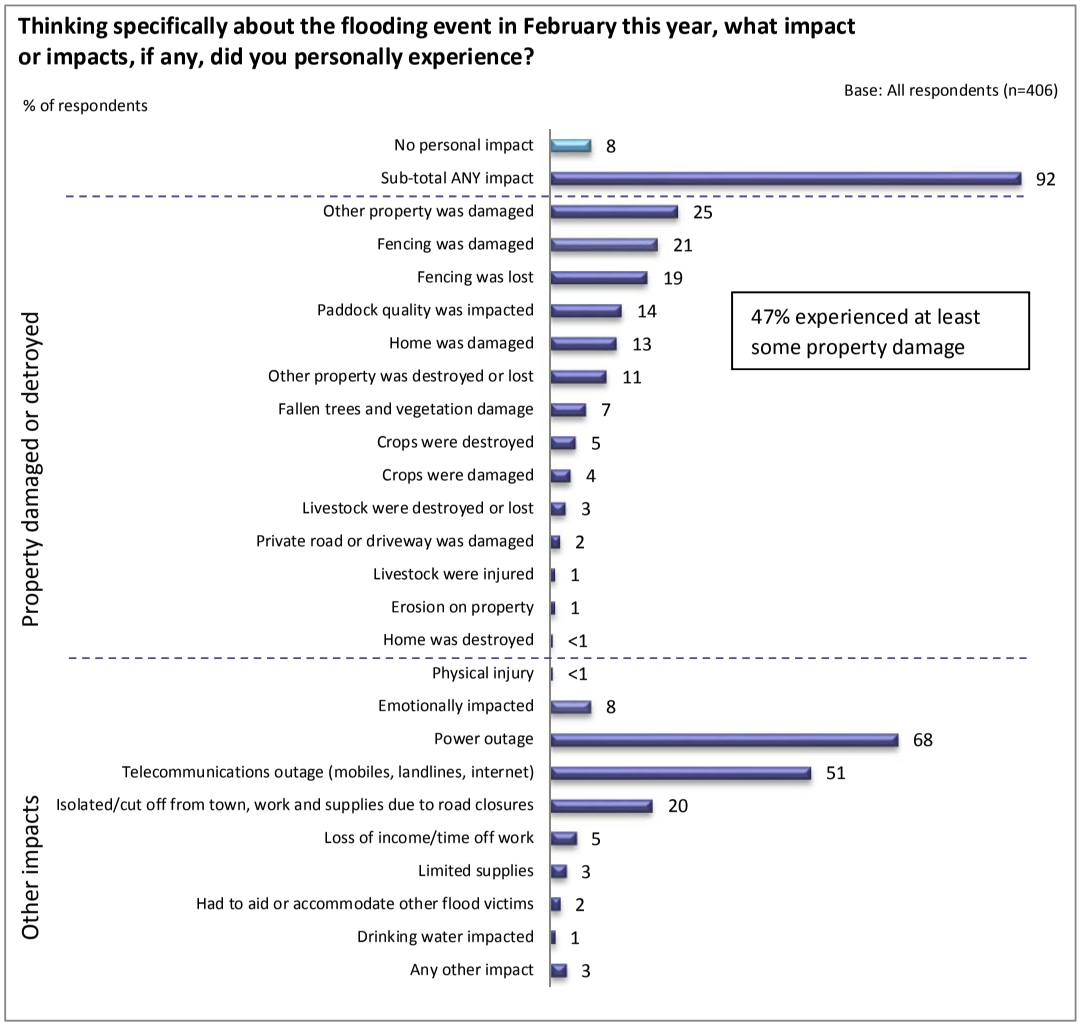
- damage to property (other than home or agricultural property) (25%)
- fencing damage (21%)
- loss of fencing (19%)
- paddock quality impacts (14%)
- damage to home (13%)
- destruction or loss of other property (11%).

See adjacent chart for more impacts.

3.1.1 Sub-group differences

Impacts related to home or other property damage/agricultural property damage are more likely than average (47%) to be found among those:

- living outside the Biloela township (70%)
- who evacuated their home (96%)
- involved in primary production (88%).



*Q14 Thinking specifically now about the **flooding event** in February this year, what impact or impacts, if any, did you personally experience? [UNPROMPTED MR]*

*Table: Q14 Thinking specifically now about the **flooding event** in February this year, what impact or impacts, if any, did you personally experience? [Unprompted MR]*

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
No personal Impact	8	**11**	**4**	**100**								8	4	8	5	10	7	8
SUB-TOTAL Impacted	92	**89**	**96**		**100**	100	**100**	**100**	**100**	**100**	100	92	96	92	95	90	93	92
SUB-TOTAL Home-property-agri	47	**26**	**70**		**51**	**80**	**100**	**58**	49	**30**	**96**	**43**	**88**	**36**	47	48	47	47
Other property was damaged	25	**10**	**41**		**27**	**53**	**53**	**28**	25	**16**	**74**	**21**	**46**	**19**	24	27	26	24
Fencing was damaged	21	**4**	**39**		**22**	**56**	**44**	**23**	19	14	**42**	**19**	**62**	**9**	25	16	22	19
Fencing was lost	19	**2**	**37**		**20**	**66**	**40**	**24**	19	**4**	**40**	**17**	**67**	**5**	19	18	20	18
Paddock quality was impacted	14		**28**		**15**	**47**	**29**	**18**	15	**3**	23	13	**47**	**4**	15	12	13	14
Home was damaged	13	**8**	**18**		**14**	**27**	**27**	13	12	**1**	**70**	**8**	10	13	13	12	12	13
Other property was destroyed or lost	11	**4**	**18**		**12**	**43**	**23**	**15**	11	**2**	**33**	**9**	**25**	**7**	9	13	11	11
Fallen trees and vegetation damage	7	8	7		8	6	**15**	10	8	12		8	5	8	8	6	8	7
Crops were destroyed	5		**9**		5	**12**	**10**	5	4	1	11	4	**20**	*	4	5	5	4
Crops were damaged	4		7		4	6	8	4	3	1	2	4	16		6	1	4	3
Livestock were destroyed or lost	3	**1**	**6**		4	**15**	**7**	3	3		4	3	**13**	**1**	4	3	5	2
Private road or driveway was damaged	2		**4**		2	6	**4**	3	2		6	2	**7**	*	1	3	1	2
Livestock were injured	1		2		1	**9**	**2**	1	1		**7**	*	**3**	*	1	1	*	1
Erosion on property	1	*	1		1		**2**	*	*			1	**3**	*	1	1		1
Home was destroyed	*	*	*		*		1				**3**	*		*	*	*		1
Physical injury	*		*		*		*	*	*			*	1			*	*	
Emotionally impacted	8	**5**	**10**		8	**100**	**13**	8	8	5	**22**	**6**	**19**	**4**	5	10	7	8
Power outage	68	67	70		**74**	73	71	**85**	**100**	70	**55**	**69**	73	67	70	66	70	67
Telecommunications outage (mobiles, landlines, internet)	51	**36**	**67**		**55**	55	**63**	**100**	**64**	62	56	51	**67**	**47**	50	52	53	49
Isolated/cut off from town, work and supplies due to road closures	20	20	20		**22**	12	**13**	25	21	**100**	**9**	**21**	11	23	23	17	22	18
Loss of income/time off work	5	6	4		5	16	4	3	3		13	4	1	6	7	3	7	3
Limited Supplies	3	**5**	**1**		3	2	*	4	3	**12**		3		**4**	3	3	3	3
Had to aid or accommodate other flood victims	2	**4**	*		2	7	1	1	2	1		2	2	2	*	4	2	3
Drinking water impacted	1	1	1		1		2	1	2	1		1		1		2	2	*
Any other impact	3	3	4		3		4	3	2	5	5	3	5	2	1	5	**4**	**2**

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

*Table: Q14 Thinking specifically now about the **flooding event** in February this year, what impact or impacts, if any, did you personally experience? [Unprompted MR] (continued)*

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
No personal impact	8				9	2	3			10				9		9	**10**
SUB-TOTAL Impacted	92	100	100	100	91	98	97	100	100	90	100	100	100	91	100	91	**90**
SUB-TOTAL Home-property-agri	47	80	52	**68**	79	**69**	**80**	75	55	76	**86**	57	90	47	96	64	**33**
Other property was damaged	25	64	34	**51**	38	**43**	32	61	35	30	**58**	29	25	18	49	**39**	**16**
Fencing was damaged	21	64	37	**52**	44	**32**	**44**	67	43	42	**48**	25	44	16	65	32	**9**
Fencing was lost	19	43	37	**40**	56	**31**	**52**	45	39	66	**46**	28	50	19	81	23	**6**
Paddock quality was impacted	14	57	20	**41**	24	**24**	**42**	56	16	19	**37**	19	37	23	61	15	**3**
Home was damaged	13	11	11	11	25	18	7	6	15	15	23	18	6	9	6	**29**	12
Other property was destroyed or lost	11	12	19	15	22	15	22	9	19	18	**29**	8	6	16	43	**22**	**7**
Fallen trees and vegetation damage	7	9		5		11	3	8			12	2	4	7		8	8
Crops were destroyed	5	35	8	**24**	12	4	**14**	33	11		7	2	6	7	27	2	*
Crops were damaged	4	30	8	**21**	6	1	13	22	4			2	33	5		2	*
Livestock were destroyed or lost	3	25	6	**17**		**6**	2	31	8		6	**8**	6			1	**1**
Private road or driveway was damaged	2	7		4	6	**7**	1	9			**14**	4	4			1	*
Livestock were injured	1				6	2					**6**					2	*
Erosion on property	1					1						2				**3**	1
Home was destroyed	*															1	1
Physical injury	*					**2**						**3**					
Emotionally impacted	8	11	3	8	17	6	7	3	4	5	15	2		7	14	**18**	7
Power outage	68	74	94	**83**	37	74	**89**	72	92	14	**36**	**97**	100	82	85	**52**	**64**
Telecommunications outage (mobiles, landlines, internet)	51	56	86	**69**	63	**72**	**82**	50	92	66	70	**74**	87	68	88	51	**39**
Isolated/cut off from town, work and supplies due to road closures	20	5	34	18	11	24	8	3	28	14	12	23	8	9	7	29	22
Loss of income/time off work	5	2	6	4	9		1		8					5		11	7
Limited Supplies	3					1	1				4			5			**4**
Had to aid or accommodate other flood victims	2	2		1				3									**3**
Drinking water impacted	1		3	1		1			4			2				3	1
Any other impact	3	14		8		6		17				**11**				1	2

^ Caution: small cell size.

* Indicates less than 1% of respondents.

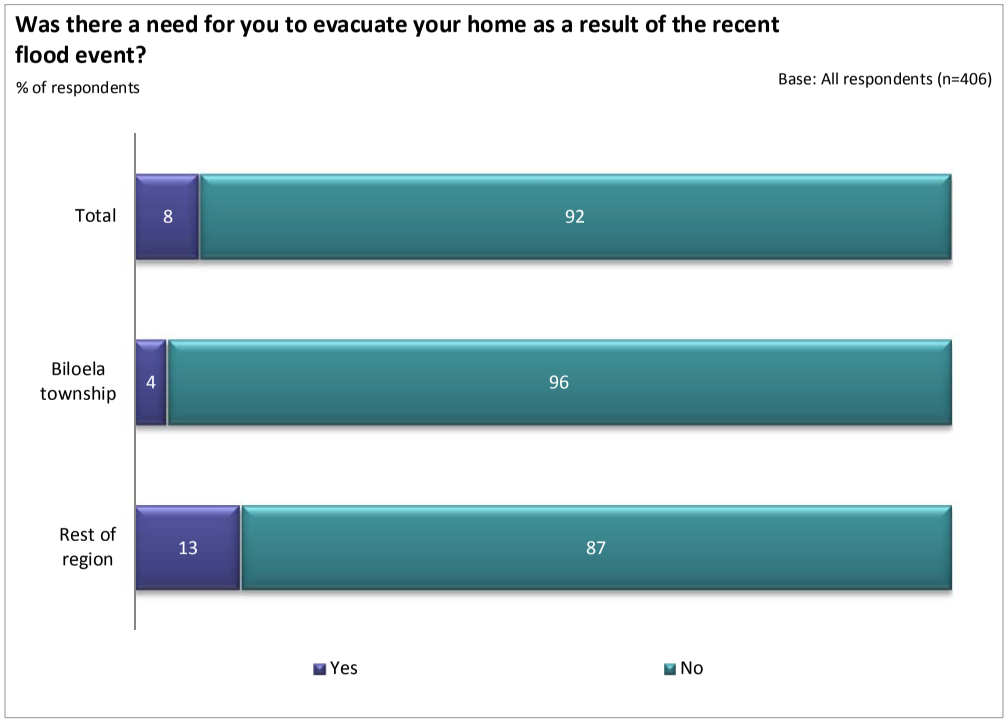
Bold figures are significantly different to the average at at least the 95% confidence level.

3.2 Evacuation of home due to flooding in February 2015

8% of survey respondents report having had to evacuate their home as a result of the recent flood event.

3.2.1 Sub-group differences

Those living outside the Biloela township area (13%) are more likely than those living within the town (4%) to report evacuating their home during the February event. Evacuation is more likely than average (8%) to be reported by those from Valentine Plains (28%).



Q15 Was there any need for you to evacuate your home as a result of the recent flood event?

Table: Q15 Was there any need for you to evacuate your home as a result of the recent flood event?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	8	**4**	**13**		9	**23**	**16**	9	**6**	**3**	**100**		6	8	9	7	8	8
No	92	**96**	**87**	100	91	**77**	**84**	91	**94**	**97**		**100**	94	92	91	93	92	92

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	8	11	6	9	29	10	2	6	8	39	**28**		6			**22**	7
No	92	89	94	91	71	90	98	94	92	61	**72**	100	94	100	100	**78**	93

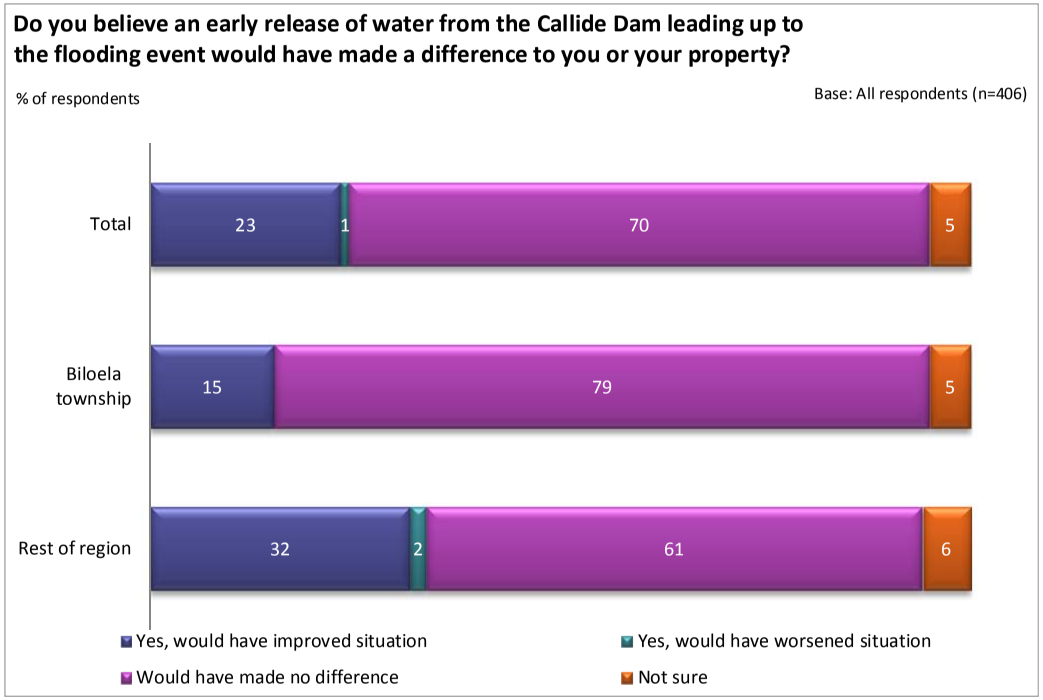
^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

3.3 Perceptions about the impacts of an early release of water from the Callide Dam

23% of survey respondents believe an early release of water from the Callide Dam leading up to the flooding event would have improved the situation for them and their property. 1% of respondents consider an early release would have worsened their situation.

70% of respondents consider an early release would have made no difference in their situation, while 5% are unsure.



Q16 Do you believe an early release of water from the Callide Dam leading up to the flooding event would have made a difference to you or your property?

3.3.1 Sub-group differences

Those living outside the Biloela township (32%) are more likely than average (23%) to believe an early release would have improved their situation. This is especially the case among those living in the combined areas of Jambin/Argoon/ Goovigen/Orange Creek/Greycliffe (39%).

Other sub-groups more likely than average (23%) to believe an early release from the Callide Dam would have improved their situation are those:

- who feel they have been emotionally impacted by the event (55%)
- who evacuated their home (76%)
- involved in primary production (32%).

Table: Q16 Do you believe an early release of water from the Callide Dam leading up to the flooding event would have made a difference to you or your property?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
SUB-TOTAL Yes	24	**15**	**34**	24	24	**60**	**37**	24	**21**	16	**76**	**20**	**36**	**21**	27	21	**28**	**20**
Yes improved situation	23	**15**	**32**	24	23	**55**	**35**	23	**20**	16	**76**	**19**	**32**	**21**	27	20	27	19
Yes worsened situation	1		2		1	5	2	1	1			1	**4**		*	1	1	*
Have made no difference	70	**79**	**61**	74	70	**38**	**57**	70	73	82	**13**	**75**	62	73	69	72	67	74
Not sure	5	5	6	2	6	2	6	6	6	2	**12**	**5**	2	7	4	7	5	6

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
SUB-TOTAL Yes	24	40	38	**39**	52	**16**	28	42	41	44	23	**14**	7	12	61	**50**	22
Yes improved situation	23	40	38	**39**	52	**16**	23	42	41	44	23	**14**		12	56	**46**	21
Yes worsened situation	1						**5**						7		6	3	1
Have made no difference	70	42	53	**47**	42	**82**	68	36	51	46	71	**85**	85	84	39	**46**	73
Not sure	5	18	9	14	6	3	4	22	8	10	6	2	8	5		4	5

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

3.4 Perceived difference an early release of water would have made

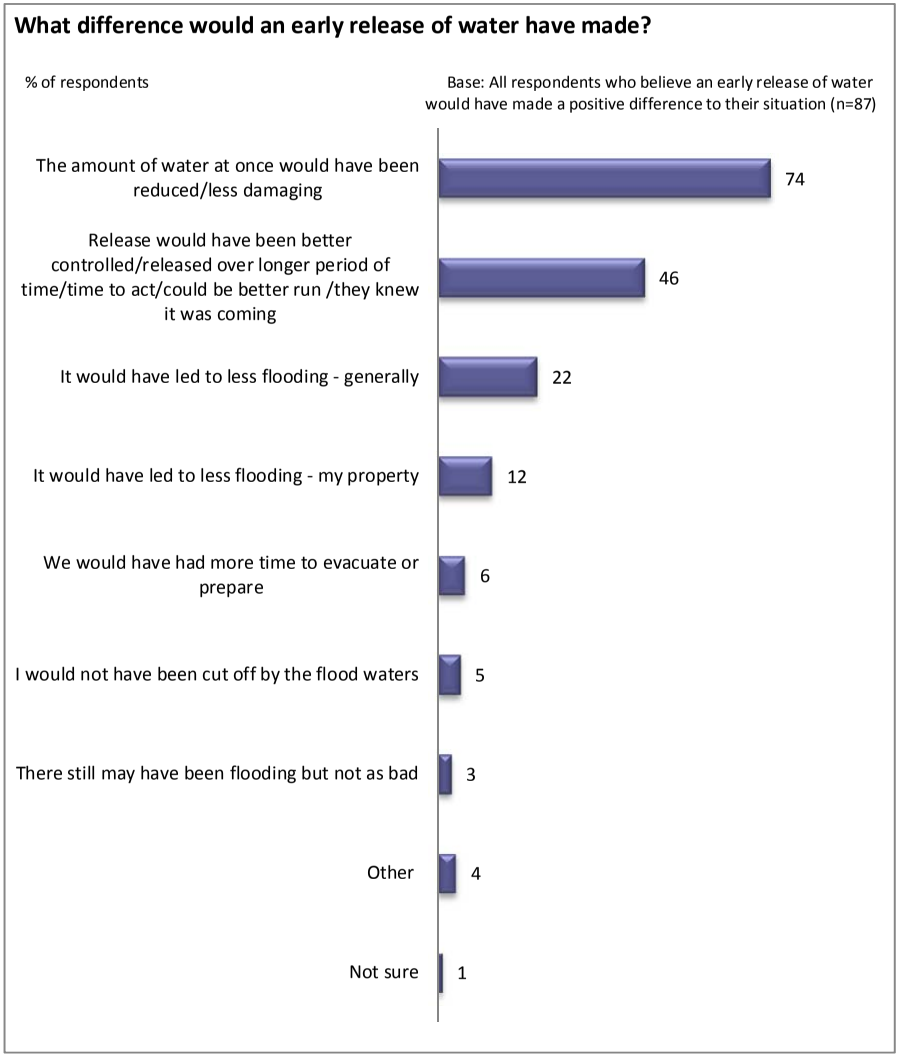
By far the most commonly perceived difference an early release of water could have made is that the amount of water arriving at once would have been reduced and the damage therefore lessened (74%).

One in two (46%) say an earlier release would have allowed for the release to have been better controlled and better communicated to residents (that authorities knew the water was coming).

After this mentions of less flooding generally (22%) or less flooding to the respondent's property (12%) are the next most common responses.

3.4.1 Sub-group differences

No significant sub-group differences are noted on this issue.



Q16a What difference would this have made? [Unprompted MR]

3.4.2 Perceived difference among those who believe an early release would have worsened their situation

Three respondents (1%) believe an early release of water from the Callide Dam would have worsened their situation. The following are the verbatim comments from respondents (each bullet point represents n=1 respondent):

- I believe it would have put more water down my end. We live right on the bottom end of Callide Creek, there are seven major creeks that feed the water that comes past our place and a bit further down there are two other major rivers from Mt Morgan way. If Callide Creek is pre-charged that's just going to back water up and add to the water. Releasing water from the dam is just going to add to the problem down the line. If they let water out early the creeks down around us will all peak at the same time.
- It would have made things a lot worse than it was. If they had released it early we would have all been flooded worse.
- I think if they had released the water earlier we would have been flooded worse here as we're on the Dee River and it would have backed up there.

Table: Q16a What difference would this have made? [Unprompted MR]

Base: All respondents who believe an early release of water would have made a positive difference to their situation	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	87	23^	64^	6^	81	18^	62	47	51	12^	22^	65	31	56	35	52	30	57
	% of respondents																	
The amount of water at once would have been reduced/less damaging	74	58	82	87	73	88	77	72	69	67	88	69	82	71	75	72	74	73
Release would have been better controlled/released over longer period of time/they had time to act/could be better run /they knew it was coming	46	39	50	35	47	67	54	45	51	11	62	41	51	44	51	39	51	39
It would have led to less flooding - generally	22	22	22	41	20	28	21	7	14	24	20	22	19	23	23	21	24	19
It would have led to less flooding - my property	12	10	13		13	18	16	13	10		14	12	14	12	6	21	9	16
We would have had more time to evacuate or prepare	6	2	8		7	6	8	2	2	5		8	5	6	5	7	5	7
I would not have been cut off by the flood waters	5	9	3		5			9	8	34		6	3	6	6	2	7	2
There still may have been flooding but not as bad	3	4	3		3	4	1		5	5		4		4	3	3		8
Other	4	9	1		4	17	5	1	6	4		5	11		5	1	5	1
Not sure	1	3			1		1					1		1	2			2

^ Caution: small cell size.

Table: Q16a What difference would this have made? [Unprompted MR]

Base: All respondents who believe an early release of water would have made a positive difference to their situation	Total	REGION DETAILED														
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	87	7^	9^	16^	11^	9^	9^	5^	7^	6^	7^	2^	2^	7^	19^	42	7^
	% of respondents																
The amount of water at once would have been reduced/less damaging	74	94	67	83	73	90	49	100	58	78	100	79	100	41	93	73	94
Release would have been better controlled/released over longer period of time/they had time to act/could be better run /they knew it was coming	46	21	33	26	53	81	61	13	42	43	64	100	61	60	47	42	21
It would have led to less flooding - generally	22	50	30	42		18	6	52	39		35		39		25	23	50
It would have led to less flooding - my property	12	11		7	45		19	13		34				23	10	10	11
We would have had more time to evacuate or prepare	6					5	6				10			7	18	9	
I would not have been cut off by the flood waters	5		29	12					20							5	
There still may have been flooding but not as bad	3				10										4	4	
Other specify	4		8	4					11							5	
Not sure	1															2	

^ Caution: small cell size.

3.5 Reasons for perceiving that an early release of water would NOT have made a difference

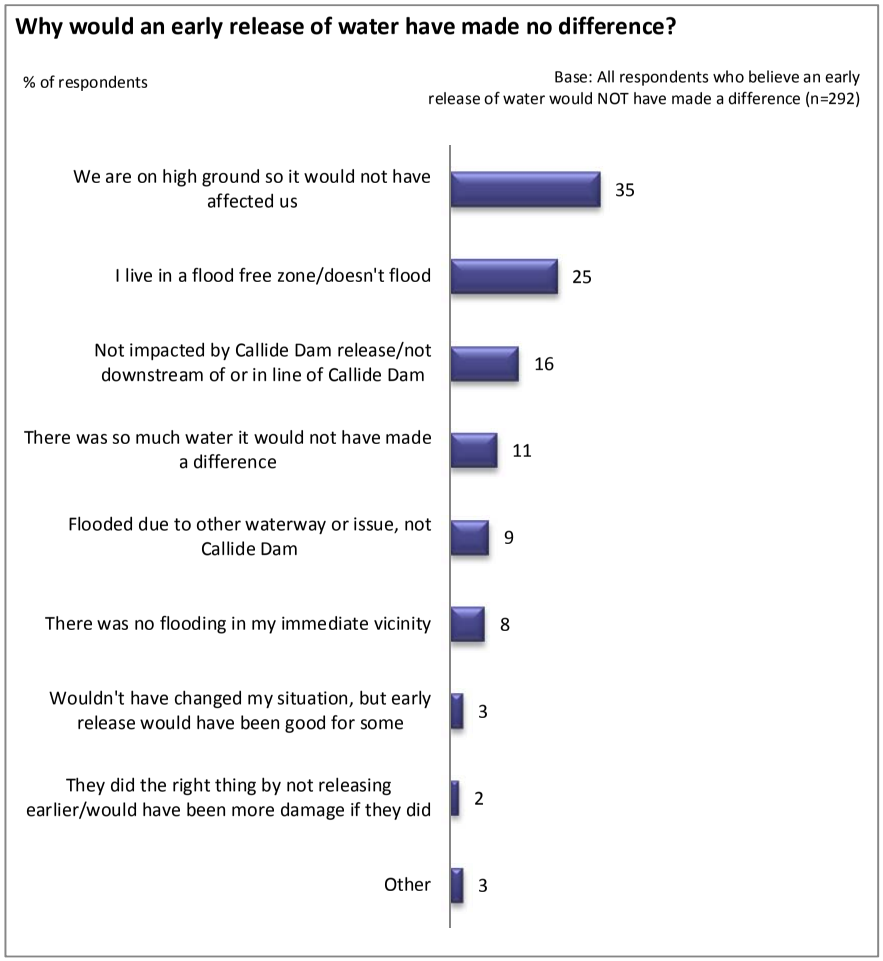
Being on high ground (35%) or living in a flood free zone (25%) are the main reasons for believing an early release from Callide Dam would not have made a difference to the impacts personally experienced during the February event. Not being impacted by Callide Dam waters is mentioned by 16%.

11% consider that there was so much water, an early release would not have made a difference.

Other responses are illustrated in the adjacent chart.

3.5.1 Sub-group differences

No significant sub-group differences are noted on this issue.



Q16b Why would this have made no difference? [Unprompted MR]

Table: Q16b Why would this have made no difference? [Unprompted MR]

Base: Those who believe an early release of water would *not* have made a difference	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	292	148	144	25^	267	15^	123	153	206	59	6^	286	72	220	112	180	72	220
	% of respondents																	
We are on high ground so it would not have affected us	35	51	13	54	34	33	24	31	35	41		36	20	39	36	35	42	30
I live in a flood free zone/doesn't flood	25	28	22	27	25	9	16	20	28	16		26	13	28	25	26	18	32
Not impacted by Callide Dam release/not downstream of or in line of Callide Dam	16	7	30	2	17	4	26	21	16	27	50	16	28	13	16	17	15	17
There was so much water it would not have made a difference	11	10	12	7	11	9	13	9	9	2	12	11	16	10	12	9	11	11
Flooded due to other waterway or issue, not Callide Dam	9	1	19		10	24	16	14	11	12	38	8	22	6	8	9	9	9
There was no flooding in my immediate vicinity	8	11	5	15	8	14	5	6	7	10		8	3	9	6	11	12	5
Wouldn't have changed my situation, but early release would have been good for some	3	4	1		3		5	5	4	5		3		4	1	5	5	1
They did the right thing by not releasing earlier/would have been more damage if they did	2	1	2		2	7	4	2	2	1		2	4	1	1	3	2	2
Other	3	3	2	8	2		1	3	2	1		3	4	2	4	1	2	3

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q16b Why would this have made no difference? [Unprompted MR] (continued)

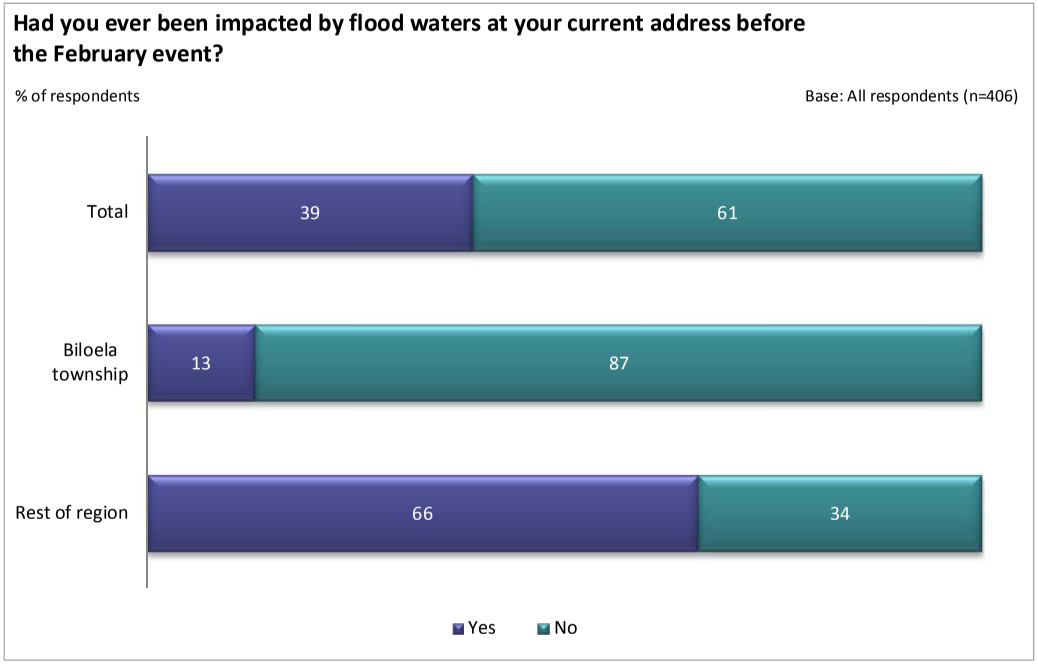
Base: Those who believe an early release of water would *not* have made a difference	**Total**	**REGION DETAILED**															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	292	9^	12^	21^	10^	59	36	5^	9^	6^	21^	32	13^	15^	8^	18^	166
	% of respondents																
We are on high ground so it would not have affected us	35	6	35	20	12	15	7	9	49	18	17	17		19		11	46
I live in a flood free zone/doesn't flood	25	42	38	40	32	15	35	61	26	37		21	34	42	24	7	25
Not impacted by Callide Dam release/not downstream of or in line of Callide Dam	16	15		8		29	46	13			27	24	61	25	49	38	10
There was so much water it would not have made a difference	11	6	10	8	49	13	2	9		33	9	15		5		15	11
Flooded due to other waterway or issue, not Callide Dam	9	22	11	17	8	27	11	9	16	12	25	34	4	9	27	18	3
There was no flooding in my immediate vicinity	8				14	2	2			22	5			5		15	11
Wouldn't have changed my situation, but early release would have been good for some	3															7	5
They did the right thing by not releasing earlier/would have been more damage if they did	2	9		5		3	2				6	2		5			1
Other	3		6	3		4			9		11	2					2

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

3.6 Previous flood impact

39% of survey respondents report having been impacted by flood waters at their current address before the February event.



Q17 Have you ever been impacted by flood waters at your current address before the February event?

3.6.1 Sub-group differences

Prior flooding impacts are most commonly found among those living outside the Biloela township (66%, compared to township residents 13%).

Those who have been emotionally impacted by the February event (64%) or primary producers (77%) are more likely than average (39%) to have been impacted by flood waters before 2015.

Table: Q17 Have you ever been impacted by flood waters at your current address before the February event?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Yes	39	**13**	**66**	**9**	**41**	**64**	**64**	**47**	**41**	31	60	37	**77**	**28**	43	34	40	37
No	61	**87**	**34**	**91**	**59**	**36**	**36**	**53**	**59**	69	40	63	**23**	**72**	57	66	60	63

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Yes	39	69	61	**65**	66	**59**	**85**	67	72	63	45	**67**	88	84	84	**61**	**22**
No	61	31	39	**35**	34	**41**	**15**	33	28	37	55	**33**	12	16	16	**39**	**78**

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

3.7 Difference of impact between 2015 and previous years

Of those with prior flood experience, the majority (82%) believe there was a difference between the impact experienced as a result of the February 2015 event and earlier floods.

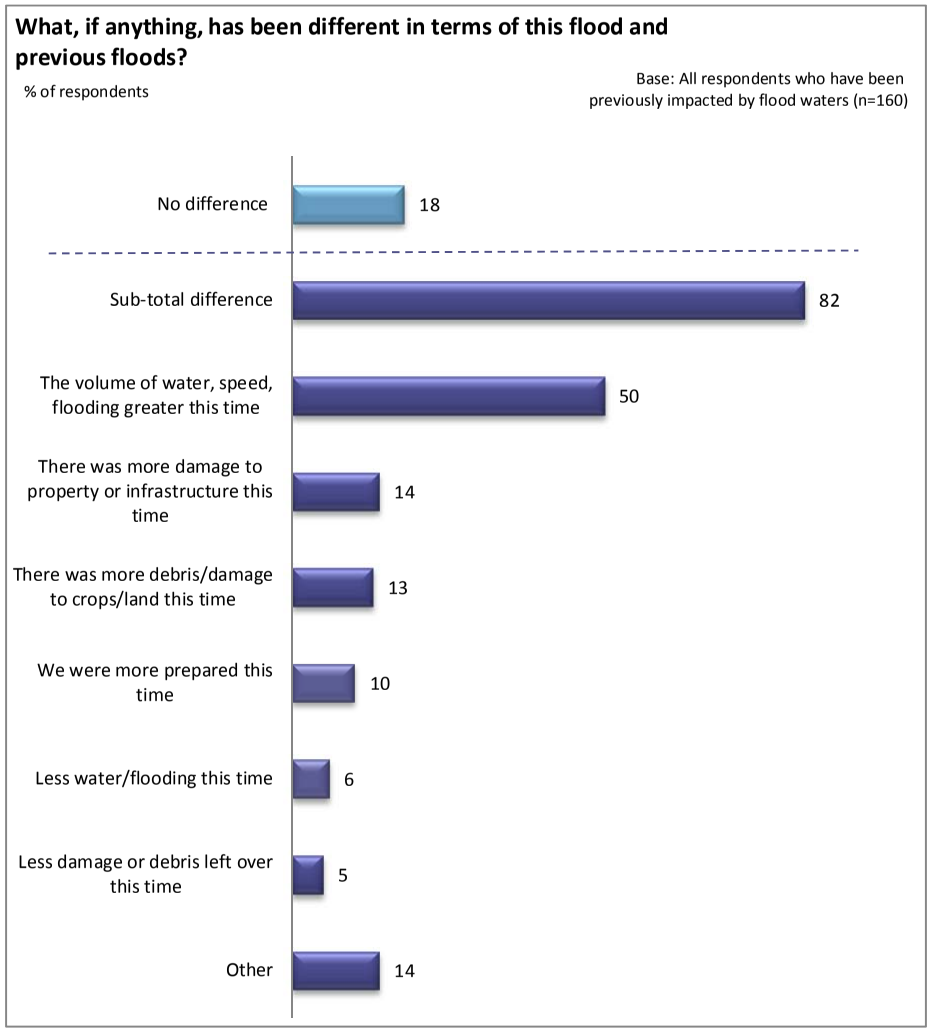
The main difference perceived was that the volume of water, the speed with which it came and the amount of flooding was greater in February 2015 than during previous flooding events (50%).

14% say there was more damage to property or infrastructure this time compared to previous floods, 13% noticed more debris/damage to crops or land this time.

Positive differences noted include a perception that they were more prepared in February than in previous floods (10%), that there was less water or flooding this time (6%) or that there was less damage or debris left over this time (5%).

3.7.1 Sub-group differences

Those living in the combined areas of Dululu/Wowan/Smoky Creek (27%) are more likely than average (18%) to consider there to be no difference between the 2015 event and previous floods.



Q17a What, if anything, has been different in terms of the impact of this flood and previous floods? [Unprompted MR]

Table: Q17a What, if anything, has been different in terms of the impact of this flood and previous floods? [Unprompted MR]

Base: Respondents who have been previously impacted by flood waters	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	160	19	141	3	157	20	128	105	119	27	18	142	82	78	64	96	45	115
	% of respondents																	
No Difference	18	21	17	18	18	2	16	14	19	41		20	18	17	14	22	13	23
SUB-TOTAL difference	82	79	83	82	82	98	84	86	81	59	100	80	82	83	86	78	87	77
The volume of water and speed higher in 2015, flooding more widespread	50	36	52	82	49	72	**53**	50	**44**	28	62	48	59	42	48	52	51	49
There was more damage to property or infrastructure this time	14	20	13		15	27	**18**	14	11	6	23	13	8	19	**18**	**9**	10	19
There was more debris/damage to crops/land this time	13	14	13		14	28	16	10	13	2		15	**24**	**5**	14	13	**19**	**7**
We were more prepared this time	10	15	9		10		10	9	11	8	19	8	7	12	8	11	8	11
Less water/flooding this time	6	4	7		6		**5**	7	7	2		7	9	4	6	6	4	8
Less damage or debris left over than last time	5		7		6		6	6	5		9	5	10	2	7	3	5	6
Other	14	17	14		15	32	12	16	18	20	15	14	10	18	16	13	18	10

Base: Respondents who have been previously impacted by flood waters	**Total**	**REGION DETAILED**															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	160	11^	14^	25^	14^	36	42	7^	12^	8^	13^	20^	14^	15^	13^	24^	43
	% of respondents																
No difference	18	10	38	21		23	**27**		28		5	15	34	22	23	2	**11**
SUB-TOTAL difference	90	62	79	100	77	73	100	72	100	95	85	66	78	77	98	89	90
The volume of water and speed higher in 2015, flooding more widespread	50	83	35	64	95	44	**38**	92	40	91	78	38	57	22	32	54	46
There was more damage to property or infrastructure this time	14	6	11	8	20	17	6		12	9	17	21		14	4	18	19
There was more debris/damage to crops/land this time	13	43	25	35	10	15	4	54	29	9	10	20		9	4	5	10
We were more prepared this time	10	6	8	7		6	6		10			10		9	11	19	**17**
Less water/flooding this time	6						**21**						9	16	38	6	5
Less damage or debris left over than last time	5	6	15	9			18		18				31	9	14	2	1
Other	14	4	8	6		20	6	5	10		22	23		17	4	25	21

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

4.0 Information sources

4.1 Information sources used

Two key sources of information were relied upon in the lead-up to the February event; the Bureau of Meteorology website (73%) or family/friends/neighbours (67%). During the event reliance on family, friends or neighbours was maintained (71%) while use of the Bureau of Meteorology website decreased to 46%.

46% consulted ABC News prior to the event, with a similar proportion (40%) doing so during the event.

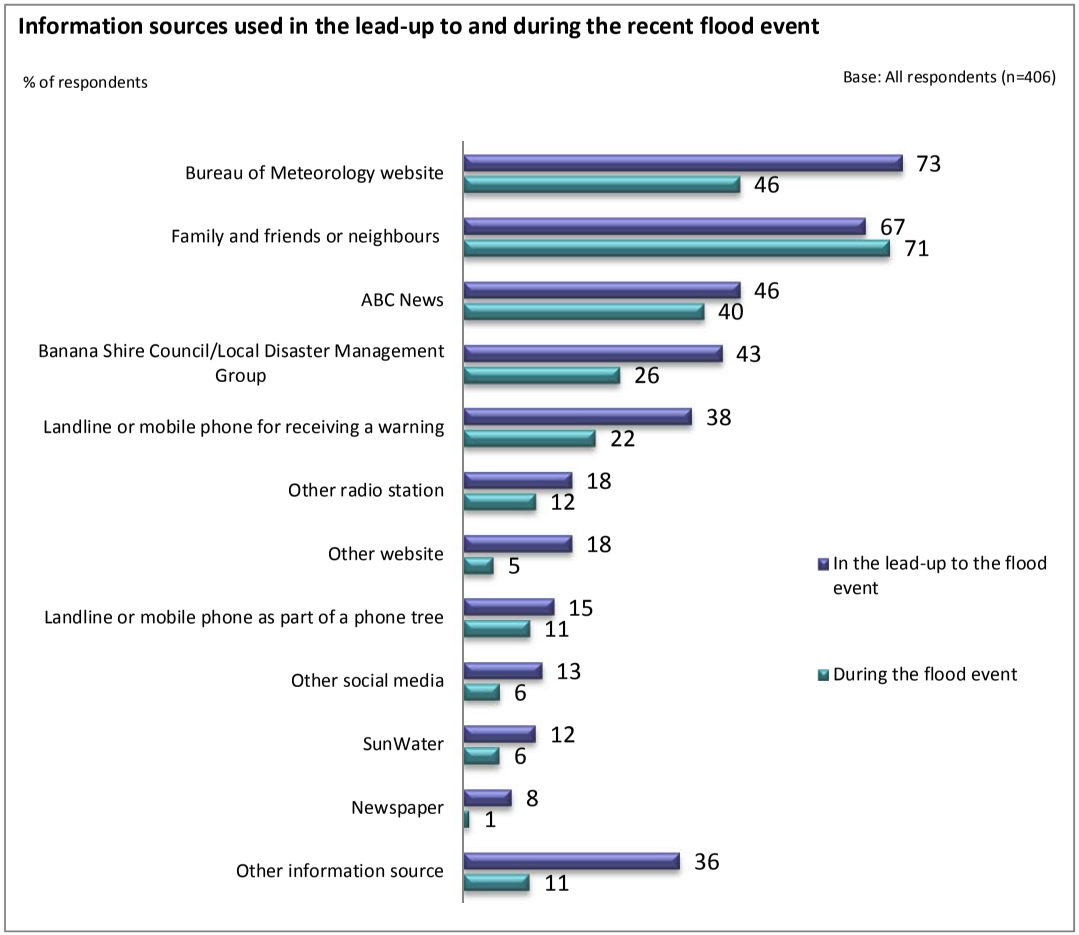
Other information sources were more commonly referred to in the lead-up to, rather than during the event. See adjacent chart for more details.

4.1.1 Sub-group differences

Those who evacuated their home during the February event (37%) were more likely than average (12%) to have used **SunWater** for advice in the lead-up to the event (in particular by phoning them). They were also more likely than average to have consulted the **official Banana Shire Council Facebook** page (33%, versus 17% average) or **Bureau of Meteorology website** (88%, versus 73% average) in the lead-up to the flooding event.

Primary producers were more likely than average to have used information from **SunWater** (18%, versus 12%), **ABC News** (60%, versus 46%) or a **local phone tree** (28%, versus 15%) in the lead-up to the event.

The tables on pages 66-69 highlight these and other sub-group differences.



Q18a In the lead-up to the recent flood event which, if any, of the following sources of information did you use?
Q18b And during the recent flood event which, if any, of the following sources of information did you use?

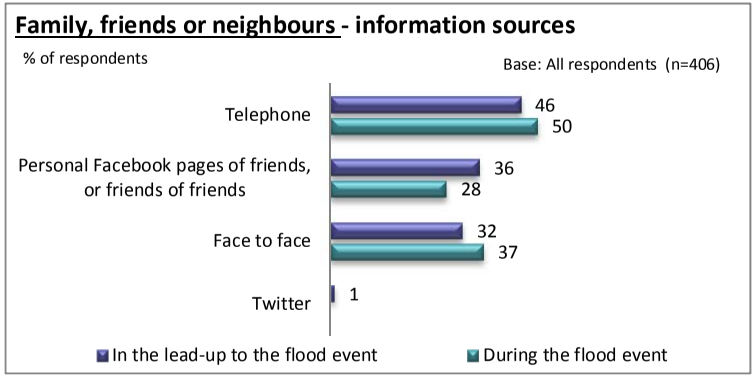
4.1.2 Information channel by source

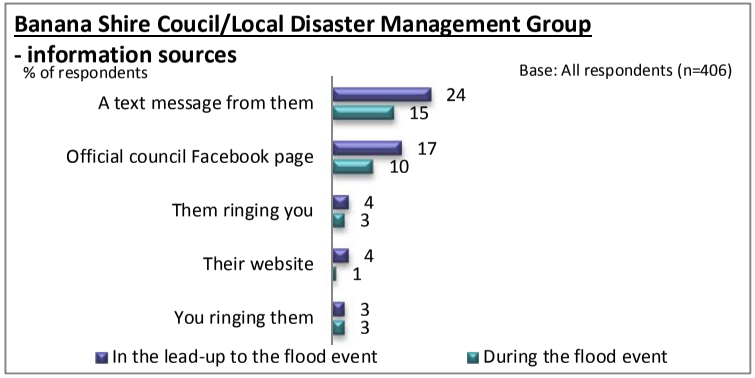
Data presented in each of the following charts is expressed as a percentage of all respondents.

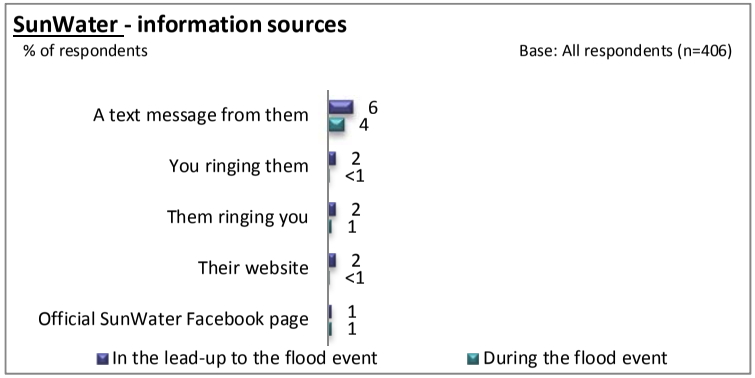
One in two respondents in the survey region (46% lead-up/50% during) consulted **family, friends or neighbours** via telephone, while one in three used personal Facebook pages (36% lead-up, 28% during) or face to face discussions with family, friends of neighbours (32% lead-up, 37% during).

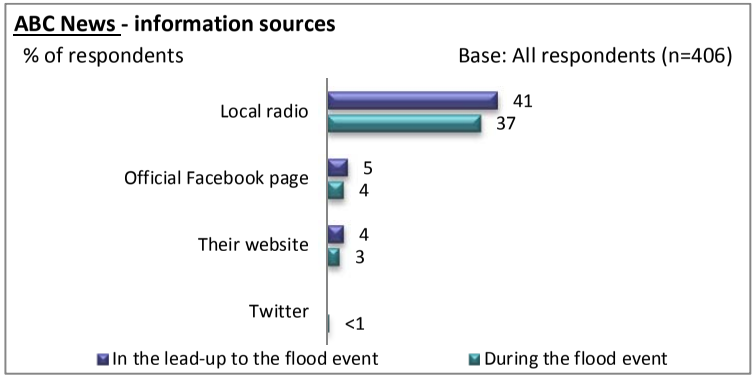
Communications with **Banana Shire Council or the LDMG** were most likely to have occurred via a text message (24% lead-up, 15% during), or through the official council Facebook page (17% lead-up, 10% during).

Local radio (41% lead-up, 37% during) was the most common way people sourced information from **ABC News**. A text message from **SunWater** (6% lead-up, 4% during) was the most common information channel used between residents and SunWater.









Q18a In the lead-up to the recent flood event which, if any, of the following sources of information did you use?
Q18b And during the recent flood event which, if any, of the following sources of information did you use?

Table: Q18a In the lead-up to the recent flood event which, if any, of the following sources of information did you use?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
FAMILY, FRIENDS OR NEIGHBOURS SUB-TOTAL Yes	67	63	72	**55**	**68**	72	**70**	72	67	75	76	66	64	68	63	72	**75**	**59**
Face to face	32	**38**	**26**	18	33	34	29	**32**	31	45	26	33	**15**	**37**	**28**	**37**	38	26
Telephone	46	**39**	**54**	**40**	**47**	57	**53**	**51**	45	42	61	45	**48**	**46**	42	51	50	43
Personal Facebook pages of friends, or friends of friends	36	39	32	37	36	33	35	34	34	42	41	35	26	39	33	38	**54**	**17**
Twitter	1	1	*		1		*	1	1			1		1	1	*	1	*
BANANA SHIRE COUNCIL/LOCAL DISASTER MANAGEMENT GROUP SUB-TOTAL Yes	43	48	37	29	44	40	44	38	40	42	49	42	38	44	38	48	**54**	**31**
You ringing them	3	2	4		3	**16**	**5**	3	**1**		**8**	**3**	4	3	2	4	4	2
Them ringing you	4	**1**	**8**	2	5	7	7	5	3	2	4	4	**11**	**2**	4	5	4	5
A text message from them	24	**31**	**16**	19	24	20	22	20	22	19	22	24	18	26	25	23	**29**	**19**
Official council Facebook page	17	**21**	**13**	14	18	21	19	16	17	20	**33**	**16**	15	18	**10**	**25**	**27**	**7**
Their website	4	**6**	**2**	5	4		1	3	4	7		5	1	5	**2**	**7**	5	3
SUNWATER SUB-TOTAL Yes	12	**9**	**16**	7	13	15	**20**	12	13	11	**37**	**10**	**18**	**10**	14	11	15	9
You ringing them	2	1	3		2	9	**4**	1	1		**14**	**1**	2	2	3	1	**4**	*****
Them ringing you	2	1	3	2	2		2	1	2		2	2	3	1	1	3	1	2
A text message from them	6	5	8	5	7	3	9	8	8	6	18	5	12	5	7	6	7	6
Official SunWater Facebook page	1	1	*		1		2		1			1		1	1	*	1	*
Their website	2	*	3		2	3	3	3	2	5	3	2	3	1	2	2	2	1
ABC NEWS SUB-TOTAL Yes	46	44	48	47	46	44	52	48	44	43	59	45	**60**	**42**	44	48	42	51
Local radio	41	38	44	45	40	29	44	42	39	39	53	40	**58**	**36**	41	40	**34**	**48**
Their website	4	6	2		4	5	5	4	3	3	6	4	4	4	3	6	3	5
Official Facebook page	5	**8**	**3**	7	5	14	5	4	4	9	2	6	**1**	**7**	**2**	**9**	**8**	**3**
Other radio station	18	18	18	17	18	7	17	21	19	18	3	19	13	19	19	16	**23**	**12**
Bureau of Meteorology website	73	72	74	**65**	**74**	87	**78**	75	73	82	**88**	**72**	71	74	74	72	**87**	**59**
Landline or mobile phone for receiving a warning	38	**42**	**34**	53	37	42	41	36	36	24	39	38	40	38	35	41	**43**	**33**
Landline or mobile phone as part of a phone tree	15	**7**	**24**	**5**	**16**	**34**	**23**	**20**	14	9	**36**	**13**	**28**	**11**	14	17	**17**	**13**
Newspaper	8	**4**	**13**		9	5	11	9	9	6	12	8	12	7	10	7	8	8
Other social media	13	12	13	9	13	14	14	**18**	**15**	13	6	13	11	13	**8**	**18**	**18**	**8**
Other website	18	20	17	**3**	**20**	**42**	19	**22**	18	16	22	18	23	17	**17**	**20**	**26**	**11**
Other information source	36	37	35	31	36	**66**	37	34	36	37	34	36	40	34	33	39	**25**	**47**

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q18a In the lead-up to the recent flood event which, if any, of the following sources of information did you use? (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
FAMILY, FRIENDS OR NEIGHBOURS SUB-TOTAL Yes	67	71	70	71	72	75	48	67	78	67	66	81	41	53	51	86	67
Face to face	32	5	28	15	29	25	**13**	6	27	25	17	30	11	16	13	43	**39**
Telephone	46	67	52	60	53	44	38	67	57	49	49	46	33	44	39	72	46
Personal Facebook pages of friends, or friends of friends	36	34	18	27	35	37	**6**	36	24	34	19	44	4	5	10	47	**41**
Twitter	1					1						2					1
BANANA SHIRE COUNCIL/LOCAL DISASTER MANAGEMENT GROUP SUB-TOTAL Yes	43	49	51	**50**	35	**36**	**9**	47	60	53	36	**41**	13	12	4	49	**48**
You ringing them	3		6	3	15	**3**			8	20	10					5	3
Them ringing you	4	24	26	**25**		3	1	22	31		8				4	8	3
A text message from them	24	37	21	30	29	**11**	**5**	38	24	48	14	**11**	6	12		18	**29**
Official council Facebook page	17	14	6	11	15	20	**2**	14	8	20	9	30	7			15	**20**
Their website	4		3	1	3	1			4	5						6	**6**
SUNWATER SUB-TOTAL Yes	12	12	11	11	27	15	15	14	15	21	**25**		27	12	7	17	10
You ringing them	2	5		3	6		1	6		10					4	6	2
Them ringing you	2	5		3	8	3		6		5	9					2	1
A text message from them	6	2	11	6	3	6	14	3	15	5	**18**		27	12	4	8	6
Official SunWater Facebook page	1				3					5							1
Their website	2				12	8				5	2						**0**
ABC NEWS SUB-TOTAL Yes	46	40	57	48	55	35	66	39	60	34	49	28	81	47	67	50	45
Local radio	41	38	57	46	55	31	**66**	39	60	34	49	21	81	47	67	37	**38**
Their website	4	2	3	3		1	2		4			2		7		5	**6**
Official Facebook page	5		3	1		3			4			6				8	**8**
Other radio station	18	29	11	21	12	23	15	36	15	21	10	35	6	19	22	14	17
Bureau of Meteorology website	73	85	62	75	69	77	**50**	92	67	63	70	79	42	28	75	**90**	75
Landline or mobile phone for receiving a warning	38	63	55	**60**	17	**20**	32	63	71	28	30	**15**	19	32	43	40	**42**
Landline or mobile phone as part of a phone tree	15	33	33	**33**	23	17	24	31	45	24	25	12	10	19	42	24	**11**
Newspaper	8	35	14	26	15	5	**13**	44	19	11	10	3	19	14	6	12	**5**
Other social media	13	20	17	19	5	14	9	22	23		17	16	11	5	10	14	13
Other website	18	11	6	9	27	22	10	6	8	20	24	23	6	9	15	19	20
Other information source	36	24	59	39	26	33	39	12	55	25	51	24	32	53	33	34	36

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q18b And during the recent flood event which, if any, of the following sources of information did you use?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
FAMILY, FRIENDS OR NEIGHBOURS SUB-TOTAL Yes	71	**76**	**66**	69	71	84	70	68	67	**76**	71	71	65	73	69	73	**78**	**64**
Face to face	37	**45**	**29**	40	37	43	33	32	**33**	39	28	38	**27**	**40**	37	38	41	34
Telephone	50	51	49	57	50	60	51	47	47	45	64	49	52	50	51	49	**57**	**43**
Personal Facebook pages of friends, or friends of friends	28	29	26	32	27	35	27	23	23	35	24	28	22	29	27	29	**43**	**11**
No	29	**24**	**34**	31	29	16	30	32	33	**24**	29	29	35	27	31	27	**22**	**36**
BANANA SHIRE COUNCIL/LOCAL DISASTER MANAGEMENT GROUP SUB-TOTAL Yes	26	28	24	14	27	**47**	27	24	25	26	37	25	21	28	**18**	**35**	**34**	**18**
You ringing them	3	**2**	**4**	5	3	**8**	4	4	3	3	**10**	**2**	5	3	1	5	3	3
Them ringing you	3	2	4	5	3	9	4	2	3		9	2	4	3	3	3	3	2
A text message from them	15	**20**	**9**	11	15	14	14	15	15	15	7	15	9	17	**10**	**20**	**20**	**10**
Official council Facebook page	10	10	9	14	9	17	9	8	**7**	13	14	9	8	10	**5**	**15**	**15**	**5**
Their website	1	1	*	5	1			*	1			1		1		2	1	1
No	74	72	76	86	73	**53**	73	76	75	74	63	75	79	72	**82**	**65**	**66**	**82**
SUNWATER SUB-TOTAL Yes	6	5	6	17	5	13	**9**	4	5		**19**	**5**	8	5	6	6	8	4
You ringing them	*		1		*		1		*		**3**	*	1	*		1	*	*
Them ringing you	1	1	1		1		2	1	1		3	1	3	*	*	2	1	1
A text message from them	4	3	5	17	3	13	5	3	3		13	3	5	4	4	4	5	3
Official SunWater Facebook page	1	1			1		1		1			1		1	1		1	
Their website	*		*		*		*		*			*		*		*		*
No	94	95	94	83	95	87	**91**	96	95	**100**	**81**	**95**	92	95	94	94	92	96
ABC NEWS SUB-TOTAL Yes	40	38	42	39	40	29	39	44	40	35	32	41	**54**	**36**	41	39	38	42
Local radio	37	35	39	39	37	25	35	39	38	31	29	38	**53**	**32**	37	37	34	40
Their website	3	**5**	**1**	5	3	5	4	4	1	4	3	3	2	3	3	3	3	3
Official Facebook page	4	4	3	5	4		1	2	2	4	3	4		5	4	4	**6**	**2**
Twitter	*	1			*		1		1			*		1		1	1	
No	60	62	58	61	60	71	61	56	60	65	68	59	**46**	**64**	59	61	62	58
Other radio station	12	14	10	15	12	11	11	13	12	12	2	13	9	13	15	10	**17**	**7**
Bureau of Meteorology website	46	46	47	47	46	63	51	46	43	52	38	47	46	46	49	43	**59**	**34**
Landline or mobile phone for receiving a warning	22	**29**	**15**	21	22	20	21	19	22	10	14	23	18	24	17	28	20	24
Landline or mobile phone as part of a phone tree	11	**6**	**17**	5	12	20	**17**	13	12	**3**	**27**	**10**	**18**	**10**	11	12	**15**	**7**
Newspaper	1	1	1		1		0	1	1	1		1		1	1	1		1
Other social media	6	**10**	**3**	9	6	9	7	8	**8**	5		7	**3**	**7**	**4**	**9**	**10**	**2**
Other website	5	5	5	5	5	5	5	4	4	1	3	5	4	5	5	5	6	3
Other information source	11	**13**	**9**	19	11	5	**7**	10	**8**	14	3	12	7	12	10	12	**6**	**16**

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q18b And during the recent flood event which, if any, of the following sources of information did you use? (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
FAMILY, FRIENDS OR NEIGHBOURS SUB-TOTAL Yes	71	95	70	84	53	63	**50**	97	78	44	78	60	44	37	67	71	**75**
Face to face	37	27	54	39	23	23	**20**	31	63	30	35	18	4	12	41	38	**44**
Telephone	50	66	44	56	53	41	**42**	66	46	44	53	37	41	25	58	58	52
Personal Facebook pages of friends, or friends of friends	28	69	18	47	12	19	**2**	80	24	11	7	29			7	**40**	**31**
No	29	5	30	16	47	37	**50**	3	22	56	22	40	56	63	33	29	**25**
BANANA SHIRE COUNCIL/LOCAL DISASTER MANAGEMENT GROUP SUB-TOTAL Yes	26	18	17	18	27	29	**10**	19	23	21	21	27		12	18	32	**29**
You ringing them	3		5	2	9	6			7	10	12	3				**6**	3
Them ringing you	3	5	5	5	6	2		6	7		4					9	3
A text message from them	15	13		8	9	**8**	8	14		5	4	2		12	12	11	**19**
Official council Facebook page	10	5	12	8	6	14	2	6	16	5	9	19			7	10	10
Their website	1					2						3					1
No	74	82	83	82	73	71	**90**	81	77	79	79	73	100	88	82	68	**71**
SUNWATER SUB-TOTAL Yes	6	15		9	17	6		14		5	17					7	6
You ringing them	*	5		3	3			6		5							
Them ringing you	1	5		3		2					4					1	1
A text message from them	4	6		4	14	4		8			12					7	4
Official SunWater Facebook page	1																1
Their website	*				3					5							
No	94	85	100	91	83	94	100	86	100	95	83	100	100	100	100	93	94
ABC NEWS SUB-TOTAL Yes	40	64	58	**62**	35	**22**	**65**	61	65	24	28	**15**	71	47	74	36	38
Local radio	37	47	58	**52**	35	**21**	**65**	39	65	24	28	**12**	71	47	74	34	35
Their website	3	2		1												2	**4**
Official Facebook page	4	18		10		2		22				3				3	4
Twitter	*																1
No	60	36	42	**38**	65	**78**	**35**	39	35	76	72	**85**	29	53	26	64	62
Other radio station	12	8	11	10	8	15	7	10	15	5	6	24	10	5	7	8	13
Bureau of Meteorology website	46	82	34	61	29	45	**37**	89	35	29	49	34	33	21	53	51	47
Landline or mobile phone for receiving a warning	22	37	8	25	12	**6**	20	33	11		12	**2**	27	16	17	17	**27**
Landline or mobile phone as part of a phone tree	11	31	17	25	6	**15**	14	38	23	5	**27**	10		7	33	19	9
Newspaper	1					1					4					2	1
Other social media	6					2	1					4		5		7	**9**
Other website	5	5		3		11	3	6			7	15		5	6	2	4
Other information source	11	5	5	5	8	8	7		7	8	17	3	4	9	9	14	13

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

5.0 Text message warnings

To facilitate accurate respondent recall of text messages received, wherever possible, respondents were asked to read out the message(s) directly from their mobile phone to the interviewer.

Prior to checking their mobile phone, 158 respondents stated that they had received a text message from either Banana Shire Council (127 people) and/or SunWater (34 people). Of those, 74 people believed they had the message(s) retained on their mobile phone. These respondents were then asked to read-out the message(s) and the time it was received to the interviewer.

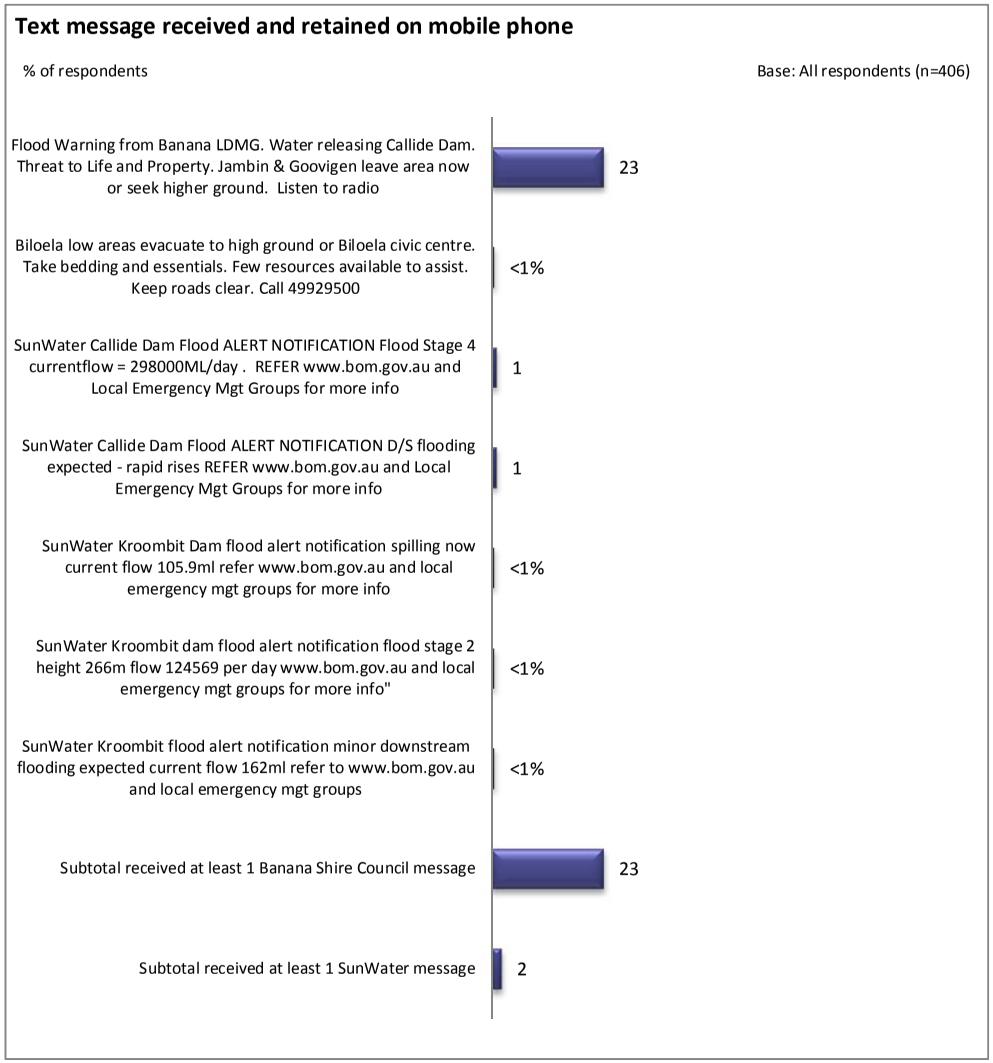
Those who had not retained the message were asked more general questions (see section 5.4).

The survey only measured text messages received from Banana Shire Council or SunWater.

5.1 Warnings received via text message – those with retained message(s) on mobile phone

23% of all survey respondents received (and retained) the text message: 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. Those living in Biloela township (23%) are equally as likely as those living outside this area (23%) to have received this message.

Other messages receive 1% or fewer mentions – see adjacent chart.



Q21c/x Can you read to me the message exactly?

Table: Q21c/x Can you read to me the message exactly?

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
MESSAGE RECEIVED:	*% of respondents*																	
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	23	23	23	27	22	**39**	28	23	21	23	**37**	**22**	21	23	25	21	**31**	**14**
Biloela low areas evacuate to high ground or Biloela civic centre. Take bedding and essentials. Few resources available to assist. Keep roads clear. Call 49929500	*	*			*			*	*			*		*		*		*
SunWater Callide Dam Flood ALERT NOTIFICATION D/S flooding expected - rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	1		2	3	1	9	2	*	1		**11**	*	2	1	2		1	1
SunWater Callide Dam Flood ALERT NOTIFICATION Flood Stage 4 current flow = 298000ML/day. REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	1		3	3	1	9	2	*	1		**11**	*	**3**	1	2	*	1	1
SunWater Kroombit flood alert notification minor downstream flooding expected current flow 162ml refer to www.bom.gov.au and Local Emergency Mgt Groups	*		*		*	**2**	*	*	*			*	1			*		*
SunWater Kroombit flood alert notification minor downstream flooding expected current flow 162ml refer to www.bom.gov.au and Local Emergency Mgt Groups	*		1		*	**2**	1	1	1			*	**2**			1	*	*
SunWater Kroombit dam flood alert notification flood stage 2 height 266m flow 124569 per day www.bom.gov.au and local emergency Local Emergency Mgt Groups	*		1		*	**2**	1	1	1			*	**2**			1	*	*
Received at least 1 Banana Shire Council message	23	23	23	27	22	**39**	28	23	21	23	**37**	**22**	21	23	25	21	**31**	**14**
Received at least 1 SunWater message	2		3	3	1	**11**	3	1	2		**11**	**1**	**4**	1	2	1	2	1

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
MESSAGE RECEIVED:	*% of respondents*																
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	23	31	11	22	30	**16**	14	33	15	25	8	**11**	27		13	**35**	**25**
Biloela low areas evacuate to high ground or Biloela civic centre. Take bedding and essentials. Few resources available to assist. Keep roads clear. Call 49929500	*																*
SunWater Callide Dam Flood ALERT NOTIFICATION D/S flooding expected - rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	1					1					4					**8**	1
SunWater Callide Dam Flood ALERT NOTIFICATION Flood Stage 4 current flow = 298000ML/day. REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	1					1					4					**9**	2
SunWater Kroombit flood alert notification minor downstream flooding expected current flow 162ml refer to www.bom.gov.au and Local Emergency Mgt Groups	*						**1**								4		
SunWater Kroombit flood alert notification minor downstream flooding expected current flow 162ml refer to www.bom.gov.au and Local Emergency Mgt Groups	*					2	1				**4**				4		
SunWater Kroombit dam flood alert notification flood stage 2 height 266m flow 124569 per day www.bom.gov.au and Local Emergency Mgt Groups	*					2	1				**4**				4		
Received at least 1 Banana Shire Council message	23	31	11	22	30	**16**	14	33	15	25	8	**11**	27		13	**35**	**25**
Received at least 1 SunWater message	2					3	1				**8**				4	**9**	2

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

5.2 Date and time message received - those with retained message(s) on mobile phone

5.2.1 MESSAGE: 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

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			
What date and time did it come in? *(Base: those who received and retained message n=71)*	*Fri 20th Feb*	*8.39pm*	*1%*
	Fri 20th Feb	*9.40pm-9.46pm*	*86%*
	Fri 20th Feb	*10pm-10.43pm*	*13%*
Overall, was the warning message easy or hard to understand? *(Base: those who received and retained message n=71)*	*Easy*	*95%*	
	Hard	*5%*	
Did the message refer you somewhere else for more information? *(Base: those who received and retained message n=71)*	*Yes*	*75%*	
	No	*25%*	
Did you go to this source for more information? *(Base: those who believe message did refer elsewhere n=53)*	*YES*	*25%*	
	NO	*75%*	
Was the message about where to go for more information specific enough? *(Base: those who believe message did refer elsewhere n=53)*	*YES*	*55%*	
	NO	*45%*	

5.2.2 Other messages

Given the small cell sizes for each message, the data on this page is presented as a number (n=) rather than a percentage.

	Biloela low areas evacuate to high ground or Biloela civic centre. Take bedding and essentials. Few resources available to assist. Keep roads clear. Call 49929500	SunWater Callide Dam Flood ALERT NOTIFICATION Flood Stage 4 current flow = 298000ML/day. REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	SunWater Callide Dam Flood ALERT NOTIFICATION D/S flooding expected - rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info	SunWater Kroombit Dam flood alert notification spilling now current flow 105.9ml refer www.bom.gov.au and Local Emergency Mgt Groups for more info	SunWater Kroombit dam flood alert notification flood stage 2 height 266m flow 124569 per day www.bom.gov.au and Local Emergency Mgt Groups for more info	SunWater Kroombit flood alert notification minor downstream flooding expected current flow 162ml refer to www.bom.gov.au and Local Emergency Mgt Groups
	n=1	n=4	n=3	n=2	n=2	n=1
What date and time did it come in?	*Fri 20th Feb 9.48pm: n=1*	*Fri 20th Feb 10.37-10.38pm: n=4*	*Fri 20th Feb 8.39-8.40pm: n=3*	*Fri 20th Feb 6.28pm: n=2*	*Fri 20th Feb 7.45pm: n=2*	*Fri 20th Feb 1.42pm: n=1*
Overall, was the warning message easy or hard to understand?	*Easy: n=1*	*Easy: n=2* *Hard: n=2*	*Easy: n=1* *Hard: n=2*	*Easy: n=2*	*Easy: n=2*	*Easy: n=1*
Did the message refer you somewhere else for more information?	*Yes: n=1*	*Yes: n=4*	*Yes: n=3*	*Yes: n=2*	*Yes: n=2*	*Yes: n=1*
Did you go to this source for more information?	*No: n=1*	*Yes: n=1* *No: n=3*	*Yes: n=2* *No: n=1*	*Yes: n=1* *No: n=1*	*Yes: n=1* *No: n=1*	*No: n=1*
Was the message about where to go for more information specific enough?	*Yes: n=1*	*Yes: n=1* *No: n=3*	*Yes: n=1* *No: n=2*	*Yes: n=2*	*Yes: n=2*	*Yes: n=1*

5.3 Reasons why message was hard to understand - those with retained message(s) on mobile phone

Those who rated a message as 'hard' to understand were asked to describe the reason for this. The following are the verbatim comments from respondents. (Each bullet point represents n=1 respondent)

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

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

SunWater Callide Dam Flood ALERT NOTIFICATION D/S flooding expected - rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info

- 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.

SunWater Callide Dam Flood ALERT NOTIFICATION Flood Stage 4 current flow = 298000ML/day. REFER www.bom.gov.au and Local Emergency Mgt Groups for more info

- 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.

SunWater Callide Dam Flood ALERT NOTIFICATION D/S flooding expected - rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info

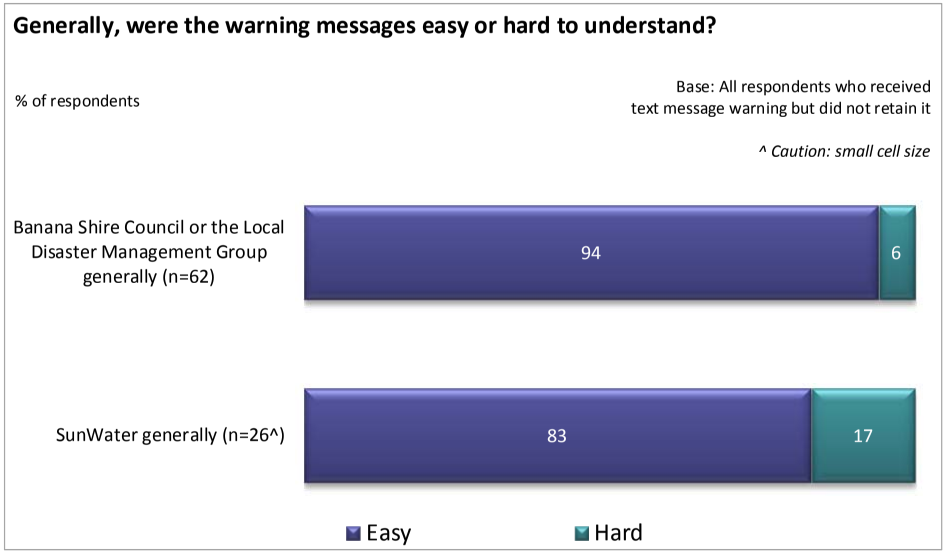
- I tried to get onto the (web)site that they had sent through with the message but could not get on, none of us could get on (to the website) from around here.

5.4 General reactions to text messages – text messages received but not retained on mobile phone

5.4.1 Ease of understanding text messages

94% of those who received (but did not retain) a text message warning from Banana Shire Council or the Local Disaster Management Group rate the message as easy to understand. 83% of those who received a message from SunWater consider the message as being easy to understand.

No significant sub-group differences are noted on this issue.



*Q23a Thinking about the warning message or messages from the **Banana Shire Council or the Local Disaster Management Group**. Generally, were the warning messages easy or hard to understand?*
*Q24a Thinking about the warning message or messages from **SunWater**. Generally, were the warning messages easy or hard to understand?*

*Table: Q23a Thinking about the warning message or messages from the **Banana Shire Council or the Local Disaster Management Group**. Generally, were the warning messages easy or hard to understand?*

Base: Respondents who received text message warning from Banana Shire Council/LDMG but did not retain it	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	62	41	21^	2^	60	4^	24^	27^	44	13^	5^	57	16^	46	23^	39	17^	45
	% of respondents																	
Easy	94	97	87	100	94	100	90	94	95	96	77	95	88	95	98	90	92	96
Hard	6	3	13		6		10	6	5	4	23	5	12	5	2	10	8	4

Base: Respondents who received text message warning from Banana Shire Council/LDMG but did not retain it	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	62	4^	4^	8^	2^	3^	5^	2^	3^	2^	2^	1^	1^	3^	1^	3^	44
	% of respondents																
Easy	94	79	100	90	46	64	100	65	100	46	54	100	100	100	100	100	97
Hard	6	21		10	54	36		35		54	46						3

^ Caution: small cell size.

*Table: Q24a Thinking about the warning message or messages from **SunWater**. Generally, were the warning messages easy or hard to understand?*

Base: Respondents who received text message warning from SunWater but did not retain it	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	26^	14^	12^	3^	23^	1^	13^	14^	18^	2^	2^	24^	6^	20^	5^	21^	7^	19^
	% of respondents																	
Easy	83	86	81	100	80	100	73	74	81	61	100	81	80	84	100	79	73	91
Hard	17	14	19		20		27	26	19	39		19	20	16		21	27	9

Base: Respondents who received text message warning from SunWater but did not retain it	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	26^	1^	1^	2^	3^	2^	1^	1^	1^	2^	2^	1^	4^	18^	1^	1^	2^
	% of respondents																
Easy	83	100	100	100	77	46	100	100	100	65	46	100	86	86	100	100	100
Hard	17				23	54				35	54		14	14			

^ Caution: small cell size.

5.4.2 Reasons messages were hard to understand – text messages received but not retained on mobile phone

Those who rated a message as 'hard' to understand were asked to describe the reason for this. The following are the verbatim comments from respondents. (Each bullet point represents n=1 respondent)

Responses in relation to messages from **Banana Shire Council / LDMG** (each mentioned by one person):

- 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.
- (Message was) incorrect because we were told to evacuate when we did not need to, we were told to go to the Jambin school but the roads were all cut and there was no way you could have done that anyway.
- The text said anyone near the Callide River and the river runs about 500 metres from our place but we're on a hill so it wasn't easy to understand if we would be affected or not.
- Although (we were) in the direct path of the water release (we) didn't know it applied to us as the areas mentioned don't apply to us, so (we) didn't know what it meant for us.

Responses in relation to messages from **SunWater** (each mentioned by one person):

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

*Q23b Why were the messages hard to understand? [**Banana Shire Council or the Local Disaster Management Group**]*
*Q24b Why were the messages hard to understand? [**SunWater**]*

6.0 Perceived effectiveness of communication channels for receiving warnings

Respondents were asked to rate the effectiveness of a range of communication channels in delivering warnings during times of disaster.

Calls to mobile telephone (81%), text messages to mobile telephone (79%) or radio broadcasts (77%) are the methods most likely to be considered effective.

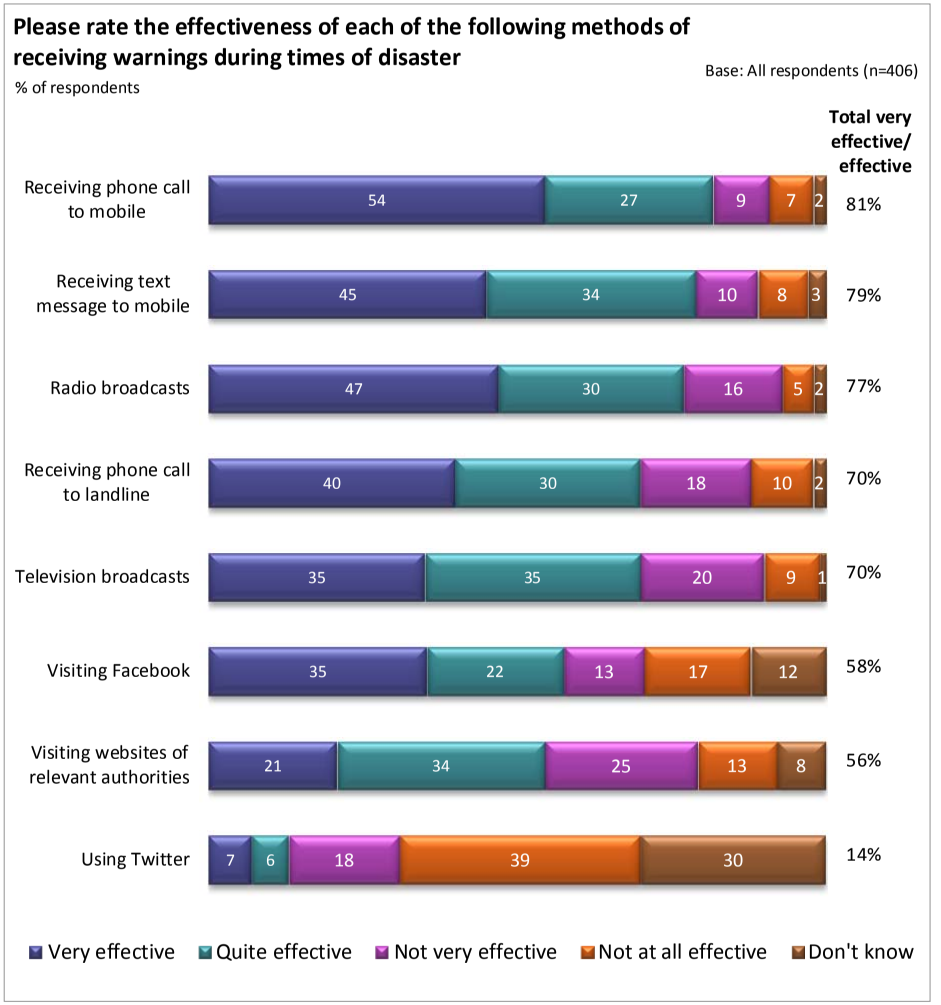
Seven in ten respondents rate a phone call to a landline (70%) or television broadcasts (70%) as effective. 58% consider Facebook to be effective, while 56% rate the websites of relevant authorities as an effective way of delivering warnings during disasters. Twitter is perceived as effective by 14% of respondents.

6.0.1 Sub-group differences

Sub-groups less likely than average (81%) to rate a phone call to a mobile phone as effective are:

- those living outside the Biloela township (77%) – especially those living in the combined areas of Dululu/Wowan/Smoky Creek (53%)
- primary producers (72%)
- those aged 45 years or older (72%).

Those living outside the Biloela township are also less likely than average to rate Facebook (54%, versus 58% average), websites of relevant authorities (53%, versus 55% average) or Twitter (10%, versus 14% average) as effective communication channels for distributing warnings during times of disaster.



Q25 Please rate the effectiveness of each of the following methods of receiving warnings during times of disaster. The first method is a, The next method is a …

Table: Q25 Please rate the effectiveness of each of the following methods of receiving warnings during times of disaster. The first method is a, The next method is a …

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents – SUB-TOTAL very/quite effective																	
Phone call to mobile	81	**85**	**77**	83	81	81	78	80	**80**	80	76	81	**72**	**84**	81	81	**90**	**72**
Text message to mobile	79	81	77	79	79	85	77	79	**77**	79	74	80	73	81	77	82	**91**	**67**
Radio broadcasts	77	77	78	79	77	70	74	76	**81**	62	65	78	82	76	79	75	75	80
Phone call to landline	70	70	70	70	70	67	66	69	72	68	67	70	74	69	73	67	72	68
Television broadcasts	70	69	72	75	70	59	66	67	70	67	61	71	68	71	68	73	67	74
Facebook	58	**62**	**54**	64	57	74	61	57	57	50	73	57	48	61	**52**	**64**	74	41
The websites of relevant authorities	55	**56**	**53**	56	55	49	55	51	54	**41**	51	55	51	56	50	59	**61**	**48**
Twitter	14	**17**	**10**	10	14	11	11	10	12	11	5	14	9	15	16	11	17	11

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents – SUB-TOTAL very/quite effective																
Phone call to mobile	81	86	81	83	89	83	**53**	82	82	92	82	81	48	63	51	80	**84**
Text message to mobile	79	93	69	82	83	85	**53**	94	74	92	81	87	53	44	61	79	81
Radio broadcasts	77	93	92	92	71	**68**	91	91	100	61	69	75	100	82	89	72	76
Phone call to landline	70	77	74	76	73	71	73	78	75	71	74	74	68	70	81	60	69
Television broadcasts	70	67	88	76	72	72	61	69	83	86	64	75	59	72	55	77	71
Facebook	58	74	51	64	49	57	**20**	86	63	49	46	72	21	23	17	69	**63**
The websites of relevant authorities	55	58	34	**47**	44	61	41	58	32	53	49	62	57	37	29	59	**57**
Twitter	14	2	12	7	5	15	**1**	3	17			28	4			12	**16**

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

7.0 Suggestions for improving emergency warnings

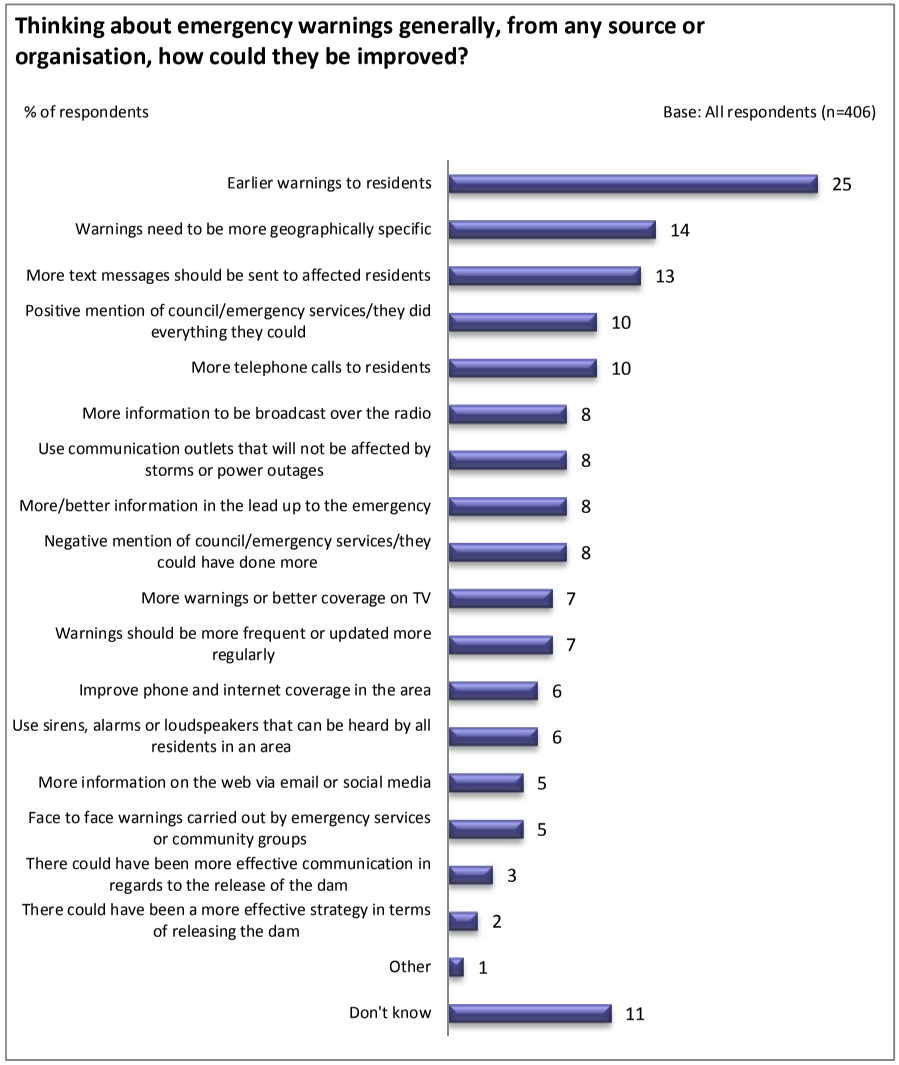
When asked for suggestions about how to improve emergency warnings generally, the most common response given was to provide warnings to residents earlier (from any source or organisation) (25%). After this, residents called for more geographically specific warnings (14%), more text messages (13%) or more telephone calls to residents (10%).

7.0.1 Sub-group differences

Those who evacuated their home in the February 2015 event are more likely than average to suggest the following improvements:

- Warnings should be more geographically specific (22%, versus 14% average)
- More information should be provided in the lead-up to an emergency (15%, versus 8% average)
- More effective communication should be provided in regards to the release of the dam (5%, versus 3% average).

Those who have been emotionally impacted by the February 2015 event (14%) are more likely than average (6%) to suggest improvements in phone and internet coverage be made in the area.



Q26 Thinking about emergency warnings generally, from any source or organisation, how could they be improved? How else? [Unprompted MR]

Table: Q26 Thinking about emergency warnings generally, from any source or organisation, how could they be improved? How else? [Unprompted MR]

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Earlier warnings to residents	25	22	29	41	24	49	31	19	**20**	29	35	24	31	23	**21**	**29**	28	22
Warnings need to be more geographically specific	14	15	13	22	13	16	15	12	14	7	**22**	**13**	12	15	13	14	11	17
More text messages should be sent to affected residents	13	15	11	9	13	14	12	16	13	13	18	13	15	12	13	13	14	11
Positive mention of council/emergency services/they did everything they could	10	8	12	4	11	2	10	11	11	10		11	12	10	13	7	11	9
More telephone calls to residents	10	13	6	11	10	18	7	**13**	12	9	2	10	**13**	**9**	10	10	12	8
More information to be broadcast over the radio	8	10	7	3	9	10	8	5	7	10	3	9	11	8	11	6	10	7
Use communication outlets that will not be affected by storms or power outages	8	12	5	5	8	11	6	9	9	11	2	9	4	9	8	9	11	6
More/better information in the lead up to the emergency	8	7	9		8	9	**12**	9	8	6	**15**	**7**	9	7	6	9	7	9
Negative mention of council/emergency services/they could have done more	8	5	10	12	7	11	10	**6**	6	2	23	6	4	8	10	5	8	7
More warnings or better coverage on TV	7	10	4		8	17	6	5	7	6	3	7	8	7	8	6	10	3
Warnings should be more frequent or updated more regularly	7	7	6	5	7	7	5	8	8	13	8	6	7	6	7	6	6	7
Improve phone and internet coverage in the area	6	4	9		7	**14**	8	**9**	8	5	10	6	13	5	7	5	4	9
Use sirens, alarms or a loudspeakers that can be heard by all residents in an area	6	9	4	5	7	9	**3**	5	6	9	3	7	**2**	**8**	6	7	7	6
More information on the web via email or social media	5	**8**	**3**		6	9	6	**6**	6	4		6	4	6	4	7	7	3
Face to face warnings carried out by emergency services or community groups	5	6	4	5	5	4	2	5	6	6	5	5	2	6	5	5	5	4
There could have been more effective communication in regards to the release of the dam	3	3	4		4	3	3	3	3	3	**5**	**3**	3	3	3	4	3	3
There could have been a more effective strategy in terms of releasing the dam	2	2	2		2	9	3	3	3	1	7	2	3	2	2	2	*	4
Other	1	2	1		1		1	2	2			1	1	1	*	2	1	1
Don't know	11	11	11	9	11	4	10	7	11	9	6	12	9	12	9	13	9	13

* Indicates less than 1% of respondents.
Bold figures are significantly different to the average at at least the 95% confidence level.

Table: Q26 Thinking about emergency warnings generally, from any source or organisation, how could they be improved? How else? [Unprompted MR] (continued)

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Earlier warnings to residents	25	41	18	31	38	18	**9**	42	13	25	13	11		18	9	**51**	27
Warnings need to be more geographically specific	14	9	16	12	26	13	**5**	6	15	29	25	6	6		7	15	15
More text messages should be sent to affected residents	13	9	14	12	31	11	12	9	19	22	14	10	27		7	5	13
Positive mention of council/emergency services/they did everything they could	10		29	13	3	16	13		28	5	2	26	11	12	15	9	9
More telephone calls to residents	10	12	8	10	3	4	12	9	11		6	3	12	9	13	2	11
More information to be broadcast over the radio	8	18	5	12	15	2	13	22		8	7		31	7		1	8
Use communication outlets that will not be affected by storms or power outages	8		6	3		1	8		9		4		6	14	6	8	**11**
More/better information in the lead up to the emergency	8	12	5	9	14	**10**	5	6	7	14	18	8	6	5	4	8	7
Negative mention of council/emergency services/they could have done more	8	20	5	14	5	6	2	25		8	8	6		7		**22**	8
More warnings or better coverage on TV	7	18		10		3		22			4	3				3	**9**
Warnings should be more frequent or updated more regularly	7	7	10	8	3	11	3	9	7	5	4	18	4	5		2	6
Improve phone and internet coverage in the area	6	5	6	5		10	19		8		24	4	16		37	5	4
Use sirens, alarms or a loudspeakers that can be heard by all residents in an area	6				3	6	3			5	7	6		12		5	8
More information on the web via email or social media	5	6	3	5		4	4	3	4		6	3	6		6		6
Face to face warnings carried out by emergency services or community groups	5		6	3		4	3		8		2	6	4	7		5	6
There could have been more effective communication in regards to the release of the dam	3	8		5	10		3	6					4		6	5	4
There could have been a more effective strategy in terms of releasing the dam	2				6		5			5					13	4	2
Other	1					2	1					3		5			1
Don't know	11	24	10	18	15	13	15	30	13	20	14	12	17	14	13	**1**	9

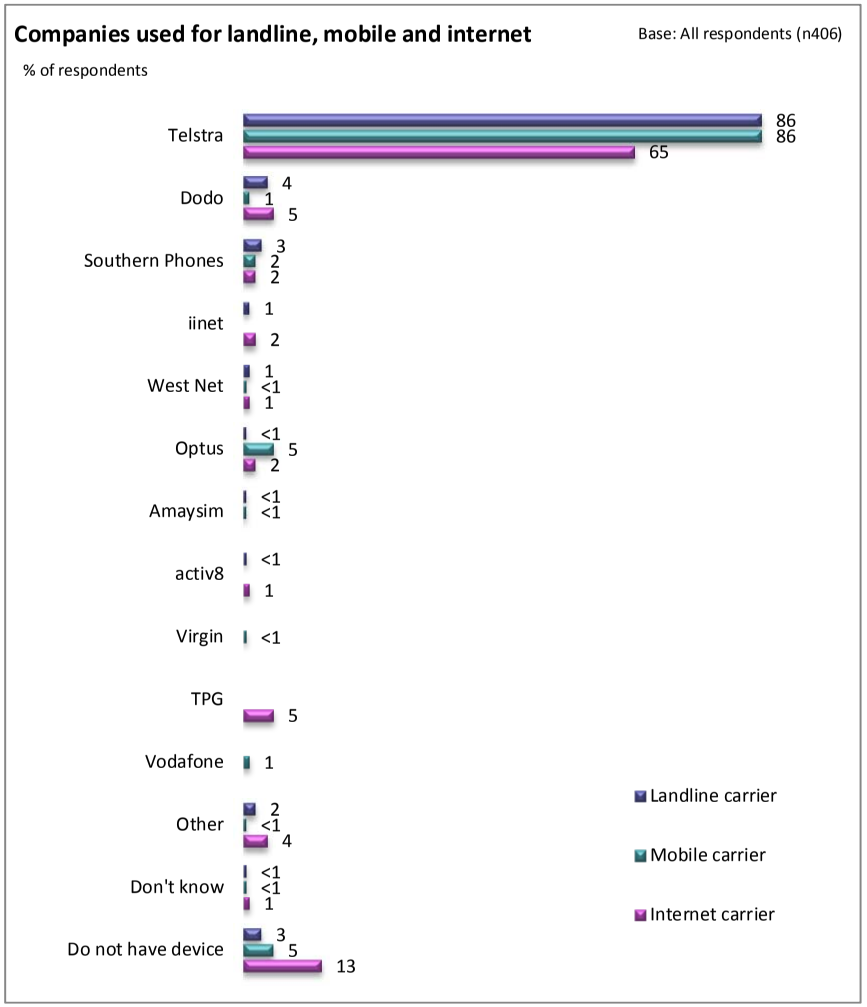
^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

8.0 Companies used for landline, mobile and internet

Telstra is by far the most common brand used for landline telephone (86%), mobile telephone (86%) and internet (65%) by those residing in the survey region. This is particularly the case among those living outside Biloela township for landline service (90% Telstra).

Other brands each receive 5% or fewer mentions.



D2a/b/c Which company do you use for your landline telephone/mobile phone/internet?

*Table: D2a Which company do you use for your **landline telephone**?*

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Telstra	86	**82**	**90**	85	86	84	**91**	85	**82**	88	77	86	**96**	**83**	84	87	83	88
Dodo	4	4	3		4		2	5	4	5	9	3		5	5	2	**6**	**1**
Southern Phones	3	4	1		3		1	3	4	3		3	1	3	4	1	3	2
iinet	1	**3**			1		1	2	2		3	1		2	*	2	2	1
West Net	1	**1**			1	2	1	1	1	1		1		1	*	1		1
Optus	*		*		*			*	*			*		*		*	*	
Amaysim	*	1			*			*	1			*		*	*	*		1
activ8	*		*		*		*		*			*	1			*	*	
Other	2	2	1	**9**	**1**	3	1	1	1			2	1	2	1	2	1	3
Don't know	*	1		**6**								1	1	*	1			1
Do not have device	3	3	3		3	11	3	3	**5**	2	11	2	1	4	3	3	4	2

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Telstra	86	82	95	88	95	95	92	78	100	100	96	93	83	100	94	81	**82**
Dodo	4	18		10		1		22				2				6	4
Southern Phones	3		5	2		2						3				2	3
iinet	1																**2**
West Net	1																1
Optus	*					**2**						**3**					
Amaysim	*																1
activ8	*						**2**						7				
Other	2				5		3						4		6	1	2
Don't know	*																1
Do not have device	3					1	2				4		6			**10**	4

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

*Table: D2b Which company do you use for your **mobile phone**?*

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Telstra	86	80	91	85	86	94	**93**	83	84	85	98	84	92	84	84	87	86	85
Optus	5	7	2		5	3	2	**8**	7			5	2	5	6	4	**8**	**1**
Southern Phones	2	2	1		2		1	3	2	3		2	1	2	3	1	2	2
Vodafone	1	2			1		1	1				1		1		2	**2**	
Dodo	1	2			1			1	1	**5**		1		1	1	1	**2**	
Virgin	*	*			*			*	*			*		*		*		*
West Net	*	*			*		*	*	*			*		*	*			*
Amaysim	*	1			*			*	1			*		*	*	*		1
Other	*	*			*			*	*			*		*		*		*
Don't know	*	*		**3**								*	1		*			*
Do not have device	5	5	5	**12**	**4**	3	**3**	3	5	6	2	5	4	5	5	5		**10**

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Telstra	86	98	79	89	97	**93**	**81**	97	82	95	96	90	71	77	94	96	83
Optus	5	2	3	3		3	5	3	4			6	8		6		6
Southern Phones	2		5	2		2						3				2	2
Vodafone	1																1
Dodo	1																2
Virgin	*																*
West Net	*																*
Amaysim	*																1
Other	*																*
Don't know	*																*
Do not have device	5		13	6	3	2	**14**		13	5	4	2	21	23		2	4

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

*Table: D2c Which company do you use for your **internet**?*

Base: All respondents	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	406	182	224	32	374	35	201	214	275	74	33	373	109	297	155	251	110	296
	% of respondents																	
Telstra	65	64	67	66	65	85	**71**	64	61	77	78	64	73	63	**60**	**71**	**73**	**58**
TPG	5	**9**	**2**		6		6	**2**	6	2	3	6		**7**	**8**	**3**	5	6
Dodo	5	4	6		5		4	8	6	5	9	4		6	6	3	**9**	**1**
Optus	2	**1**	**3**		2	3	2	**4**	3			2	4	2	2	2	2	2
iinet	2	3	*		2		1	2	2		3	2	1	2	1	2	2	1
Southern Phones	2	3	*		2			2	2	3		2		2	3	*	**3**	
West Net	1	2	*		1	2	2	1	1	1		1	1	1	1	1		2
activ8	1		**2**		1	2	2	1	1		3	1	2	1	1	1	1	1
Other	4	3	4	9	3	4	5	5	4	2		4	8	2	2	5	4	3
Don't know	1	1	*	**5**	*		*	*	*			1	2	*	1	1		1
Do not have device	13	11	15	**20**	**12**	6	**8**	11	14	9	5	13	10	14	14	11	**2**	**24**

Base: All respondents	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	406	17^	23^	40	22^	71	50	11^	17^	13^	30	35	16^	18^	16^	41	223
	% of respondents																
Telstra	65	69	49	60	72	72	**46**	70	58	72	77	67	22	42	73	**78**	67
TPG	5					1						2				8	**8**
Dodo	5	18		10		7		22				12				8	5
Optus	2				3	2	**12**					3	21	7	6		**1**
iinet	2	5		3													2
Southern Phones	2					2						3					2
West Net	1						2								6		1
activ8	1		9	**4**		3	2		13		4	2	7				
Other	4	2	5	4		3	13	3			4	2	35		4	1	2
Don't know	1		5	2													1
Do not have device	13	6	31	17	25	12	**25**	5	29	28	15	8	16	51	12	6	**10**

^ Caution: small cell size.

* Indicates less than 1% of respondents.

Bold figures are significantly different to the average at at least the 95% confidence level.

8.1 Connection difficulties

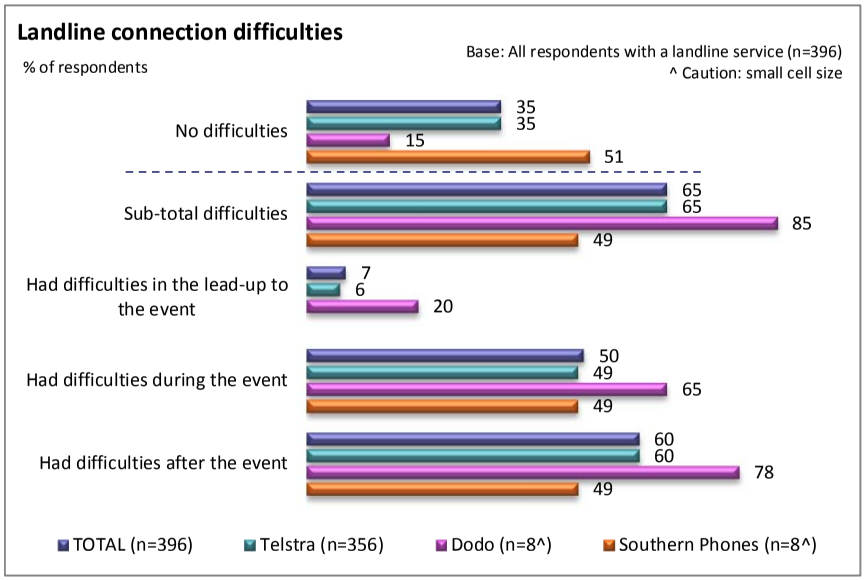
65% of residents experienced connection difficulties with their landline service with most of these difficulties being experienced during the event (50%) or after the event (60%), as opposed to in the lead-up to the event (7%).

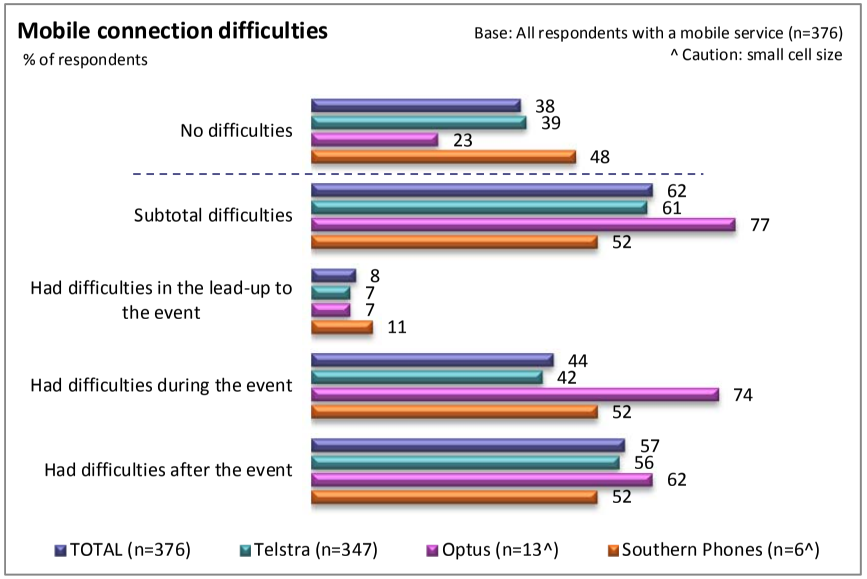
Results are similar when analysing mobile phone connection difficulties – 62% experienced difficulties, again most occurred during the event (44%) or after the flood (57%), rather than in the lead-up to the event (8%).

Cell sizes are too small to declare differences between providers.

8.1.1 Sub-group differences

Reported connection difficulties are more widespread among those living outside the Biloela township (75% landline, 67% mobile difficulties) than those living within the town (56% landline, 57% mobile difficulties).





D2aa/bb In the lead-up to and during the recent flood event did you have any problems getting a connection on your landline telephone/mobile phone?

*Table: D2aa In the lead-up to and during the recent flood event did you have any problems getting a connection on your **landline telephone**...*

Base: All respondents with a landline telephone	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	396	177	219	32	364	33	196	209	265	73	31	365	108	288	151	245	106	290
	% of respondents																	
SUB-TOTAL Yes	65	**56**	**75**	**49**	**67**	77	**76**	**85**	**68**	63	75	65	**85**	**59**	63	68	67	64
In the lead-up to the event	7	6	7	3	7	12	7	8	6	9		7	7	7	6	7	7	6
During the event	50	**42**	**58**	**34**	**51**	60	**57**	**66**	**54**	49	29	51	**68**	**44**	48	51	50	49
After the event	60	**50**	**72**	**47**	**62**	72	**72**	**81**	**64**	58	67	60	**84**	**54**	57	64	63	58
No	35	**44**	**25**	**51**	**33**	23	**24**	**15**	**32**	37	25	35	**15**	**41**	37	32	33	36

Base: All respondents with a landline telephone	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	396	17^	23^	40	22^	70	49	11^	17^	13^	29^	35	15^	18^	16^	38	215
	% of respondents																
SUB-TOTAL Yes	65	78	100	**87**	59	66	**97**	72	100	47	58	**81**	100	88	100	64	**58**
In the lead-up to the event	7	9	6	8	3	6	3	6	8		6	7	10			11	7
During the event	50	65	90	**76**	31	53	**72**	67	91	28	41	**68**	90	60	66	48	**43**
After the event	60	78	100	**87**	53	65	**93**	72	100	47	58	**79**	100	77	100	58	**51**
No	35	22		**13**	41	34	**3**	28		53	42	**19**		12		36	**42**

^ Caution: small cell size.
Bold figures are significantly different to the average at at least the 95% confidence level.

*Table: D2bb In the lead-up to and during the recent flood event did you have any problems getting a connection on your **mobile phone**...*

Base: All respondents with a mobile phone	Total	REGION SUMMARY		EVENT IMPACT							EVACUATED HOME		PRIMARY PRODUCER		GENDER		AGE	
		Biloela township	Rest of region	Not Impacted	Sub-total Impacted	Emotionally impacted	Home-property-agri	Telco outage	Power outage	Isolated/ cut off from town	Yes	No	Yes	No	Male	Female	<45 yrs	45+ yrs
	376	169	207	26^	350	34	192	203	256	67	32	344	104	272	143	233	110	266
	% of respondents																	
SUB-TOTAL Yes	62	**57**	**67**	49	63	66	67	**77**	66	74	68	62	**68**	**61**	63	62	**69**	**55**
In the lead-up to the event	8	6	9	3	8	**16**	9	9	7	10	18	7	11	7	8	7	7	9
During the event	44	43	45	31	45	42	45	**53**	45	55	30	45	**51**	**42**	47	40	48	39
After the event	57	**51**	**63**	49	58	66	62	**71**	**61**	71	57	57	**65**	**55**	56	59	**64**	**49**
No	38	**43**	**33**	51	37	34	33	**23**	34	26	32	38	**32**	**39**	37	38	**31**	**45**

Base: All respondents with a mobile phone	Total	REGION DETAILED															
		Jambin and Argoon	Goovigen, Orange Creek, Greycliffe	Jambin, Argoon, Goovigen, Orange Creek, Greycliffe	Mt Murchison, Dakenba, Callide	Valentine Plains, Prospect, Thangool	Dululu, Wowan and Smoky Creek	Argoon	Goovigen	Mt Murchison	Valentine Plains	Thangool	Dululu	Wowan	Smoky Creek	Biloela non-township	Biloela Total
	376	17^	19^	36	21^	69	41	11^	14^	12^	29^	34	11^	14^	16^	40	209
	% of respondents																
SUB-TOTAL Yes	62	45	69	55	42	**78**	**86**	40	63	60	70	**87**	95	88	77	59	**58**
In the lead-up to the event	8	12	6	10	3	6	7	12			6	7	15		6	17	8
During the event	44	42	64	**51**	17	51	**58**	40	63	23	49	53	74	67	41	**31**	**41**
After the event	57	45	66	53	42	72	**86**	40	58	60	51	**87**	95	88	77	53	**51**
No	38	55	31	45	58	**22**	**14**	60	37	40	30	**13**	5	12	23	41	**42**

^ Caution: small cell size.

Bold figures are significantly different to the average at at least the 95% confidence level.

appendices

appendix a – questionnaire

INTRODUCTION / SCREENERS

Good morning/afternoon/evening. This is <name> calling from Q&A Market Research on behalf of the Office of the Inspector-General Emergency Management. The Inspector-General has asked us to undertake a survey of residents living in the Callide Valley to gather community feedback in relation to disaster management. The survey will take approximately 20 minutes and your answers will remain anonymous. Would you be able to help us out?

If no, ask: Would there be another adult in your household who would be interested in providing feedback?

If agreed to interview:
Thank-you. Throughout the interview I'll be following a standard questionnaire to keep the interview as brief as possible and ensure that questions are consistent from interview to interview. Because I'm following the questionnaire, it may sometimes seem like I'm being too formal or mechanical. Please be assured your opinions are very important to us and I want to be sure I record them accurately.

Firstly I need to ask a few demographic type questions to ensure we're talking with a good cross section of the Callide Valley Community.

AA Just confirming, do you live in or very close to {*computer insert locality*}?

1. Biloela, {interviewer classify as…}
    a. Within the actual township
    b. Or in areas surrounding the town of Biloela
2. Argoon
3. Callide
4. Dakenba
5. Dululu
6. Goovigen
7. Greycliffe
8. Jambin
9. Mt/Mount Murchison
10. Orange Creek
11. Prospect
12. Smoky/Smoky Creek
13. Thangool
14. Valentine Plains
15. Wowan

CC Are you a primary producer? …

1. NO
2. Yes:

If yes *ask* Is that… READ OUT

3. Livestock
4. Cropping such as cotton, grain or hay
5. Horticulture
6. All of the above

DD Record gender

1. Male
2. Female

DD And are you aged 18 years or older?

1. Yes
2. No TERMINATE

EE What is your postcode?

Direct numeric entry: _____

READ OUT:
This survey is about disaster management arrangements. Disaster management arrangements refer to the arrangements for preventing or reducing the impact of, preparing for, responding to and recovering from a disaster.

The first section of this survey asks about your general experience with disaster management arrangements in your area. Later in the survey there will be questions specifically about the most recent flooding event that occurred in February this year.

COMMUNITY ENGAGEMENT

Q1 Firstly, how would you rate your knowledge of the Disaster Management Arrangements in the Banana Shire? Would it be…? (READ OUT) (SR)

1. Extensive
2. Good
3. Limited
4. Or do you have no knowledge at all
5. Don't know (do not read out)

Q2 Who do you believe is responsible for Disaster Management generally in Banana Shire? (UNPROMPTED) (MR)

1. Banana Shire Council
2. The Local Disaster Management Group
3. SunWater
4. Queensland Police Service
5. Queensland Fire and Emergency Services
6. State Emergency Service / SES
7. Individual residents such as family, friends or neighbours
8. Service Clubs
9. Other (please specify) _____
10. Don't know

Q2a Before today had you heard of the Local Disaster Management Group? It may also be known as the Local Emergency Management Group?

1. Yes
2. No

Ask those aware of LDMG code 1 at Q2a

Q2b To the best of your knowledge, what is the Local Disaster or Emergency Management Group responsible for? What do they do? UNRPOMPTED MR

1. DON'T KNOW
2. Plan for emergencies
3. Coordinate and organise emergency services such as police, fire and rescue and ambulance during an emergency
4. Broadcast warnings in the lead-up to and during emergencies
5. Help coordinate and organise recovery or clean-up efforts after an emergency
6. Other (specify) _____

Q2c If you needed to contact your Local Disaster or Emergency Management Group, would you know how to do this?

1. Yes
2. No

Ask all

Q3 In the past few years, had you heard about any community events, public meetings or presentations about Disaster Management arrangements in your local area?

1. Yes
2. No

Ask those aware of community events code 1 at Q3

Q4 Did you attend any of these community events, public meetings or presentations about Disaster Management arrangements?

1. NO
2. YES – if yes *ask:*
   Which organisation or organisations were present at such events? (UNPROMPTED) (MR)
3. Banana Shire Council
4. The Local Disaster Management Group
5. SunWater
6. Queensland Police Service
7. Queensland Fire and Emergency Services
8. State Emergency Service or SES
9. Individual residents such as family, friends or neighbours
10. Service Clubs
11. Other (please specify) _____

There is no Q5, Q6, Q7, Q8

FLOOD RISKS

Ask all

Q9 Have you enquired about the risks of flood to your property from any of the following organisations in the past few years? READ OUT MR

1. Banana Shire Council
2. The Local Disaster Management Group
3. SunWater
4. Queensland Police Service
5. Queensland Fire and Emergency Services
6. State Emergency Service SES
7. Individual residents such as family, friends or neighbours
8. Other (please specify) _____
9. NONE

If enquired to Banana Shire Council or SunWater – LOOP FOR THESE TWO ONLY

Q10 How satisfied were you with the information provided by {Banana Shire Council} {SunWater} at that time?

1. Very satisfied
2. Quite satisfied
3. Not very satisfied
4. Not at all satisfied
5. Don't know (do not read)

Ask all

Q11 How confident are you about your understanding of the flood risk to you and your property? Are you… READ OUT SR

1. Very confident
2. Quite confident
3. Not very confident
4. Not at all confident
5. Don't know (do not read out)

Q12 How confident are you in regards to being prepared for and knowing how to respond to flooding events in the future? Are you… READ OUT SR

1. Very confident
2. Quite confident
3. Not very confident
4. Not at all confident
5. Don't know (do not read out)

Q13 Are you aware of how and where to seek information from river gauges within the Callide Valley?

1. Yes
2. No
3. Not sure

IMPACT OF EVENT

Q14 Thinking specifically now about the **flooding event** in February this year, what impact or impacts, if any, did you personally experience? UNPROMPTED MR

1. NONE
2. Physical injury
3. Emotionally impacted
4. Home was damaged
5. Home was destroyed
6. Other property was damaged
7. Other property was destroyed or lost
8. Crops were damaged
9. Crops were destroyed
10. Livestock were injured
11. Livestock were destroyed or lost
12. Fencing was damaged
13. Fencing was lost
14. Paddock quality was impacted
15. Telecommunications outage (mobiles, landlines, internet)
16. Power outage
17. Any other impact (specify) _____

Q15 Was there a need for you to evacuate your home as a result of the recent flood event?

1. Yes
2. No

There is no Q15a

Ask all

Q16 Do you believe an early release of water from the Callide Dam leading up to the flooding event would have made a difference to you or your property?

1. Yes
2. No
3. Not sure

Ask yes code 1 at Q16

Q16a What difference would this have made?

Ask no code 2 at Q15

Q16b Why would this have made no difference?

UNPROMPTED MR

_____

_____

Ask all

Q17 Had you ever been impacted by flood waters at your current address before the February event?

1. Yes
2. No

Ask those who have been previously impacted by flood waters code 1 at Q17

Q17a What, if anything, has been different in terms of the impact of this flood and previous floods?

1. No difference
2. Difference: _____

INFORMATION & WARNINGS

ASK ALL

Q18a In the lead-up to the recent flood event which, if any, of the following sources of information did you use?

Q18b And during the recent flood event which, if any, of the following sources of information did you use?

READ OUT MR

a) Family friends or neighbours
    1. No
    2. Yes – was that via (MR)
        1. Face to face
        2. Telephone
        3. Personal Facebook pages of friends or friends of friends
        4. Twitter

b) Banana Shire Council/Local Disaster Management Group
    1. No
    2. Yes – was that via (MR)
        1. You ringing them
        2. Them ringing you
        3. A text message from them
        4. Official council Facebook page
        5. Twitter
        6. Their website

c) SunWater
    1. No
    2. Yes – was that via (MR)
        1. You ringing them
        2. Them ringing you
        3. A text message from them
        4. Official SunWater Facebook page
        5. Twitter
        6. Their website

d) ABC News
    1. No
    2. Yes – was that (MR)
        1. Local radio
        2. Their website
        3. Official Facebook page
        4. Twitter

e) Other radio station (specify) _____
f) Bureau of Meteorology website
g) Landline or mobile phone for receiving a warning
h) Landline or mobile phone as part of a phone tree
i) Newspaper (specify) _____
j) Other social media (specify) _____
k) Other website (specify) _____
l) Other information source (specify) _____

TEXT MESSAGE WARNINGS

Ask all

Q19 In the lead-up to or during the recent flooding event, did you receive any WARNINGS via TEXT MESSAGE from either the **Banana Shire Council or the Local Disaster Management Group** or **SunWater**? READ OUT MR

1. Banana Shire Council or the Local Disaster Management Group
2. SunWater
3. None of the above

Ask those who received text warnings – code 1 or 2 at Q19

Q19a I'd now like to ask some specific questions about the text messages you received. Did you save any or all of those messages/are they still on your phone?

1. Yes
2. No SKIP to Q23

READ TO THOSE BEING INTERVIEWED ON LANDLINE

Q20 Do you have your mobile phone close by to refer to?
If no: Are you able to access your mobile phone while we talk? If not, I can hang up and call you back once you have access to your phone.

READ TO THOSE BEING INTERVIEWED ON MOBILE

Q20 I'd like you to refer to the warning text messages on your mobile phone while we talk – do you have another phone number (landline or mobile) that I could call back on so that you can look at your mobile while we talk?

If yes, gather details and phone back, confirm phone number
If no, say
I can hang up and give you some time to write down the text messages and the date and time each came in and then call you back? *If yes gather details and phone back as appropriate*

FOR EACH TEXT MESSAGE – REPEAT Q21 a-h

Q21 Please note it's very important that I accurately record each message and the date and time it came in. Let's go back to the very first warning you received – can you locate that warning?
Interviewer note: if there are multiple messages on the one date, record each separately by time

a) Who was it from?
   1. Banana Shire Council OR the Local Disaster or Emergency Management group
   2. SunWater

b) What date and time did it come in?
   If necessary – this information should appear above or beside the text message
   1. Thursday 19th February, time __:__ am/pm
   2. Friday 20th February , time __:__ am/pm
   3. Saturday 21st February, time __:__ am/pm
   4. Sunday 22nd February , time __:__ am/pm
   5. Other (specify) _____

c) Can you please read to me the message exactly:

   Banana Shire Council or LDMG
   1. 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
   2. OTHER - Record verbatim: _____

   SunWater
   3. SunWater Callide Dam Flood ALERT NOTIFICATION: D/S flooding expected – rapid rises REFER www.bom.gov.au and Local Emergency Mgt Groups for more info
   4. SunWater Callide Dam Flood ALERT NOTIFICATION: Flood Stage 4 current flow = 298000ML/day . REFER www.bom.gov.au and Local Emergency Mgt Groups for more info
   5. OTHER - Record verbatim: _____

d) Overall, was the warning message easy or hard to understand?
   1. Easy
   2. Hard

If hard to understand, ask

e) Why was the message hard to understand?

   Record verbatim: _____

Ask all message recipients

f) Did the message refer you somewhere else for more information?
   1. Yes
   2. No

g) *If yes at (f)* - Did you go to this source for more information?
   1. Yes
   2. No

h) *If yes at (f)* - Was the message about where to go for more information specific enough?
   1. Yes
   2. No

OK, let's go on to the next text message now *Go back to Q21 (a)*
If no more messages skip to Q25
If there were more messages but they were deleted– probe with:

Q22 Were the deleted messages from…
1. Banana Shire Council or the Local Disaster Management Group
2. SunWater
3. None of the above SKIP TO Q25

Ask code 1 at Q19 OR code 1 at Q23X

Q23 Thinking about the warning message or messages from the **Banana Shire Council or the Local Disaster Management Group**

a) Generally, were the warning messages easy or hard to understand?
   1. Easy
   2. Hard

If hard ask

b) Why were the messages hard to understand?

Record verbatim: _____

Ask code 2 at Q19 OR code 2 at Q23X

Q24 Thinking about the warning message or messages from **SunWater**…

a) Generally, were the warning messages easy or hard to understand?
   1. Easy
   2. Hard

If hard ask

b) Why were the messages hard to understand?

Record verbatim: _____

Ask all

Q25 Please rate the effectiveness of each of the following methods of receiving warnings during times of disaster. The first method is a, the next method is a …

ROTATE

a) Phone call to landline
b) Phone call to mobile
c) Text message to mobile
d) The websites of relevant authorities
e) Television broadcasts
f) Radio broadcasts
g) Facebook
h) Twitter

Would you rate this as … READ OUT

1. Very effective
2. Quite effective
3. Not very effective
4. Not at all effective
5. Don't know (do not read out)

Q26 Thinking about emergency warnings generally, from any source or organisation, how could they be improved? How else? UNPROMPTED MR

DEMOGRAPHICS

Ask all

D1 Which of the following do you have (or will have once it is repaired)?

1. Landline
2. Mobile phone
3. Internet connection

Ask those who have relevant service

D2a Which company do you use for your landline telephone?

D2b Which company do you use for your mobile phone?

D2c Which company do you use for your internet?

If use more than one, ask for main brand

1. Telstra
2. Optus
3. TPG
4. iinet
5. Virgin
6. Vodafone
7. Dodo
8. Other (specify)
9. Don't know

D2aa In the lead-up to and during the recent flood event did you have any problems getting a connection on your landline telephone… READ OUT

D2bb In the lead-up to and during the recent flood event did you have any problems getting a connection on your mobile phone… READ OUT

Interviewer note – problems are regarding connection issues not flat batteries or lost phones

1. NO
2. Yes, Was that… *specify MR*
    a. In the lead-up to the event
    b. During the event
    c. After the event

Ask all

D3 To which of the following age categories do you belong? Are you under or over 40 years of age?
READ OUT SR

1. 18 to 24 years
2. 25 to 29 years
3. 30 to 34 years
4. 35 to 39 years

---

5. 40 to 44 years
6. 45 to 49 years
7. 50 to 54 years
8. 55 to 59 years
9. 60 to 64 years
10. 65 years or over

D3a Which of the following categories, best describes your household type? READ OUT SR

1. Lone person household
2. Couple with no children
3. Single or couple with dependent children (mostly aged under 13 years)
4. Single or couple with dependent children (mostly aged over 13 years)
5. Single or couple with adult children (aged over 18 years)
6. Couple whose children have left the family home
7. Group household (non related individuals)
8. Other/specify _____

D4 Do you have any people aged 75 years or older living in your household?

1. Yes
2. No

D5 How long have you lived in the Callide Valley area?

Direct numeric entry _____(years) _____ (months)

D6 Are you an active member of…? READ OUT MR

1. Service club
2. SES
3. Rural fire brigade
4. Church groups
5. Sporting groups

D7 Which of the following describes your work status? READ OUT SR

1. You work full time
2. You work part time
3. You do home duties
4. You are a student
5. You are currently in between jobs
6. You are on a pension/benefit
7. Other /specify

Display if codes 1 or 2 at D7

D8 What is your occupation?

Record verbatim and then code as follows:

1. "On-site" or "hands-on" job without formal qualifications or with a basic licence *(e.g. general labourer, fruit picker, manufacturing or factory workers, truck/fork-lift driver, machine operator).*
2. "On-site" or "hands-on" job, but with a formal qualification (TAFE, completed apprenticeship, certificate etc) *(e.g. qualified trades people such as electricians/plumbers/carpenters/ sign-writers, mechanics etc) as well as some small goods or services industries (e.g. butcher, baker, hairdresser, florist etc). Also includes defence force members (non-officer level).*
3. Office, or non-manual job, not necessarily requiring qualifications *(e.g. hospitality, retail, administration, sales representative, office clerk etc.)*
4. A professional job, requiring a completed formal degree *(e.g. accountant, lawyer, engineer, scientist, architect, marketing/advertising, most managers,/senior managers etc), plus teachers and most health professionals (nurses, physiotherapists, dentists, naturopaths etc)*.
5. Other / type in……

D9 Apart from the recent flood event, have you ever been impact by another disaster?

1. NO
2. Yes,
   if yes ask: What type of disaster have you been impacted by before? MR
3. Storm damage
4. Flood
5. Cyclone
6. Earthquake
7. Fire
8. Drought
9. Health epidemic
10. Failure of essential services such as water or power
11. Other (specify _____)

Thank you for your time today.
Some people may find the topic of this research distressing. If you do feel upset or distressed in any way, you may like to contact Lifeline on: 13 11 14.

Privacy statement
The information you have provided today will be used only by the Office of the Inspector-General Emergency Management for research purposes. Your answers will be combined with those of other participants to provide feedback to the Office on the needs and views of the community. Your name and responses to this survey will always remain anonymous.

appendix b – sample composition

TOTAL RESPONDENTS	n = 406	% = 100
GENDER		
Male	155	38%
Female	251	62%
AGE		
18 to 24 years	6	1%
25 to 29 years	14	3%
30 to 34 years	20	5%
35 to 39 years	30	7%
40 to 44 years	40	10%
45 to 49 years	43	11%
50 to 54 years	49	12%
55 to 59 years	44	11%
60 to 64 years	42	10%
65 years or over	118	29%
Under 40 years	70	17%
40+ years	336	83%
PRIMARY PRODUCER		
No	297	73%
Livestock	102	25%
Cropping such as cotton, grain or hay	45	11%
Horticulture	5	1%
LOCATION		
Biloela township	182	45%
Biloela no-township (i.e. live within Biloela boundary but outside Biloela township)	41	10%
Jambin	6	1%
Argoon	11	3%
Goovigen	17	4%
Orange Creek	5	1%
Greycliffe	1	0%
Mt/Mount Murchison	13	3%
Dakenba	6	1%
Callide	3	1%
Valentine Plains	30	7%
Prospect	6	1%
Thangool	35	9%
Dululu	16	4%
Wowan	18	4%
Smoky/Smoky Creek	16	4%
HOUSEHOLD TYPE		
Lone person household	56	14%
Couple with no children	26	6%
Single or couple with dependent children (mostly aged under 13 years)	91	22%
Single or couple with dependent children (mostly aged over 13 years)	49	12%
Single or couple with adult children (aged over 18 years)	50	12%
Couple whose children have left the family home	126	31%
Group household (non-related individuals)	5	1%
Other	3	1%
RESIDENCY IN CALLIDE VALLEY AREA		
< 5 years	33	8%
5-10 years	49	12%
11-91 years	63	16%
20+ years	261	64%
MEMBERSHIP OF GROUPS		
Service club	45	11%
SES	3	1%
Rural fire brigade	37	9%
Church groups	72	18%
Sporting groups	87	21%
None of the above	212	52%
WORK STATUS		
Full time	188	46%
Part time	57	14%
Home duties	46	11%
Student	2	*
Between jobs	2	*
Pensioner	74	18%
Other	37	9%

Sample composition (cont'd)

TOTAL RESPONDENTS	n = 406	% = 100
IMPACTED BY OTHER DISASTER		
NO	140	34%
Flood	214	53%
Cyclone	68	17%
Failure of essential services such as water or power	59	15%
Storm damage	54	13%
Drought	52	13%
Fire	17	4%
Earthquake	6	1%
Mini tornado	6	1%

appendix c – fieldwork statistics

Field dates:	14/4/2015 - 26/4/2015
Sample disposition:	
Completes	406
Virgin	641
Refusals	234
Language	5
No Answer	104
Appointment	275
Disconnected	21
Fax	9
Quota not available	53
Business number	4
Dead	165
Quota Full	0
Interview length average:	23:18 minutes
Response rate:	63%

appendix d – 'other' responses

Q2 – Who do you believe is responsible for Disaster Management generally in the Banana Shire?	
Weather bureau	1
The army if necessary	1
Everyone is represented within Disaster Management Group/has representatives	1
A lot of it seems to be directed from Brisbane or groups within Brisbane	1
Coordinating team/they have a committee	1
Locals, community officials, people who own businesses and have some sort of status in the town are kept in the know	1
Mt Morgan mines, Telstra and Optus telecommunications	1
Local schools	1
ABC radio	1

Q2b – To the best of your knowledge, what is the Local Disaster or Emergency Management Group responsible for? What do they do?	
Liaising with other communities who want to give to the disaster-affected community	1
Open evacuation centres	1
Check on whether or not it is safe for people to build their houses in certain areas	1
Coordinate with SunWater to find out what they are doing with the flood gates	1
Review their performance in previous emergencies	1
Help prevent damage	1
Apply for grants after disasters	1

Q4a – Did you attend any of these community events, public events or presentations about Disaster Management arrangements? If yes, which organisations were present at such events?	
Community health organisations	1
Local business people	1
Authority figures within the community/EBAI/group within Biloela	1
School	1
Cannot remember	1
Local Area Coordinator	1

Q9 – Have you enquired about the risks of flood to your property from any of the following organisations in the past few years?	
Have looked at topographical maps	1
Local map	1
Community recovery group	1

D2a – Which company do you use for your landline telephone?	
Club Telco	1
Total Telecom	1
AAPT	1
Telecom	1
Liacom/backpackers mobile service	1
Foxtel	1
Teleos	1
Spriall	1
Telus	1

D2b – Which company do you use for your mobile phone?	
Liacom/backpackers mobile service	1

'Other' responses (cont'd)

D2c – Which company do you use for your internet?	
Club Telco	2
Netspace	1
CQNET	1
Satelite through clearworks	1
AAPT	1
Harvoursat	1
Skymesh	1
ANT	1
Reachnet	1
Ipstar	2
AA Net	1
Foxtel	1
Bordernet	1

D3a – Which of the following categories best describes your household type?	
My brother and myself	1
Refused/85 year old female	1
3 adult siblings/all single	1

D9 – Apart from the recent flood event, have you ever been impacted by another disaster?	
Mouse plague in the township	1
Blizzards	1
Possibly a car accident	1

Q16a – What difference would this [early water release] have made?	
I don't believe they should have released the water early as if the cyclone had turned around they would have been left with an empty dam	1
Only half the people received texts	1

Q16b – Why would this [early water release] have made no difference?	
Should have released the dam water earlier	1
They should not have released the dam	1
If they had done a little bit more homework they could have evacuated people during the day instead of night time/the risk that people were exposed to could have been reduced	1
I believe the Callide Dam saved everything downstream from a worse disaster	1
Some trees were washed away	1
Releasing Dam caused floodwaters to peak	1
They should have released the Dam sooner	1

Q26 – Thinking about emergency warnings generally, from any source or organisation, how could they be improved?	
A reply function to say you have received or noticed the message	1
Stop building houses in flood prone areas	1
Maybe letters	1
Be prepared. Get extra food and buy basics	1
We need to do our part as well	1

appendix e – sampling error chart

All sample surveys and polls, whether or not they use probability sampling, are subject to multiple sources of error which are most often not possible to quantify or estimate, including sampling error, coverage error, error associated with non-response, error associated with question wording and response options and post survey weighting and adjustments. Therefore MCR avoids the words "margin of error" as they are not able to be verified. All that can be calculated are different possible sampling errors with different probabilities of pure, unweighted, random samples with 100% response rates. These are only theoretical because no published surveys come close to this ideal. Respondents for this survey were randomly selected (using probability sampling) from the available telephone number database. Because the sample is based on those who agreed to be invited to participate in the online panel, accurate estimates of theoretical sampling cannot be definitively calculated. At the absolute minimum, sampling error based on various cell sizes for this survey could fall within the following ranges.

(at the 95% confidence level)

Sample size	10%/90%	20%/80%	30%/70%	40%/60%	50%/50%
5	±27.0	±36.0	±41.0	±44.0	±45.0
10	±19.0	±25.0	±29.0	±31.0	±32.0
15	±15.0	±21.0	±24.0	±25.0	±26.0
20	±13.0	±18.0	±20.0	±22.0	±22.0
25	±12.0	±16.0	±18.0	±19.5	±20.0
30	±11.0	±15.0	±16.7	±17.9	±18.0
35	±10.0	13.5	±15.5	±16.6	±16.9
40	±9.0	±12.6	±14.5	±15.5	±15.8
50	±8.0	±11.3	±13.0	±13.9	±14.1
60	±7.7	±10.3	±11.8	±12.6	±12.9
70	±7.2	±9.6	±11.0	±11.7	±12.0
80	±6.7	±8.9	±10.2	±11.0	±11.1
90	±6.3	±8.4	±9.7	±10.3	±10.5
100	±6.0	±8.0	±9.2	±9.8	±10.0
150	±4.8	±6.5	±7.5	±8.0	±8.2
160	±4.7	±6.3	±7.2	±7.7	±7.9
170	±4.6	±6.1	±7.0	±7.5	±7.7
200	±4.2	±5.6	±6.5	±6.9	±7.0
220	±4.0	±5.4	±6.2	±6.6	±6.7
240	±3.9	±5.2	±5.7	±6.3	±6.5
250	±3.8	±5.1	±5.8	±6.2	±6.3
260	±3.7	±5.0	±5.7	±6.1	±6.2
280	±3.6	±4.8	±5.5	±5.9	±6.0
300	±3.5	±4.6	±5.3	±5.7	±5.8
320	±3.4	±4.5	±5.1	±5.5	±5.6
340	±3.3	±4.3	±5.0	±5.3	±5.4
350	±3.2	±4.3	±4.9	±5.2	±5.3
360	±3.2	±4.2	±4.8	±5.2	±5.3
380	±3.1	±4.1	±4.7	±5.0	±5.1
400	±3.0	±4.0	±4.6	±4.9	±5.0
420	±2.9	±3.9	±4.5	±4.8	±4.9
440	±2.9	±3.8	±4.4	±4.7	±4.8
450	±2.8	±3.8	±4.3	±4.6	±4.7
460	±2.8	±3.7	±4.3	±4.6	±4.7
480	±2.7	±3.7	±4.2	±4.5	±4.6
500	±2.7	±3.6	±4.1	±4.4	±4.5
550	±2.6	±3.4	±3.9	±4.1	±4.3
600	±2.4	±3.3	±3.7	±4.0	±4.1
650	±2.4	±3.1	±3.6	±3.8	±3.9
700	±2.3	±3.0	±3.5	±3.7	±3.8
750	±2.2	±2.9	±3.3	±3.6	±3.7
800	±2.1	±2.8	±3.2	±3.5	±3.5
850	±2.1	±2.7	±3.1	±3.4	±3.4
900	±2.0	±2.4	±3.1	±3.3	±3.3
950	±1.9	±2.6	±3.0	±3.2	±3.2
1000	±1.9	±2.5	±2.9	±3.1	±3.2

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Appendix B

Community questions and concerns

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Community questions and concerns

The Office of the Inspector-General Emergency Management (IGEM) has compiled a list of representative questions and concerns asked by the community about flooding in the Callide Valley. Simple answers are provided here with a reference to where you can find more information in the main report. Similar questions and concerns have been grouped.

Operation of dams: Callide, Kroombit and Awoonga

1. Could the [Callide Dam] gates have been opened beforehand?[1]

It is possible for the gates to have been opened beforehand, but it was not a decision SunWater could make. Generally, it is a decision for the relevant Minister/s. The decision-maker must consider the sustainable management of the wider Fitzroy Basin in accordance with legislation and the Fitzroy Basin Resource Operations Plan. Any changes to this would require extensive consultation with stakeholders with an interest in the dam's water, including the community that uses it, or that may be impacted by its release. For further detail, see the report section 'Can the Callide Dam be operated differently?'

Other community concerns addressed above:

- *The weir behind Callide Creek was brimming. If we knew significant rain was coming, why was water from the weir not let go early to take the spike off flooding?*[2]
- *Why couldn't they [SunWater] release water from the Callide Dam a few days beforehand?*[3]
- *If the [Callide Dam] gates had opened at 8.00am on Friday, everything would have been fine.*[4]
- *In this day and age engineers should be able to do the math on maximum safe levels for the public 72 hours out. If the [Callide Dam] release only caused a 50mm/100mm difference in flooding, did it really make a difference?*[5]
- *If the water was released from the Callide Dam sooner, it wouldn't have backed up other waterways.*[6]
- *Were there no releases [from Callide Dam] because SunWater didn't want landholders outside the 'benefit area' to get the water?*[7]
- *Why couldn't they release water [from the Callide Dam] knowing the cyclone was coming?*[8]

2. Would it hurt to change Callide Dam to a flood mitigation dam?[9]

It is possible for the Callide Dam to have increased flood mitigation potential and there are a number of ways this can occur. Many of the options for making the Callide Dam a flood mitigation dam are expensive and would require thorough enquiries into the potential benefits and risks. For further detail, see the report section 'Can the Callide Dam be operated differently?'.

3. The Callide Dam level should be fixed at 75% during December to March to assist Jambin residents.[10]

Fixed or variable airspace management is a flood mitigation strategy that involves reducing a dam to a pre-determined level for the duration of the rainy season, or in anticipation of a rain event. This can have impacts on water security, and like any other change to the operation of the dam, the benefits and risks to all stakeholders must be considered thoroughly. For further detail, see the report section 'Can the Callide Dam be operated differently?'.

4. Can the IGEM find out how many times SunWater has opened the Callide Dam manually?[11]

SunWater advised us that the gates have been operated manually as follows:

- for discharge events in January 2013 and February 2013
- for discharge during the tail end of the February 2015 event (gate closing)
- for functional testing without discharge of water (preventative maintenance program), which occurs for each month where the water level is below the spillway crest level.

5. When did the Callide Dam gates close and how much water flowed into the Callide Creek?[12]

The Callide Dam gates closed at about 2.00pm on Sunday 22 February 2015. The total inflow to the Callide Dam was about 98,500ML and the total outflow into the Callide Creek downstream was about 84,000ML. More information is available in the Hydrologist Report.

6. Concern that impact to Kroombit Tourist Park must be [Kroombit] dam related.[13]

Kroombit Tourist Park is upstream from the Kroombit Dam and could not have been impacted by the dam. Kroombit Dam does not have gates and the storage level was at 99% prior to the event.

7. Why did the Callide Dam not release water like the Gladstone Area Water Board did from Awoonga Dam on the Tuesday beforehand as a safety measure?[14]

Awoonga Dam is an ungated dam and so releases are uncontrolled. As to the reason the Callide Dam did not release water on the Tuesday beforehand, see question one.

8. Has a risk assessment been done if the Callide Dam gates do not open?[15]

Yes, there are a number of fail-safes if there are problems with the gates. For further detail, see the Planning section of the report for information about SunWater's approach to Hazard Identification and Risk Management.

9. Why can't they have email or electronic control of the Callide Dam gates like farmers have with remote irrigation control?[16]

Electronic and remote control of the gates is possible, along with electronic surveillance of the gates. The dam safety regulator cautions though, that remote operations and/or unmanned electronic controls have not always operated as desired (e.g. inadequacy of automatic gate opening systems contributed to the failure of Oaky Creek Dam in northern New South Wales).[17]

10. Heard Callide Dam gates were overflowing and that is why they couldn't open them.[18]

The gates at the Callide Dam did not overflow. Manual gate operation was not possible as the cyclone made it too dangerous for SunWater staff to go out on to the dam wall to control and monitor the gates.

11. The opening of the Callide Dam was too fast.[19]

The dam gates work when water flows into a chamber with a float and the gates rise as the dam level rises. That means the speed of the gate opening is directly related to the speed of the flood. This cannot be controlled unless the gates are manually operated. The safety of the dam is protected by the speed of the gate opening to allow the flood through. If the gates opened more slowly, the dam may have filled to a level that was not safe or may even have 'over-topped', creating an even greater impact from flooding downstream. It is noted however, that the dam did provide flood attenuation benefits. The maximum flow into the dam from the flood was approximately 5,900m^3 per second, while the maximum flow discharged from the dam was approximately 3,500m^3 per second. For further discussion on the opening of the gates during the February 2015 event, please refer to section 6.2.4 of the hydrologist report.

12. Can't the Local Disaster Management Group (LDMG) order SunWater to open the gates and start releasing water?[20]

No. The LDMG cannot make decisions about the operation of the dam, including releasing water. Refer to question one as to why water was not released from the Callide Dam before the flood event.

Warnings

13. Why are warnings over the computer? Is there a better and more effective system for warnings? Concerns were raised at the general referral for warnings to the Bureau of Meterology (BoM) website.[21]

There is no single method for warning that will reach all of the community. In this event, multiple methods were used. Warnings were issued by the Banana Shire Council (the Council), SunWater and the BoM. The BoM told us that:

> *'... the Bureau will continue to seek feedback regarding community needs in distribution mechanisms for warnings. The Bureau is always working towards providing improved situational awareness to the community'.*[22]

A detailed discussion of warnings and the issues encountered with consistency, coverage, timeliness and message content is included in the Warnings section of our report.

Evacuations

14. In 2013 there was clear communication to evacuate, including notification to people living in low lying areas of Biloela. This time there was nothing and reference only to those in Jambin and Goovigen.[23]

There were several issues with the Emergency Alert message sent by the LDMG. For further detail, see the Warnings section of the report.

15. Why weren't evacuation plans activated earlier for low lying areas, particularly, during daylight hours?[24]

The Council's evacuation plans require planning and preparation for evacuation to occur, on average, seven hours before evacuation is required. The Council told us they did not foresee the need for evacuation during the day. The issues with Council's ability to predict the impact of flood is discussed in the Operational Information and Intelligence section of the report, both for the Council and the BoM.

The facilities the Council has for sheltering are basic and may not be appropriate for shelter during a cyclone. Around 6.20pm, the Council issued a media release encouraging people to seek shelter with friends and family first. For more detail, please refer to the report's Evacuation section.

Other community concerns that the above answer should cover include:

- *Why wasn't the emergency evacuation centre set up at the civic centre earlier on Friday, rather than being left until the last minute?[25]*
- *There was flash flooding. People should be evacuated in daylight.[26]*

River and rainfall gauges

16. Why was the automatic stream gauge on Bell Creek near Craigland not indicating changes in stream height on the BoM?[27]

The Department of Natural Resources and Mines (DNRM) owns the Bell Creek near Craiglands gauge and the data is shared via the BoM website. Since the Bell Creek at Craiglands gauge is outside mobile telephone network coverage, a satellite modem and antenna transmits the data. The DNRM told us that there were problems with satellite data transmission from this gauge for about seven hours from 5.00pm to midnight Friday 20 February 2015.[28] Dense cloud and high rainfall, such as during a cyclone, can affect satellite transmissions. The gauge was fully operational and data was retrieved from the field data logger after the cyclone.

17. How many rainfall gauges and flood level gauges are in the Callide, Kroombit, Rainbow and Kariboe creeks?[29]

On the following page is a table of gauges in the Callide, Kroombit, Rainbow and Kariboe creeks. This information is available on the BoM website.

For a discussion on gauges, please see the Hydrologist Report and the section on Operational Information and Intelligence in the report.

Ref #	Gauge location	Gauge type
130319A	Bell Creek at Craiglands	Rain
1303P006	Blue Hills Standalone Pluvio	Rain
1361P002	Boolaroo Tops Standalone Pluvio	Rain
539071	Callide Ck TM	Rain
130327A	Callide Creek at Goovigen	Rain
539111	Callide Dam Inflow TM	Rain
539107	Craiglands TM	Rain
539068	Goovigen TM	Rain
130336A	Grevillea Creek at Folding Hill	Rain
1303P003	Kroombit Tops Standalone Pluvio	Rain
130348A	Prospect Creek at Red Hills	Rain
539100	Red Hill TM	Rain
130334A	South Kariboe Creek at Pump Station	Rain
539106	South Kariboe Creek TM	Rain
130315C	Callide Creek at Stepanoff	River Height
130319A	Bell Creek at Craiglands	River Height
130327A	Callide Creek at Goovigen	River Height
130334A	South Kariboe Creek at Pump Station	River Height
130336A	Grevillea Creek at Folding Hills	River Height
130347A	Callide Creek at 96km	River Height
130348A	Prospect Creek at Red Hill	River Height
130349	Don R at Kingsborough	River Height
130355	Dee R at Kenbula	River Height
130335	Dee R at Wura	River Height
130362	Dawson R at Knebworth	River Height
130306	Don R at Rannes	River Height
130378	Dee R at Dululu	River Height
130360	Kroombit Ch at Kroombit Dam HW	River Height

Flood risk management

18. The review needs strong input from those affected by the Kroombit.[30]

Local governments are primarily responsible for flood risk management and there are a number of mitigation options for the future. For further detail, see the report section on Floodplain Management and Planning: Banana Shire Council.

Our review has sought community input through:

- visiting the homes and businesses of affected residents from Kroombit, Biloela, Jambin, Mount Murchison, Argoon, Smokey Creek, Dakenba, Goovigen, Valentines Plains and Dululu
- a community meeting with approximately 200-250 Callide Valley residents
- a telephone survey of 406 residents from across the Callide Valley
- inviting submissions to the review.

Other community concerns addressed above:

- *What is going to be done about the Kroombit Dam? There are many homes that have been affected in the pathway of the Kroombit.*[31]

19. Circumstances around the dams have changed. There are now a number of homes built around and in the water pathway of dams. Operational procedures need to change to reflect this changed circumstance.[32]

Please see the answer to question one and the report sections on Floodplain Management, and Planning: Banana Shire Council.

20. We wouldn't have built if we knew it was a floodplain.[33]

For detailed discussion on floodplain management, see the report section on Floodplain Management. For specific information about the Council, please see Planning: Banana Shire Council.

21. What is a 1 in 10,000 year flood?[34]

A 1 in 10,000 year event refers to the magnitude of flood that has a certain chance of occurring each year. This does not mean it will only occur once every 10,000 years. The estimates of flood probability are based on historic records for the area and so they can change over time as there is more data to make the calculations. Discussion of the rainfall magnitude for this event is included in section 4.4 of the hydrologist report.

22. Can the power be channelled underground to prevent power loss?[35]

The issue of power is outside the scope of this review

Endnotes Appendix C

1. Community meeting with the Inspector-General Emergency Management, March 2015.
2. Community meeting with the Inspector-General Emergency Management, March 2015.
3. Community meeting with the Inspector-General Emergency Management, March 2015.
4. Interview with resident, March 2015.
5. Community meeting with the Inspector-General Emergency Management, March 2015.
6. Interview with resident, March 2015.
7. Interview with resident, March 2015.
8. Interview with resident, March 2015.
9. Interview with resident, March 2015
10. Interview with resident, March 2015.
11. Community meeting with the Inspector-General Emergency Management, March 2015.
12. Community meeting with the Inspector-General Emergency Management, March 2015.
13. Community meeting with the Inspector-General Emergency Management, March 2015.
14. Community meeting with the Inspector-General Emergency Management, March 2015.
15. Interview with resident, March 2015.
16. Interview with resident, March 2015.
17. Department of Energy and Water Supply letter to the Office of the Inspector-General Emergency Management, 13 May 2015.
18. Interview with resident, March 2015.
19. Interview with resident, March 2015.
20. Interview with resident, March 2015.
21. Community meeting with the Inspector-General Emergency Management, March 2015.
22. Bureau of Meteorology letter to the Office of the Inspector-General Emergency Management, 13 May 2015, p. 5.
23. Community meeting with the Inspector-General Emergency Management, March 2015.
24. Local newspaper enquiry to Banana Shire Council. Details provided to Inspector-General Emergency Management by the Banana Shire Council.
25. Local newspaper enquiry to Banana Shire Council. Details provided to the Office of the Inspector-General Emergency Management by the Banana Shire Council.
26. Community meeting with the Inspector-General Emergency Management, March 2015.
27. Resident's Submission to the Office of the Inspector-General Emergency Management, March 2015.
28. Department of Natural Resources and Mines email to the Office of the Inspector-General Emergency Management,19 May 2015.
29. Community meeting with the Inspector-General Emergency Management, March 2015.
30. Community meeting with the Inspector-General Emergency Management, March 2015.
31. Community meeting with the Inspector-General Emergency Management, March 2015.
32. Community meeting with the Inspector-General Emergency Management, March 2015.
33. Interview with resident, March 2015.
34. Interview with resident, March 2015.
35. Interview with resident, March 2015.

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Appendix C

SunWater responses

A copy of the 2015 Callide Creek Flood Review Report (draft) was provided to SunWater with a request for their response.

Responsibility for the accuracy, fairness and balance of the following responses from SunWater, rests with the head of SunWater.

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Contact: [redacted]
Direct Line: [redacted]
Our ref: 15-000984/001 - #1723209
Your ref: CON/47995

SunWater Limited
Level 10, 179 Turbot Street
PO Box 15536 City East
Brisbane Queensland 4002
www.sunwater.com.au
ACN 131 034 985

21 May 2015

Office of the Inspector-General Emergency Management
GPO Box 1425, Mail Cluster 15.7
Brisbane QLD 4001

BY EMAIL: [redacted]

Dear Mr MacKenzie

2015 Callide Creek Flood Review
Response to Sections of the Draft Review Report as provided to SunWater 18 May 2015

I refer to your letter of 18 May 2015,that included sections of the revised draft review report as provided to SunWater (Sections 1 to 9). Thank you for the opportunity to review this and provide responses.

The attached table details SunWater's response to the Draft Review Report (Parts 1 to 9) as received from the Inspector General Emergency Management on 18 May 2015. The response is set out in tabular format to allow your consideration SunWater's comments and suggestions in relation to specific paragraphs, sentences or phrases within the draft Report. The table also includes references to detailed commentary in previous SunWater submissions that relate to each of these comments and suggestions.

Please contact SunWater's project manager for the Callide Review, [redacted] on (07) [redacted] via email [redacted] if SunWater can be of any assistance or offer any further explanation in relation to these matters.

Yours sincerely

Tom Vanderbyl
General Manager
Bulk Water and Irrigation Systems

Att(s)

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
EAP Compliance	Part 1 – Overview, pages 7, 1st paragraph	"SunWater's understanding of EAP compliance requirements is divergent to those of the dam safety regulator that supports the notion of flexibility to deal with emergent conditions."	SunWater disagrees with the statement that there are no current requirements for dam owners to explicitly comply with an EAP during an event. SunWater also is concerned that the draft Review Report does not set out the foundation for SunWater's understanding of its legal obligations to comply with the EAP within the relevant sections of Parts 1 and 6. SunWater has no doubt that under s356A of the Water Supply (Safety and Reliability) Act 2008, it must comply with a safety condition applied to a referable dam which, in the case of Callide, includes condition DS13 which requires that in all emergencies the dam be operated in accordance with the EAP for the dam. There is no broad discretion to deviate from the EAP. The Draft Review Report itself affirms this fact in the Disaster Management Response section (Part 7), page 32, stating: "The *Water Supply (Safety and Reliability) Act 2008* states that dam owners 'must not contravene' a dam safety condition. Of relevance, dam safety condition 13 for the Callide Dam outlines 'In all emergencies, the dam owner must respond in accordance with the Emergency Action Plan'". Refer to SunWater's second submission, dated 13 May 2015, Section C3 for more detailed commentary in relation to this issue.	1. SunWater requests that Part 1 (page 7) and Part 6 (page 21) of the draft Review Report include the following statement that provides the reader with contextual information about the foundation of SunWater's understanding about its legal obligation to follow the EAP: ***Under s356A of the Water Supply (Safety and Reliability) Act 2008, a dam owner must comply with a safety condition applied to a referable dam which, in the case of Callide, includes condition DS13 which requires that in all emergencies the dam be operated in accordance with the EAP for the dam.***
	Part 1 – Overview, page 10, Finding No. 7	"SunWater's understanding of Emergency Action Plan compliance requirements is divergent to that of the dam safety regulator, which supports the notion of flexibility to deal with emergent conditions"		
	Part 6 – Disaster Mgt Plan'g & Preparedness, page 21, Finding No. 6 and 7	"Believing there to be no legal option, SunWater rigidly followed the Emergency Action Plan, despite having information regarding emerging risks to downstream residents."		
	Part 7 – Disaster Mgt Response, Page 33 *and* Part 6 – Disaster Mgt Plan'g & Preparedness, page 12	"DEWS told us that: '*…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.*'"		

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
Role of SunWater in Emergency Management	Part 1 – Overview, page 7, Disaster Mgt Arrangements	"Again, SunWater told the Council, but we could not identify where the public were informed."	This wording infers that SunWater was responsible for issuing general warnings about the flood event to the community throughout the valley. It is unreasonable to imply that it is part of SunWater's role to check whether the information that it provided to the Council was forwarded on through the Council's subsequent communications to the broader community. Refer to SunWater's second submission dated 13 May 2015, Section C1; and also further comment below.	2. SunWater requests that the wording in Part 1 page 7 be amended to clarify this point as follows: "**Again, SunWater told the Council, but we could not identify where this information was subsequently passed on to the broader community**."
Role of SunWater in Emergency Management	Page 13, Recommendation 4 and Part 7 – Disaster Mgt Response, page 36 and 37, Message Content	"SunWater provide downstream residents with easily understood information regarding operation of the dam, and the impacts to them that various outflows may have. This information should be complementary to any information from Banana Shire Council." and "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."	Caution should be taken as to the extent that it may be considered that any SunWater communication and messaging is able to advise "the recipient what to do". SunWater cannot advise on specific impacts to downstream residents, particularly considering the potential impact of other catchment flows (outside of the dam catchment). The Queensland Floods Commission of Inquiry made clear that it is not the dam operator's responsibility to predict river heights or inundation areas, and downstream residents have a responsibility to apprise themselves of how outflows from a dam will affect their property. Notifications to immediate downstream residents are limited to the timing and outflow from the dam. Refer to SunWater's second submission dated 13 May 2015, Section C1, paragraphs 10 to 18.	3. SunWater requests that the wording in Recommendation 4 on page 13 be amended as follows: **"SunWater provide downstream residents with easily understood information regarding operation of the dam including about the timing and outflows from the dam."**

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
Flood Mitigation	Part 1 – Overview, page 13, Recommendation 1 *and* Part 2 – Introduction, page 9, Recommendation 1	Recommendation relates to studies to be undertaken by SunWater, considering dam operational strategies.	SunWater can, and is willing, to assist and consult with Government in these studies being carried out. SunWater suggests that any final decision should be made by Government having regard to the broad range of interests involved. SunWater also suggests that the lead responsibility for carrying out this work should be Government (e.g. DEWS), as was the case following the 2011 Queensland Floods Commission of Inquiry. Refer to SunWater's second submission, dated 13 May 2015, Section B, paragraph 7; and to SunWater's first submission dated 17 April 2015, Section C3.	4. Replace **"SunWater"** with **"DEWS"** as the "Responsible Entity" for Recommendation 1. **5.** In addition, reword the start of Recommendation 1 to read **"In accordance with recommendation G1 of the BMT WBM report, that DEWS in liaison with SunWater, undertake…** etc.**"** 6. Further, at the end of the last paragraph of Recommendation 1, add: **"This will allow consideration and decision by Government as to the future operation of Callide Dam."**
EAP Development and Requirements	Part 6 – Disaster Mgt Plan'g & Preparedness, page 14 and 15	"The EAP is comprehensive, but it is designed to be used by dam operators. A simplified version could be considered for community education purposes. This may achieve an incidental purpose for SunWater by improving community understanding of the capabilities and limitations of the Callide Dam and confidence in its operation"	The suggestion that the EAP could be simplified for "community education purposes" must be very carefully considered. The content of the EAP is dictated by the *Water Supply (Safety and Reliability) Act 2008*. It is not feasible to have a separate, simplified document which is also the EAP – there must be one version only.	7. Suggested rewording as follows: **"The EAP is comprehensive, but it is designed to be used by dam operators. A separate simplified explanatory document could be considered for community education purposes. This may achieve an incidental purpose for SunWater by improving community understanding of the capabilities and limitations of the Callide Dam and confidence in its operation"**

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
Gate Opening	Part 3 – The Event, Page 10	"The Callide Dam gates opened at approximately 8.30pm. The exact time of gate opening cannot be confirmed as there is no equipment connected to the gates that records this information. The 8.30pm approximation is based on the known storage levels and the rate of rise in the storage level at the time."	Despite the qualification, this incorrectly implies that the gates opened at 8:30pm. This is based on a purely theoretical estimation that does not account for measured flood slope effects (level difference) between the dam headwater gauging station and the location of the headwater gauging station, and the effect of extrapolating this slope to the spillway and gates (approximately 400m away). This would result in a difference in estimated level at the gates of approximately 0.3m (i.e. lower than the headwater gauging station water level) which would indicate a later gate opening time. SunWater also suggests that when hypothesizing about the precise gate opening time, equal if not greater weight should be given to the recorded observation of the onsite operators.	8. SunWater requests that the wording in Part 3 Page 10 be amended to reflect the correct accuracy of estimates and logged observations as follows: **"Based on theoretical estimations of storage levels and the rate of rise in the storage level at the time, the Callide Dam gates opened sometime after 8.30pm although the exact time of gate opening cannot be confirmed as there is no equipment connected to the gates that records this information. SunWater's onsite operators reported at the time that they believed hearing the gates opening between 8:37pm and 8:42pm".**
	Part 3 – The Event, page 4, Timeline	"20 Feb 8:30pm Approximate time of Callide Dam gate opening"	Again, this incorrectly implies that the gates opened at 8:30pm. Between 8:37pm and 8:42pm, SunWater's onsite operators are logged as reporting via a phone call at the time: "*believes there may be a rumble in the spillway now. Assume it is the gates opening*." This is the earliest evidence of when the gates may have commenced opening. The first positive confirmation that the gates had actually opened was when SunWater's onsite operator is logged as hearing the sound of the water flowing down the spillway at 8:51pm.	9. SunWater requests that the Part 3 Event Timeline wording on page 4 be amended to take proper account of the onsite observations that were logged at the time as follows: **"20 Feb 8:37pm to 8:42pm Approximate time of Callide Dam gate opening based on audio observation of onsite operators."**

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
	Overview (Part 1), bottom of p. 7	"The exact time the gates opened is a matter of theory, modelling and conjecture as no one witnessed the event, and there is no telemetry or recording means to capture this information. The hydrologist has calculated an opening time of approximately 8.30pm, though SunWater will state a time closer to 8.45pm."	As per previous 2 comments above. SunWater suggests that this wording be similarly amended to reflect the correct accuracy of estimates and logged observations.	10. Suggested rewording as follows: **"The exact time the gates opened is a matter of theory, modelling and conjecture as witnesses to the event were limited to audio observations by operators during high winds, and there is no telemetry or recording means to capture this information. The hydrologist has calculated an opening time of approximately 8.30pm, though SunWater operators reported at the time that they believed hearing the gates opening between 8:37pm and 8:42pm."**
Correction	Part 7 – Disaster Mgt Response, page 9, 2nd paragraph	"… The gauge was designed to monitor low flows. In 2013, the '96 kilometre gauge' was inundated by flood water and stopped working."	This statement is not true. The 96k gauge continued to operate throughout the 2013 event. The only issue was the maximum height exceeded the rating that was available at that time. The gauge was not inundated and did not stop working.	11. Suggested rewording as follows: **"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."**
Correction	Part 7 – Disaster Mgt Response, page 9, 1st paragraph	"SunWater had been using the Callide Dam headwater gauge (near the gates) to monitor flows released from the dam's outlet valves."	Correct "headwater gauge" to be "tailwater gauge".	12. Suggested rewording as follows: **"SunWater had been using the Callide Dam tailwater gauge (near the gates) to monitor flows released from the dam's outlet valves."**

SunWater's Responses to Sections of the Draft Review Report as provided by the Inspector General Emergence Management on 18 May 2015

Issue	Draft Review Report Reference	Statement / Content in Draft Report	SunWater Comment / Reference to Previous Details	Suggestion
Correction	Part 9 – Community Questions & Concerns, Page 3, Item 11.	"The dam gates work when water flows into a chamber with a float and the gates rise as the dam level rises. That means the speed of the gate opening is directly related to the speed of the flood. This cannot be controlled unless the gates are manually operated…"	This implies that manual gate operation above the FSL could have slowed water releases. This is not correct as manual operation is not possible once the water level exceeds the automatic trigger	13. Suggested rewording as follows: **"The dam gates work when water flows into a chamber with a float and the gates rise as the dam level rises. That means the speed of the gate opening is directly related to the speed of the flood. This cannot be manually controlled once the water level exceeds the full supply level of the dam…"**

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Inspector-General Emergency Management

CALLIDE CREEK FLOOD REVIEW

Further Submission by SunWater

13 May 2015

A Context

1 The Callide Creek Flood Review is being carried out by the Inspector General Emergency Management.

2 On 11 May 2015, the IGEM provided SunWater with part of the IGEM's draft review report ("draft report") and requested a response to it. This submission is SunWater's response to the IGEM's draft report.

3 SunWater offers its comments and suggestions in relation to the draft sections of the report noting that:

(a) these comments and suggestions are offered in the context of Sunwater reviewing just the selected sections of the draft report, rather than the complete draft report.

(b) similarly, as the draft sections of the report that have been provided do not include any recommendations, SunWater's comments and suggestions obviously do not consider the feasibility or potential implications of any recommendations.

(c) SunWater anticipates being given an opportunity to review the draft hydrology report being prepared for the IGEM in order that SunWater can be afforded a reasonable opportunity to respond, if necessary, with any further comments and suggestions.

4 This submission is structured as follows:

(a) Section A (this section) sets the context for SunWater's comments and suggestions.

(b) Section B addresses the IGEM's draft comments regarding changing Callide Dam from a water supply dam to a flood mitigation dam.

(c) Section C addresses the draft findings in relation to SunWater's role in emergency management and the requirement to comply with the Emergency Action Plan.

(d) Section D addresses draft criticisms of SunWater's notifications during the event.

(e) Section E identifies a number of other matters including in relation to the role of Callide Dam in the context of the catchment wide flooding impacts arising from Tropical Cyclone Marcia.

5 SunWater welcomes the opportunity to provide further information, or to address any other matters raised during the review or in the public submissions, as and if requested by the IGEM.

B Reducing the Callide Dam level in advance of the 2015 Flood Event

6 The draft report contains[1] a discussion about the potential to change Callide Dam from a water supply dam to a flood mitigation dam. In the course of that discussion the draft report suggests:

(a) that this is not a decision for SunWater alone;[2]

(b) that variable airspace management is used by authorities within South Australia and New South Wales.[3]

7 It appears that there is confusion in the community as to SunWater's role. SunWater suggests that the IGEM consider including the following clarifications within the final report:

(a) Any decision to change the status of Callide Dam should only be made after a comprehensive study is undertaken examining:

[1] See the section headed "Operation of the Callide Dam" – pages 30-35 of the draft report.
[2] Page 32 of the draft report.
[3] Page 35 of the draft report.

(i) the water supply issues associated with the change; and

(ii) flood operations across a large number of actual and design floods.

(b) The decision to change the status of Callide Dam is not one at all for SunWater (contrary to the draft finding referred to above). It is a decision for the relevant Minister. SunWater respectfully refers the IGEM to the Queensland Floods Commission of Inquiry discussion of a similar issue in respect of North Pine Dam (see the Final Report section 17.1.4 – page 569).

(c) SunWater did not reduce the lake level in Callide Dam (similar to the variable airspace management reference in the draft report[4]) prior to the arrival of Tropical Cyclone Marcia as this was outside of the dam's operating licence and it would have been an offence for SunWater to do so.

(d) In any event, there was no reasonable justification for discharging large volumes of water in advance of the flood event. As to this:

(iii) The forecast rainfall (100-150 millimetres) was not substantial in terms of the dam's storage capability. Indeed, depending on the spatial and temporal distribution of the rainfall, the dam may not have even filled with that depth of rainfall (bearing in mind the dam was at 84% at the commencement of the event).

(iv) The forecast could not be relied on to release water. The Bureau's forecasts are, by their nature, inherently unreliable.

(v) Depending on the nature of the flood, the lowering of the level would not necessarily provide any substantial flood mitigation benefits.

(vi) The forecast track range of the cyclone was uncertain and could not be relied upon to not change. A number of other dams in other central Queensland catchments potentially in the path of Marcia (namely Bjelke-Petersen Dam and Boondooma Dam) received minimal inflows as a result of the rainfall event.

(e) For completeness, SunWater notes that it has a record of only one resident calling in advance of the flood event requesting that the lake level be lowered (contrary to the draft report reference to "several" unidentified residents[5]).

C Emergency Action Plan issues

C1 Role of SunWater in the emergency framework

8 The draft report contains a number of observations of SunWater's engagement with the community in advance of flood events.[6] For example, the draft suggests that:

(a) SunWater's approach to public information and engagement on the topic of dams in floods is "minimal";[7]

(b) In the lead up to the February 2015 event, SunWater did not engage the community or local media about what was happening at its dams, including the likelihood that the dams would spill[8];

[4] A recent seminar hosted by Engineers Australia on early release strategies noted that variable airspace management required reliable sources of inflow such as snow melt
[5] Page 25 of the draft report.
[6] Pages 41-43 of the draft report
[7] Page 41 of the draft report
[8] Page 42 of the draft report

(c) Early public engagement and an open dialogue about how the situation was developing would have enabled the community to assess and respond to their personal risk;[9]

(d) SunWater engages defensively on the topic of dams in floods.[10]

9 These observations fail to take into account the limited role that SunWater has in emergency management.

10 SunWater's understanding is that central to effective disaster management is that local governments are primarily responsible for managing disaster events in the local government area. They are the conduit through which the community is informed about the disaster. There is a high risk of conflicting information if multiple agencies are communicating with affected residents. Refer to the Australian Emergency Management best practice guidelines for emergency warnings principles:

http://www.em.gov.au/Emergency-Warnings/Pages/Emergencywarningsguidelinesandprinciples.aspx

11 As a result, SunWater's role is limited to:

(f) monitoring inflows to its dam and providing notifications of outflows to a limited number of stakeholders in accordance with the relevant Emergency Action Plan – see further below;

(g) passing water inflows through the dam's spillway or outlet works in accordance with the operational procedures for the dam.

12 It is not SunWater's role to provide general flood warnings. This is the role of:

(a) the Bureau of Meteorology in respect of riverine or non-flash flooding;

(b) Councils in respect of flash flooding (being flooding arising less than 6 hours after the rain).

13 It is also not SunWater's role to translate flood predictions into the likely impact on local communities in terms of inundation of properties. That is the role of Councils.

14 Except in a specific case (discussed below), it is not SunWater's role to warn the local community. Generally, that also is a role for Councils.

15 Following the Queensland Floods Commission of Inquiry, changes were made to the legislative regime[11] to make dam operators such as SunWater responsible for providing a very limited number of warnings – namely, to those people who live immediately downstream of dams where there is insufficient time for the Local Disaster Management Group to process the information and issue the warning.

16 The content of the warning is limited to the timing and volume of outflow from the dam. As the Queensland Floods Commission of Inquiry made clear:[12]

(a) it is not the dam operator's responsibility to predict river heights or inundation areas; and

(b) downstream residents have a responsibility to apprise themselves of how outflows from a dam will affect their property.

17 Consistently with this limited role, in advance of flood events, SunWater's approach is to (amongst other things):

[9] Page 42 of the draft report
[10] Page 42 of the draft report
[11] The changes were incorporated into Chapter 4, Part 1, Division 2A of the *Water Supply (Safety and Reliability) Act 2008.*
[12] Queensland Floods Commission of Inquiry Interim Report, page 138.

(a) provide general information on its website, by brochures, on social media and by way of media release;

(b) provide immediately downstream residents with an opportunity to register for dam release notifications;

(c) engage with the local disaster management group in relation to the Emergency Action Plan.

18 Given the above, SunWater has not seen it as appropriate to:

(a) take over communications with the general public in relation to the event;

(b) educate the local disaster management group about the limited role that SunWater has (as suggested in the draft report[13]).

19 SunWater suggests that the IGEM consider including the above information within the final report.

C2 The development of the Emergency Action Plan

20 The draft report contains two implicit observations of SunWater in relation to the development of the Callide Dam Emergency Action Plan.

21 First, it is said that the Council provided feedback on the draft Emergency Action Plan but SunWater did not respond.[14] SunWater can advise that it explicitly considered the Council's feedback and made changes where changes were required or considered appropriate. A copy of records detailing SunWater's consideration of the Council's feedback will be provided to the IGEM.

22 Secondly, the draft report notes that there were only 58 downstream residents included within the Emergency Action Plan notwithstanding that there are 189 properties within a 10 kilometre area downstream.

23 SunWater makes the following points:

(a) The 10 kilometre cut-off is taken from the draft guideline that has been published by the Department of Energy & Water Supply for the preparation of emergency action plans.[15]

(b) As the draft report notes (see pages 53 and 54), the manner in which SunWater went about identifying downstream residents was appropriate (and comprehensive).

(c) Accordingly, SunWater believes that the conclusion that there are 189 properties within the 10 kilometre zone is incorrect. SunWater's investigations indicate that there are a total of 66 properties in that zone (a map showing this analysis will provided to IGEM).

24 SunWater requests the IGEM update the final report to reflect the above details.

C3 There is a requirement to comply with the Emergency Action Plan

25 In several places, the draft report suggests that SunWater is not obliged to comply with the Emergency Action Plan.[16] This is incorrect.

[13] Draft report page 58 second paragraph.
[14] Draft report page 38 second paragraph.
[15] Emergency Action Planning for Referable Dams June 2013 at page 23.
[16] Draft report – page 38, third last paragraph; page 52 second half of the page.

26 Under the *Water Supply (Safety & Reliability) Act 2008*:

(a) The Chief Executive can apply dam safety conditions to a referable dam such as Callide Dam.[17]

(b) It is an offence for the owner of a referable dam to which a safety condition applies to contravene the condition.[18]

27 The Dam Safety Conditions for Callide Dam are shown in **Appendix D** to SunWater's submission dated 17 April 2015.

28 Relevantly, the Dam Safety Conditions require that in all emergencies the dam must be operated in accordance with the Emergency Action Plan for the dam (condition DS13).

29 Accordingly, SunWater must comply with the Emergency Action Plan.

30 The final report must be amended to remove any comments or findings to the contrary.

D Warnings and notifications during the event

D1 Earlier communications with downstream residents

31 The draft report states that SunWater did not communicate with downstream residents until 20:39 despite (it is alleged):

(a) SunWater having data from the river gauge upstream from the dam showing an almost vertical rise in inflows for more than 3 hours; and

(b) significant rises in the dam level were seen from 6pm.

32 The correct position is set out below.

33 The 96km gauge had recorded a rainfall burst of 25mm in the hour to 15:00. The rainfall intensity at 16:00 and 17:00 had reduced to 10mm/hr and 12mm/hr respectively.

34 At 16:15 the 96km gauge read 1.9m. This equates to a flow rate of 5.95m^3/s or 514ML/d.

35 At 16:30 this had increased to 3.19m, 3.6m at 16:45 and 3.69m at 17:00. It is apparent from this information that the initial rate of rise had slowed at 17:00 hours.

36 The flow at 17:00 hours was estimated at 240m^3/s or 20,700ML/d.

37 The storage level of Callide dam at 17:00 was 214.39m. This equates to a storage volume of 118,410ML or 17,960ML below full supply level

38 There was a time lag of up to 30 minutes between these data points being recorded by the instruments and availability of the data on the web site.

39 Based on these facts, The Technical Decision Maker issued an email advice at 17:41 that stated “we do not expect Callide to spill at this stage. This could change if the system is slow to move south.”

40 The rate of increase in flow rate at the 96km gauge increased at approximately 17:30 and remained relatively steady from approximately 17:45 to 19:00. At approximately 19:15 the rate of increase escalated approximately fourfold.

41 At 19:03 on the 20th February 2015 SunWater advised the Local Disaster Management Group that "we may reach the reduced FSL trigger tonight". It was still not certain at that time that gate operations would be required. Accordingly, it is incorrect to infer that SunWater had known for several hours that gate operations would be required.

[17] Section 353.
[18] Section 356A.

42 The comments of SunWater's representative at the Local Disaster Management Group meeting on the day before at 1pm on 19 February 2015[19] are to be understood in this light. The SunWater representative's comments conveyed the message that if there was credible information available during daylight hours that a spill would definitely occur later that night, early advice would be given to the LDMG and downstream residents. In the event, as is evident from the above discussion, it was not known during daylight hours on either the 19th or 20th February that the dam would spill on either of those nights. This explains why an early advice was not made.

43 Importantly, the SunWater representative did not say that the EAP would be activated early or deviated from in any way. The representative's reference to the word "activate" as quoted on page 53 of the draft report was used in a general sense with respect to advising people early and not in the sense of the technical meaning of the word as used in the EAP. SunWater therefore submit that the statement in the draft report that "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" is both incorrect and misleading and should be deleted (both on page 53 as well as the similar quote on page 25).

44 As per the Emergency Management Framework Local Disaster Management Groups are responsible for community warnings more generally. SunWater provided timely information to the Local Disaster Management Group from 17:00 that the dam might spill over the next 24 hours. The draft report identified that the Local Disaster Management Group attempted to issue a warning to the community of the possibility of releases at 17:41 but did not proceed with this, indicating that it would soon issue a warning message. [20]

45 Further, SunWater's communications to the Local Disaster Management Group at 19:03 and 19:52 specifically referred to the possibility of releases within hours. It was open to the Local Disaster Management Group to issue a warning to the community at that time.

46 SunWater did not issue notifications to the downstream residents under the Emergency Action Plan at this time as the plan had not been activated at that time (and nor was it required to be). The plan was activated at 20:18 (as the draft report finds) and arrangements were made to immediately notify downstream residents.

47 The draft report states that SunWater "inflexibly" followed the Emergency Action Plan.[21] This reference assumes that SunWater was entitled to depart from the Emergency Action Plan during the event. As has already been made clear, SunWater is required (by statute) to comply with the Emergency Action Plan. Accordingly, the suggestion of "inflexibility" is not appropriate and SunWater requests that this finding be amended.

D2 When did the gates open?

48 The draft report suggests that the Callide Dam gates opened at 20:30.[22]

49 There is no sound evidentiary basis to conclude that the gates opened at 20:30 and the draft report should be amended accordingly.

50 In particular:

(a) As the draft report itself concedes, the exact timing of the opening of the gates cannot be confirmed as there is no record of it.[23]

[19] Referred to in the draft report at pages 25 and 53
[20] Draft report at page 26.
[21] Draft report at page 52.
[22] Draft report at page 27.
[23] Draft report at page 27

(b) It appears that the IGEM has relied on the storage levels to calculate the opening time, although the calculation has not been provided. It is not correct to calculate the gate opening time in this way for the following reasons:

(i) The storage level of Callide Dam was not known with any certainty during the event. As to this:

(A) The water surface in the storage during a significant event is not flat. There would have been a significant flood slope on the storage. At the peak of the flood the 96km gauge is at the very top end of the storage. At 19:45 on the 20th February the difference in water level at 96km gauge and the headwater gauge was 11.269m. The average slope between the 96km gauge and the head water gauge was 0.0008. If the average slope continued from the head water gauge to the spillway structure then the water level at the spillway structure would have been 0.30m lower than that recorded at the headwater gauge. There is significant uncertainty in the above calculations, but it is the best information available at this time.

(B) The cyclonic conditions that existed at the time included high velocity winds. High winds would have impacted the accuracy of the recorder.

(C) High winds would have created substantial waves on the storage. Waves would have impacted the accuracy of the recorder.

(ii) Also, the storage level recorder is located in the inlet tower. The inlet tower is approximately 400m away from the spillway gates. The spillway gates respond to the water level at the spillway structure. The water level at the spillway structure would likely have been different to the water level at the inlet tower due to flood slope, wind and waves.

(iii) Whilst the gates are designed to commence opening at a particular water level, it is possible that the actual gate opening varied slightly from the design level.

(c) Accordingly, it is incorrect to speculate (even in hindsight) that the Callide Dam gates opened at 20:30.[24]

(d) The first positive confirmation that the gates had opened was when SunWater's on-site operator heard the sound of water flowing down the spillway at 20:51.

D3 Other matters

51 In view of the comments in Sections D1 and D2 above, a number of observations in the draft report, which rely upon the findings challenged above, should not be made. The relevant passages which SunWater believes should be removed are:

(a) The suggestion that there "were issues" with the timing of SunWater's warnings;[25]

(b) The final paragraph on page 51 and first paragraph on page 52.

52 The draft report also suggests[26] that the information provided by SunWater to the SDCC was not always up to date. An example is given, being the situation report issued at 19:07 on 20 February 2015. It appears the IGEM has referenced a draft version of this situation report.

[24] Draft report at page 27.
[25] Page 51 last sentence of the paragraph under the heading "SunWater".
[26] Page 46 of the draft report, second last paragraph.

Situation report 7 as attached to the original email will be provided to IGEM. It was accurate and the comments in the draft report on this point should be deleted.

E Other comments

53 The sections of the draft report reviewed by SunWater narrowly describes the flood event by focussing solely on Callide Dam. These sections do not provide any description of the extreme nature of the rainfall event or the response of relevant authorities across the broader Callide catchment area. This has the potential to mislead the reader to conclude that the entire event passed through the Callide Dam, and that the operations at the dam, and the SunWater response, represented the entirety of the flood. This is clearly not the case.

54 However, SunWater expects that these issues will be addressed in the final report based on information within the draft hydrology report being prepared for the IGEM.

55 SunWater in unclear of the purpose of the selective in-text highlighting (italic, bold, blue) of statements within the draft report (p24-27). The selective highlighting of statements within the report will potentially result in those highlighted sections taking on a greater significance than is intended or appropriate, whilst other non-highlighted statements which are of equal or greater importance may be missed. This use of selective formatting is unintentionally misleading. SunWater suggests that these highlighted texts and formatting be removed.

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Appendix D

Banana Shire Council response

A copy of the 2015 Callide Creek Flood Review Report (draft) was provided to Banana Shire Council with a request for their response.

Responsibility for the accuracy, fairness and balance of the following response from Banana Shire Council, rests with the Chief Executive Officer of Banana Shire Council.

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Your Reference:
Our Reference: RG:wn (ES8.12)
Contact: Ray Geraghty (CEO)

21 May 2015

Mr Iain S MacKenzie
Inspector-General
Emergency Management
By email

Dear Mr MacKenzie

Re:

Thank you for the further consultation draft of the Callide Creek Flood Review. In response, Council would like to make the submissions set out below.

At the outset, Council remains concerned that in many instances, it is not clear precisely what information has been relied upon to make particular statements and findings. While Council acknowledges the constraints associated with a review of this kind, it would appear that some statements and findings have been based merely on personal opinions, matters of impression and hearsay information, rather than fact. It is also unclear to Council what efforts were made to substantiate particular opinions, impressions and hearsay information. In the absence of such information, there are some matters in the report that Council cannot respond to meaningfully.

Council is also concerned about that throughout the report, there is use of the terms Council, LDMG and LDCC interchangeably. Council is not the sole body responsible for preparing for and coordinating a response to a disaster event. Statements to this effect in the report are misleading and should be corrected to refer to the LDMG. The responsibility lies with the LDMG as a whole which includes some Council representatives as well as representatives of key State government entities including the QPS, QFRS, QAS, SES as well as others.

Otherwise, Council believes it is important for the final report to contain the most accurate information possible, as well as balanced views on the matters the subject of your investigation. As such, Council requests that this response be included in the appendices to your final report.

BACKGROUND

Banana Shire is a low growth rural council west of the Great Dividing Range characterised by sparsely populated rural land and small townships with low annual rainfall; as is common of most of Queensland west of the divide. Banana Shire and others like it are unfairly compared to high growth coastal or urban settings. Banana Shire has limited financial resources and its corporate priorities reflect its setting and circumstances. Recent natural disasters have increased demands on financial and human resources.

Flood events occur over the years in Banana Shire. However, the 2010 to 2015 period has seen a greater number of intense events than normal.

The 2010 flood event within Banana Shire impacted the Dawson River catchment mainly around Taroom and Theodore.

The 2013 and 2015 flood events affected the Callide River catchment mainly around Biloela and Jambin; the event was mostly a coastal system which just came over the Great Divide and impacted the eastern part of the Shire. The events from an intensity perspective were reported to be greater than 1 in 1000 year events and much greater than any normal event.

The magnitude of the event, as well as the pressure under which officers were operating while the event was unfolding, should be acknowledged when considering the appropriateness of the actions of Council, the LDMG and other staff.

COUNCIL'S TIMELINE COMMENTS

The draft report contains three timelines with varying levels of detail which discuss actions taken by the LDMG, LECC and/or Council during the event (being the timeline beginning on page 4 of "The Event" section of the report, the "Summary of the Callide Creek Flood Event" beginning on page 6 of "The Event" section of the report and the timeline contained on page 20 of the "Disaster Management Response" section of the report). These timelines do not identify the following key activities that took place:

- All three timelines do not refer to the LDCC issuing a Facebook post at 5:16 pm on 20 February 2015 advising, in response to the phones going out in the call centre, that if followers could not get through to the LDCC they should private message Facebook or email disaster@banana.qld.gov.au.
- All three timelines do not refer to the plateau of the inflows into the Callide Dam shown by the 96 km gauge from 5:00 pm til 6:00 pm on 20 February 2015.
- The "Summary of the Callide Creek Flood Event" does not refer to the fact that the Sunwater modelling at 5:41pm on 20 February 2015 did not predict a Callide Dam spill that night. Further, at that time, the 96km gauge was showing that inflows had plateaued.
- All three timelines do not refer to the LDCC issuing a Facebook post at 5:56 pm on 20 February 2015 advising "*Please be aware we are getting reports of trees down. Please don't go out in these conditions*".
- All three timelines do not refer to the LDCC issuing a Media Release at 6:10 pm on 20 February 2015 stating "*GENERAL UPDATE FOR BANANA SHIRE Sunwater monitoring levels at the Callide Dam, appealing to residents in low lying areas to remain vigilant and be prepared to self-evacuate if their situation becomes unsafe.*"
- The "Summary of the Callide Creek Flood Event" which details the request at 4:51pm on 20 February 2015 for an emergency alert should identify that the decision to cancel the request occurred at 6:18 pm. At this time, the LDCC identified that the level of alert which was requested at 4:51 pm (being the lowest level) was no longer appropriate and the LDCC had determined that an emergency warning (being the highest level) should be prepared instead.

- All three timelines do not refer to the LDCC issuing a Facebook post at 6:19 pm on 20 February 2015 advising "*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 available in the Shire, the Local Disaster Coordination Centre will provide advice accordingly.*" The post also advised residents to contact the numbers provided.
- The "Summary of the Callide Creek Flood Event" does not refer to the fact that the Sunwater modelling changed at 6:37 pm on 20 February 2015 to show that the Callide Dam could spill that night.
- The timeline contained on page 5 of "The Event" section of the report does not refer to the advice provided to the LDMG at 7:03 pm that the reduced full supply level may be reached that evening, that the inflows were still rising but that rainfall needed monitoring.
- All three timelines do not refer to all of the LDCC's attempts to contact the SDCC to have an Emergency Alert issued. For instance, officers recall attempts being made between 7:15 pm and 7:30 pm on 20 February 2015 and are attempting to obtain phone logs to confirm this. In addition, an email from the LDCC to the SDCC at 8:09 pm on 20 February 2015 provides mapping "as discussed", which suggests that earlier discussions did take place.
- All three timelines should refer to the fact that between 6:49 pm and 8:48 pm numerous telephone conversations were held between the LDCC and the Watchdesk to attempt to issue an Emergency Warning via the EA system. All timelines should also refer to the LDCC having difficulty sending and receiving emails to the Watchdesk at that time and making telephone calls to the Watchdesk at that time.
- The timeline contained on page 5 of "The Event" section of the report should refer to the fact that the LDMG was not notified that the gates could open as early as 9:00 pm until 7:52 pm on 20 February 2015.
- All three timelines do not refer to the LDCC issuing a Facebook post at 7:52 pm on 20 February 2015 advising "*The LDMG will meet at 9:00 pm and will be in touch with Sunwater. If possible we will provide a further update.*"
- The "Summary of the Callide Creek Flood Event" and the timeline contained on page 20 of the "Disaster Management Response" section of the report do not refer to the fact that it was not until 8:18 pm that the LDMG was informed that inflows into the dam were higher than 2013 and that gate releases were imminent.
- All three timelines do not refer to the LDCC issuing a Facebook post at 8:27 pm on 20 February 2015 stating that Ergon advised residents to be patient.
- The description of the Facebook post at 8:36 pm on 20 February 2015 contained in page 5 of "The Event" section of the report is misleading as it was not addressed to the Shire at large. It was directed to Biloela residents and advised that emergency services requested that residents stay indoors after the wind and rain has passed as there were powerlines and trees down and emergency services would need to assess the situation. It is not referred to at all in the timeline contained on page 20 of the "Disaster Management Response" section of the report.
- The timeline contained on page 5 of "The Event" section of the report and the "Summary of the Callide Creek Flood Event" do not refer to the call made by the LDCC to the LECC (Acting Jambin Chair) at 8:37 pm on 20 February 2015 informing them to notify residents to evacuate to the school as water was expected to be released soon.

- The timeline contained on page 5 of "The Event" section of the report and the "Summary of the Callide Creek Flood Event" do not refer to the further call made by the LDCC to the LECC (Acting Jambin Chair) at 8:41 pm on 20 February 2015 notifying that the gates had opened and reports were the water may be higher than 2013.
- All three timelines do not refer to the fact that from 8:41 pm onwards on 20 February 2015, staff in the LDCC began ringing contacts and local residents in the affected areas to advise them of the situation and to contact others that they knew to be at risk to provide warnings. A log kept by a member of the LDCC, [redacted], shows [redacted] telephoned seven individuals to provide warning and requested that they too make contact with any people they knew who would be affected.
- All three timelines make no reference to the LDMG Chair telephoning media outlets from 8:41 pm on 20 February 2015 to inform residents that an emergency evacuation of Jambin and Goovigen had been ordered and that there were problems with the EA system.
- The descriptions of the Banana Shire Council Facebook post at 8:45 pm on 20 February 2015 contained in all three timelines are misleading as they do not reference the fact that the message informed residents that the Council was experiencing difficulties with the SMS alert system at that time.
- All three timelines make no reference to the Facebook post made by the LDCC at 9:19 pm on 20 February 2015 advising "*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 49924927 to arrange emergency shelter*". This was the first time that the LDCC has ever known of flooding in this area and it was not until shortly before this time that the LDCC was aware that this area would be affected by flood waters.
- The descriptions of the Banana Shire Council Facebook post at 9:58 pm on 20 February 2015 contained on page 5 of "The Event" section of the report and page 11 of the "Summary of the Callide Creek Flood Event" are misleading. The post did not simply state that the Callide Dam gates were open and that water levels were higher than 2013. The message read "*The Coordination Centre along with the rest of the Shire is experiencing difficulties with the 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 you are in a low lying area, we urge you to self-evacuate to higher ground.*" The complete message should be included in all three timelines as it gives the context which explains the delay in posting the message (being the communication difficulties) and also shows that the LDCC was urging people in all low lying areas to self-evacuate.
- All three timelines do not refer to the LDCC issuing a Facebook post at 10:02 pm on 20 February 2015 stating "*Please note the Biloela Civic Centre is open for those evacuating. Please take your own bedding and supplies.*"
- All three timelines do not refer to the LDCC issuing a Facebook post at 12:04 am on 21 February 2015 stating "*The Mt Murchinson State School is open if anyone needs to evacuate.*"
- All three timelines do not refer to the LDCC issuing a Facebook post at 12:29 am on 21 February 2015 stating "*Council staff and emergency services are attending to requests. Please stay off the roads and follow for updates.*"

- All three timelines do not refer to the LDCC issuing a Facebook post at 12:53 am on 21 February 2015 restating emergency contact numbers that could be used by residents.
- All three timelines do not refer to the LDCC issuing a Facebook post at 3:03 am on 21 February 2015 advising residents of Road Closures.
- All three timelines do not refer to the LDCC issuing a Facebook post at 3:52 am on 21 February 2015 stating "*Council staff and emergency services are continuing to attend to callouts and requests. All highways into Biloela are now closed and we encourage people to stay at home. There is water still rising in areas and hazards are present. Remember – if it's flooded – forget it!*"
- All three timelines do not refer to the LDCC issuing a Facebook post at 4:18 am on 21 February 2015 stating that Ergon had advised they would be there that morning.
- All three timelines do not refer to the LDCC issuing a Facebook post at 5:22 am on 21 February 2015 stating "*Callide Dame Update: Sunwater have advised that the gates to the Callide Dam are now closed, however there is still large amounts of moving water. We are urging people to stay off the roads and if it is flooded "forget it"*." The LDCC was later informed that the gates were in fact "closing" not "closed".
- All three timelines do not refer to the LDCC issuing a Facebook post at 6:57 am on 21 February 2015 stating "*Helicopters are currently evacuating people from Jambin to Biloela and the situation in Goovigen is being monitored. Hills Avenue residents and people at the Caravan Park on Valentine Plans Road are in the process of being evacuated. We would appreciate it if people could stay off the roads.*"
- All three timelines do not refer to the LDCC issuing a media release providing a general public advice at 7:06 am on 21 February 2015.
- All three timelines do not refer to the LDCC issuing further Facebook posts at 7:23 am, 8:01 am and 9:33 am on 21 February 2015.

The absence of these actions in the timelines gives the appearance that they did not occur or that perhaps there was insufficient activity by the LDCC, which is misleading. Council believes that in order for the final report to paint the complete picture of event, all timelines should identify the above activities.

These comments will be referenced throughout this response as Council's Timeline Comments.

COUNCIL'S AVAILABLE INFORMATION COMMENTS

The following comments relate to the information available to the LDCC on 20 February 2015 and 21 February 2015.

In numerous places throughout the draft report there are statements that the Council had sufficient information to better prepare the community and that those who were likely at risk could have been identified and told more about what was known.

Council reiterates that it not the sole body responsible for preparing for and coordinating a response to a disaster event. Statements to this effect in the report are misleading and should be corrected to refer to the LDMG. The responsibility lies with the LDMG as a whole which includes some Council representatives as well as representatives of key State government entities including the QPS, QFRS, QAS, SES as well as others.

Once the LDMG moves to "stand up" status, the actioning of a response to the disaster is carried out by the LDCC, which is the operational arm of the LDMG. The LDCC coordinates the response. Once again the LDCC includes some Council representatives as well as representatives of key State government entities including the QPS, QFRS, QAS, SES as well as others. It is not the sole responsibility of the Council to respond to a disaster as this is a responsibility collectively shared by those entities participating in the LDCC. Statements to this effect in the draft report are misleading and should be corrected to refer to the LDCC and not Council where operational matters are being referred to.

In the lead up to the event, information provided by BoM was very general in nature and referred to a flood watch for the entire Dawson catchment and the possibility of flash flooding. The information identified that widespread heavy rainfall of 200 - 300 millimetres could be expected. However, this general information was not sufficient to enable the LDMG to identify whether evacuations would be required, if so which areas would require evacuation, what time the evacuations should be made and by what route they should be made. The information was also of no utility in identifying trigger points for any part of the Banana Shire.

In relation to stream inflows and the river gauge information available to the LDCC during the event, the only real time river gauge information that the LDCC had access to was the gauges which are owned and operated by the Council. All of those gauges are located in the Dawson River catchment and none of them are located in the Callide Creek or the Kroombit Creek.

Council acknowledges that BoM makes publicly available information from gauges which are owned by entities other than Council on its website. However, it is Council's view that the draft report fails to note the significance of this information not being loaded up in real time. The availability of information is dependent upon when the BoM website is refreshed and this can be impacted by communications issues affecting the various gauges. Council has not seen any information which details to what extent problems with the gauges and communications issues resulted in delays to updates on the BoM website on the night. Page 10 of the draft report details that there were problems. However the draft report does not detail how long it was taking before information from the gauges was being uploaded onto the BoM website. It is Council's view that it is important that such information be obtained before an assessment can be made of whether the LDCC had available sufficient information to provide earlier warnings.

It is worthy to note that during 20 February 2015, the only warnings that BoM made that were specific to catchments in Banana Shire were an 11:34 am warning of a flood watch for Dawson catchment and that flash flooding was possible and then a 10:03 pm minor flood warning for the Dawson River, Don River and Callide Creek (their first flood warning for the event).

In addition to the delay issue, pages 9 and 10 of the "Disaster Management" section of the report acknowledge the shortcomings in the quality of information available to the BoM. In particular, it states:-

- *The data issues with the rain gauges above Callide Dam became apparent several hours before midnight;*
- *The BoM provided us with a map of the Flood Warning Network for the Dawson Catchment. This shows that there are no forecast sites in the Callide Valley. ...There are no qualitative forecast sites in the network.*
- *The current documented and endorsed service levels do not require a detailed hydrological model for Callide Creek.*

- *Few information sources of any type are available for the Callide Valley, but improvements are being considered.*
- *With current technology and data sources available for the Callide Valley, predicting the timing and exact location of flash flooding is unlikely. 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.*

The LDCC was relying upon the BoM information to understand the nature and extent of the event, the fact that the information was not available in real time, the information for the Callide Valley had significant shortcomings and the LDCC had communication difficulties on the night all contributed to the difficulties of the LDCC using the BoM information to provide more timely warnings.

For many areas where localised flooding occurred, there simply was no information available via the BoM website. The best information that the LDCC had during the event was anecdotal accounts which were coming in via the call centre.

The 96km gauge is owned and operated by SunWater. The LDCC did not have real time access to this gauge during the event. The LDCC maintained regular contact with SunWater regarding the readings of this gauge throughout the event. However, there was some lag in the communication of these readings at times.

These lags in information together with the communication difficulties on the night slowed the flow of information coming to the LDCC and slowed the ability of the LDCC to disseminate the information in a more timely manner.

It is also Council's view that the criticisms made about the utilisation of the five LECCs in the Banana Shire area on pages 3 and 4 of the "Disaster Management" section of the report are not warranted. The Council agrees that LECCs are a valuable means of gathering and sharing vital information – this is their key role (as per the Terms of Reference included in the Bundle of Further Documents attached to this response as **Attachment 2**). During the event of 20 and 21 February 2015, the only LECC which was seriously affected by flooding was the Jambin/Goovigen LECC. Communications were made directly between the LDCC and the acting chair of this LECC during the event (refer to Council's comments on the timelines above). Communication to a greater extent with the other four LECCs during the night would not have provided greater intelligence as they were not affected by the event to the same extent as the areas subject to the Callide and Kroombit Creeks. Further, to suggest that LECCs can go out during a cyclone and provide information on "*the heights of watercourses in the area or any key risks for that location*" is not reasonable as this would put members of LECCs at risk. As mentioned in the draft report, often times these people are volunteer local residents acting as a liaison and they do not possess the necessary expertise to be undertaking such tasks.

These comments will be referenced throughout this response as Council's Available Information Comments.

COUNCIL'S EMERGENCY ALERT COMMENTS

The following comments relate to the difficulties with the emergency alert system on 20 February 2015.

Council regrets the difficulties that were experienced with the use of the EA system on 20 February 2015 and acknowledges that had they not occurred, more information could have been provided in a more timely fashion.

It is important to note that the LDCC can only *request* than an emergency alert be sent; it cannot actually send one. As such, Council is concerned that the repeated emphasis of the first emergency warning being sent to the Watchdesk at 8:56 pm, without acknowledging the attempts to send the first message from as early as 4:52 pm and the subsequent ongoing discussions between the LDCC and the Watchdesk from 6:49 pm to address the problems being experienced in sending an EA leaves the impression that the LDCC did nothing until 8:56 pm. In that respect, an email attempting to send the mapping at 8:09pm has been provided as part of the Bundle of Further Documents in **Attachment 2** further evidence.

The timeline contained on page 20 of the "Disaster Management Response" section of the report refers to eight telephone calls between the Watchdesk and the LDCC (or the QFRS on behalf of the LDCC) and one email between 6:49 pm and the successful call at 8:56 pm. It was over this two hour period that the difficulties were trying to be overcome.

Council officers had commenced preparation of a template text for warnings as well as template maps as early as 8:00 am on 20 February 2015, which were consistent with the template provided by the State. At this time, the Council was assured that the maps were in the correct format and with the correct file extension as indicated on the application form the LDCC is required to fill out to request an emergency alert.

The message that was attempted to be sent from 4:52 pm until 6:49 pm was a template message. However, due to the problem with the maps it was unable to be dispatched via the EA system.

Between the time when the LDCC cancelled the first EA message attempt and the successful request being made at 8:56 pm, the information regarding the nature and extent of flooding was rapidly changing.

At the time the message was cancelled, the LDCC was of the understanding that the Callide Dam may open sometime during the next 24 hours.

At 7:03 pm, the LDCC was advised that the full supply level trigger may be reached that evening and that the inflows were still rising, but rainfall needed monitoring.

At 7:52 pm, the LDCC was advised that automatic opening of the gates at Callide Dam would occur within hours.

At 8:18 pm, the LDCC was advised that inflows to the Callide Dam were greater than 2013 and automatic gate operation at Callide Dam was imminent.

The notification that the flooding was going to be greater than 2013 meant that the template messages and template maps needed to be changed in order to send out the emergency alert. The information available to the LDCC prior to 8:18 pm did not cause the LDCC to anticipate that the eventual flood was going to be greater than 2013.

Limitations with the EA system made it difficult to quickly draft an appropriate warning. For voice messages, the message is limited to 450 characters (including spaces). For SMS messages, the message is limited to 160 characters (including spaces). It is difficult to quickly draft an appropriate message within these confined parameters together with preparing the relevant map in a high pressure environment like that being experienced at the LDCC at the relevant time.

This explains why at 8:48 pm and again at 8:50 pm, when the LDCC was communicating with the Watchdesk, the advice was that the LDCC had not finalised the message yet. However, an email from the SDCC to the LDCC at 8:29 pm clearly shows that the SDCC had already received the emergency alert message before that time – that email has been included in the Bundle of Further Documents in **Attachment 2**.

The criticisms of the content of the Emergency Warning on pages 24 to 26 of the "Disaster Management Response" section of the report also does not acknowledge the constraints with the number of characters that can be contained in EA messages and fails to identify that this was the reason why more communities could not be identified in the messages that were sent out.

These comments will **be referenced** throughout this response **as** Council's Emergency Alert Comments.

COUNCIL'S SPECIFIC COMMENTS ON THE DRAFT REPORT

OVERVIEW

Foreword

Pg.2 / Paragraph 5 –

- Council believes that describing solutions to any systemic difficulties **as** being "easily addressed" is taking an overly simplistic view of inherently complex matters. Such solutions not only require coordinated efforts and the support of a number of entities, but also significant resources.
- For instance, longer term improvements around flood modelling is particularly resource intensive and has been estimated by Council to cost between $350,000 and $400,000.
- Council has already taken the first step in that process and has commissioned the first phase of the study which will cost around $60,000.
- The reality is that such processes are anything but easy.

Pg.3 / Paragraph 1 –

- While Council appreciates the circumstances and constraints in which the review has been carried out, it has concerns about statements identifying the report as being based on "facts", when in reality much of the report is based on recollections and opinions that were formed in testing circumstances. Council says this not as a criticism of the investigation process, but more out of concern that other circumstances are likely to have existed that were not known to those expressing particular opinions.

Executive Summary

Pg.6 / Paragraph 4

- Given that the main risk was from the operation of the dam gates, Council believes it was entirely appropriate for focus to be on the gates, notwithstanding that other activities were also monitored (e.g. high winds – a circus was advised to take precautionary measures by securing rides).

Pg.6 / Paragraph 5

- The reference to 'cyclone ratings' (which is presumably a reference to wind ratings) is unnecessary and of no assistance.

- Unlike northern councils in Queensland where purpose-built shelters are built to particular wind ratings, the Civic Centre was built in the late 1970s and is not wind rated, notwithstanding that it was built in accordance with the applicable standards at the time. As such, any suggestion that advising the community to shelter in place put them at greater risk is unjustified.
- Council believes that the statement 'significant flooding in many parts of the shire' is overstating the event. The event only affected catchments in the Biloela and north-eastern area of the Shire.

Pg.7 / Paragraph 1 -
- As to Council having sufficient information to better prepare the community, refer to Council's Available Information Comments above.

Pg.7 / Paragraphs 2 & 3 –
- Refer to Council's Available Information Comments.

Pg.7 / Paragraph 4 –
- Council believes this paragraph is misleading, as it suggests that no other actions were taken by the LDMG during the event. The paragraph makes no reference to media releases throughout the event, and calls made to the SDCC and earlier attempt to issue emergency alerts. Refer to Council's Timeline Comments, Available Information Comments and Emergency Alert Comments.

Pg.7 / Paragraph 5 –
- Refer to Council's Timeline Comments above.

Pg.8 / Paragraph 1 –
- Refer to Council's Emergency Alert Comments above.

Pg.8 / Paragraph 3 –
- Following the 2013 event, Council was assured by Telstra that a failure of the system would not be repeated. However, during this event, Council was faced with multiple issues, including:
    - land lines failing due to the fibre optic cables being washed away; and
    - mobile coverage failing due to tower failures, including the generators and other back- up power sources.

Findings

Pg.10 / Finding 3 –
- Council has already taken the first step in that process and has commissioned the first phase of the study which will cost around $60,000. The total project will cost between $350,000 and $400,000.

Pg.10 / Finding 4 –
- Council is concerned about the subjective nature of the survey undertaken. In particular, Council is aware of one particular person who was contacted for the purposes of the survey, who found the questions and the manner in which they were asked to be leading and provocative in nature.

Pg.10 / Finding 8 –
- Council is not clear on what is meant by "operational information sources" or the gaps that exist in availability thereof.

Pg.11 / Finding 12 –
- Refer to Council's Emergency Alert Comments.

Pg.10 / Finding 15 –

- While a continuity plan would not have necessarily overcome the problem, the LDMG has since directed that this occur.
- Otherwise, Council issue with communications was that following the 2013 event, Council was assured by Telstra that a failure of the system would not be repeated. However, during this event, Council was faced with multiple issues, including:
  - Land lines failing due to the fibre optic cables being washed away; and
  - Mobile coverage failing due to tower failures, including the generators and back- up generators to the towers failing.

Recommendations

Pg.13 / Recommendation 2 –

- Council has already taken the first step in that process and has commissioned the first phase of the study which will cost around $60,000. The total project will cost between $350,000 and $400,000.

Pg.14 / Recommendation 6 –

- The independent hydrological assessment was provided to Council on the afternoon of 19 May 2015. Given the technical nature of the document, Council has not had sufficient time to properly consider the matters raised therein in detail. However, Council agrees that the concept has potential, though resourcing will be the critical issue.

Pg.14 / Recommendation 7 –

- Council acknowledges the desire for this to occur and notes that it can be challenging, particularly in rural/remote areas.
- The issue is often compounded by ABC coverage in the Banana Shire where various parts receive coverage from three different areas (Rockhampton, Longreach and Toowoomba), which requires Council to liaise with three different locations.

Pg.14 / Recommendation 8 –

- As above.

Pg.14 / Recommendation 10 –

- While Council agrees that a review is appropriate, it believes that such a review should be carried out independently to ensure unbiased, independent results.
- Council would have concerns about a review being undertaken by key LDMG member agencies. Instead, Council suggests that such reviews be undertaken by the Inspector-General's office if possible.

Pg.15 / Recommendation 11 –

- This has been directed by LDMG at a recent meeting held on 18 May 2015.

INTRODUCTION

Pg.3 / Last sentence –

- The independent hydrological assessment was provided to Council on the afternoon of 19 May 2015. Given the highly technical nature of the document, Council has not had sufficient time to properly consider the matters raised therein in detail.

THE EVENT

Pg.5 – 8.48 pm
- Refer to Council's Timeline Comments.

Pg.7 / Paragraph 3 –
- Refer to Council's Available Information Comments.

Pg.7 / Paragraph 8 –
- Refer to Council's Available Information Comments.

Pg.9 –
- Refer to Council's Timeline Comments.

Pg.11 –
- Refer to Council's Timeline Comments.

MANAGING DAMS

Pg.3 / Full Supply Level, Paragraph 4
- The reduced maximum operating level was adjusted in January 2015, and Council did not get the revised EAP until 16 February 2015, i.e. Issue 3 (revision of lake operating levels covering sections 1, 2, 3, 4, 5, 6, 7 8, 9, 10). Further, a revision of sections 3 and 5A of Issue 3 was only received by Council on 20 February 2015 (the day of the event).

Pg.5 / Last paragraph –
- It should be noted that the 2013 Review of the Callide Dam Gate Operations was only received by Council this week, on Monday, 18 May 2015.

DISASTER MANAGEMENT & PREPAREDNESS

Pg.4 / Paragraph 3 –
- There are numerous creek systems within the Banana Shire that pose a flood risk. Undertaking such an exercise will require considerable resources as well as making important decisions about how much detail should be included in the LDMP in order to ensure that it is effective.
- Council believes the disaster management guidelines could be improved to provide further guidance on this issue.

Pg.5 / Paragraph 3 / Last Sentence –
- Council believes the statement should read, 'the study has not been undertaken to date, and is reliant on the availability of external funding'.

Pg.5 / Paragraph 4 / Fourth Sentence –
- The statement that Council 'had not actually put out a tender for the project' is incorrect.
- Council advertised the tender in December 2013.
- The tender was awarded in June 2014.
- Ultimately, the project was delayed due to the State government advising that Council had not been successful with its funding renewal application for the continuation of the project.

Pg.5 / Paragraph 5 –
- Council believes it is misleading to describe projects as being 'funded from sources external to the Council'.

- Such projects are only *partially* funded in that manner, and Council is still required to contribute considerable funds of its own, which it simply did not have.

Pg.6 / Paragraph 2 –

- Refer to **Attachment 1** for Council's response to town planning matters.

Pg.6 / Town planning –

- Council disagrees that there is 'no evidence' of risk treatment strategies existing for town planning or building requirements.
- In the paragraphs that follow the statement above, planning scheme provisions are identified which seek to ensure houses are 'not subjected to unreasonable hazards...because of their location'.
- Otherwise, refer to Attachment 1 for Council's response to town planning matters.

Pg.7 / Paragraph 5 –

- Council's view that the State should pursue such legal advice on a State-wide basis is based on a desire to ensure consistency on such matters. Individual councils seeking separate advice could lead to an inconsistent approach across the State. The statement should reflect this.
- Additionally, in accordance with protocols, the LDMG has raised the issue with DDMG about seeking the legal advice required.

Pg.8 / Paragraph 3 / CB Radios –

- It should be noted that CB Radio itself has significant limitations both in range and audience.
- In any event, the use of CB radio would require resources to closely monitor its use and the information being disseminated.

Pg.8 / Telstra offer –

- To the best of Council's knowledge, the Telstra system had not been proven in the field. As such, saying the potential options 'would' have reduced communication issues is being overly optimistic in Council opinion.
- Describing the option as being 'free' is also somewhat misleading. It should be made clear that, while the offer was free for a period of twelve months, it then becomes a pay-for-service arrangement that is limited to two phones.

Pg.9 / Paragraph 1 –

- Council does not believe there is any confusion. The facility was identified in late 2014 and is being assessed for its suitability.
- Any alternative site will require considerable expenditure to meet the needs and requirements of a fully functional LDCC and LDMG.

Pg.11 / Paragraph 3 –

- While Council acknowledges that the LDMG may have not have followed through with action items as expeditiously as it could have, Council disagrees that the LDMG regularly did not follow through on action items. As no examples have been identified, Council cannot otherwise respond to this issue meaningfully.
- As for opinions that Council was too reliant on the knowledge and skills of outside agency personnel, it should be noted that the purpose of the LDMG is to utilise the skills and experience of its core members.
- It should also be remembered that the LDMG is not just a Council function. All core members have roles and responsibilities, and it is unfair to attribute comments solely to 'Council'.

DISASTER MANAGMENT RESPONSE

Pg.4 – LDCC –

- Refer to Council's Timeline Comments.
- The statement that 'many parts of the shire were flooded' is incorrect. As previously stated, there was only flooding in the Biloela area and north eastern area of the Shire.

Pg.5 / Paragraph 1 –

- It is unclear what is meant by 'deficiencies in the control and coordination of the centre's functions'. Council requires further and better details in order to respond meaningfully.
- As for record keeping, all agencies have had training in Guardian and it is their responsibility to update their database accordingly. That said, the statement makes no recognition of the fact that during the height of an event, it is simply not possible to document each and every detail and action. In that respect, Council notes that some of the personal notes made by its officers have not been formally entered into the system. However, some of these notes (e.g. those of the chief executive officer) have been provided to your office as part of this review.

Pg.15 / Emergency Alert / Paragraph 1 –

- It should be noted that the Chair of the LDMG was constantly in touch with the media and other outlets. Refer to Council's Timeline Comments.
- In addition, when communication became problematic, staff rang a number of residents in affected areas, although Council notes that the report is critical of such a 'phone-tree' approach in other parts of the report – unfairly in Council's opinion.

Pg.15 / Emergency Alert / Paragraph 3 –

- Council disagrees with this paragraph.
- The LDMG had to rely on information supplied by SunWater as the dam operator with regard to inflow and release of water from Callide Dam.
- Council believes that focus on the dam gates is justified given that it was the major component of the flood event. However, Council disagrees that any focus was unduly narrowed as a result, as there were also discussions and actions regarding other hazards, such as high winds. For example, a circus was directed to secure its rides as a precautionary measure. Council had also stockpiled sand at key locations in preparation of the event.

Pg.16 / Paragraph 1 –

- Council is unclear what is meant by these statements and cannot meaningfully respond.
- Council has previously stated that the LDCC staff member is a qualified engineer, who is competent with GIS mapping and uses it in her daily role. She had also performed this task during the 2013 flood event.
- The staff member made three attempts to forward the map files to the SDCC. On the third occasion, the SDCC GIS staff advised that the mapping was acceptable.
- The real issue relates to file types, specification and compatibility.

Pg.17 / Last Paragraph –

- The focus on a formal resolution is unnecessary. While there was no formal resolution by the LDMG, staff were nonetheless proactive in preparing maps and alerts on the morning of the 20 February 2015.
- Otherwise, refer to Council's Emergency Alert Comments.

Pg.18 –

- Refer to Council's Emergency Alert Comments.

Pg.18 – Issued Emergency Alert –

- Refer to Council's Timeline Comments, Available Information Comments and Emergency Alert Comments.

Pgs.20, 21, 22 & 23 –

- Refer to Council's Timeline Comments and Emergency Alert Comments.

Pg.23 / Bottom of Page –

- Refer to Council's Timeline Comments and Emergency Alert Comments.
- Cancellation of the advice message was the only option in the circumstances, as a new message was pending.

Pg.24 / Ongoing Issue re: Alert –

- Refer to Council's Timeline Comments and Emergency Alert Comments.

Pg.26 / Top of Page –

- Refer to Council's Timeline Comments and Emergency Alert Comments.

Pg.26 - Effectiveness of Emergency Alert –

- Council is concerned about the accuracy of information given. To Council's knowledge, there is no street close to Callide Dam. In the absence of more precise information, Council cannot respond to this paragraph meaningfully.

Pg.28 - Facebook & Other Warnings / Paragraph 2 -

- Refer to Council's Timeline Comments and Emergency Alert Comments.

Pg.28 - Facebook & Other Warnings / Paragraph 3 –

- The criticisms of the 'phone-tree' approach are unfair in Council's view. Staff made the best of the situation at the time.
- In any event, such actions should be recognised in the various timelines as proactive steps taken at the LDCC to warn residents.

Pg.29 / Paragraph 1 –

- Refer to Council's Timeline Comments and Emergency Alert Comments.

Pg.31 / Paragraph 1 -

- In Council's view, the delays experienced is likely to be a result of the communication issues that were being experienced.

Pg.31 / Last Paragraph Last Sentence –

- Council does not believe this to be practical. The important thing was to advise of the operation of the dam gates as soon as possible. In the circumstances, it is unrealistic to expect the first message upon regaining connectivity to be about communication difficulties.

Pg.34 / SunWater Downstream Residents, Paragraph 3 –

- The view that one hour warning is sufficient is of some concern as emergency alerts can take well over that amount of time to be approved and sent.

Pg.35 –

- Council is concerned about any suggestion that SunWater is only responsible for notifying residents 10km downstream from dam wall.

Pg.38 / First Sentence –

- The LDMG was advised by SunWater that it would review the messages.

Pg.45 / Paragraph 5 –

- Refer to Available Information Comments.

Pg.46 / Paragraph 1 –

- The issue of opening shelters was a conscious decision of the LDMG not to open and was based on the information available at the time.
- The shelters are not wind/cyclone rated so they may offer no greater protection than a house in any event. For example, unlike northern councils in Queensland where purpose-built shelters are built to particular wind ratings, the Civic Centre was built in the late 1970s and was built in accordance with the building regulations, standards and codes at the time.

Pg.46 / Last Paragraph –

- It is important to note that the overtopping of Kroombit Dam itself does not trigger evacuation requirements.

Pg.47 / Paragraph 3 –

- It should be noted that there was the cyclone itself, followed by flooding post-cyclone – both of which occurred at night, which made it difficult to safely mobilise rescue teams.
- As such, Council does not agree with the last sentence in particular, as it was not a resourcing issue but a situational condition issue.

Pg.48 / Paragraph 1 –

- Refer to Council's Available Information Comments.

Pg.48 / Paragraph 2 –

- Refers to 8 hours. This varies depending on the location, the scenario and the event.
- Council believes that identifying a blanket 8 hours is too simplistic.

Pg.53 / Paragraphs 2 & 3 –

- Suggestions that Telstra attended an LDMG meeting to provide a presentation on DisPlan are somewhat misleading. While Telstra did provide a presentation, DisPlan was only one component of that presentation and inadequate emphasis was put forward about the product to allow the LDMG to make an informed decision one way or another. As such, the statement that Council advised Telstra that it did not wish to take up either offer is not entirely correct. It is otherwise noted that the system is not without its limitations and Council is unsure if it has been proven in the field.
- It should be noted that the Whispir system will work on a subscription-based program and does not replace the emergency alert system.

Council trusts that the above concerns will be appropriately considered for inclusion in your final report.

Yours sincerely

Ray Geraghty
CHIEF EXECUTIVE OFFICER

ATTACHMENT 1

Response to town planning matters

Background

Subsequent to the 2010 flood event, the State Government recognised the inadequacy of the majority of flood mapping in Queensland and created the QRA Flood mapping, which is available free on the internet.

The 2005 Banana Planning Scheme included the majority of the shire in the rural zone (characterised by rural production), and this includes the majority of the Shire's flood prone land. This planning scheme approach is normal for the majority of Queensland and was approved by the State Government. The rural zone is extensive and there is a low level of building development which often inhibits the extent and accuracy of flood studies. Much of the rural residential development occurring in flood prone areas of the rural zone is historic (1960's to 1980's) and developed prior to land use planning for natural hazards.

Specific comments

IGEM Cyclone Marcia report page 6/7 town planning section – paragraphs	Council comment/response
We found no evidence of risk treatment strategies for town planning or building requirements. Discussions with community members also indicate this disconnect.	1. Council disagrees that there is no risk treatment strategy identified for land-use planning or building requirements any suggestion that Council does not take its responsibility seriously. 2. Refer to the background statement. 3. Council declared land liable to flooding across the Shire and minimum habitable floor heights for Taroom and Theodore under Council Minute dated 14/12/2011. The resolution is reflective of the effect amendments to the current planning schemes would have had. 4. Consideration of flood hazards under the former State Planning Policy (SPP) and current SPP form part of assessment and reporting for development applications made assessable under the current planning schemes. It should be noted that most development in the Shire including new land subdivisions are assessable development under both schemes. 5. Council is currently preparing a *Sustainable Planning Act 2009* (SPA) compliant planning scheme, which addresses flood hazards. It should be noted that ongoing consultation about flood provisions in the scheme is occurring between Council and State agencies, including the display of the draft scheme for public comment. It should also be noted that changes of Government and significant adjustments to Queensland's planning system have resulted in delays in finalising the draft

IGEM Cyclone Marcia report page 6/7 town planning section – paragraphs	Council comment/response
	planning scheme. 6. Council provides free planning enquiry and pre-lodgement services, and Council staff are available to assist property owners in determining whether properties are mapped and provide additional information from Council's records and GIS system. 7. Council is preparing a flood study to accurately document flood information and new planning scheme. 8. Subsequent to the 2010 flood event, the State Government recognised the inadequacy of the majority of flood mapping in Queensland and created the QRA Flood mapping which is available free on the internet.
The Natural Hazard Risk Assessment report prepared for the Council in 2012 outlines existing preventative and preparedness controls for flood risks. Controls include land use controls and building restrictions, such as zoning, removal of existing buildings, establishing minimum floor levels, and raising buildings. In practice, this does not appear to occur. Lessons identified from previous events, along with information available in the Natural Hazard Risk Assessment Report do not appear to inform town planning, with the exception of Taroom and Theodore. We have been told, however, that Council has lodged an amended planning scheme with government.	1. Subsequent to the 2010 event, Council adopted Council Minute dated 14/12/2011 to adopt the QRA flood mapping as this was the best resource available to Council; the Council resolution was in the form suggested by the State Government. It is noted that the resolution set floor heights for Taroom and Theodore as these were the areas impacted by the 2010 flood event. In any case, the Council resolution should trigger, as a minimum, enquiries about flooding from building certifiers practicing in the Banana Shire (see section 30 (f) of the *Building Act 1975*). 2. Council is currently preparing a SPA-compliant planning scheme which addresses flood hazards. 3. Amendments to the planning scheme to reflect the 2010 resolution could do little more than the resolution provided for. Moreover, given the intensity of the recent events, it may have proved ineffective in terms of the level of inundation. 4. Council is preparing a flood study to accurately document flood information and new planning scheme. 5. Most development in the Shire including new land subdivisions are assessable development under both schemes. This triggers (in identified flood areas) Council's consideration of the SPP provisions for flood (see SPA s313 & s314). This assessment, in practice, has resulted in conditional requirements for new development in flood prone areas

IGEM Cyclone Marcia report page 6/7 town planning section – paragraphs	Council comment/response
	or grounds for refusing applications.
Queensland Reconstruction Authority (QRA) maps are used to show past flood areas (in the form of a map overlay). These maps are not available in high enough resolution to enable the identification of flood levels expected for particular properties.	1. Council provides free planning enquiry and pre-lodgement services, and Council staff are available to assist property owners in determining whether properties are mapped and provide additional information from Council's records and GIS system.
The issues with town planning came to light through an example highlighted to us. Two dwellings in the same street, approved and constructed in the last five years, were inundated in this event. The dwellings were approved after the Callide Valley Flood Study had been prepared for the Council, but before the events of 2013 and 2015. As the land is zoned 'rural', the building applications are therefore self-assessable. According to the council development codes, houses must be situated so they are "not subjected to unreasonable hazards…because of their location". Despite the street being within the QRA flood overlay area, there is no specific information provided by the Council to assist self-assessable applicants to determine what building or location decisions should be made to mitigate against the risk of flood. For one of these residences, the application and approval form that was prepared by the builder and lodged with Council did not acknowledge that the building site was adjacent to a watercourse. This error on the form may not have changed the outcome for the residents during the events of 2015, but is indicative of the lack of attention to detail regarding building controls or associated information.	1. In the case of the two dwellings indentified, Council understands both applications were approved by private certifiers and not Council. The lodging of plans to Council is an administrative process under the *Building Act*. 2. Council assumes the paragraph refers to IDAS Form 1 – Item 10. These application forms are prepared by the applicant in this case and lodged with a private building certifier. The accurate completion of these forms is the responsibility of the private certifier.
Currently, local knowledge appears the most likely factor to stop a similar situation occurring in the future, where a new residence is built on a comparable piece of land. A defined flood event level can be prescribed based on any information available to the Council at the time, including the flood heights in 2013 and 2015. This can be applied across the Banana Shire and is not restricted to only the areas that currently have minimum floor	1. The *Building Act* regime requires all building certifiers (Council and non-Council) to ensure that new dwellings are not affected by surface waters, i.e. no inundation in a Q100 design event. Other building industry best practice standards including the 'Queensland Development Code MP 3.5 – Construction of buildings in flood hazard areas' and 'National Flood Standard' are available for building certifiers and

IGEM Cyclone Marcia report page 6/7 town planning section – paragraphs	Council comment/response
heights.	members of the public when considering the design and location of new dwellings. 2. Council on request provides the best available flood information based on the local knowledge, the Callide flood study, QRA mapping and subsequent information and work. 3. Subsequent to the 2010 event, Council adopted Council Minute dated 14/12/2011 to adopt the QRA flood mapping as this was the best resource available to Council; the Council resolution was in the form suggested by the State Government . It is noted that the resolution set floor heights for Taroom and Theodore as these were the areas impacted by the 2010 flood event. In any case, the Council resolution should trigger, as a minimum, enquiries about flooding from building certifiers practicing in the Banana Shire (see section 30 (f) of the *Building Act*).
The Council is presently pursuing amendments to its Planning Scheme through the Department of Infrastructure, Local Government and Planning (DILGP). The Council's proposed plan has been in draft form for nearly two years, although this is not unusual for local government planning schemes. While it is for the DILGP to assess the appropriateness of the Council's proposed revisions, we note that the Council's proposal appears to include some improvements on its existing land use planning arrangements, including: • Flooding is more prominently highlighted • Floor heights are based on either being (a) above 1% AEP flood height (i.e. a 1 in 100 year flood), or (b) the highest part of the site (if the 1% AEP flood height is unknown).41	1. Council is preparing a flood study to accurately document flood information and new planning scheme. 2. The State Government (DILGP) review the new planning scheme for compliance with the flooding issues and to sign off the new planning scheme. 3. The draft scheme also seeks to: • provide greater strategic direction in terms of land use planning and flooding; and • manage other development in floodplains more effectively.
The absence of flood modelling will still impact the proposed plan, as there will continue to be a reliance on local knowledge about previous flood heights rather than the ability to use more accurate data to inform planning decisions.	1. Council is preparing a flood study to accurately document flood information.

ATTACHMENT 2

Bundle of Further Documents

- LECC Terms of Reference;
- EA Request Template;
- Email to SDCC enclosing relevant EA mapping;
- Email chain to SDCC re EA

APPENDIX D

TERMS OF REFERENCE

Local Emergency Coordination Committee (LECC)

BANANA SHIRE COUNCIL
LOCAL DISASTER MANAGEMENT PLAN

Document Control

Version	Notes	Release Date
1	December 2010 Version	February 2011
2	June 2011 Version	June 2011

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1. BACKGROUND

On the 15 March 2008 as part of the Queensland governments reform of local governments (Local Government Reform Implementation Regulation 2008), new local government boundaries came into affect. This reform has had significant impact in the reduction of Local Disaster Management Groups (LDMG) within Local Government areas.

2. INTRODUCTION

While Local Emergency Coordination Committees (LECC) are not recognized under the *Queensland Disaster Management Arrangements, Disaster Management Strategic Policy Framework* and the *Disaster Management Act 2003*, the Local Disaster Management Group is establishing these committees to assist in preparing for disaster events.

The purpose of the Local Emergency Coordination Committee is to establish a core group of people within the local community, who possess the local knowledge and expertise by providing information to the Local Disaster Management Group to ensure that disaster management and disaster operations within the local area are coordinated.

In the event of a disaster, the LECC does not have an operational role. However, members may be co-opted to assist with the on ground operational activities of the Local Disaster Coordination Centre.

3. DEFINITIONS / LIST OF TERMS, SYMBOLS, ACRONYMS

Disaster	A serious disruption in a community, caused by the impact of an event, that requires a significant coordinated response by the State and other entities to help the community recover from the disruption.
LECC	Local Emergency Coordination Committee
LEOC	Local Emergency Operations Centre
LDMG	Local Disaster Management Group
LDMP	Local Disaster Management Plan
LDCC	Local Disaster Coordination Centre
DDMG	District Disaster Management Group
DDMP	District Disaster Management Plan
DDCC	District Disaster Coordination Centre
SDMG	State Disaster Management Group
SDMP	State Disaster Management Plan
SDCC	State Disaster Coordination Centre
DDC	District Disaster Coordinator
DMA 2003	Disaster Management Act 2003
TOR	Terms of Reference
BSC	Banana Shire Council

4. RELEVANT DOCUMENTATION

Queensland Disaster Management Arrangements;
Queensland Disaster Management Planning Guidelines;
Disaster Management Strategic Policy Framework and
Disaster Management Act 2003.

5. GROUPS

- **Taroom**
- **Theodore / Cracow**
- **Moura / Banana**
- **Baralaba / Rannes**
- **Goovigen / Jambin**
- **Wowan / Dululu**

Biloela and Thangool will be managed by the Local Disaster Management Group.

6. ROLE

To provide information and assistance to the Banana Shire Local Disaster Management Group of potential or approaching disasters using local knowledge, expertise and understanding of social, environmental and economic issues for the local area.

7. FUNCTIONS

Banana Shire Council will establish a Local Emergency Coordination Committee for localities within the Banana Shire Local Disaster Management Group area that can be, in the event of a disaster, isolated from the Corporate Office locality.

Functions of the LECC groups will include but not limited to:

1. To provide relevant local information to the LDMG/LDC to ensure that disaster management and disaster operations in the area are consistent with the State group's strategic policy framework for disaster management in the State;

2. To help the LDMG/LDC prepare a Local Disaster Management sub-plan for its area;

3. To prepare and advise the LDMG/LDC of the requirements for effective local disaster management and regularly review and assess the disaster management arrangements and procedures which are consistent with the Local Disaster sub-plan;

4. To assist the LDMG in determining support services required to facilitate disaster management and disaster operations in the area;

5. To disseminate information from the LDMG to the community of ways of mitigating the adverse effects of an event, and preparing for, responding to and recovering from a disaster;

6. To provide reports and make recommendations to the LDMG/LDC about matters relating to disaster preparedness and operations;

7. To identify local resources available for use by the LDMG/LDC for disaster operations in the area;

8. To identify and review communications system in the LECC, and with the LDMG/LDC for use when a disaster happens;

9. To ensure information about a disaster or major incident in the area is promptly given to the LDMG/LDC; and

10. To perform functions as directed by the LDMG/LDC that is not mentioned in the points above.

8. SCOPE OF THE COMMITTEE

The scope of the Local Emergency Coordination Committee is as follows:

- This group is a local group operating under the direction of the Banana Shire Local Disaster Management Group and/or the Local Disaster Coordinator or delegate;
- It does not have any legal standing within the disaster management system;
- It must follow the direction of the LDMG and/or the Local Disaster Coordinator or delegate; and
- All activities and actions of the group must be appropriately endorsed and/or approved by the LDMG and/or the Local Disaster Coordinator or delegate.

9. MEMBERSHIP

The LDMG has determined the following membership guideline for the LECC as:

BSC Councillor	Chair
BSC Works Foreman (local area)	Deputy Chair
Police OIC	Member
QFRS Representative	Member
QAS OIC	Member
SES Group Leader (where established)	Member
QRFRS Representative (optional)	Member
Community Representative	Advisor

Other government and non government agencies may be called upon by the LECC to provide advice and assistance as required.

10. OPERATIONS

Preparation of Disaster Management Plan
In line with DMA 2003 and consistent with the Queensland Disaster Management Guidelines (for local governments) the LECC shall contribute to the development of the Local Disaster Management Plans and any subsidiary plans as may be relevant to the area.

Review of the Disaster Management Plan
The LECC may review and recommend amendments to the Disaster Management Plan and any relevant subsidiary plans when the group considers it appropriate. Any such recommendations are to be provided in writing to the Local Disaster Management Group.

11. GOVERNANCE

Reporting Arrangements and Key Performance Indicators:
The LECC reports directly to the LDMG. At meetings held during the year the members of the LECC are to provide to the Chair of LDMG a report on agency disaster management arrangements. This information will be collated/recorded and at the end of each financial period, the chair of the LECC must prepare and give to the LDMG a written report about disaster management in the local area. Please refer to **Appendix A** for Report Form.

The report must include the following:
- Information about activities undertaken during the financial year to maintain or enhance the LECC disaster management arrangements;

- Information about priorities for disaster management; and
- Other matters about disaster management the LDMG considers appropriate.

12. FREQUENCY OF MEETINGS

LECC meetings shall be held at least once in every 6 months at the times and places decided by the chairperson of the group. One exercise is to be conducted during the year. This exercise can be incorporated into one of the meetings or as part of a Regional Exercise.

13. QUORUM

A quorum for a meeting of the LECC is the number equal to one half of its members plus 1, or if one-half of its member is not a whole number, then the next highest whole number.

Advisors to the committee do not count toward a quorum.

14. REGISTER OF ATTENDANCE

A register of attendance will be kept as part of the governance of this group.

15. REVIEW OF TERMS OF REFERENCE

This Terms of Reference will be reviewed every two (2) years or whenever deemed necessary by changes to DMA 2003, DM policy, Local Disaster Management Group or organisational structure.

Appendix A

Local Emergency Coordination Committee Report

Report submitted by: (insert name/position)

Agency/organization: (insert name of agency)

Date: / / 20__

Report submitted for inclusion in the minutes of the (insert Local/Agency/Organisation) Disaster Management Group meeting scheduled for (insert full date)

The following activities have been undertaken or are being undertaken by this agency:

PLANNING:

TRAINING (Internal):

TRAINING (External):

OPERATIONS:

EXERCISES:

PROJECTED ACTIVITIES:

DEVELOPMENT PROJECTS:

NATURAL DISASTER RISK MANAGEMENT PROJECT ACTIVITIES: (if applicable)

CONTENTIOUS ISSUES OR MATTERS TO BE RAISED:

GENERAL BUSINESS:

Signed: (Insert Signature)

QUEENSLAND GOVERNMENT Emergency Management EMQ Queensland September 2013	**EMERGENCY ALERT REQUEST**			
	Date:		**Time:**	
	Incident/Event			
	Requesting Agency: (e.g. xxxx LDMG) Contact details			
	Prepared By:		**Position:**	

Event Type	☐ Cyclone ☐ Flash Flood ☐ Flood ☐ Storm Surge ☐ Tsunami ☐ Bushfire ☐ Chemical Spill ☐ Fire Incident ☐ Smoke or Toxic Plume ☐ Other (please specify):
Message Severity	☐ Advice only ☐ Watch & Act ☐ Emergency Warning (**N.B. activates the SEWS**)
LDMG Advised?	☐ YES ☐ NO **DDC Advised?** ☐ YES ☐ NO
Threat Direction Required?	☐ YES ☐ NO Note: Can only be used for Emergency Warnings. Indicate direction on map

1. EA Polygon Area: ☐ Map attached

2. Spatial format:	**Use only these file extensions:**	Indicate the format used:	For spatial data, is it supplied via
ESRI	*.dbf, *.prj, *.shp, *.shx	☐	☐ DMportal - specify filenames below
GML	*.gml, *.xsd	☐	☐ FTP - specify filenames below
KML	*.kml	☐	☐ Email
MapInfo TAB	*.dat, *.id, *.map, *.tab	☐	☐ Other (please specify)
MapInfo Mid/Mif	*.MIDI Sequence, *.mif	☐	

Filename:

3. Handwrite (please use capitals for clarity) or Type Voice message (Ideally message should be less than 450 characters).

4. Type SMS below (maximum of 160 characters including spaces)

OR handwrite SMS in the following boxes.

For use by SDCC: **Authorising Officer** Name:	Approved? ☐ YES ☐ NO Consequence Management ☐	☐ DCS MACC Notified? ☐ IC Notified? ☐ Local Gov Notified?
EA User Name:	☐ Attach EA Status Report	☐ Spreadsheet Updated

DO NOT SEND THIS PAGE

STEPS TO COMPLETE FIELDS 1 - 4

1. **EA Polygon Area** (e.g. detailed description and location reference to allow positive identification of message area, including street names with cross street, areas of interest such as parks, rivers, dams, coastal areas) it is preferable to attach a map identifying the message area. If a Threat Direction has been requested, please clearly indicate it on the map.

2. Tick applicable box and note the file name.

3. **Voice Message** Handwrite or type the required message. As the message will be translated by a Text To Speech process it is important that words are not unintelligible when translated e.g. "qld" used in a web site address must be entered as "q l d", similarly the word "dot" must be entered into a web address instead of a full stop.

   Voice Message ideally should have no more than 450 characters including spaces. Do not use special characters – refer to EA Operational Guidelines for details. Warning message must start with "Emergency Emergency"

   Example Voice: *Emergency, Emergency. This is a Flash Flood Warning from the State Emergency Services. Areas in the Opal Valley are likely to experience rapidly rising water levels and property inundation over the next 2 hours, posing an immediate danger to residents. You should warn neighbours, secure your belongings and move to higher ground now. For more information listen to local radio. For flood assistance contact the State Emergency Services on 1 3 2 500*

4. **SMS** Is restricted to a maximum of 160 characters including spaces and punctuation. Either type the message or handwrite the characters into the boxes.

   Example *SMS Flash Flood Warning from SES for Opal Valley-immediate threat to life/property-Warn others-Leave area/prepare NOW or seek higher ground-Listen to local radio*

If using existing EA templates, please provide the appropriate variables that are in the template. Refer to the Queensland Emergency Alert Guidelines for copies of the templates.

//DIRECTIONANDAREA//

//NAME//

//NUMBER//

//TIME//

//TIMEandDAY//

//DIRECTIONandPLACE//

//HOURSMINUTES//

//PLACE//

//PLACEPLACE//

//EXTERNAL/INTERNAL//

//SUBURBS//

//FireIncident//

From: [redacted]
Sent: Friday, 20 February 2015 8:09 PM
To: [redacted]
Subject: Banana Shire Disaster Centre - Map

Here is the mapping as discussed. Please let me know if you are still having problems. My number is [redacted]

Thanks

[redacted]

[redacted]

Disaster Management Coordinator
[redacted] enquiries@banana.qld.gov.au | www.banana.qld.gov.au
Biloela Office: 62 Valentine Plains Road | Taroom Office: 18 Yaldwyn Street
Moura Office: 34 Gillespie Street | Postal: PO Box 412 Biloela QLD 4715

From: SDCC [SDCC@qfes.qld.gov.au]
Sent: Friday, 20 February 2015 8:29:38 PM
To: [redacted]
Subject: RE: Banana Shire Coordination Centre - Map

Hi [redacted]

In the event that the map still does not load after following this attempt with GIS.

I have free drawn the polygon in EA. Could you please review attached and advise.

Regards,

[redacted]

State Duty Officer
State Disaster Coordination Centre | Queensland Fire and Emergency Services
[redacted]

From: [redacted]
Sent: Friday, 20 February 2015 6:18 PM
To: SDCC
Cc: [redacted]e@police.qld.gov.au'; [redacted]@police.qld.gov.au'; [redacted]
Subject: RE: Banana Shire Coordination Centre - Map

Hi [redacted]

Last advice I had was that your GIS were ok with the map. Given the problems encountered the Local Disaster Coordinator has advised that the request for the advisory alert should be cancelled 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.

Thanks for your assistance.

[redacted]

Disaster Management Coordinator
[redacted] enquiries@banana.qld.gov.au | www.banana.qld.gov.au

Biloela Office	Taroom Office	Moura Office	Postal
62 Valentine Plains Road	18 Yaldwyn Street	34 Gillespie Street	PO Box 412 Biloela QLD 4715

Please consider the environment before printing

From: [redacted] **On Behalf Of** SDCC
Sent: Friday, 20 February 2015 6:11 PM
To: [redacted]
Subject: FW: Banana Shire Coordination Centre - Map

Hi [redacted]

GIS are still attempting to open the map file.

Would you please scan the map if possible and email a copy down?

Regards,[redacted]
[redacted] | **State Duty Supervisor, State Disaster Coordination Centre**
Queensland Fire and Emergency Services
[redacted]

From: [redacted]
Sent: Friday, 20 February 2015 5:31 PM
To: SDCC
Subject: Banana Shire Coordination Centre - Map

As discussed with Tony and GIS person

[redacted]

Disaster Management Coordinator
[redacted] enquiries@banana.qld.gov.au | www.banana.qld.gov.au
Biloela Office: 62 Valentine Plains Road | Taroom Office: 18 Yaldwyn Street
Moura Office: 34 Gillespie Street | Postal: PO Box 412 Biloela QLD 4715

Please consider the environment before printing

Appendix E

Submission by SunWater

Please note some components from this submission have been either omitted or redacted for the purposes of protecting infrastructure security and preventing the publication of personal information.

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Contact: [redacted]
Direct Line: [redacted]
Our ref: 15-000984/001 - #1712317
Your ref: nil

SunWater Limited
PO Box 15536 City East
Brisbane Queensland 4002
www.sunwater.com.au
ACN 131 034 985

17 April 2015

Office of the Inspector-General Emergency Management
GPO Box 1425, Mail Cluster 15.7
Brisbane QLD 4001

BY EMAIL: info@igem.qld.gov.au

Dear Mr MacKenzie

2015 Callide Creek Flood Review
Public Submission of SunWater Limited

I understand that as part of the 2015 Callide Creek Flood Review, the Office of the Inspector-General Emergency Management (**IGEM**) is accepting public submissions.

As an interested organisation, SunWater has prepared the **attached** submission. SunWater will also hand deliver a copy of the submission and all appendices to your office on an electronic storage device.

I agree to my submission being treated as outlined in the "Guide to providing submissions" on the IGEM website.

Please contact SunWater's project manager for the Callide Review, [redacted], on [redacted] via email [redacted] if SunWater can be of any assistance or offer any further explanation.

Yours sincerely

Thomas Vanderbyl

Tom Vanderbyl
General Manager
Bulk Water and Irrigation Systems

Att(s)
Attachment – 2015 Callide Creed Flood Review – Submission of SunWater Limited

MAKING WATER WORK

SunWater Limited
Level 10, 179 Turbot Street
PO Box 15536 City East
Brisbane Queensland 4002
www.sunwater.com.au
ACN 131 034 985

Inspector-General Emergency Management

CALLIDE CREEK FLOOD REVIEW

Submission by SunWater
17 April 2015

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APPENDIX C: Resource Operations Plan – Fitzroy Basin

APPENDIX D: Callide Dam Safety Condition Schedule

APPENDIX E: 2013 Flood Review - Summary Status of Recommendations

APPENDIX F: Summer Preparedness Paper – September 2014

A Context

1 The Callide Creek Flood Review is being carried out by the Inspector General Emergency Management.

2 In accordance with the functions of the IGEM as set out in the *Disaster Management Act 2003* and the Terms of Reference for the Callide Creek Flood Review, the IGEM is to review the circumstances of the Callide Creek flood event during Tropical Cyclone Marcia to determine whether disaster management arrangements and Callide Dam planning and operations were effective, and identify opportunities to improve disaster management.

3 Under the Terms of Reference, the review is to report on:

(a) The impact to the community of the Callide Valley from the flooding event on Friday 20 February 2015.

(b) The operation of the Callide Dam in the lead-up to and during the event, including:

(i) whether recommendations from the report on the "Review of Callide Dam Gate Operations in the January 2013 Flood Event" were implemented, and did, or would have if implemented, affected the impact to the community;

(ii) the application of the Emergency Action Plan including integration with relevant disaster management plans;

(iii) whether the operating specifications of the Callide Dam at the time of the event were reasonable.

(c) Disaster management arrangements, specifically:

(i) risk assessment and hazard mitigation strategies;

(ii) disaster management planning and disaster operations, including warnings;

(iii) engagement and communications, including with the community.

(d) Performance of critical telecommunications infrastructure in the event.

4 The IGEM has called for public submissions to assist with the review.

5 This is a submission by SunWater Limited, the owner and operator of Callide Dam. It is principally directed to the Terms of Reference referred to in paragraph 3(b) above.

6 This submission is structured as follows:

(a) Section B contains an executive summary;

(b) Section C provides background information on SunWater, Callide Dam and the regulatory environment for dam operations;

(c) Section D addresses the 2015 Flood Event, including SunWater's preparedness for the event and the details of the event itself;

(d) Section E examines the suggestion that the Callide Dam level should have been lowered in advance of the flood event; and

7 This submission draws from the following material that has previously been provided by SunWater to the IGEM including:

(a) Callide Dam Emergency Event Report 20-22 February 2015 (***Event Report***);

(b) Report to Support Callide Dam 2015 Flood Review Request for Documents dated 1 April 2015 (***Background Briefing Paper***).

8 As is standard practice for it, SunWater has conducted a lessons learnt exercise into the 2015 Flood Event. The lessons learnt has produced a number of findings and recommendations for future action. A copy of the lesson learnt report which includes number of findings and recommendations for future action is at **Appendix A.**

9 SunWater welcomes the opportunity to provide further information, or to address any other matters raised during the review or in the public submissions, as and if requested by the IGEM.

10 In particular, SunWater would be willing to make SunWater's modelling experts available to the IGEM's hydrology experts to assist their understanding in relation to the hydrologic modelling inputs and outcomes that are referred to in this submission.

B Executive Summary

Tropical Cyclone Marcia

11 Tropical Cyclone Marcia crossed the Queensland coast north of Yeppoon on 20 February 2015. It travelled in a southerly direction towards the Callide Dam catchment once making landfall.

12 The Bureau of Meteorology forecast that the catchment above Callide Dam would receive between 100-150 millimetres that day. The forecast did not include (as is customary) a prediction of either the intensity or the spatial and temporal distribution of the forecast rainfall. Accordingly, it was not possible in advance of the rainfall to reliably predict the likely run-off from the forecast rainfall.

SunWater's preparations

13 In advance of the arrival of Marcia, SunWater, as owner and operator of Callide Dam, had made all necessary arrangements to be ready to at Callide Dam, if required. In particular, SunWater had:

(a) undertaken standard wet season readiness preparations;

(b) been in close contact with the Local Disaster Management Group; and

(c) closely considered, and was ready to enact, the Emergency Action Plan for Callide Dam. It is necessary for IGEM to understand that SunWater's role in an emergency such as Tropical Cyclone Marcia is limited to monitoring inflows and communicating in accordance with the Emergency Action Plan and to pass flows.

14 SunWater did not reduce the lake level in Callide Dam prior to the arrival of Marcia as this was outside of the dam's operating licence and it would have been an offence for SunWater to do so. In any event, there was no reasonable justification for discharging large volumes of water in advance of the flood event. As to this:

(a) The forecast rainfall (100-150 millimetres) was not substantial in terms of the dam's capability. Indeed, depending on the spatial and temporal distribution of the rainfall, the dam may not have even filled with that depth of rainfall (bearing in mind the dam was at 84% at the commencement of the event).

(b) The forecast could not be relied on to release water. The Bureau's forecasts are, by their nature, inherently unreliable.

(c) Depending on the nature of the flood, the lowering of the level would not necessarily provide any substantial flood mitigation benefits.

(d) The forecast track range of the cyclone was uncertain and could not be relied upon to not change. A number of other dams in other central Queensland catchments potentially in the path of Marcia (namely Bjelke-Petersen Dam and Boondooma Dam) received minimal inflows as a result of the rainfall event.

Intense, unpredicted rainfall

15 On arrival of Marcia, the catchment above Callide Dam was affected by intense rainfall.

16 The catchment above Callide Dam received 48 hour rainfall totals of between 200mm and 350mm, although much of this fell in the 5 hours between 16:00 and 21:00 on 20 February 2015. The depth and intensity of this rainfall was not forecast.

17 At the the Kroombit Tops DNRM gauging station, the rainfall intensity was approaching 1 in 1,000 year Annual Exceedance Probability (AEP). Over 6 hours from 14:00 to 20:00, the total rainfall at the Kroombit Tops DNRM gauge was 251mm.

Gate operations were automatic

18 Callide Dam is a water supply dam. It is not a flood mitigation dam.

19 The gates are designed to operate automatically once storage levels exceed the design full supply level. The dam does not contain a dedicated flood storage compartment, with the effect that as dam inflows are received at or above full supply level, they are passed downstream. The automatic operation is purely driven by hydraulic floats and occurs without the need for electrical controls or motors.

20 Following investigations SunWater included, as a temporary measure, provisions within the Emergency Action Plan to override operation of the gates in order to maintain the storage level at slightly less than the design full supply level. This temporary measure was introduced to support precautionary monitoring and investigation of a section of the dam embankment.

21 This did not occur on 20 February 2015 given there were cyclonic winds in the area. No criticism can be made of the operators for deciding that it was unsafe to manually operate the gates under these conditions. As a result, all water releases occurred automatically and in accordance with design.

Communications with Local Disaster Management Group and downstream residents

22 SunWater was in constant contact with the Local Disaster Management Group throughout the event. As to this:

(a) SunWater had 13 separate communications with the Local Disaster Management Group between 17:08 and 23:41 on 20 February 2015.

(b) Before any water was released from Callide Dam, SunWater informed the Local Disaster Management Group that automatic release of water was imminent. Earlier communications from SunWater to the Local Disaster Management Group specifically alerted to the possibility of releases within hours.

23 SunWater also notified the residents referred to in the Emergency Action Plan by SMS sent at 20:39 on 20 February 2015 that flooding was expected and there were "*rapid rises*". Follow up phone calls were made to those residents listed in the Emergency Action Plan between 20:39 and 21:02. A further SMS was sent at 22:37 advising of "*Flood Stage 4*".

24 Whilst it might be argued that the notice given to residents of the releases was short, this was merely a function of the intensity of the rainfall and the unprecedented rate of rise in the dam, and not as a result of any delay or fault on the part of SunWater. To put the matter in perspective, at 18:00 on 20 February 2015 the storage level was 214.46m, a rise of only 0.17m from the morning. By 20:15, the storage level was 215.92m and was rising at the unprecedented rate of 1.6m per hour.

Downstream impacts

25 Since the 2015 Flood Event there have been questions raised about the extent to which releases from Callide Dam impacted on downstream communities. SunWater has undertaken preliminary modelling to investigate these impacts.

26 The following conclusions can be drawn from the modelling in relation to the impacts at Goovigen, Jambin and Biloela:

(a) There is no doubt that even though Callide Dam is not a flood mitigation dam it nevertheless attenuated the peak of the flood.

(b) Downstream flooding impacts were substantially caused by waters emanating from locations other than Callide Dam, with major flood levels experienced at Goovigen and Jambin before any of the peak discharges from Callide Dam arrived at those locations.

(c) When the peak discharges from Callide Dam arrived at Goovigen and Jambin, the result was to create a minor increase in flood levels at those locations, which were already experiencing major flood levels.

(d) Modelling confirms that peak flood levels around Biloela in this flood event were caused by discharges from the Kroombit Creek catchment and the discharge from Callide Dam made less than an estimated 1cm difference to the flood peak in the immediate vicinity of Biloela.

(e) Even if Callide Dam had commenced the flood event at the fixed spillway crest level (being 41% of the design full supply level), which was not permitted, the modelled reduction in flood levels at Goovigen and Jambin are minor (260mm and 130mm respectively) compared to the size of the flood that was experienced.

C SunWater and Callide Dam

C1 Preliminary

27 SunWater is a government owned corporation.

28 SunWater owns and operates 22 water supply schemes. All are bulk water supply schemes that supply untreated water for irrigation, mining, power generation, groundwater replenishment and stock watering.

29 As a part of this, SunWater owns and operates a large number of referable dams, one of which is Callide Dam. Details of the physical characteristics of Callide Dam are contained in Section 3.3 of the Background Briefing Paper.

30 SunWater has a world class and comprehensive dam safety management program. Details of this program and the independent review of it by Len McDonald, Past Chair of ANCOLD, are included in Section 3.2 of the Background Briefing Paper.

C2 Role of SunWater in the emergency framework

31 When conducting the review, it is necessary for the IGEM to understand the important, but limited, role that SunWater has in emergency management.

32 A summary of the roles and responsibilities in Queensland's tiered disaster management arrangements is set out in Section 2 of the Background Briefing Paper. SunWater also notes that the Queensland Floods Commission of Inquiry Interim Report examined the roles and responsibilities of the various agencies (see, in particular, Chapters 3 and 4 of the Interim Report).

33 By way of summary, during flood event emergencies:

(a) SunWater's role is to:

(i) monitor inflows to the dam and provide notifications of outflows to a limited number of stakeholders in accordance with the Emergency Action Plan – this is addressed further below;

(ii) pass water inflows through the dam's spillway or outlet works in accordance with the operational procedures for the dam.

(b) It is not SunWater's role to provide flood warnings. This is the role of:

(i) the Bureau of Meteorology in respect of riverine or non-flash flooding;

(ii) Councils in respect of flash flooding (being flooding arising less than 6 hours after the rain).

(c) It is not SunWater's role to translate flood predictions into the likely impact on local communities in terms of inundation of properties. That is the role of Councils.

(d) Except in a very limited case (discussed below), it is not SunWater's role to warn the local community. Generally, that is a role for Councils. Following the Queensland Floods Commission of Inquiry, changes were made to the legislative regime[1] to make dam operators such as SunWater responsible for providing a very limited number of warnings – namely, to those people who live immediately downstream of dams where there is insufficient time for the Local Disaster Management Group to process the information and issue the warning. Accordingly, Emergency Action Plans now contain references to specific individuals who live in close proximity to the dam who will be warned directly by the dam operator. The content of the warning is limited to the timing

[1] The changes were incorporated into Chapter 4, Part 1, Division 2A of the *Water Supply (Safety and Reliability) Act 2008.*

and volume of outflow from the dam. As the Queensland Floods Commission of Inquiry made clear:[2]

(i) it is not the dam operator's responsibility to predict river heights or inundation areas; and

(ii) downstream residents have a responsibility to apprise themselves of how outflows from a dam will affect their property.

34 Accordingly, it should be acknowledged that SunWater's only relevant obligation when dealing with the 2015 Flood Event, insofar as it is relevant to the disaster management framework, was to comply with the Emergency Action Plan. The Emergency Action Plan's role in the overall regulatory framework applicable to SunWater is addressed in the Section C3 below.

C3 Regulatory framework governing SunWater's operations

35 The regulatory framework governing dam operations is complex.

36 A summary of the relevant regulatory framework is set out in Sections 3.1 and 3.2 of the Background Briefing Paper. The following key observations can be made.

ROP limitations on water releases

37 SunWater holds a Resource Operations Licence (***ROL***) authorising interference with the flow of water in the Callide Valley Water Supply Scheme as detailed in Chapters 4 and 8 of the Fitzroy Basin Resources Operations Plan (***ROP***).[3] SunWater's ROL is **Appendix B**.

38 The ROL applies to the water infrastructure detailed in Attachment 12, Part 5 of the ROP, which includes Callide Dam.

39 It is an offence to contravene a condition of a ROL.[4]

40 The conditions of SunWater's ROL (condition 1) oblige SunWater to comply with the operating requirements and supply arrangements set out in the ROP. The ROP is a statutory instrument issued under the Water Act. The ROP is **Appendix C**.

41 The operating rules and water sharing rules for Callide Dam (being the operating requirements referred to in the preceding paragraph) are contained in Chapter 8 Parts 1 and 2 of the ROP.

42 In line with these requirements, SunWater must not release water from Callide Dam other than for groundwater recharge or the supply of water for stock and domestic purposes and in accordance with an approved release strategy.

43 Importantly, the release of water by SunWater, in advance of a flood event, to provide capacity in the dam for a future flood, is not permitted. If SunWater did so, it would commit an offence (because, for the reasons set out above, it would have contravened the ROL).

44 There are logical reasons why this prohibition exists. Callide Dam is a water supply dam. It is not a flood mitigation dam. Callide Dam supplies water to the Callide power stations. It also supplies irrigation customers (through recharging groundwater) and the township of Biloela. The operating rules are designed to ensure that water is preserved for these valuable purposes and not discharged because there is the possibility of rain.

45 It is also important to note that the ability of the Minister to declare a temporary full supply level to mitigate against floods only relates to dams for which an approved flood mitigation manual is in force. This does not apply to Callide Dam. Accordingly, the statutory regime for temporarily lowering full supply levels in Chapter 4 Part 3 of the *Water Supply (Safety & Reliability) Act 2008* does not apply to Callide Dam.[5]

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[2] Queensland Floods Commission of Inquiry Interim Report, page 138.
[3] The ROL is held under the Water Act.
[4] Section 875 of the Water Act
[5] See section 389.

Compliance with Dam Safety Conditions

46 Under the *Water Supply (Safety & Reliability) Act 2008*:

(a) The Chief Executive can apply dam safety conditions to a referable dam such as Callide Dam.[6]

(b) It is an offence for the owner of a referable dam to which a safety condition applies to contravene the condition.[7]

47 The Dam Safety Conditions for Callide Dam are **Appendix D**.

48 Relevantly, the Dam Safety Conditions require:

(a) That the dam be operated and maintained in accordance with the detailed operating and maintenance manuals prepared in accordance with the Queensland Dam Safety Management Guidelines (condition DS8);

(b) That the dam be operated in accordance with specific standard operating procedures (condition DS7);

(c) That in all emergencies the dam be operated in accordance with the Emergency Action Plan for the dam (condition DS13).

49 Consistently with these requirements (and as explained further below), SunWater has:

(a) an operations and maintenance manual for Callide Dam, which includes at Appendix A of manual, the procedures to be followed during flood events;

(b) standing operating procedures;

(c) an Emergency Action Plan.

[6] Section 353.
[7] Section 356A.

D 2015 Flood Event

D1 Preparedness

50 SunWater was well prepared to carry out operations at Callide Dam.

51 Four matters should be mentioned.

52 *First*, Callide Dam experienced the flood of record in 2013. Following that event, the Department of Energy and Water Supply engaged an independent expert (Water Solutions) to undertake a review of the dam operations during the event.

53 The report contained a series of recommendations to be addressed by SunWater, the Department and the Local Disaster Management Group.

54 SunWater fully considered each recommendation which related to it and accepted most of them.

55 Where SunWater accepted the recommendations, they were implemented by SunWater in advance of the 2015 Flood Event or, in a limited number of cases, implementation is ongoing.

56 As to this, SunWater directs the IGEM to **Appendix E**, which is a summary of each recommendation relating to SunWater in the independent review and SunWater's response to that recommendation. SunWater would be happy to provide further detail if required.

57 *Secondly*, as is standard procedure for it, SunWater conducted its own "lessons learnt" from the 2013 flood. That process led to (amongst other things) further refinements to the Emergency Action Plan and operations and maintenance manual (see further below).

58 It is noted that after the 2015 Flood Event some questions have been asked whether SunWater learnt anything from the 2013 flood event. The above analysis demonstrates that SunWater did implement learnings from the 2013 flood event.

59 *Thirdly,* as is standard procedure for it, SunWater conducted extensive wet season preparation. **Appendix F** is the summer preparedness paper submitted to the Executive Management Committee in September 2014 summarising the preparatory steps SunWater had undertaken. Further detail on the specific training that had been undertaken is included in Section 2.5 of the Background Briefing Paper.

60 *Fourthly*, the Emergency Action Plan had been reviewed and consultation with the Local Disaster Management Group had been undertaken. Details of this are contained in Section 6 of the Background Briefing Paper. Importantly:

(a) The Emergency Action Plan was updated after the 2013 flood event, and it incorporated the learnings from that event.

(b) Consultation with the Local Disaster Management Group occurred before the Emergency Action Plan was submitted for approval.

(c) The Chief Executive of the Department approved the Callide Emergency Action Plan (Version 3E) on 29 May 2014.

(d) SunWater gave further consideration to the Emergency Action Plan in December 2014 and submitted an updated version (Version 3F) with minor amendments to the Chief Executive on 11 February 2015.

(e) SunWater met with staff of the Local Disaster Management Group on 2 February 2015 to discuss the Emergency Action Plans for dams in the area including Callide Dam.

(f) In preparation for the arrival of Tropical Cyclone Marcia, SunWater gave further consideration to the Emergency Action Plan and submitted a further updated version (Version 3G) with minor amendments to the Chief Executive on 19 February 2015. The changes from the approved version of the Emergency Action Plan to Version 3G were minor.

(g) From the time the Local Disaster Management Group activated to ALERT level on 18 February 2015, SunWater was in contact with the Local Disaster Management Group.

D2 2015 Flood Event details

61 Section 4 of the Background Briefing Paper contains a comprehensive analysis of the 2015 Flood Event and SunWater's management of its assets and responsibilities.

62 Whilst the entirety of that material is relied on by SunWater, the following points should be noted.

Pre-event

63 SunWater was in close contact with the Local Disaster Management Group from 18 February 2015, two days before the flood event.

64 SunWater participated in three Local Disaster Management Group meetings held on 20 February 2015.

65 At the commencement of the event, the dam was at 84% of the design full supply level.

66 The Bureau of Meteorology forecast rainfall for the Callide Creek catchment for 20 February 2015 predicted 100-150 millimetres for the 24 hour period.

67 The Bureau of Meteorology forecast did not include (as is customary) a prediction of either the intensity or the spatial and temporal distribution of the forecast rainfall. Accordingly, it was not possible in advance of the rainfall to reliably predict the likely run-off from the forecast rainfall. Indeed, there were infinite permutations, ranging from minor run-off that would not fill the dam to a significant flood event.

Intense rainfall in a short period

68 SunWater has conducted a preliminary analysis of the rainfall event. The comments below are based on this analysis.

69 Tropical Cyclone Marcia moved in a southerly direction with extreme rainfall along the Calliope Range and the eastern side of the Callide Valley, moving over Bell Creek and Goovigen first and passing the southern catchment boundary by about 21:00 on 20 February 2015.

70 **Figure 1** shows the rainfall distribution of 48 hour rainfall totals from 9am on the 19 February 2015 to 9am on 21 February 2015.

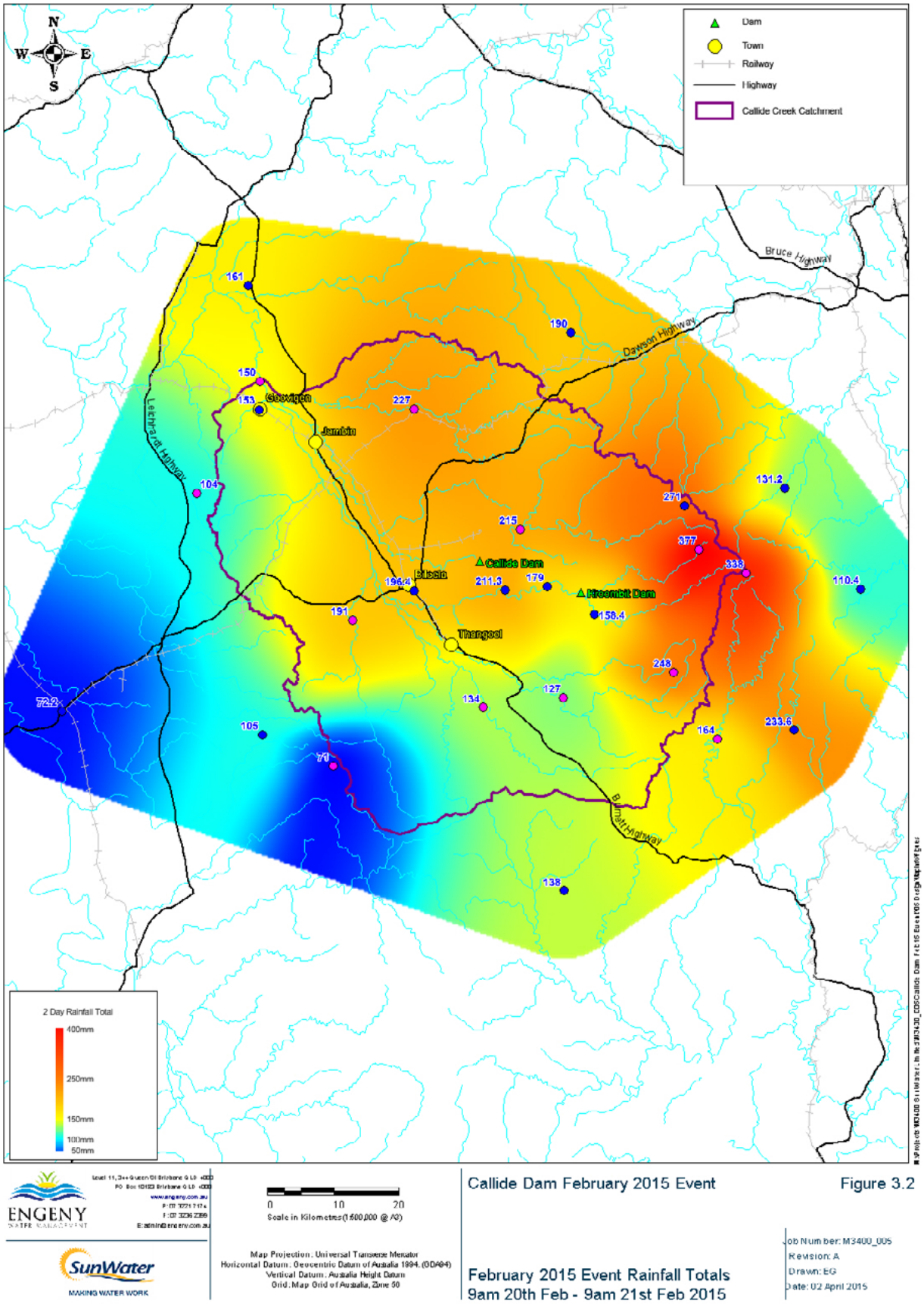

Figure 1 Rainfall Distribution February 2015

71 The following points are evident from **Figure 1**.

72 The first catchment to receive rainfall in the catchment upstream of Goovigen was Bell Creek catchment where rainfall commenced during the afternoon and was at its most intense between 16:00 and 17:00 as measured at Craiglands gauging station. Gerard, Smoky and Back Creek catchments (all ungauged) responded and record flood levels were recorded at Craiglands along Bell Creek. A height of 8.45m was recorded at 20:48 on 20 February 2015.

73 As Tropical Cyclone Marcia moved south, catchments responded in turn with inflows from other tributaries such as Oaky Creek, discharging from the Gully Trap Mine vicinity.

74 The catchment above Callide Dam received 48 hour rainfall totals of between 200 mm and 350 mm, although much of this fell between 16:00 and 21:00 on 20 February 2015. The depth and intensity of this rainfall was not specifically forecast for the catchment.

75 With such intense rainfall in such a short period, the river height station '96k' was inundated by Callide Creek floodwaters and was unable to record the peak flood level. Flood marks inside the hut indicate a peak gauge height of 11.18m (depth) was reached.

76 Analysis of the reservoir level and gate opening monitoring data for Callide Dam indicates that a peak inflow to Callide Dam of approximately 5,800 m^3/s occurred at around 21:00 pm on 20th February 2015. Significant attenuation of the flood through the dam resulted in a peak discharge from the dam of around 3,400m^3/s at 22:00 on 20th February 2015. This is evident from **Figure 2**, which demonstrates the estimated inflows and outflows from Callide Dam.

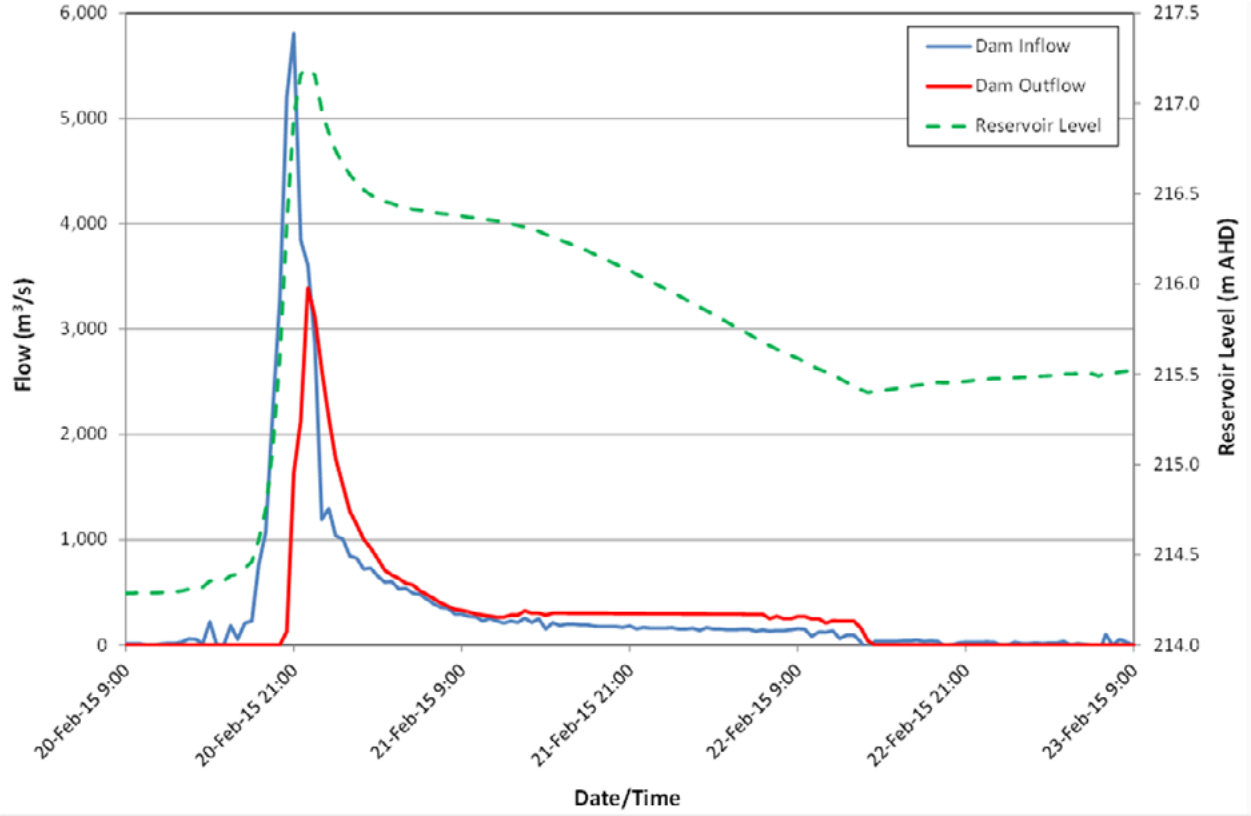

Figure 2 Estimated Inflows and Outflows – Callide Dam 2015

77 As Tropical Cyclone Marcia moved south, the Kroombit, Kariboe and Grevillia catchments reached record levels with peaks as shown in **Table 1.** The rainfall in Kroombit Creek catchment was at its most intense at the Kroombit Tops DNRM gauge with 173mm of rain recorded in the 3 hours from 17:30 to 20:30.

Location	Gauge Height (m)	Time
Bell Creek at Craiglands	8.45 (R)	20:48 on 20 February 2015
Callide Dam	217.19 (R)	22:00 on 20 February 2015
Kroombit Dam	268.36 (R)	22:00 on 20 February 2015
South Kariboe Creek at Pump Station	8.66 (R)	23:10 on 20 February 2015
Grevillea Creek at Folding Hills	6.577(R)	02:00 on 21 February 2015
Prospect Creek at Red Hill	5.285	03:00 on 21 February 2015
Goovigen at Goovigen gauging Station	2 peaks – 10.73(1st peak) 10.99 (2nd peak)	 06:00 on 21 February 2015 18:30 on 21 February 2015

Table 1 Recorded Flood heights in the Callide Valley (R) Record Flood Height

78 Australian Rainfall and Runoff intensity frequency duration curves sourced from the Bureau of Meteorology website confirm the rare and intense nature of the rainfall at elevated locations in the Callide Valley. Within the Kroombit Dam catchment, this was approaching 1 in 1,000 year AEP. Over 6 hours from 14:00 to 20:00, the total rainfall at the Kroombit Tops DNRM gauge was 251mm.

Dam operations

79 Under the Emergency Action Plan and operations and maintenance manual for the dam, SunWater is to manually operate the gates when the dam reaches 215.5m,[8] provided it is safe to do so.

80 This was not done on 20 February 2015 given Tropical Cyclone Marcia was tracking close to the dam and there were cyclonic winds in the area.

81 No criticism can be made of the operators for deciding that it was unsafe to manually operate the gates.

82 As a result, all water releases occurred automatically and as designed.

Close communication with Local Disaster Management Group

83 Once the event commenced, SunWater was in constant contact with the Local Disaster Management Group in accordance with the Emergency Action Plan.

84 As to this:

(a) SunWater had 13 separate communications with the Local Disaster Management Group between 17:08 and 23:41 on 20 February 2015.

(b) Before <u>any</u> water was released from Callide Dam, SunWater informed the Local Disaster Management Group that automatic release of water was imminent. This communication occurred at 20:18. Earlier communications from SunWater to the

[8] In the approved Emergency Action Plan this is stated as 215.10m. This was one of the changes submitted to the Dam Safety Regulator in Versions 3F and 3G submitted in accordance with Section 352Q of the Act.

Local Disaster Management Group at 19:03 and 19:52 specifically adverted to the possibility of releases within hours.

(c) Whilst it might be argued that the notice of imminent releases was short, this was through no fault of SunWater. It was a function of the intensity of the rainfall and the unprecedented rate of rise in the dam. In this regard, at 18:00 the storage level was 214.46m, a rise of only 0.17m from the morning. By 20:15, the storage level was 215.92m and was rising at the unprecedented rate of 1.6m per hour.

Notification to immediately downstream residents

85 SunWater notified the residents referred to in the Emergency Action Plan by SMS sent at 20:39 that flooding was expected and there were "*rapid rises*". Follow up phone calls were made to those residents listed in the EAP between 20:39 and 21:02.

86 A further SMS was sent at 22:37 advising of "*Flood Stage 4*".

87 Again, whilst it might be argued that the notice given to residents of the releases was short, this was merely a function of the intensity of the rainfall and the unprecedented rate of rise in the dam, and not as a result of any delay or fault on the part of SunWater.

Downstream impacts

88 Since the 2015 Flood Event there have been questions raised about the extent to which releases from Callide Dam impacted on downstream communities.

89 SunWater has undertaken preliminary modelling to investigate these impacts.

90 A number of points should be made.

91 *First*, there is no doubt Callide Dam attenuated the flood. As shown in **Figure 2**, the existence and operation of Callide Dam resulted in a substantial reduction in the peak flow at that location.

92 *Secondly*, the rainfall was catchment wide. It would be wrong to conclude that floodwaters emanating from upstream of Callide Dam were the major contributors to flood volumes downstream. This is demonstrated in **Table 2**. As is evident, of the estimated 400GL flood inflow volume from the catchment to Goovigen, only 21% emanated from upstream of Callide Dam.

Waterway / Location	Flood Inflow Volume (GL) to Goovigen	% of Flood Inflow Volume to Goovigen
Kroombit Dam	49	12%
Kariboe Creek at Thangool	35	9%
Grevillea Creek at Thangool	22	6%
Callide Dam	82	21%
Other inflows	134	32%
Total Flow to Jambin	322	(80%)
Bell Creek / Gerard Creek catchment	78	20%
Total Flow to Goovigen	**400**	(100%)

Table 2 Estimated Contributions to Flood Inflow Volumes

93 *Thirdly*, when analysing downstream impacts, it is very important to bear in mind the timing of the releases from Callide Dam and the travel time for peak flows to downstream locations. As indicated in the Emergency Action Plan and modelling of the 2015 event, travel time to Goovigen is not less than 19 hours and travel time to Jambin is not less than 12 hours.

94 The following comments can be made about the impacts at Goovigen, Jambin and Biloela.

Goovigen

95 Goovigen was impacted by discharge from the Bell Creek early on 21 February 2015 with an initial peak level of 10.73m at 6:00am on 21 February 2015. This is confirmed by modelling and given the time of the peaks observed elsewhere is the only explanation for the first peak observed at Goovigen.

96 Water levels then steadied prior to a second peak arriving from upstream areas composed of discharge from the Callide, Kroombit, Grevillea and Kariboe Creek catchments.

97 The second peak was observed at Goovigen around 18:30 on 21 February 2015 about 20 hours after peak discharges from Callide and Kroombit Dams.

98 The combination of Kroombit Creek discharge, combining with Kariboe and Grevillea Creek catchment discharges exceeds the discharge and volume from Callide Dam and so the timing of the second peak is largely driven by this discharge, albeit with a significant contribution from Callide Dam.

99 Goovigen was already experiencing major flood levels (classified by the Bureau of Meteorology as greater than 10.5 metres) by 03:30 on 21 February 2015.

100 It is not possible for any discharge from Callide Dam to have reached Goovigen only 5.5 hours after peak discharge. Accordingly, the major flooding experienced in Goovigen in the early hours of 21 February 2015 was not contributed to by releases from Callide Dam. As noted above, Goovigen had already experienced major flood levels by this time.

101 **Figure 3** shows modelling for the event at Goovigen township for 3 scenarios:

(a) as happened;

(b) with no dam at all; and

(c) assuming a lower lake starting level of fixed spillway crest, being 41% of the design full supply level.

102 The actual and lowered scenarios are almost identical until about 10am on 21 February 2015 confirming that flood levels at Goovigen to this point in time were unaffected by water from Callide Dam catchment.

103 If the dam commenced the flood event at the fixed spillway crest level (which was not permitted, as explained above), the maximum benefit at Goovigen would have been a lowering of the second flood peak at Goovigen of around 250mm.

104 If the dam had not been in place at all, the event at Goovigen would have been a triple-peaked event with an additional peak at 10:00 on 21 February 2015 as discharge from Callide Dam arrived.

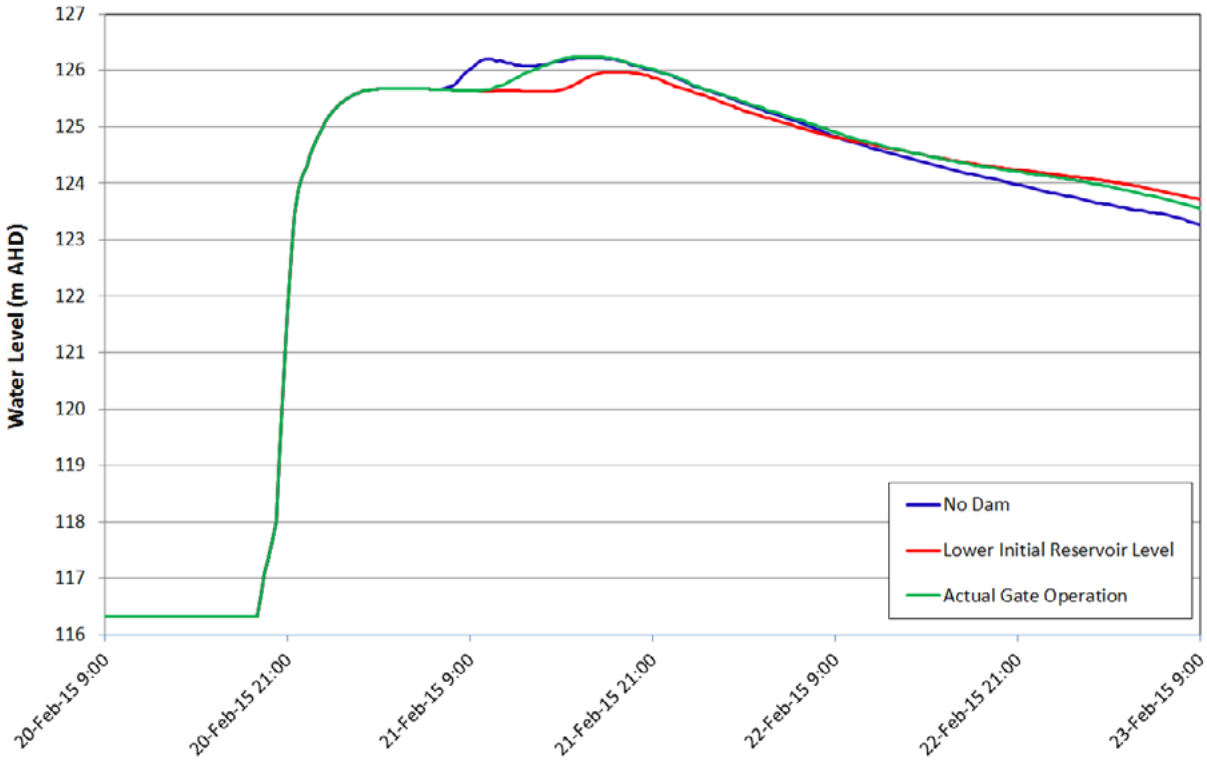

Figure 3 – Flood levels at Goovigen Township for three scenarios

Jambin

105 As no gauge exists at Jambin, modelling was used to estimate flood heights.

106 Rising flood levels at Jambin were initially caused by local tributaries and inflows such as Oaky Creek. The initial and rapid rise from local tributaries occurred well prior to water arriving from the Callide, Kroombit, Kariboe and Grevillea Creek systems.

107 The no dam scenario, also shown in **Figure 4**, indicates that significant benefit was provided at Jambin in terms of flood attenuation.

108 If the dam commenced the flood event at the fixed spillway crest level (which was not permitted, as explained above), the maximum benefit at Jambin would have been a lowering of the flood peak by about 130mm.

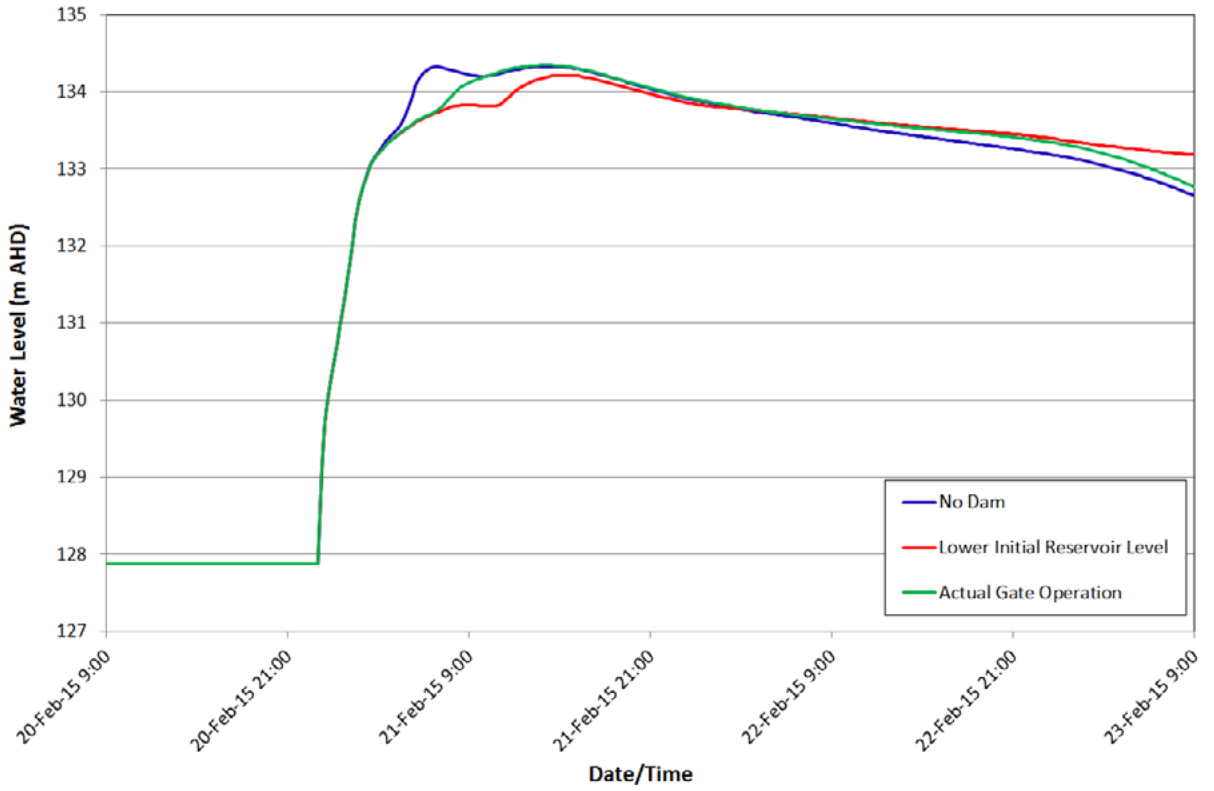

Figure 4 – Flood levels at Jambin for three scenarios

Biloela

109 Modelling confirms that peak flood levels around Biloela in this flood event were caused by discharges from the Kroombit Creek catchment and that Washpool Gully on the eastern side of Biloela was flowing south to north at the peak of this event. This is evidenced by on-site debris.

110 **Figure 5** shows the difference in modelled flood levels around Biloela between what actually occurred and what would have happened in the hypothetical scenario if the dam had been drained down to a level of the fixed spillway crest prior to the onset of rain. The red area indicates the area that would have experienced lower peak flood levels under this hypothetical scenario.

111 The grey area shows where there was no difference in peak flood levels between what actually occurred and the hypothetical scenario. This means that the peak flood levels around Biloela were not attributable to flows from Callide Dam but rather were attributable to Kroombit Creek.

112 In summary, peak flood levels in the vicinity of Biloela during the February 2015 flood event were a result of Kroombit Creek discharges and the discharge from Callide Dam made negligible (less than 1cm) difference to the flood peak in the immediate vicinity of Biloela.

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SunWater
MAKING WATER WORK

0 500 1000
Scale in Metres (1:25,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Callide Dam February 2015 Event

Figure 5

Predicted February 2015 Flood Impacts
Actual Operation vs Lower IWL Dam

Job Number: M3400_005
Revision: 0
Drawn: MH
Date: 16 APR 2015

Modelling Conclusions

113 As a result, the following conclusions can be drawn from the modelling in relation to the impacts at Goovigen, Jambin and Biloela:

(a) There is no doubt Callide Dam attenuated the flood.

(b) Downstream impacts were substantially caused by waters emanating from locations other than Callide Dam.

(c) Major flood levels were experienced at Goovigen and Jambin before any of the peak discharges from Callide Dam arrived at those locations.

(d) When the peak discharges from Callide Dam arrived at Goovigen and Jambin, the result was to create a minor increase in flood levels at those locations, which were already experiencing major flood levels.

(e) Modelling confirms that peak flood levels around Biloela in this flood event were caused by discharges from the Kroombit Creek catchment and the discharge from the dam made negligible (less than 1cm) difference to the flood peak in the immediate vicinity of Biloela.

(f) Even if Callide Dam had commenced the flood event at the fixed spillway crest level (being 41% of the design full supply level), which was not permitted for the reasons outlined above, the modelled reduction in flood levels at Goovigen and Jambin are very minor (250mm and 130mm respectively).

E Reducing the Callide Dam level in advance of the 2015 Flood Event

114 There have been suggestions that SunWater should have lowered the level of Callide Dam in advance of the flood event to provide further space in the dam for the impending rainfall event. It appears to be contended that if SunWater did this, downstream flooding might have been avoided.

115 The suggestion is misconceived.

116 *First*, as indicated in Section C3 of this submission, if SunWater pre-emptively released water as suggested for flood mitigation purposes, SunWater would have committed an offence.

117 *Secondly,* even if was lawful to do so, there was no reasonable justification for discharging large volumes of water in advance of the flood event. As to this:

(a) The forecast rainfall (100-150 millimetres) was not substantial in terms of the dam's capability. Indeed, depending on the spatial and temporal distribution of the rainfall, the dam may not have even filled with that depth of rainfall (bearing in mind the dam was at 84% at the commencement of the event).

(b) In any event, the forecast could not be relied on to discharge water. As explained in Section D2, the Bureau's forecasts are, by their nature, inherently unreliable.

(c) Depending on the nature of the flood, the lowering of the level would not necessarily provide any substantial flood mitigation benefits. The modelling discussed above in Section D2 demonstrates this point in the case of the 2015 Flood Event. As indicated, even if Callide Dam had commenced the 2015 Flood Event at the fixed spillway crest level (being 41% of the design full supply level), which was not permitted for the reasons outlined above, the modelled reduction in flood levels at Goovigen and Jambin are very minor (250mm and 130mm respectively).

118 *Thirdly*, any decision to release water in the face of an oncoming weather system runs the risk of exacerbating downstream flooding if the rainfall falls downstream of the dam particularly whilst water that has been released from the dam is still within the river system.

119 *Fourthly*, the suggestion is made purely with the benefit of hindsight. As explained in Section D2, the actual rainfall received was substantially in excess of the forecast. The intensity of the rainfall was not forecast at all.

120 *Fifthly*, as demonstrated in Section D2, lowering the dam level to the fixed crest would not have made any material difference to the flooding impacts at Goovigen, Jambin and Biloela.

121 SunWater notes that the IGEM may, as part of the review, consider the impacts and benefits of changing Callide Dam from a purely water supply dam to a dual purpose dam. In SunWater's view, any decision to change the status of the dam should only be made after a comprehensive study is undertaken examining:

(a) the water supply issues associated with the change; and

(b) flood operations across a large number of actual and design floods.

APPENDIX A:
Callide Dam February 2015 Operations Lessons Learnt

[redacted]

Callide Dam February 2015 Operations Lessons Learnt

Author: [redacted]

Reviewed

Approved

Date: 10 March 2015

Project: N-WLBC-01-07-01-AE **File No:** 15-000598/001

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1. Background

1.1 Callide Dam Description

Callide and Kroombit Dams are both in the headwaters of the Callide Valley upstream of the town of Biloela. The dams are managed as part of the one water supply scheme. The major creeks in the Callide Valley Region are the Callide, Kroombit and Kariboe Creeks.

The Callide Valley Water Supply Scheme is centred on the Callide and Kroombit Creeks. The purpose of the scheme is to provide water for the Callide Power Stations, downstream irrigation and town water supplies. Callide Dam is the major headworks of the Callide Valley Water Supply Scheme.

Callide dam is situated on the Callide Creek at AMTD 81.0 km upstream from its junction with the Don River and is approximately 12 km by road east of the town of Biloela.

Callide dam has a catchment area of 516 km^2. Construction of the rock and earth fill dam with a central spillway was completed in early 1965. The spillway is of concrete ogee crest construction with automatically operated, radial gates. The spillway gates were installed in 1988. The storage capacity at Full Supply Level (FSL), EL 216.10m is 136,300 ML.

1.2 Spillway Gates

[redacted]

1.2.1 Callide Dam Statistics

Table 1-1 Callide Dam Details

Overview	
Dam Name	Callide Dam
Storage Name	Lake Callide
Location	Latitude 24° 25’ 38” S Longitude 150° 64’ 00” E
Regional Council	Banana Shire
Nearest Town with Road Access	Biloela
Stream and AMTD	Callide Creek AMTD 80.1 km
Catchment area	516 km^2
Average rainfall	683.3 mm
Main Dam	
Type	Rock and Earthfill
Full Supply Level (FSL)	216.10 m AHD
Storage capacity at FSL	136,300 ML
Storage area at FSL	1,240 ha
Dam Crest Level (DCL)	219.24 m AHD
Maximum height of the dam	37.24 m above foundation
Crest length along axis (main embankment)	2008 m (including spillway)
Spillway	
Spillway type	Automatically operated, Radial Gate controlled reinforced concrete ogee crest
Spillway crest level	207.57 m AHD
Crest length	79.25 m
Outlet Works	
Description	• Concrete Intake Tower

	• 2/1220 mm diameter concrete lined MS pipes, within a reinforced concrete outlet conduit • Concrete Valve House
Outlet Control	• Callide A Outlet – 2 x 400mm Gate Valves • Callide Creek Outlet 1 x 600mm Cone Valve & 1 x 300mm Cone Valve • Kroombit & Kariboe Creek Outlet 1 x 914mm Butterfly Valve • 2 x 1200mm butterfly Valves to isolate Callide B and Biloela water supply pipes. • Callide B & C Outlets 2x 850mm pipes • Biloela Shire Council O/T 2 x 450 Gate Valves

1.2.2 Historical Operations

Until January 2011 the gates Callide Dam spillway gates had never been operated during a flood. During January 2011 only the centre pair of gates opened. They opened automatically as expected. The maximum gate opening was approximately 17cm. The peak discharge was only about 20m^3/s.

Prior to January 2013 the gates had never been operated manually except for the purpose of function testing of the gates and only one gate pair at a time.

In January 2013 the dam experienced its flood of record. Due to a reduced operating level that was in place at the time of the 2013 event, the spillway gates were initially operated manually until the storage level rose and the gates then operated automatically. At the commencement of the January 2013 event the storage was at EL 211.14m or 61%. At this storage level there was 53,000ML of spare capacity to FSL. The estimated peak inflow was 2,411m^3/s. The storage reached a level of 216.75 and a peak discharge of approximately 2,062m^3/s

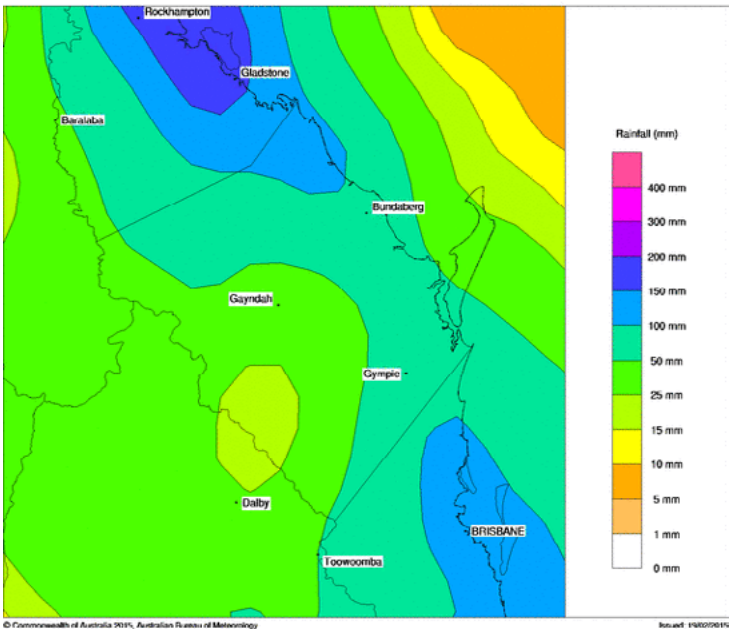
In February 2013 the dam experienced a further flood event. This event was significantly smaller than the January 2013 event. The estimated peak inflow was 1,291m^3/s. The storage reached a level of 215.54 and a peak discharge of approximately 723m^3/s

1.3 Description of February 2015 Flood Event

On the morning of the 20th February 2015 Callide Dam was at 214.29m. This was 1.21m below the reduced maximum operating level of 215.5m. This was a storage volume of 114,900ML or 89% of the reduced operating level storage volume of 129,041ML or 84% of the design full supply volume of 136,300ML.

The Bureau of Meteorology (BoM) was forecasting TC Marcia would cross the coast as a category 5 cyclone north of Yeppoon. The BoM rainfall forecast for the Callide catchment for the 20th February was 100mm to 150mm.

Rainfall forecast for 20/02/2015



Throughout Friday 20th February SunWater undertook preparation activities and continued to monitor the weather situation.

The Gauging station on Callide Creek at 96km recorded minor amounts of rainfall from about 9am on the 20th February. All recordings were less than 10mm per hour until 14:00 hours when the station started to record more significant totals.

The recorded streamflow height at 96km indicated stream flows of less than $10m^3/s$ until approximately16:30 hours on the 20th February.

The Callide Dam headwater level recorder indicated small rises in storage from rainfall until approximately 18:00hours. At 18:00 hours on 20th February the storage level was 214.46m. From 18:00 hours the storage rate of rise began to increase. At 20:15 hours the storage was at 215.92m and rising at a rate of 39m per day. This was the peak rate of rise during the event..

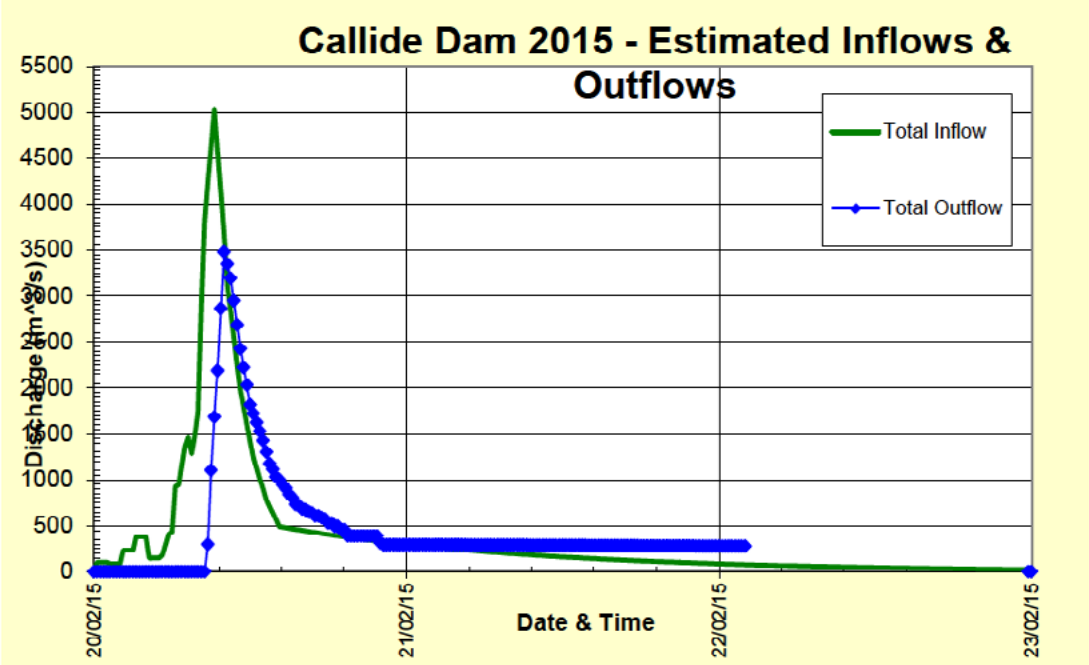
At 19:45 the recorded height at 96km had reached 10.23m and rising. At this time the gauging station ceased recording due to inundation of the instrumentation hut. Later surveys have indicated that the water level peaked at approximately 11.1m. This is some 2.5m higher than the previously recorded record of 8.6m in 2013. The estimated peak inflow was $4,600m^3/s$.

The recorded storage level exceeded the reduced maximum operating level of 215.5m at approximately 20:00 hours on 20th February 2015. At this time the Callide Dam EAP contemplated the manual operation of the spillway gates. However due to the close proximity of TC Marcia and cyclonic winds it was assessed as too dangerous for staff to leave the relative safety of the site office.

The Callide Dam tailwater gauge ceased recording shortly after 20:00 hours and gave no indication of a spillway discharge

Staff first confirmed that all 6 spillway gates were open at approximately 21:30. This was the first opportunity for staff to safely undertake surveillance activities. At that time the centre gates were open 4.0m. The outer gate pairs were 3.0m open.

The storage level peaked at 22:00 at a level of 217.19m. This was also the time of maximum gate opening with the centre gates 7.0m open and outer gates 6.0m open. The estimated peak discharge was 3,480m^3/s.



After the peak of the event, flows receded rapidly with the gates progressively closing automatically.

The outer gates were closed at about 10:00 on the 21st February. From that point the spillway gate test pump was used to maintain the centre gates open at approximately 1.0m as per the EAP and O&M Manual. This resulted in a progressive drain down of the storage to the target maximum operation level of 215.5m. The target level was achieved at about 11:45 on 22nd February. The centre gates were kept open until 14:00 on 22nd February in order to create air space to allow for expected base flows from Callide Creek.

2. Lessons Learnt

SunWater undertook an Operational Lessons Learnt Workshop to review the Callide Dam Flood of Record on 20 February 2015.

Workshop Conducted on: 10 March 2015

Location: Callide Dam Depot

Attendees and role during event:

[redacted] - Dam Safety Technical Decision Maker (DSTDM) and FOC for Callide,

[redacted] - On-Call Hydrographer,

[redacted] - FOC Coordinator,

[redacted] - EEC support,

[redacted]

Facilitator: [redacted]

Record Keeper: [redacted]

2.1 Findings

2.1.1 Event Planning

Finding	Recommendation
The region undertook significant logistical planning prior to the event. The Service Manager was generally satisfied that sufficient resources, including back up teams were in place at all sites prior to event. Planning had considered a number of scenarios and contingency plans were in place. For example the possibility of unsafe conditions during manual operation phase had been considered.	Nil Action
The rapid onset of the event and its occurrence at the end of a working day resulted in some staff continuing in roles beyond normal shift lengths. This did not impact on the performance of any role during the event, however future planning will need to consider triggers for sending staff home prior to an event to ensure staff can back up in all roles and better manage fatigue	Review and update SOP for emergency event rostering

2.1.2 Gate Operations

Finding	Recommendation
EAP required that the gates be manually operated when the storage level rose above the reduced operating level (EL215.5). The EAP further required a transition to automatic gate operation when the storage level rose above the design FSL (EL216.1). SunWater was unable to manually operate the gates due to the unsafe conditions that existed (cyclonic winds). This scenario had been contemplated during the event planning. The EAP notes that actions can only be undertaken when it is safe to do so. The Dam Safety Technical Decision Maker made the decision not to manually operate the gates due to the safety concerns. The actions taken are considered to be consistent with the EAP	Nil Action
If manual operation of the gates is expected to be undertaken in the long term either due to ongoing reduced operating level or alternate operating arrangement then consideration should be given to an investigation and/or feasibility study into remote control of the gates	Determine long term strategy for gate operation as part of the CRA review

Finding	Recommendation
Towards the end of the event as the outer gate pairs were almost closed, operators reported observing some gate oscillation. The amplitude was reported to be approximately 100mm and occurred over a period of a minute of so. Post event inspection did not identify any damage to the gates. The cause of the oscillation is thought to be related to gate configuration. When the storage level is close to the gate opening level, the gates are in a balanced condition with no net opening or closing force. This is an inherently unstable condition and any external load such as wind, wave or vortex collapse could result in a sudden gate movement	Consider undertaking more extensive inspection of the gates to confirm no damage and review design with a view to considering the need for installing a dampening system on the gates to prevent oscillation
During the initial gate operations it was unsafe for staff to observe the gates due to the unsafe conditions. It was noted that there was a period where the storage level was over 217m and there was no knowledge that the gates had actually opened	Investigate the installation of remote sensing system for gate openings
The only record of gate opening is from the manual recording by operators. There is no continuous record of gate opening nor independent verification of operator records	Consider an electronic time series logging of gate opening

2.1.3 Data

Finding	Recommendation
The tailwater gauge is designed to monitor and record normal releases from the dam through the outlet works. The tailwater gauge was almost immediately flooded by spillway discharge and provided no record or confirmation of gate operation.	Consider redesigning and upgrading the tailwater Gauge so that it is capable of recording both outlet works releases and spillway discharge
It was noted that data feeds and communications at Callide Dam have a reliance on the 3G mobile network	Investigate backup data feeds such a linkages to the VHF (Two-way) system
An additional rain station was identified at Stag Creek Weir. The station is linked to the pipeline SCADA system but is not visible to the FOC or external agencies	Investigate the connection of the Stag Creek Rainfall to SunWater's WIN network and providing the data to BoM

2.1.4 Flood Modelling and Predictions

Finding	Recommendation
It is noted that Callide Dam is not included in the list of designated dams provided with predictive flood models and surveillance from the Flood Operations centre (FOC). However SunWater developed a spreadsheet predictive flood model prior to the 2013 flood. The purpose of the model was to support manual gate operations following the introduction of a reduced operating level. The model relies on measured flows at 96km and only provides a forward view of approximately 1 hour. The model cannot predict the flood peak at the dam until a peak has been recorded at 96km. In this event the fast rate of	Consider investment in an expansion of the rainfall network in the Callide catchment and the development and calibration of an URBS model.

Finding	Recommendation
rise at 96km resulted in continual and substantial revision of predicted gate operation. Peak prediction was not possible as 96km data flow was lost prior to it peaking. SunWater had a URBS model under development prior to the 2015 event, however it was ineffective due to the limited rainfall data available in the catchment	

2.1.5 Emergency Event Coordinator (EEC) Role

Finding	Recommendation
SunWater maintains a duty roster for the EEC role for each region. There are four trained EECs available for each region. During most historic EAP activation events across Central region a single EEC has been able to fulfil the EEC role. Early in the evening of the 20th February, the Service Manager recognised the potential need for additional EEC resources and mobilised backup for the EEC role. The duty EEC role was assigned to all dams other than Callide Dam. The Service Manager took over the role of EEC for Callide Dam. At 8:23 the EEC requested assistance to ensure adequate communications with both LDMG and downstream residents. By 8:33 the backup EEC was activated to commence notifications to downstream residents. In extreme or rapidly escalating events a single EEC per region is not practical	Undertake scenario planning exercise with a view to re-evaluate resourcing levels and EEC rosters
With a number of concurrently active EECs there was no transparency of activity and communications between EECs	Investigate the use of shared communication logs and data flows (eg OneNote) to improve transparency of information

2.1.6 Dam Duty Officer (DDO) Role

Finding	Recommendation
There were two duty teams of two in place prior to the event. One team was on duty at any one time with the second team stood down on a 12 hour shift arrangement. This allowed for 24 hour operations. If the stood down team had gone home then they would not have been able to return to site due to flooding conditions. It was noted that the existing facilities at Callide Dam do not have suitable accommodation to allow an off duty team to rest	Investigate upgrading staff accommodation at Callide Dam for emergency events

2.1.7 Workplace Health and Safety

Finding	Recommendation
The DDO team on site were isolated from other SunWater staff in potentially hazardous conditions. Although there was regular contact with on-site staff, there was no formal check-in procedure	Investigate and implement appropriate check-in procedures during emergency events
The Callide Dam Office is located downstream of the dam wall. During the event there was a period where it was unknown whether or not the gates were open. This prompted the thought that the dam wall could be over topped	When considering appropriate accommodation for the off duty DDOs, also consider the location and include consideration for office facilities during an emergency event
The stairs form the office to the spillway bridge do not continue all the way to the crest	Extend the stairs to the crest of the dam

2.1.8 Documentation

Finding	Recommendation
The safe work method statements were reviewed and updated as part of the event preparations	Include annual review of emergency event safe work method statements in maintenance schedules with the task scheduled to be completed prior to the wet season each year.

2.1.9 Other Issues

Finding	Recommendation
There were considerable demands on the time of the EEC and DSTDM from information requests generated by SDCC. These information request impacted on the time available for communications with LDMG and flood modelling activities	That the Inspector General Review investigate why information requests from SDCC were directed at SunWater rather than the LDMG as per SunWater's understanding of the emergency framework

APPENDIX B:
Resource Operations Licence – Callide Valley

This Appendix has been omitted due to personal details contained within

APPENDIX C:
Resource Operations Plan – Fitzroy Basin

This Appendix has been omitted as it is publicly available at

https://www.dnrm.qld.gov.au/water/catchments-planning/catchments/fitzroy-basin

APPENDIX D:
Callide Dam Safety Condition Schedule

Callide Dam September 2002

Dam Safety Condition Schedule

Description

The following conditions apply to Callide Dam being a 2118 metre long earth and rock fill dam 37 metres high located on Callide Creek and on lot 43 on plan RN 1261, Parish of Thalberg, County of Raglan, in the Shire of Banana.
The dam storage capacity at Full Supply Level is 136,300 mega litres. The dam was constructed to full height in 1988. The dam is used to supply water to the Callide Power Station and for irrigation.
The dam has a Dam Failure Impact Category of 2.

Condition DS 1 - Documentation

Any documentation prepared to comply with these conditions must be stored securely until such time as the dam is decommissioned.
The documentation must be made available for inspection by the Chief Executive, Department of Natural Resources and Mines, within 7 days of a written request for access being received by the dam owner.
On change of ownership of the dam, all documentation prepared in compliance with these conditions must be transferred to the new owner.

Condition DS 2 - Incidents and Failures

The dam owner must report in writing all incidents and failures (as defined in the **Queensland Dam Safety Management Guidelines – February 2002**) to the Chief Executive, Department of Natural Resources and Mines, within 7 days of becoming aware of the incident or failure.

The dam owner must advise the Chief Executive, Department of Natural Resources and Mines of any proposed remedial actions in writing within one month of the incident or failure.

Condition DS 3 - Design Reports

NOT APPLICABLE

Condition DS 4 - Design and Construction

Any remedial works or reconstruction of the dam must be carried out in accordance with current engineering practice and ensure that the dam remains generally in accordance with the following documentation: -

Drawings:

Irrigation and Water Supply Commission - Callide Creek – AMTM 49.8 - Callide Dam – General Arrangement

Queensland Water Resources Commission – Callide Dam – Stage II – General Layout A3 – 72888

Irrigation and Water Supply Commission - Callide Creek – AMTM 49.8 - Callide Dam – Inlet Tower - General Arrangement - Elevations - L19303 (D)

Irrigation and Water Supply Commission - Callide Creek – AMTM 49.8 - Callide Dam – Inlet Tower - General Arrangement – Plan & Sections - L19304 (C)

Irrigation and Water Supply Commission - Callide Creek – AMTM 49.8 - Callide

Condition DS 5 - Data Book

The following data book for the dam must be updated in accordance with the **Queensland Dam Safety Management Guidelines – February 2002** :

a. SunWater - Callide Dam, Data Book, Part 1 – Text, Volume 1,
b. SunWater - Callide Dam, Data Book, Part 2 – Drawings, Volume 1,

Condition DS 6 - As Constructed Documentation

NOT APPLICABLE

Condition DS 7 - Standing Operating Procedures

The dam must be operated in accordance with the following existing Standing Operating Procedures that are contained in "Callide Dam - Standing Operating Procedures" Specifically the following existing SOPs:

SOP 001 Verification of Emergency Contact Numbers
SOP 003 Loss of Communication during an Emergency Event
SOP 007 Accident and Incident Reports
SOP 012 Dam Log Book
SOP 016 Instrumentation Surveillance and Data Recording
SOP 017 Bulkhead Gate Installation, Penstock Drainage and Trash Screen Removal
SOP 019 Operator Training
SOP 020 Dam Security and Restricted Areas
SOP 022 Notification of Controlled Spillway Discharge
SOP 025 Spillway Gate Operation
SOP 026 Documentation Control and Review
SOP 027 Variable Intake and Winch Operation
SOP 028 Owners Routine Dam Safety Inspection
SOP 029 Regulatory Dam Safety 5 Yearly Inspections
SOP 030 Assignment of Responsibilities
SOP 031 Monitoring Inflow Events
SOP 032 Normal Operation Criteria
SOP 035 Data Reporting
SOP 038 Bulkhead Gate Installation for Spillway Gate Inspection

As well as the following SOP's under development:

SOP 037 Storage Level Monitoring and Control
SOP 040 Emergency Action Plans
SOP 041 Attendance at Dam

The dam owner must ensure the Standing Operating Procedures are reviewed annually, by 1st of May.

The Standing Operating Procedures, if changed, must remain in accordance with the requirements of the **Queensland Dam Safety Management Guidelines – February 2002**.

The dam owner must submit copies of any changed SOPs to the Chief Executive, Department of Natural Resources and Mines within three (3) months after 1st of May.

Condition DS 8 - Detailed Operating and Maintenance Manuals

The dam owner must prepare Detailed Operating and Maintenance Manuals in accordance with the **Queensland Dam Safety Management Guidelines – February 2002**, by 1st of July 2004.

The dam must be operated and maintained in accordance with the Detailed Operating and Maintenance Manuals

The dam owner must ensure the Detailed Operating and Maintenance Manuals are reviewed by 1st of May of each year after 2004.

Condition DS 9 - Special Inspections

When directed by the Chief Executive, Department of Natural Resources and Mines a Special Inspection must be carried out at the cost of the dam owner and a report must be prepared in accordance with the **Queensland Dam Safety Management Guidelines - February 2002**. The dam owner must provide one copy of the Special Inspection Report to the Chief Executive, Department of Natural Resources and Mines within 1 months of completing the inspection.

Condition DS 10 - Annual Periodic Inspections

The dam owner must undertake an annual (periodic) inspection of the dam in accordance with the **Queensland Dam Safety Management Guidelines – February 2002** on or before 1st of May.

The owner must produce a written record of these annual inspections.

Condition DS 11 - Comprehensive Inspections

The dam owner must carry out a comprehensive inspection of the dam in accordance with the **Queensland Dam Safety Management Guidelines – February 2002**, on or before 1st of May 2005 and on or before every fifth anniversary thereafter. The comprehensive inspection must include a review of the annual inspection records preceding the comprehensive inspection.

A Comprehensive Inspection Report detailing the findings of the comprehensive inspection in accordance with the **Queensland Dam Safety Management Guidelines – February 2002** must be submitted to Chief Executive, Department of Natural Resources and Mines, within three months after completion of the comprehensive inspection.

Condition DS 12 - Safety Review

By 1st of May 2019 the dam owner must carry out a Safety Review in accordance with the **Queensland Dam Safety Management Guidelines – February 2002**. The dam owner must prepare a Safety Review Report and provide one copy of the Safety Review Report to the Chief Executive, Department of Natural Resources and Mines. Further Safety Reviews are to be carried out at 20 year intervals.

Condition DS 13 - Emergency Action Plans and Event Reports

The Emergency Action Plan for the dam is the SunWater document "Emergency Action Plan Callide Dam".

The Emergency Action Plan is to be maintained in accordance with the requirements of the **Queensland Dam Safety Management Guidelines – February 2002**.

The contact details contained in the Emergency Action Plan must be reviewed prior to 1st of May each year.

The Emergency Action Plan must be reviewed at least every five years from 1st of May 2004.

If the Emergency Action Plan is changed, the dam owner must provide one copy of the changed Emergency Action Plan to the Chief Executive, Department of Natural Resources and Mines within 30 days of the changes being made.

The dam owner must ensure that in addition to the copy provided to the Chief Executive, Department of Natural Resources and Mines, current versions of the Emergency Action Plan are provided to the following parties : -

a. Banana Shire Council

2015

b. Gladstone District Disaster Coordination Committee
c. Department of Natural Resources and Mines – Dam Safety (Central West Regional Office Office)
d. Any additional group with responsibilities under the Emergency Action Plan

In all emergencies, the dam owner must respond in accordance with the Emergency Action Plan.

In the event of an emergency, the dam owner must notify the Chief Executive, Department of Natural Resources and Mines within 48 hours. The notification shall include a brief description of of the event and the time of activation of the Emergency Action Plan
Within 28 days of the event the dam owner must prepare an Emergency Event Report and provide a copy of the report to the Chief Executive, Department of Natural Resources and Mines.

The Emergency Event Report must contain:

- a description of the event;
- instrumentation readings and water levels (where appropriate);
- description of any observed damage;
- photographs;
- details of communication and actions which took place during the emergency; and
- Comment on the adequacy of the EAP and any changes proposed.

Condition DS 14 - Decommissioning

The dam must not be taken out of service (decommissioned) except in accordance with a Decommissioning Plan accepted by the Chief Executive, Department of Natural Resources and Mines.

The Decommissioning Plan must indicate how the dam is to be rendered safe in the long term and how the contents are to be drained in a controlled and safe manner.

Condition DS 15 - Spillway Investigation

The dam owner is to comply with the following investigation strategy with regard to spillway adequacy and investigation of spillway adequacy.

That strategy requires the following be carried out:-

- Before January 2003 the dam owner is to prepare a revised Probable Maximum Flood estimate based on the latest Probable Maximum Precipitation.
- Before January 2003 the dam owner is to prepare an updated estimate of the existing spillway capacity based on the latest methodology.
- A revised strategy relating to required spillway capacities will be determined by NR&M before the end of 2003 based on data from the above determinations of existing spillway capacity.
- Owners are to be guided by existing engineering standards in undertaking investigations prior to that strategy being determined.

APPENDIX E:
2013 Flood Review - Summary Status of Recommendations

Request for Information - DEWS

FROM: **Peter Boettcher** Date: 25 February 2015

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

In 2013 the Department of Energy and Water Supply engaged Water Solutions to carry out an independent review of dam operations during the 2013 Callide Valley flood event.

The report prepared for DEWS outlined a series or recommendation to be addressed by the SunWater, The Department and Energy and Water Supply and the Local Disaster Management Group.

Below is a summary of the recommendation relating to SunWater action and the status of those recommendations.

Recommendation	SunWater Response
The specified temporary FSL rules proved to be impractical in this event, Revised rules need to be developed based on experience gained in this event, including both the ramp up and drain down phases and gate sequencing. Consideration should be given to allowing some dam level increase before releases are increased. Documentation should then be updated, and training provided.	**Adopted and Fully Implemented** In the 2013 flood event, the operating instructions were to keep the storage water level steady in 214.1m AHD during a flood event by opening all gates (if required) manually. The normal full supply level is 216.1m. This reduced operating level was adopted due to stability concerns on the left embankment. During the 2013 event, 6 radial gates were operated manually. After the 2013 flood event a lessons learnt review was undertaken into the gate operations. The flood operation manual (FOM) was significantly altered after the 2013 event. The operational procedure was amended to: o allow the storage level to rise during an event. o The FOM was also amended to restrict manual operations to only the centre pair of gates. Gates are progressively opened until outflow and inflow are equalised. o Define a transition from manual to automatic operation. Once the storage level has reached or exceeds 216.4 m AHD, the manual operation is transitioned to automatic operation. This procedure was included in the FOM after 2013 o In the gate closure sequence, once the outer gates are closed, the drawdown strategy is to keep the centre pair opened 1 m manually. Then close the centre pair gradually by maintaining a storage level drop rate of 50 mm/hour. The flood operation manual, which is included in Callide Dam O&M Manual, has been updated several times since 2013.

Briefing Officer: [redacted] Manager Corporate Relations and Communication, SunWater Limited
Approved: Peter Boettcher, Chief Executive, SunWater Limited
Telephone: [redacted] Mbl: [redacted]
Date: 25 February 2015
File Ref: #1685518

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Recommendation	SunWater Response
	The EAP has also been updated to include this flood operation manual. A full functional load test to 1m opening for the full set of radial gates was carried out. An EAP training/exercise is scheduled to be undertaken during the next five yearly comprehensive inspections (in 2015).
The infrastructure issues discovered in this event need to be investigated and appropriate action taken. This includes the pump capacity restrictions and the severe oscillation of the left hand gate pair	**Adopted and Fully Implemented** SunWater investigated the issues experienced with the operational infrastructure and undertook the following refurbishments and enhancements to the assets: o A new replacement pump was purchased, installed and tested. o The old pump was refurbished and is maintained as an emergency backup to provide redundancy of equipment o The pumping capacity was not increased as this may introduce additional operational risks and gate oscillation issues. Instead the gate manual opening sequence was simplified so that the pump is utilised to open only the centre pair of gates and these can be opened relatively quickly to a fully open position until the automatic gate operation would be transitioned in at the original design FSL. o Forensic Inspection and comprehensive analysis was undertaken to determine the root courses if abnormal operation during 2013 utilising internal engineering expertise and independent external experts (SKM) o The lifting cables on all gates were replaced. o Guide rails which control the floats for each gates were extended to the bottom of the wells to eliminate all possibility of a repeat event o Gate welds and bolted connections were non destructively tested and repaired. The arms of the gates were strengthened with the installation of gussets plates o The maintenance walkways were repaired o After all repair works the full set of gates were successfully functional tested to 1m opening o All repairs were painted. o Shear pin connections were replaced. o The gate trunnion bearings were internally inspected and repacked with new grease In addition to the above the surveillance inspection and maintenance program has been revised. A new gate locking mechanism has been

Recommendation	SunWater Response
	designed, manufactured and installed to enable future gate inspections/maintenance to be undertaken. The actual cost of these repair works amounted to $ 2,074,498.
The manual method of controlling gates using the back-up pump is somewhat rudimentary. Investigations into methods to improve control, and for appropriate transitions to automatic control for larger floods, are recommended.	**Adopted and Fully Implemented** To simplify operations and reduce the risk associated with gate oscillation the gate operation sequence was limited to only single gate pair manual operation which is able to eliminate gate "hunting" phenomena. This also enabled full opening of one pair of gates. Previously with all three pairs opened concurrently which was difficult to control and limited the maximum gate opening for manual operation. The flood operations manual were revised to include a transition to automatic procedure.
Current modelling of inflows focuses on gauged flows at the 96km GS, and the rating curve at this site is poor for high flows. Improvements in instrumentation and modelling of the Callide Dam catchment would likely improve the accuracy and lead time on projected releases.	**Adopted and Implementation Progressing** **Implemented** 96km gauging station has been improved - A survey of the peak 2013 heights, flood slope and cross sections at the 96km inflow station were taken to enable a higher rating point to be determined and this was subsequently added to the rating table to help calibrate the upper limits of the curve. The flood models spreadsheets has been enhanced to include rainfall and unit hydrograph techniques. **Activities in progress** SunWater is working with Bureau of Meteorology to establish access to rainfall alert station data. The 2015-16 budget includes the establishment two rain and one river height station in addition to the existing network SunWater is developing an URBS Model for the catchment however this is currently of limited use without detailed rainfall stations and history of data to support it.

Briefing Officer:	[redacted], Manager Corporate Relations and Communication, SunWater Limited	Approved:	Peter Boettcher, Chief Executive, SunWater Limited
Telephone:	[redacted] Mbl: [redacted]	Date:	25 February 2015
File Ref:	#1685518		

MAKING WATER WORK

Recommendation	SunWater Response

A more centralised and standardised approach to maintaining logs during flood events should be considered. (including training)	**Partially Adopted and Implementation progressing**
	
	Implemented
	
	• Training of staff was undertaken which included completion of logs, communication and documentation.
	
	• SunWater purchased IPads for operators to assist capture of logs, notes and photographs, but these were not networked – refer to comments below.
	
	Considered
	
	• Networked electronic device was considered, but rejected for a number of reasons being:
	  ○ Common loss of communications/ network connection during events introduced further risks
	  ○ The electronic device was not compatible/suitable in heavy rain during events
	  ○ Need to have hands free in high winds and when working at heights (3 points of contact is required)

In an actual event little time is available to adjust flood operation rules. Hence it is recommended that SunWater endeavours to test proposed changes to rules thoroughly. Brainstorming sessions, live training exercises, and/or failure reviews may assist in identifying impractical or suboptimal procedures before being needed in areal event.	**Adopted and Implementation progressing** **Implemented** • Lesson learnt post 2013 included brainstorming, forensic workshop, forensic investigation with assistance from independent experts and the original design engineers. • Review of documentation by engineers and operators • Full functional testing to confirm manual procedures to the extent practical with a full dam. • Additional instrumentation was installed at Callide Dam to support the stability analysis (Vibrating Wire Piezometer). **Activities in progress** • Five Yearly Inspection is scheduled in 2015 which include the EAP live exercise. • Comprehensive Risk Assessment review is scheduled to include failure paths and event trees

Briefing Officer:	[redacted], Manager Corporate Relations and Communication, SunWater Limited	Approved:	Peter Boettcher, Chief Executive, SunWater Limited
Telephone:	[redacted] Mbl: [redacted]	Date:	25 February 2015
File Ref:	#1685518		

Recommendation	SunWater Response
	The stability analysis is still ongoing. The results from this analysis is used to review the Callide Dam Operating rules. The latest update as a result from the stability analysis was in January 2015 where the reduced Full Supply Level was increased from 215.1 m AHD to 2015.5 mAHD. This change reduced the amount of manual operations planned to be undertaken.

Briefing Officer:	[redacted], Manager Corporate Relations and Communication, SunWater Limited	Approved:	Peter Boettcher, Chief Executive, SunWater Limited
Telephone:	[redacted] Mbl: [redacted]	Date:	25 February 2015
File Ref:	#1685518		

MAKING WATER WORK

APPENDIX F:
Summer Preparedness Paper – September 2014

Executive Summary

SunWater preparations for the 2014-15 wet season are well advanced. Preparations include:

- Review and update of the Emergency Action Plans (EAPs) for each dam;
- Training of staff for dam duty officer (DDO), emergency event coordinator (EEC) and flood operations centre (FOC) roles;
- Staff rosters;
- Routine preparations;
- Critical repairs

Background

SunWater assets and operations are prone to impacts from flooding. During the wet season, SunWater routinely activates the Emergency Action Plans (EAPs) for its dams.

Seasonal Outlook (Bureau of Meteorology)

Currently, SOI values (typically an indicator of El Nino) are fluctuating around 0, indicating an 'average' season ahead for flood events. This will continue to be monitored. At the time of writing, the Bureau of Meteorology is still affirming the possibility of a late developing El Nino. However, whilst this development would mean the likelihood of widespread floods might be reduced; in any individual catchment major flood events are still possible. Investigation of past floods in Qld shows that low SOI values don't significantly diminish the probability of flood events until very strong El Nino events. La Nina phases do increase their probability however.

In the event an El Nino doesn't develop, an 'average' wet season is the most likely outcome. Figure 1 shows the rain outlook for October to December with the 3 month rainfall totals that have an estimated 75% chance of being exceeded.

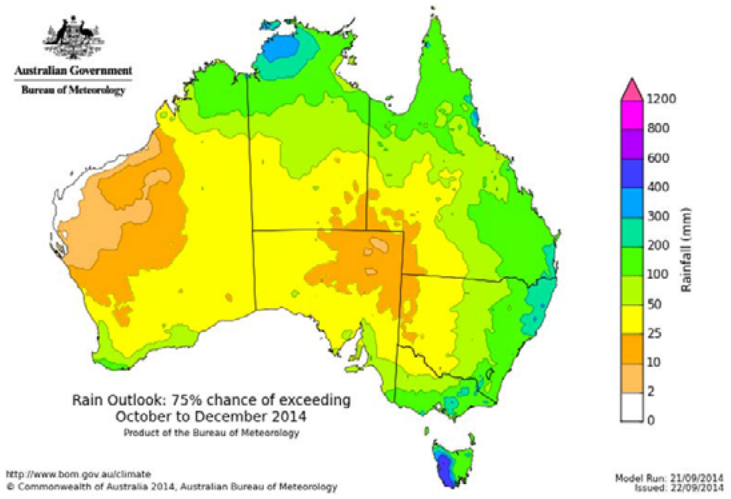

Figure 1 – Rainfall Outlook to December

The outlook on cyclones is near average. The long term average number of cyclones is 4 per season in eastern Australia. There is currently a 42% chance of more than four.

Proposal or Progress

Bulk Water

Emergency Actions Plan Updates and Training

Emergency Actions Plans are in place for each of SunWater's dams. Notification and communication lists have been reviewed and submitted to the regulator as required. The re-organisation of SunWater has been reflected in the changes. Some minor external contact changes may follow in the lead up to Christmas.

Three of the SunWater EAPs (Fairbairn, Tinaroo and Paradise) were only approved by DEWS for 1 year. SunWater has developed and submitted these EAPs in a new format. An independent consultant was engaged to assist with the development of the new EAPs. The old EAPs will continue to apply until DEWS approve the new EAPs.

Routine EAP training has been rolled out and will continue through November. Additional training will be delivered for Tinaroo, Fairbairn and Paradise Dams as soon as the new EAPs are approved.

Staffing

Staff rosters are in place for the EAP roles of Dam Duty Officer, Emergency Event Coordinators, FOC duty team, and technical decision maker. A complete set of rosters over the Christmas close down period will be published and circulated to key staff early in December. This later publication will include corporate relations and customer support groups.

Flood Operations Centre

Flood operation Centre training is in progress. Modelling and procedural components are being delivered to the flood operations teams and will be completed by mid-November.

Flood Operations will be enhanced with the roll out of the flood operations 'wiki' (see Figure 2) to be a 'live' resource on December 1st with the aim of assisting flood operations at 4 SunWater storages (Fairbairn, Burdekin, Paradise and Beardmore) and at Ross Rover and Scrivener Dams. Additional dams will be added prior to the wet season 2015-16. This is intended to be a one stop shop for flood data, history, modelling and emergency action plans.

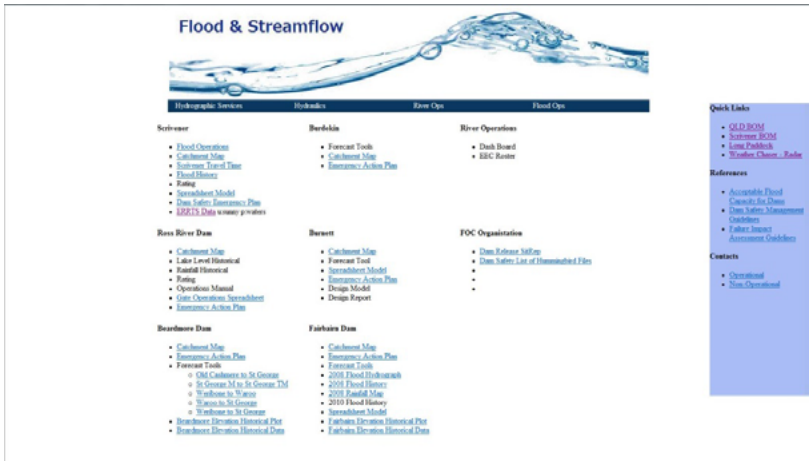

Figure 2 – Flood and Streamflow Flood event support page

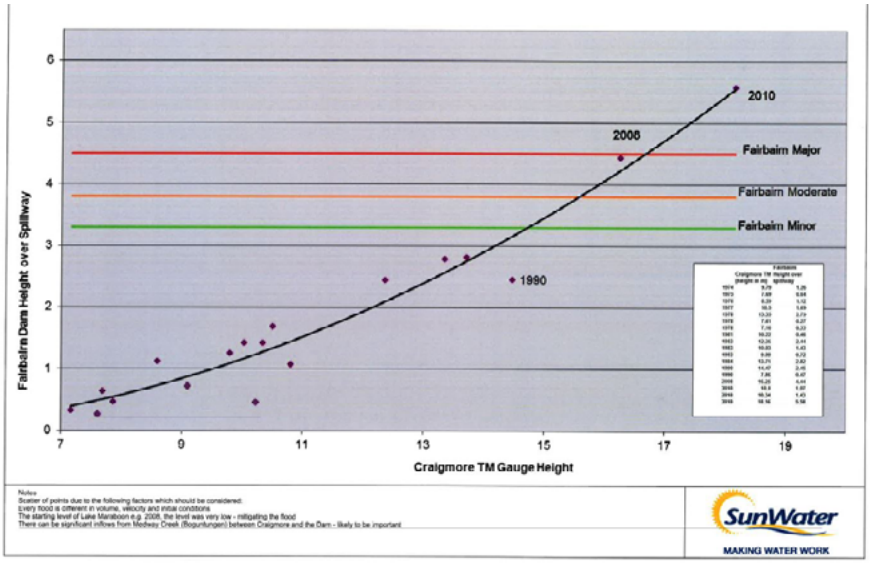

Figure 3 – Peak correlation forecasting tool example.

Additional features include peak stage graphs to assist in the confirmation of model results (Figure 3) and links to ensure quality control.

The Bureau of Meteorology data agreement has been revised and updated to reflect the additional SunWater involvement with ALERT networks for local councils. The Bureau will now supply data for all our catchments as per the agreement rather than solely the existing South East Qld sites and the Townsville area. The dataflow should be available prior to December 1st.

Routine Preparations

The SunWater maintenance programs include a number of routine preparations for the wet season. These preparations include items such as:

- Replenishment of fuel stores;
- Function testing of critical items such as spillway gates, back up generators, equipment, instrumentation and communication systems; and
- Checking of staff accommodation and provisions.

These preparations are scheduled to be complete by end November.

Asset Condition and Emergent repairs

Critical flood damage repairs have been completed or are at a stage where immediate risks have been lowered to an acceptable level.

Corporate Relations

In the lead up to the 2013/2014 wet season, SunWater's Senior Media Advisor will visit key media outlets throughout SunWater's regions to ensure that they understand:

- SunWater's responsibilities during emergency events;

- That SunWater Dams (with the exception of Peter Faust Dam) are not flood mitigation dams and large releases cannot be made pre-emptively before a wet season; and
- Other available sources of information, including the Bureau of Meteorology and Local Disaster Management Groups.

As per the Flood Commission of Inquiry requirements, the Corporate Relations Team placed Public Notices in regional newspapers advising residents living in the immediate vicinity of SunWater dams that they could register for the Emergency Notification List to be directly alerted in the event of an emergency situation. Additionally, a media release was sent to all regional media outlets to further advertise this service and a web application was developed to allow interested customers to access further information and to register for this online.

The Corporate Relations Team has implemented a roster for 24/7 media response and will work with regional rostered staff to manage any media issues, should they arise.

Additionally, SunWater's brochure regarding Dam Management during Floods will be made available from the front page of SunWater's website from the start of December 2014 and remain on the front page of the website until the end of March 2014

The Strategic Response and Crisis Management Handbook is being updated and will be redistributed in December 2014. Senior leaders will be apprised of the updated version at the Senior Leaders forum in December.

The Bulk Water Flood Management Framework has been developed from the lessons learnt exercise from the January 2013 flood events and is available on SIMON along with templates for communication reports.

Irrigation Schemes

A number of irrigation schemes are located in Far North Qld where cyclone preparedness is essential.

The following dot points are the key activities being co-ordinated by Service Managers leading into the summer wet season.

- The Bureau of Meteorology's forecast for all schemes but particularly North Queensland will be monitored for any significant weather events.
- All drainage structures cross drains, channel bank overflows and catch drains inspected and treated for weed infestations and blockages.
- Christmas/new year staff rosters are being developed and will be completed by the end of November.
- Strong focus on reducing staff leave balances by implementing leave plans prior to commencement of peak irrigation demand.
- All vehicles and equipment prestart' s conducted and with additional checks and fuelling to be done just prior to Xmas closedown.
- Depot's pre cyclone season clean up well advanced with additional clean up planned in the week leading up to the Xmas closedown
- Mechanical and Chemical treatment of Channel terrestrial and aquatic weeds ongoing to ensure channels are unrestricted prior to peak irrigation season.

- Expanded Acrolien programme instigated in the Burdekin main channels to minimise restrictions from aquatic weed infestations.
- Emerald LN1 drain is clean and free from obstructions for the entire length through town.
- Preparations well advanced to ensure temporary diesel pumps for St George and Fairbairn Dam are serviced and operational ready to be installed subject to dam Levels.
- Function testing of critical items such as back-up generators, equipment, instrumentation and communication systems will be completed prior to any significant weather events or the Xmas shutdown.
- Clare TWS backup power via portable 25KVa generator (Major check over and test run in November)
- Millaroo, Dalbeg and Mutchilba TWS backup by truck delivery from Clare and Mareeba.
- Bundaberg Scheme based workshop in Mid October to review:
  - Emergency Action Plans for Woongarra and ISIS Balancing Storages
  - Emergency Contact lists Update
  - EEC and Duty rosters ,for assistance to BW and IS responsibilities

Extremely hot and dry conditions in the Burdekin and Bundaberg schemes has caused significant aquatic weed growth and resulting channel restrictions in previous years. Service Managers have scheduled shutdowns and acrolein injections in close liaison with Irrigation Advisory Committees in the lead up, and throughout, the summer period.

Recommendation

For noting.

Attachments

Nil

24 October 2014

Appendix F

Functions of the Office of the Inspector-General Emergency Management

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Functions of the Office of the Inspector-General Emergency Management

The position of Inspector-General Emergency Management (IGEM) is established under the *Disaster Management Act 2003* (Qld) Part 1A. Section 16C of the *Disaster Management Act 2003* (Qld) provides that the functions of the Office of the IGEM are to:

- regularly review and assess the effectiveness of disaster management by the State, including the State Disaster Management Plan and its implementation;
- regularly review and assess the effectiveness of disaster management by district and local groups, including district and local disaster management plans;
- regularly review and assess cooperation between entities responsible for disaster management in the State, including whether the disaster management systems and procedures employed by those entities are compatible and consistent;
- make disaster management standards;
- regularly review and assess disaster management standards;
- review, assess and report on performance by entities responsible for disaster management in the State against the disaster management standards;
- work with entities performing emergency services, departments and the community to identify and improve disaster management capabilities, including volunteer capabilities;
- monitor compliance by departments with their disaster management responsibilities;
- identify opportunities for cooperative partnerships to improve disaster management outcomes; and
- report to, and advise, the Minister about issues relating to the functions mentioned above; and
- make all necessary inquiries to fulfill the above functions.

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Appendix G

Independent review of Callide Creek flooding, TC Marcia, February 2015

Prepared by BMT WBM

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BMT WBM

Independent Review of Callide Creek Flooding, Tropical Cyclone Marcia, February 2015

Final Report

June 2015

R.B21411.001.03

www.bmtwbm.com.au

Executive Summary

Background

On Friday 20 February 2015, tropical cyclone Marcia crossed the Queensland coast at 07:30 and tracked southwards. As the cyclone crossed the Callide Creek catchment, up to 370mm of rainfall was recorded, with over 250mm having fallen in under 6 hours in some locations. In the upper reaches of the Callide and Kroombit Creek catchments, the rainfall is estimated to have a return period of between 200 and 500 years. The highest intensity rainfall was recorded at the Kroombit Tops gauge, having a return period of approximately 500 years.

As the cyclone passed Callide Dam, the strong winds prevented SunWater dam operators from manually operating the gates of the dam. It is estimated that just before 20:30 on Friday 20 February 2015, the gates automatically opened in response to the rising water level in the dam. A significant volume of water was released into Callide Creek, which led to flooding along Callide Creek downstream of the dam. Along the north side of Biloela on the banks of Callide Creek, numerous properties were flooded.

As the floodwaters in Callide Creek started to recede, the flood from Kroombit Creek started to affect properties around Biloela. Floodwaters spilled from Kroombit Creek, flowing along Washpool Gully and into Callide Creek. The peak flood levels throughout most flood affected properties in Biloela were associated with flows from Kroombit Creek, not Callide Creek. Downstream from Biloela, the floodwaters met with runoff from other surrounding mostly unregulated tributaries of Callide Creek leading to extensive flooding. Further downstream, the towns of Jambin and Goovigen also experienced major flooding, with levels higher than the 2011 and 2013 flood events.

The Inspector-General Emergency Management (IGEM) has committed to delivering a report to The Honourable Jo-Ann Miller, Minister for Police, Fire and Emergency Services and Minister for Correctional Services on 5 June 2015, containing a review of the:

- Impact to the community of the Callide Valley from the flooding event;
- Operation of the Callide Dam in the lead-up to and during the event;
- Disaster management arrangements; and
- Performance of critical telecommunications infrastructure in the event.

IGEM has commissioned BMT WBM to prepare an independent technical review of the February 2015 flood event in Callide Creek. The independent and technical report is presented in this document and will serve as supporting information to the IGEM report.

Data

Data relating to the flooding which occurred during the February 2015 flood event has been collated and analysed in detail as part of this review. The data includes rainfall, river level and wind observations, rainfall forecasts, dam operation event logs, past flood studies and mapping, emergency management documents relating to Callide Dam, damages assessments, photographs, and notes from interviews held between IGEM and flood affected residents.

The information has been examined and cross checked to verify accuracy, and time lines have been established to show when events occurred and actions were undertaken by all personnel and agencies involved in the management of the event. This includes the lead-up to the cyclone, during the rainfall and cyclone, during the flood, until flood waters started to recede.

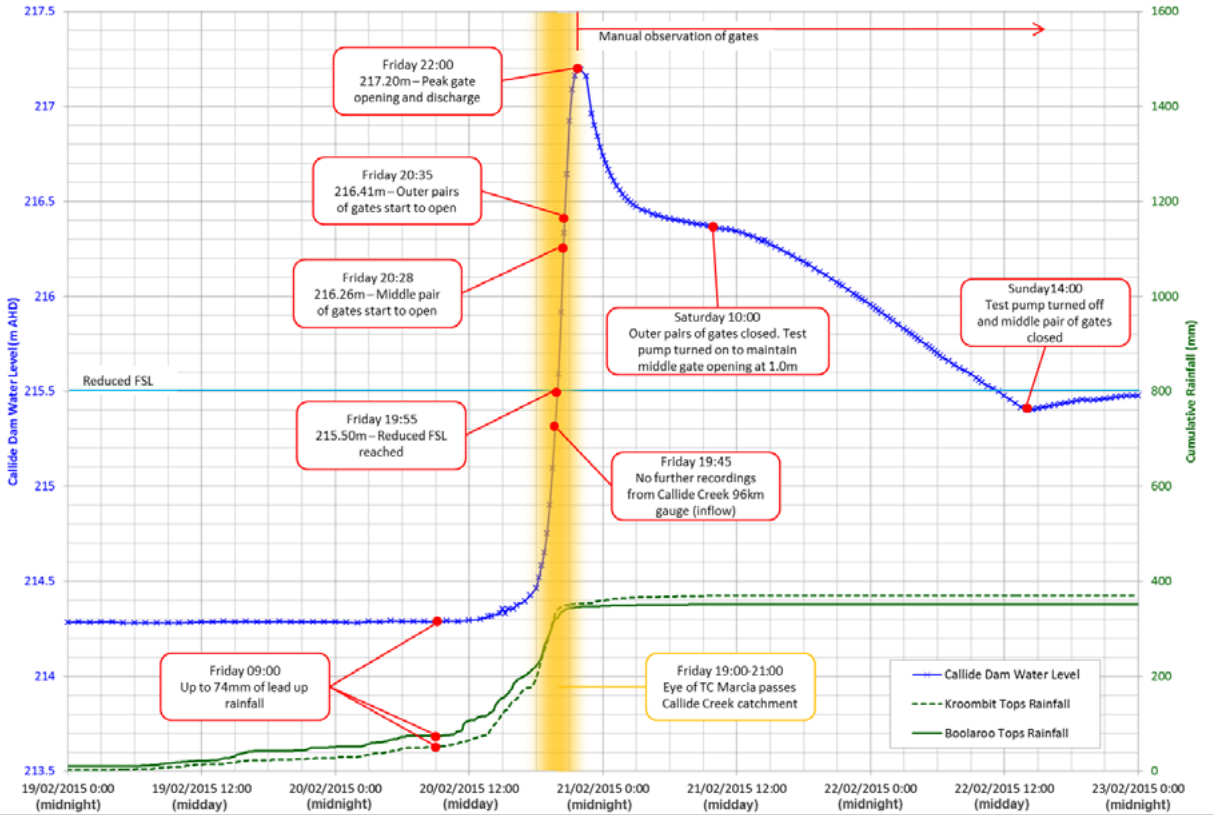

Figure 1 Gate opening timeline

Discharge from the dam has been calculated and applied to a flood model, purposely developed for this review. The flood model also receives flows from the other tributaries in the Callide Creek system, and routes the flood flows through the valley to the confluence with the Don River downstream from Goovigen. Although minimal data are available for calibration of the flood model, the model performance has been checked against photographic and anecdotal evidence of flooding within the valley. A reasonable match between actual and simulated flood behaviour has been achieved.

To assess the impact of discharges from Callide Dam, assessment has been undertaken to determine the relative portion of discharge from the dam, against discharge occurring from the other major tributaries of Callide Creek, as well as rainfall within the lower Callide Creek and its minor tributaries.

Findings

From this review, BMT WBM has found no evidence to suggest that during the February 2015 event, SunWater did not operate Callide Dam in accordance with the *Callide Dam Operation and Maintenance Manual* and the *Callide Dam Emergency Action Plan*. However, the following points are noted:

- An error in the calculation of the catchment rainfall required to fill the dam resulted in a delay in prediction by SunWater that the dam would exceed the full supply level and begin to discharge into Callide Creek during the event. Based on the current operational rules associated with the dam, this would not have had an effect on downstream flooding.
- At 20:28 the water level in the dam reached the theoretical middle gate trigger level of 216.260m. It is expected that the middle gates began to open at this time. It is possible the gates could have opened slightly earlier or later, depending on the exact configuration of the gate opening mechanism.
- Although the process to start notifying downstream residents of a release from the dam was commenced at 20:23, five minutes before the gates are estimated to have started to open, the SMS notification was not logged as being sent to residents until 20:39, 11 minutes after the gates are estimated to have opened at 20:28. Phone calls to residents commenced from this time.
- Manual operation of the dam gates was not possible during the event due to the extreme wind at the time the trigger level for manual release was reached. Modelling has shown that manual operation of the gates would have only marginally affected downstream flood levels or the time of peak.
- The tools available for SunWater to carry out reliable and accurate flood forecasting are considered inadequate, particularly given the flood risk that the downstream communities face. This includes:
    - Rainfall observations – operations rely on a single rain gauge within the catchment, with no communications redundancy.
    - Dam and spillway observations – there is no automated logging of the gate openings, and no tailwater gauge on the spillway to monitor spills.
    - River level observations – there is insufficient distribution of river gauges, with no communications redundancy.
    - Models and spreadsheets used for flood forecasting - the spreadhseet used for estimating rainfall / runoff required to fill the dam appears to be in error, the spreadsheet model does not allow for forecast rainfall input, and the more comprehensive hydrologic model is currently under development.
    - Flood warning system – the methods used for notification of downstream residents is inadequate, has no redundancy, and is not able to notify all affected residents.
- Pre-release of water from Callide Dam would have had some influence on the rate of discharge from the dam during the event. However, due to the major discharges occurring in adjacent creeks, the Callide Valley would have still experienced a major flood. This assessment is based upon modelling a range of pre-release scenarios, including a scenario which retained 91% of the February 2015 event inflows.

Recommendations

A range of recommendations have been provided to improve the flood response during future events. Recommendations are provided for implementation by:

- **SunWater:** Improvements to the monitoring, control, forecasting and warning capabilities associated with the dam management; and

- **Council and LDMG:** Improvements to land use planning, disaster planning, flood warning, and flood education and preparedness.

The recommendations are grouped according to Monitoring, Prediction, Control, Warning, Communications, Flood Planning, Flood Awareness and General.

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Abbreviations

Abbreviation	Meaning
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AMTD	Adopted Mean Thread Distance
ANCOLD	Australian National Committee on Large Dams
AOC	Area Operations Centre MA Media Advisor (SunWater)
AOM	Area Operations Manager (SunWater)
BoM	Bureau of Meteorology
BSC	Banana Shire Council
CCE	Chief Civil Engineer (SunWater)
CEO	Chief Executive Officer
CRM	Corporate Relations Manager (SunWater)
DCF	Dam Crest Flood
DCL	Dam Crest Level
DCS	Department of Community Safety
DDC	District Disaster Coordinator
DDMG	District Disaster Management Group
DDO	Dam Duty Officer (SunWater)
DDS	Director Dam Safety (SunWater)
DEWS	Department of Energy and Water Supply
DMA	Disaster Management Arrangements
DS	Dam Safety Standards
DSG	Dam Safety Group
DSR	Dam Safety Regulator
EAP	Emergency Action Plan
EEC	Emergency Event Coordinator (SunWater)
EER	Emergency Event Report
EL	Elevation Level
EMA	Emergency Management Australia
EMQ	Emergency Management Queensland
FOC	Flood Operations Centre
FOCC	Flood Operations Centre Coordinator (SunWater)

Abbreviations

FOO	Flood Operations Officer (SunWater)
FSL	Full Supply Level
LDMG	Local Disaster Management Group
LDMP	Local Disaster Management Plan
MAM	Manager Asset Management (SunWater)
O&M	Operation & Maintenance
PAR	Population At Risk
PEDS	Principal Engineer Dam Safety
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RDMG	Relevant Disaster Management Group
SDF	Sunny Day Failure
SDMG	State Disaster Management Group
SES	State Emergency Service
SHD	State Height Datum
SMS	Special Message Service
SOP	Standing Operating Procedure
WHS	Workplace Health & Safety

1 Introduction

1.1 Introduction

On Friday 20 February 2015, tropical cyclone Marcia crossed the Queensland coast at 07:30 and tracked southwards. As the cyclone crossed the Callide Creek catchment, up to 370mm of rainfall was recorded, with over 250mm having fallen in under 6 hours in some locations.

As the cyclone passed Callide Dam, the strong winds prevented SunWater dam operators from manually operating the gates of the dam. It is estimated that just before 20:30 on Friday 20 February 2015, the gates automatically opened in response to the rising water level in the dam. A significant volume of water was released into Callide Creek, which led to flooding along Callide Creek downstream of the dam. Along the north side of Biloela on the banks of Callide Creek, numerous properties were flooded.

As the floodwaters in Callide Creek started to recede, the flood from Kroombit Creek started to affect properties around Biloela. Floodwaters spilled from Kroombit Creek, flowing along Washpool Gully and into Callide Creek. The peak flood levels throughout most flood affected properties in Biloela were associated with flows from Kroombit Creek, not Callide Creek. Downstream from Biloela, the floodwaters met with runoff from other surrounding mostly unregulated tributaries of Callide Creek leading to extensive flooding. Further downstream, the towns of Jambin and Goovigen also experienced major flooding, with levels higher than the 2011 and 2013 flood events (refer to Figure 1-1).

The Inspector-General Emergency Management (IGEM) has committed to delivering a report to The Honourable Jo-Ann Miller, Minister for Police, Fire and Emergency Services and Minister for Correctional Services on 5 June 2015, containing an assessment of the following:

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

IGEM has commissioned BMT WBM to prepare an independent technical review of the February 2015 Callide Creek flood. The resultant independent and technical report is presented in this document and will serve as supporting information to the IGEM report to be delivered to The Honourable Jo-Ann Miller MP on 5 June 2015.

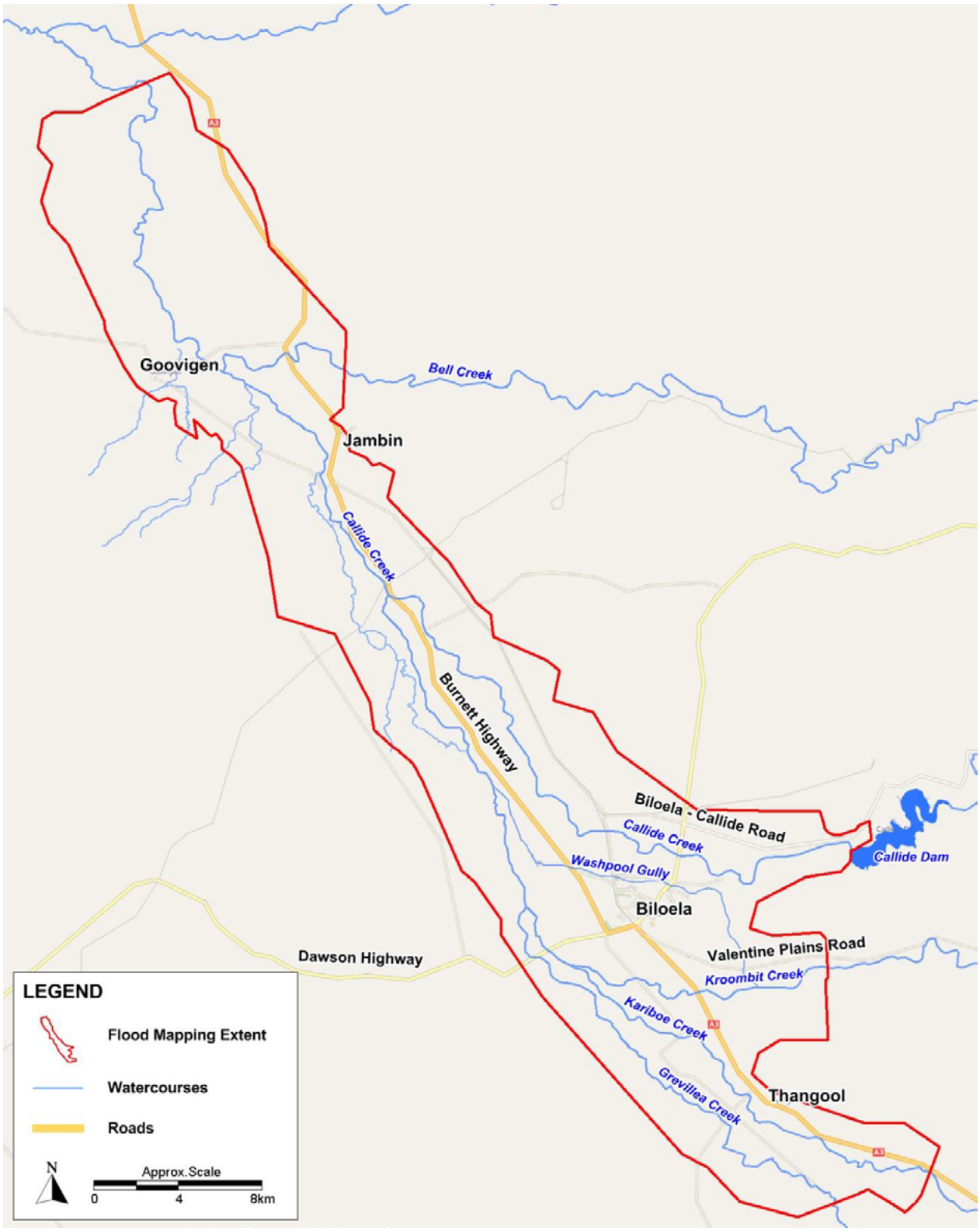

Figure 1-1 Locality Map

1.2 Scope of Works

The scope of works associated with this technical review include:

- ***An assessment of the impact of discharges from Callide Dam on the overall flooding in the Callide Valley, including the impacts on Biloela, Jambin and Goovigen townships within the Valley.***

  Through review and analysis of the literature and use of hydrologic and hydraulic models, the impacts of flooding experienced in February 2015 have been assessed. The assessment includes:

  - detailed analysis of rainfall which caused the flood, including assessment of the return period associated with the event;
  - estimate of the inflows and discharge from the Callide Dam during the event;
  - joint calibration of hydrologic and hydraulic models for simulation of the February 2015 event;
  - provision of flood maps for Biloela, Jambin and Goovigen, and overview maps of the Callide Valley to cover the rural areas between each township. Peak flood level, time of peak, and flood depth are mapped; and
  - comparison of February 2015 discharges and flood mapping to previously published flood maps throughout the Callide Valley.

- ***An assessment of whether SunWater operated Callide Dam in accordance with the relevant dam operating procedures and specifications, and the relevant aspects of the Callide Dam Emergency Action Plan (EAP).***

  Event timelines are presented covering the period from the first warning of a potential event, through to the receding of flood waters. The following timelines are provided:

  - timing of warnings and intelligence received, and warnings issued to the community; and
  - timing of gate operations.

  The timelines have been analysed to determine:

  - whether operation of the dam was compliant with the specifications;
  - any actions (within the existing operating procedures) that could have been taken to reduce the impact of flooding; and
  - any actions (outside of the existing operating procedures) that could have been taken to reduce the impact of flooding.

- ***An assessment of the possible flooding impacts on communities downstream of the dam if different dam operation rules and specifications were adopted, with the aim of providing a greater degree of flood mitigation.***

The following scenarios have been assessed to identify the impact that Callide Dam release had on flooding downstream, and how that flooding may have been different under different hypothetical scenarios:

- Flood Scenario 1 - February 2015 event – As it Happened
- Flood Scenario 2 - What if Manual Flood Operation was Possible?
- Flood Scenario 3 - What if there was no Callide Dam?
- Flood Scenario 4 - What if Callide Dam had been lowered to 50% storage capacity before the event?
- Flood Scenario 5 - What if Callide Dam was completely full to full supply level before the event?
- Flood Scenario 6 - What if there was improved prediction and warning?

Recommendations are provided where potential changes to the dam operation would have resulted in reduced flooding or improved response during the February 2015 event. Such changes would require changes to the *Operation and Maintenance Manual* and *Emergency Action Plan*.

- ***An assessment of the extent to which recommendations of the 2013 review of Callide Dam operations were implemented, and did, or would have if implemented, alter the impact to the community.***

  A review of the recommendations from the 2013 review has been undertaken and is summarised.

- ***A report on the outcomes of the assessments which includes details of the:***
  - ***Methodologies applied in undertaking the assessment***
  - ***Data which was incorporated into the assessment***
  - ***Results and conclusions of the, assessment and the facts and evidence on which these conclusions were based.***

This report addresses all listed requirements including data collation and review, hydrologic and hydraulic analysis, flood mapping, review of operations, and recommendations.

1.3 Description of Area

1.3.1 Catchment

Callide Creek is a tributary of the Don River, which is part of the Fitzroy River system. The catchment area to the confluence with the Don River is 4,648km^2. The main tributaries of Callide Creek are shown on Figure 1-2 and summarised below:

- Kariboe Creek (587km^2) – a major tributary flowing through the town of Thangool, merging with Kroombit Creek to the south of Biloela.

- Grevillea Creek (619km^2) – a major tributary merging with Kariboe Creek and Kroombit Creek to the south of Biloela.
- Prospect Creek (493km^2) – a major tributary of Kroombit Creek, merging to the west of Biloela.
- Kroombit Creek (629km^2) – a major tributary of Callide Creek, flowing past the southern side of Biloela, merging with Callide Creek at Jambin. During major flooding, floodwaters in Callide Creek and Kroombit Creek mix via Washpool Gully around the eastern side of Biloela, and across the floodplain between Biloela and Jambin. Kroombit Dam is located on Kroombit Creek, approximately 30km upstream from Biloela.
- Bell Creek (593km^2) – this tributary flows into Callide Creek at Goovigen just 20km upstream of the Callide Creek confluence with the Don River. Floodwaters from Bell Creek do not have a significant influence on Callide Creek flooding, since the Bell Creek flood wave passes before the major flows within Callide Creek reach this part of the system.

The remaining 1,727km^2 of the catchment comprises Callide Creek and its minor tributaries. Callide Dam is located 80km upstream from the Don River confluence, and approximately 10km upstream from Biloela. The catchment area draining into Callide Dam is 517km^2. ***To put the relative size of the Callide Dam catchment into perspective, it forms 11% of the 4,648km^2 Callide Creek catchment to the Don River and 17% of the 2,962km^2 of catchment upstream from Biloela.***

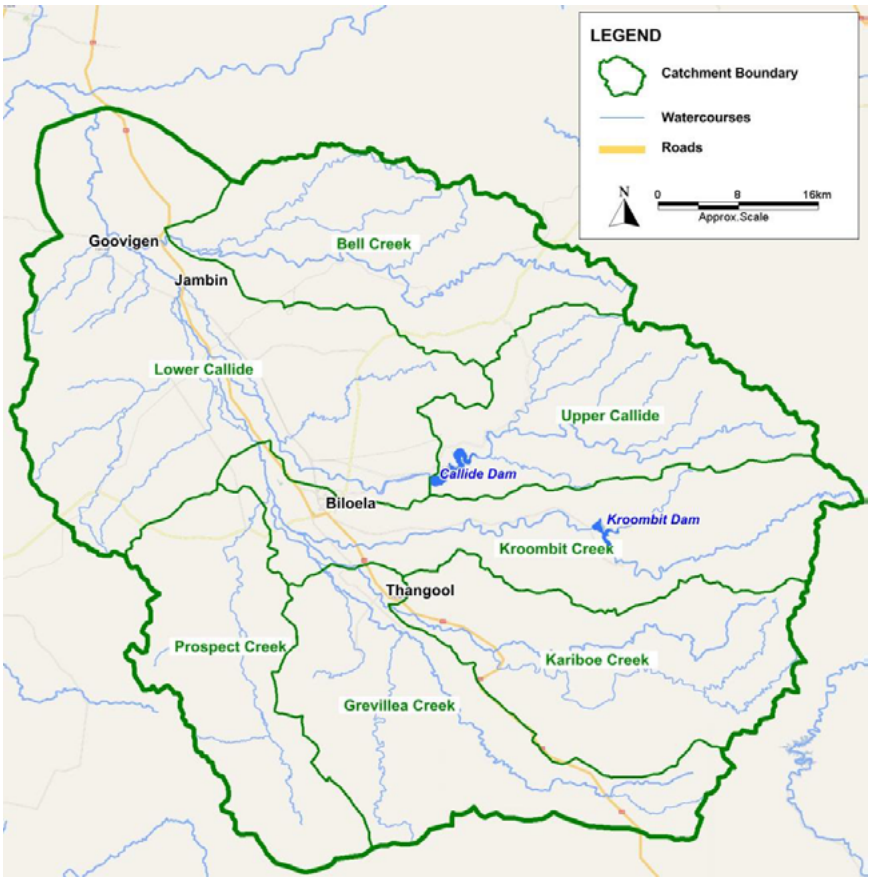

Figure 1-2 Catchment Plan

Between Thangool and Goovigen, the channels of Callide Creek and its tributaries are braided with a tendency for inter-catchment flows to occur during large flood events. The river channel is subject to scour during high flows, altering the pattern of flooding from one event to another.

1.3.2 Kroombit Dam

Kroombit Dam, is a smaller storage than Callide Dam, located in the upper reaches of Kroombit Creek, to the southeast of Callide Dam. The spillway is a fixed weir with no gates. As the water level in the Kroombit Dam exceeds the spillway level, water freely flows over the spillway.

Figure 1-3 Kroombit Dam at 08:46 on 21 February 2015 (source Banana Shire Council)

1.3.3 Callide Dam

Callide Dam is located at AMTD 80.1km on Callide Creek in the Fitzroy Basin about 10km northeast from Biloela. It was constructed in 1965 to provide cooling water for power generation and for urban and agricultural demands. In 1988 the dam was upgraded with the addition of gates, taking the full supply level (FSL) to 216.100m AHD (Water Solutions, 2013). Refer to Section 3 for description of the dam and gate operation.

Figure 1-4 Callide Dam wall and gates, with Callide Power Station in background (source: Banana Shire Council)

In the period from the construction of the dam until the extreme rainfall event of January 2011, Callide Dam had never completely filled. In January 2011 major flooding occurred across large areas of Queensland, and the rainfall was sufficient to fill the dam to its FSL of 216.100m AHD. Gate releases in this event were modest, peaking at about 100m^3/s (Water Solutions, 2013).

In January 2013 former tropical cyclone Oswald tracked southwards along a line just inland from the Queensland coast. This system led to very heavy rainfall occurring during the period from 22 to 29 January across the east coast of Queensland and New South Wales. Total recorded rainfall in the Callide Dam catchment in this event varied from about 320mm at the Callide Creek 96km gauge to 930mm at the Callemondah gauge. This led to significant releases being required from Callide Dam, with releases peaking at about 2,000m^3/s. Areas downstream of the dam were flooded, including loss of livestock, machinery, fences, damage to residential and industrial premises and disruption to the transport network (Water Solutions, 2013).

Figure 1-5 Callide Dam spillway following 2013 event (source: Water Solutions, 2013)

Figure 1-6 Callide Dam gates (source: Water Solutions, 2013)

1.4 Roles and Responsibilities

The roles and responsibilities associated with dam operation prior to, during and following a flood event are listed in the *Emergency Action Plan* (SunWater, 2015). The roles and responsibilities of key personnel within SunWater and external agencies are listed in the tables below (extract from EAP, 2015).

Table 1-1 Roles and responsibilities within SunWater

Role and Responsibilities	Current Position Title & Order of Contact[1]		Abbreviation
Owner's Area Representative • Follow standard SunWater protocols • Overall responsibility for water supply in the Area Operations Centre (AOC) • Delivering the Dam Safety Program in the AOC • Provide emergency management, dam safety training to the relevant staff • Arrange dam specific training and accreditation for relevant staff • Arrange training and a roster for EEC role and provide dedicated mobile phone for emergency contact • Arrange back-up officer for the EEC role • Provide funds for emergency management • Be prepared with appropriate training and make themselves available to assume EEC role at short notice • Make contacts as given in Action Flow Charts • Liaise with EEC (when not on roster on) • Liaise with SunWater Management • Local media liaison • Liaise with PEDS and MAM in Brisbane	(1) (2)	Area Operations Manager Service Manager	AOM SM
Owner's Representative/Technical Decision Maker • Follow standard SunWater protocols • Analyse the emergency event and provide expert technical advice • Discuss Emergency Scenario with Peers and other technical experts and make	(1) (2) (3) (4) (5)	Principal Engineer Dam Safety Senior Engineer Headworks Chief Civil Engineer Manager Asset Management Environmental Manager	PEDS SHE CCE MAM EM
Flood Operation Centre (FOC) Duty Engineer • Extract data relative to the event from available sources • Utilise this data in predictive flood models and determine results from these models • Use these results in conjunction with data obtained from BOM and inform the predictions agreed with BOM to the EEC	(1) (2) (3) (4)	Flood Operations Engineer on roster Senior Engineer Flood Operations Chief Civil Engineer Principal Engineer Dam	FOE SEFO CCE PEDS

[1] Only one person to be contacted

• Liaise with the PEDS and the EEC to update current flood situation and routing data		Safety	
Flood Operation Centre (FOC) Coordinator • Coordinate flood operation teams • Liaise with SEFO, Duty Engineers, and Data Monitors • Decide if a flood is imminent and recommend modes of operation • Ensure team is trained	(1) (2) (1)	Principal Engineer Dam Safety Manager, Asset Management Senior Engineer Headworks	PEDS MAM she
Dam Safety Technical Advisor (For Action 2 with the possibility of dam failure) • Follow standard SunWater protocols • Analyse the emergency event and provide expert technical advice • Discuss Emergency Scenario with Peers and other technical experts and make sound decisions to mitigate the risk • Advise Area Operation Centres on dam safety issues • Issue warning on dam failure and advise on protective measures • Assume Dam Owner's Representative/Technical Decision Makers Role, when required • Liaise with SEH; BOM; FOC; EEC • Advise SunWater Management • Advise Corporate Relations Manager (CRM) • Liaise with Regulator as advised by GMIM and the CEO	(2) (3) (4) (5)	Principal Engineer Dam Safety Manager Asset Management Chief Civil Engineer Senior Engineer Headworks	PEDS MAM CCE SEH
Communicator – Public • Follow standard SunWater protocols • Analyse sensitive issues, discuss with the Owner and issue media releases • Handle public and customer comments and advise the owner	(1) (2)	Corporate Relations Manager Media Advisor	CRM MA
Owner • Follow standard SunWater protocols • Liaise with the communicators • Liaise with the Board, Dam Safety Regulator and Minister • Activate Crisis Management Plan and Crisis Management Team	(1) (2)	General Manager Infrastructure Management Chief Executive Officer	GMIM CEO
Emergency Event Co-ordinator • Follow standard SunWater protocols • Liaise with the Dam Duty Officer and confirm Emergency Scenario • Liaise with the DDO, PEDS, MAM, FOC Duty Officer, Area Representative, Disaster Management Groups, and coordinate emergency action	Varies – see Roster		EEC

• Arrange notification as described in Action Flow Charts • Record notifications and observations			
Dam Duty Operator • Follow standard SunWater protocols • Follow training in EAP activation • Complete accreditation to operate and maintain relevant storage • Follow the procedures in the EAP • Make an initial assessment, liaise with the EEC and determine Emergency scenario • Arrange immediate site inspection and make informed assessment of the situation • Record notifications and observations • Implement preventative measures as directed by EEC or SM • Follow action sheets – section 5 for emergency scenario and complete the record sheets in section 6, finalise Emergency event report together with EEC • Arrange to send 'Alert Notification' under Action 3 – See Section 10 for copy of 'Alert Notification' (SIMON Procedure)	(1) (2)	Storage Supervisor Operator Maintainer	SS OM

Table 1-2 Roles and responsibilities of external agencies

Role and Responsibilities	Current Position Title & Order of Contact[2]		Abbreviation
Police • Conduct emergency operations • Co-ordinate and support to SunWater during a declared emergency at the dam • Liaise with relevant organisations • Evacuation of persons, if required • Control of essential traffic • Security of specific area	District Disaster Co-ordinator Local Police		DDC
Disaster Management Personnel • (LDMG) Ensure disaster management and disaster operations in the area are consistent with SDMG strategic policy framework for state disaster management • (LDMG) Develop effective disaster management, and regularly review and assess the disaster management	(1) (2) (3)	Local Disaster Management Group District Disaster Management Group Emergency	LDMG DDMG EMQ

[2] Only one person to be contacted

• **(LDMG) Assist local government in preparing Disaster Management Plan** • **(LDMG) Identify, and provide advice to DDMG about, support services required by the LDMG to facilitate disaster management and disaster operations in the area** • **(LDMG) Ensure the community is aware of ways of mitigating the adverse effects of an event, and preparing for, responding to & recovering from a disaster** • **(LDMG) Manage disaster operations in the area under policies and procedures decided by the SDMG** • **(LDMG) Provide reports and make recommendations to the relevant DDMG about matters relating to disaster operations** • **Identify, and coordinate the use of, manpower and resources that may be used for disaster and recovery operations in the area** • **(LDMG) Establish and review communication systems in the group, and with the relevant DDMG and other LDMGs in the disaster district of the relevant district group, for use when a disaster happens** • **(LDMG) Ensure information about a disaster in the area is promptly given to the relevant DDMG** • **(EMQ) Leads and coordinates operations before, during and after a disaster or emergency to minimise adverse community impacts** • **(EMQ) Point of contact for State Government response to emergency situation** • **(DDMG) Co-ordination of District Response and provide management of, and coordinate whole of Government support to, disaster stricken communities** • **(CTLO) Identifies Areas of Concern during the preparation of disaster plans and provides advice during counter terrorism emergency events**	(4) (5)	Management Queensland District Disaster Management Group Counter Terrorism Liaison Officer	DDMG CTLO
Dam Safety Regulator • **Liaison with relevant Minister on necessary actions**		Director Dam Safety	DDS

1.5 Some Facts and Figures

Following the February 2015 event, various concerns have been raised by the community, media and other stakeholders. The following facts that have been confirmed are provided here to address some of these:

- Callide Dam is not a flood mitigation dam.
- The gates were not opened at 16:13 on 20 February 2015 as reported on Facebook.
- The dam gates did not fail. Gate opening was automatically driven by the rising water level in the dam.
- There are media references to the dam being at either 84% or 89% capacity prior to the event. The reference to 84% relates to the design FSL of 216.100m; whereas the 89% capacity relates to the reduced FSL of 215.500m. Contrary to media reports, SunWater did not allow the dam to fill from 84% to 89% in the days leading up to 20 February 2015; the water level remained constant and did not change.
- Damage to the Telstra optic fibre occurred approximately one hour before water started to be released form Callide Dam. The damage is assumed to have occurred from stormwater runoff.
- The best estimate based on the water level, is that the gates commenced opening at 20:28[3] on 20 February. References to the gates being open at 20:18 are based upon a phone call at 20:18 advising gate opening is imminent, and a record of activation of the EAP. The water level in the dam did not reach sufficient level to trigger gate opening until 20:28.
- Contrary to media reports and early suggestions by SunWater, the flood event is not considered to have a 10,000 year return period. Rainfall observations suggest the return period across the Callide Dam catchment varied between a 200 year and 500 year return period event. It is plausible that the water levels experienced in the dam and the flooding experienced throughout the Callide Valley could have been more than a 500 year return period.

[3] This is based upon the water level reaching the theoretical trigger level, which may vary from the actual configuration of the gates.

2 Review of Documents and Data

2.1 Documents

Documents are presented in chronological order of their publication. Much of the text provided in this Section has been directly extracted from the relevant document. Copied text is presented in italics.

2.1.1 Callide Dam Stage II Radial Gates – Gate Operating Principle (Queensland Water Resources Commission, 1984)

This drawing shows a section through the gate pier with the components of the operating system labelled. Labels are referenced in a description of the operating principle. Refer to Section 3.5 for explanation of the operating principle. A simplified schematic of the operating principle is provided in Section 2.5.2[4].

2.1.2 Callide Valley Flood Risk Study – Phase 1 Flood Study (AECOM, 2010)

This study was undertaken for Banana Shire Council. URBS and XP-RAFTS hydrologic models were used to estimate discharges in the catchment associated with various design floods. A Mike11 hydraulic model was then used to model the flood behaviour.

The report contains flood mapping for the 20%, 10%, 5%, 2% and 1% AEP and PMF design flood events, and the February 1978 and February 2003 flood events.

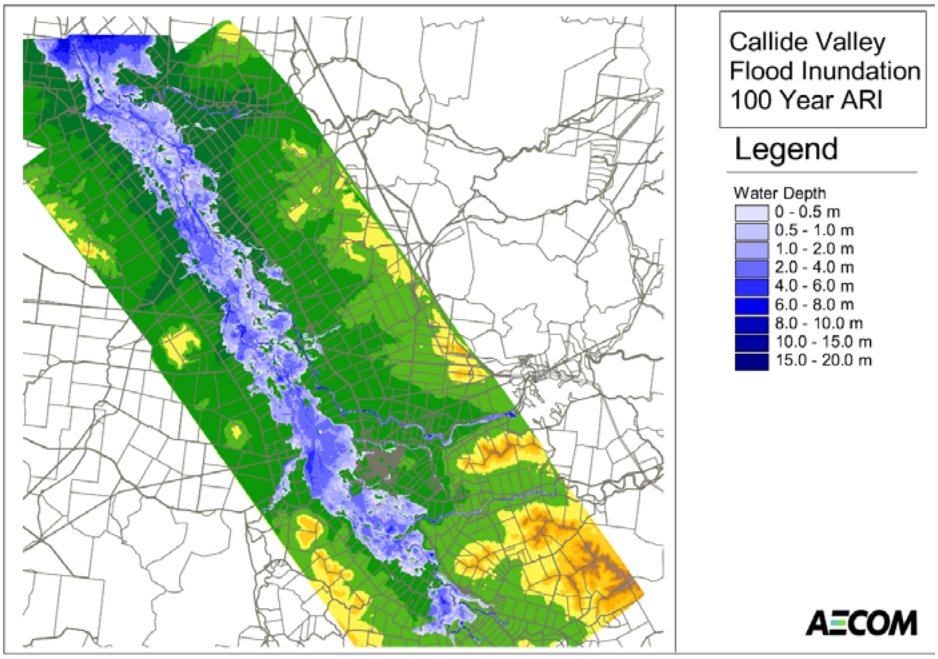

Figure 2-1 1% AEP flood mapping for the Callide Valley

[4] The operating principle description in the *Callide Dam Operation and Maintenance Manual* (SunWater, Jan 2015) contains an incorrect reference that water spills over weir (C) into the gate control chamber (B).

2.1.3 Callide Dam – Dam Break 2012 (SunWater, 2012)

This dam break analysis was undertaken as part of the required investigations following identification of dam leakage following the 2011 rainfall event. During this event, Callide Dam filled to its FSL of 216.100m for the first time. The leakage prompted a temporary lowering of the FSL to 214.000m. This assessment involved simulating a sunny day failure of the left embankment[5], opposed to the right bank used for the 2004 dam break analysis.

The left embankment is not as deep as the right embankment which extends to the bottom of the reservoir. Therefore the left bank dam break analysis only affects the top 10.5m of the dam storage (opposed to 34.7m of the right embankment). The implications are a significantly smaller dam breach and subsequent discharge.

The peak dam break discharge from this analysis was 5,070m^3/s.

2.1.4 Review of Callide Dam Gate Operations in the January 2013 Flood Event (Water Solutions, 2013)

In January 2013 former tropical cyclone Oswald tracked southwards along a line just inland from the Queensland Coast. This system led to very heavy rainfall occurring during the period from 22 to 29 January across the east coast of Queensland and New South Wales. Total recorded rainfall in the Callide Dam catchment in this event varied from about 320mm at the Callide Creek 96km gauge to 930mm at the Callemondah gauge. This led to significant releases being required from Callide Dam, with releases peaking at about 2,000m^3/s. Areas downstream of the dam were flooded, including loss of livestock, machinery, fences, damage to residential and industrial premises and disruption to the transport network (Water Solutions, 2013).

Owing to a prior dam safety issue, the full supply level of the dam was temporarily lowered in December 2012 while assessment of the issue was undertaken, and the event in January 2013 occurred with the lowered FSL in place. At the lowered FSL, the automatic gate opening system at the original FSL could not be used, and hence the gates were largely operated manually during the event.

After the event, questions were raised about the effect of dam operations on flooding downstream. The Department of Energy and Water Supply (DEWS) subsequently engaged Water Solutions to carry out an independent review of dam operations during the event.

The recommendations from the 2013 event review were:

- *The specified temporary FSL rules proved to be impractical in this event. Revised rules need to be developed based on experience gained in this event, including both the ramp up and drain down phases and gate sequencing. Consideration should be given to allowing some dam level increase before releases are increased. Documentation should then be updated, and training provided.*
- *The infrastructure issues discovered in this event need to be investigated and appropriate action taken. This includes the pump capacity restrictions and the severe oscillation of the left hand gate pair.*

[5] When referring to waterways and dams, references to left and right assume facing downstream.

- *The manual method of controlling gates using the back-up pump is somewhat rudimentary. Investigations into methods to improve control, and for appropriate transitions to automatic control for larger floods, are recommended.*
- *Current modelling of inflows focuses on gauged flows at the 96km GS, and the rating curve at this site is poor for high flows. Improvements in instrumentation and modelling of the Callide Dam catchment would likely improve the accuracy and lead time on projected releases.*
- *A more centralised and standardised approach to maintaining logs during flood events should be considered*
- *In an actual event little time is available to adjust flood operation rules. Hence it is recommended that SunWater endeavours to test proposed changes to rules thoroughly. Brainstorming sessions, live training exercises, and/or failure reviews may assist in identifying impractical or suboptimal procedures before being needed in a real event.*
- *There are also a number of minor recommendations contained within the body of the report. A number of actions could be taken to enable Callide Dam to provide more active flood mitigation than its original design, such as pre-releases, changes to the FSL and altered gate operation rules. However it is highlighted that such changes should not be undertaken without a detailed understanding of:*
  - *the effect on the performance of allocations in the Callide Valley Water Supply Scheme;*
  - *implications for the safety of the dam;*
  - *the actual flood mitigation benefit downstream, considering the full range of events that can occur;*
  - *additional costs associated with implementation of the change; and*
  - *alternate actions that may be taken downstream to provide similar benefits at reduced costs, such as improvements to land use planning.*

2.1.5 Flood Hazard Mapping – Thangool – Bundle 9 – Final Report (DHI, 2013)

This report was prepared for the Queensland Reconstruction Authority following the December 2010 flood event. The report describes the estimation of design flood discharges for the Thangool area, based on past investigations and modification of the design discharges within that study.

Flood mapping based on a Mike21 flood model is presented in the report for the following events:

- December 2010
- 0.2% AEP (500 year ARI)
- 1% AEP (100 year ARI)
- 2% AEP (50 year ARI).

Flood hazard, depth and velocity are mapped.

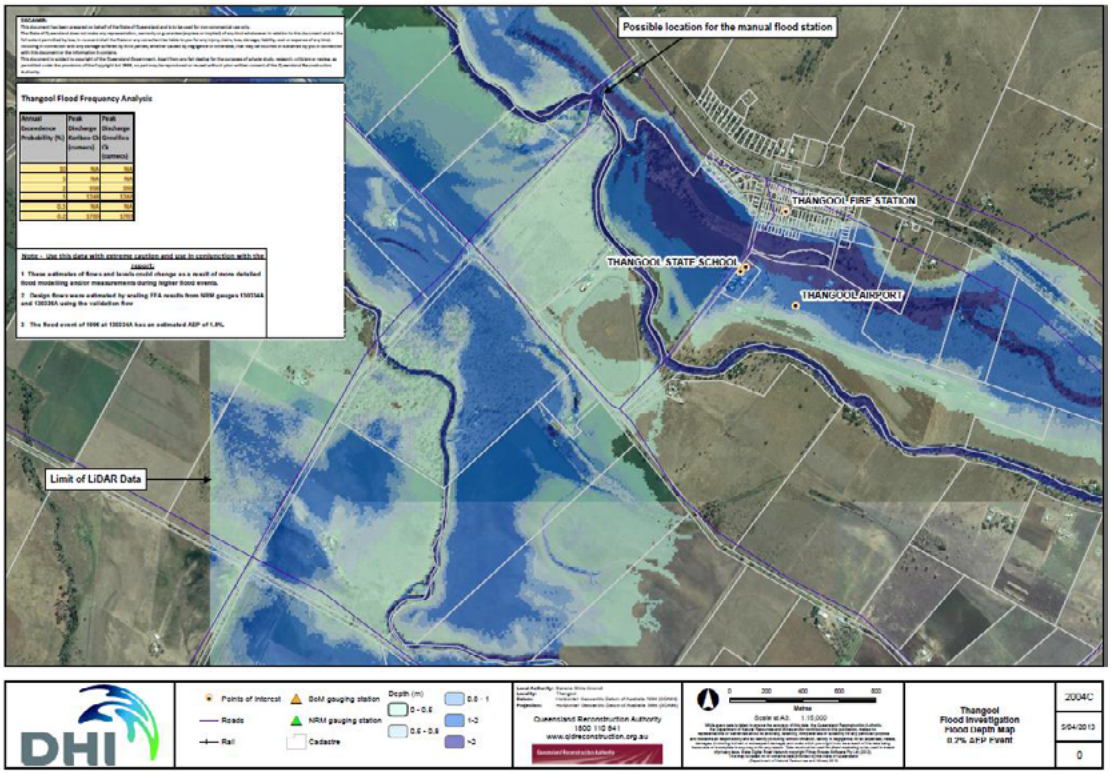

Figure 2-2 0.2% AEP flood mapping for Thangool

2.1.6 Flood Hazard Mapping – Jambin – Bundle 9 – Final Report (DHI, 2013)

This report was prepared for the Queensland Reconstruction Authority following the December 2010 flood event. The report describes the estimation of design flood discharges for the Jambin area, based on past investigations and modification of the design discharges within that study.

Flood mapping based on a Mike21 flood model is presented in the report for the following events:

- December 2010
- 0.2% AEP (500 year ARI)
- 1% AEP (100 year ARI)
- 2% AEP (50 year ARI)

Flood hazard, depth and velocity are mapped.

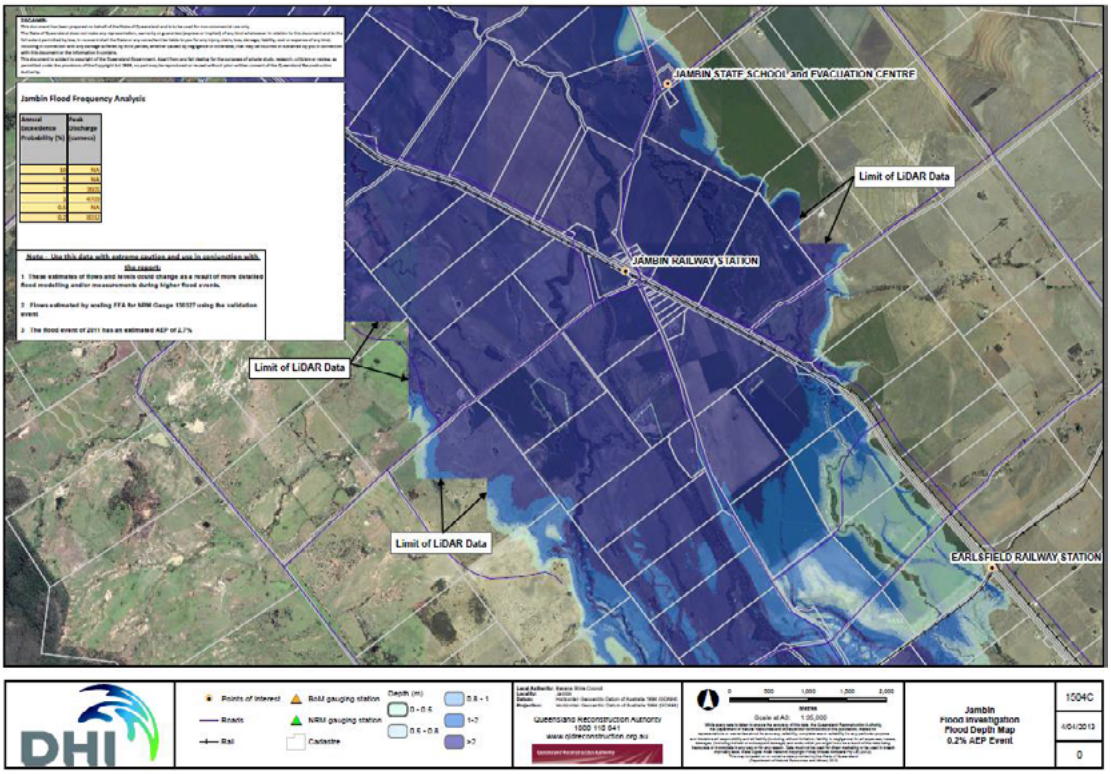

Figure 2-3 0.2% AEP flood mapping for Jambin

2.1.7 Goovigen Flood Hazard Mapping Study (WRM, 2013)

This report was prepared for the Queensland Reconstruction Authority following the December 2010 flood event. The report describes the estimation of design flood discharges for the Goovigen area, based on past investigations and modification of the design discharges within that study.

Flood mapping based on a TUFLOW flood model is presented in the report for the following events:

- December 2010
- 0.2% AEP (500 year ARI)
- 1% AEP (100 year ARI)
- 2% AEP (50 year ARI).

Flood hazard, depth and velocity are mapped.

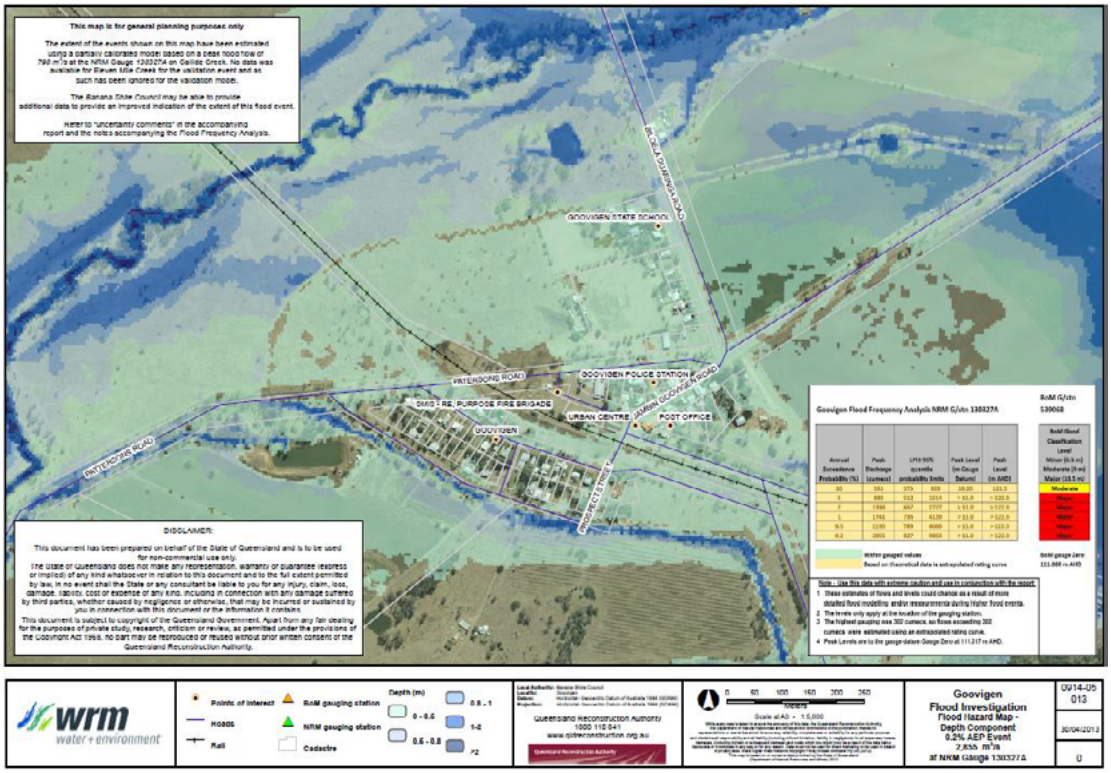

Figure 2-4 0.2% AEP flood mapping for Goovigen

2.1.8 Emergency Action Plan - Callide Dam (SunWater, 18 December 2013)

The Emergency Action Plan (EAP) defines responsibilities and procedures designed to identify conditions, including those which may endanger the Dam/Storage, in time to take remedial action and to notify the appropriate authorities, Emergency Agencies and Public Officials of possible, impending, or actual failure of the Dam/Storage.

The main purpose of the EAP is to ensure that a timely warning is provided to the appropriate authorities and Emergency Agencies in the event of a major incident impacting on the

Dam/Storage, and to provide relevant information for use in the emergency response to the situation.

The EAP identifies emergency condition scenarios at the Dam/Storage, and describes procedures to be followed by SunWater staff to investigate those conditions and provide warning to appropriate authorities and emergency agencies, so that they can implement measures for protection of the downstream communities and properties, if necessary. The EAP also provides direction to operating staff for handling unsafe or emergency conditions, so that the Dam/Storage can be returned to a safe operating condition with minimal delay.

The 2013 release of the EAP has a cover note stating the following:

- *The dam is currently operated at a reduced maximum operating level of EL 215.10m AHD until further notice (Full Supply Level = 216.10m AHD)*
- *This will require the spillway gates to be operated in a combination of both manual and automatic modes*
- *The EAP shall be activated at EL 215.10m AHD under these conditions*
- *Any reference in the EAP to full supply level should be read in the above context*

2.1.9 Callide Dam Emergency Event Report – 20-22 February 2015 (SunWater, 2015)

If the dam activation level enters Stand-up mode during an event, an Emergency Event Report (EER) is required to be prepared and submitted following the event. This EER was prepared by SunWater following the February 2015 event. The EER contains the following:

- Description of the event
- General comments and/or EAP recommendations
- Damage
- Instrument readings, inspection sheets and level data
- SunWater internal incident report
- Photos of the event
- Communications (EEC, DDO, DSTDM and Owner)
- Situation reports
- Flood damage inspection report
- Lessons learnt
- LDMG meeting minutes.

2.1.10 Emergency Action Plan - Callide Dam (SunWater, 30 January 2015)

The January 2015 revision of the EAP has some minor changes from the December 2013 version. The primary purpose for revision was to a change to reduced operating level from 215.10m AHD to 215.50m AHD.

The 2015 release of the EAP has a cover note stating the following:

- *The dam is currently operated at a reduced maximum operating level of EL 215.50m AHD until further notice (Full Supply Level = 216.10m AHD)*
- *This will require the spillway gates to be operated in a combination of both manual and automatic modes*
- *The EAP shall be activated at EL 215.50m AHD under these conditions*
- *Any reference in the EAP to full supply level should be read in the above context.*

2.1.10.1 Activation Levels

The Emergency Event Co-ordinator (EEC) is responsible for the decision to activate the EAP. Should the EEC be unavailable, the Dam Duty Operator (DDO) is responsible for the decision.

The following levels of EAP activation are consistent with the Queensland Disaster Management Arrangements (see Section 5A). The four levels of activation are:

- ***Alert –** A heightened level of vigilance due to the possibility of an event occurring. No further action may be required, however the situation should be monitored by someone capable of assessing the potential of the threat. Moving to an Alert level indicates the dam owner is getting ready to activate the Lean Forward level of the EAP if the situation deteriorates.*
- ***Lean forward** - An operational state characterised by a heightened level of situational awareness of an impending disaster event and a state of operational readiness. Disaster coordination centres are on stand-by and prepared but not activated.*
- ***Stand up** – The operational state where resources are mobilised, personnel are activated and operational activities commenced. Disaster coordination centres are activated. The dam owner needs to provide an 'Emergency Event Report' in accordance with the provision of the Act.*
- ***Stand down** - Transition from responding to an event back to normal core business and/or continuance of recovery operations. There is no longer a requirement to respond to the event and the threat is no longer present.*

The movement of dam owners through these levels of activation is not necessarily sequential. It should be applied with flexibility and adaptability and be tailored to the location and event.

The triggering of one of these levels of activation may not necessarily mean a similar activation of relevant disaster management groups. However, the provision of information to relevant group members regarding the risks associated with a pending hazard impact should still occur.

Table 2-1 Flood event Activation Levels

Activation Level	General Characteristics	When and What to Check
Alert	Storage full and water level rising	During periods of excessive rainfall - undertake visual inspection and monitoring of any instrumentation and check water levels and rates of rise of water level.
Lean Forward	Spillway discharging	Continue monitoring and inspections
Stand-up	Downstream release hazard flows anticipated, OR Highest recorded flood levels in dam anticipated or occurring, OR Overtopping imminent or high risk of failure initiating	Continue monitoring and inspections. Undertake remedial works if safe to do so.
Stand-down	Lake levels dropping to FSL	Prepare EER. Check for damage and undertake special inspection and remedial works as necessary.

2.1.10.2 Alert Levels

Under normal conditions, the operation of the storage is controlled by the Dam Duty Operator (DDO) on advice from the Owner's Area Representative.

During flood events, the dam will be continuously monitored, and the event will be coordinated from the AOC/ Depot responsible for the dam. The Emergency Event Coordinator (EEC) will liaise with the DDO and obtain local flood information (e.g. discharge through the spillway) and transmit this information to the SunWater Flood Operation Centre (FOC) staff. The EEC will then obtain from the FOC Duty Officer the results from the predictive flood models derived in conjunction with BOM data, and transmit this information to the DDO and the relevant Disaster Management personnel.

The following alerts (colour coded in the table below) will be sent to the District Disaster Coordinator and the relevant Disaster Management Personnel.

The flood emergency event will start after the storage level has reached the revised operating level of EL 215.50m – This is the point where the EAP is to be activated.

Table 2-2 below is an extract from the EAP showing the alert levels and how they correspond to the activation levels and dam water levels.

Table 2-2 Flood event Alert Levels

Activation Level (See 4.4)		Storage Level at Callide Dam mAHD	AEP	Flood Alert Level Colour Code	Discharge volume (ML/d)
STAND DOWN (as level drops)	ALERT (as level rises)	**EL 215.40 m**, and rising (0.1m below operating level)		Preparedness	0
		EL 215.50 m		EAP Activated	Spillway Discharge Imminent
LEAN FORWARD		> **EL 215.50 m** and rising	-	Stage 1A	Discharge less than or equal to **23,000 ML/d**
STAND UP (EER Required)		> **EL 215.50 m** and rising	-	Stage 1B	Discharge less than or equal to **50,000 ML/d**
		Above **EL 215.50 m** and approaching **EL 216.4 m** (Trigger level for outer gates)	-	Stage 2	Discharge less than or equal to **131,000 ML/d**
		Above **EL 216.4 m** and approaching **EL 217.11 m** (Flood of Record 2013 EL 216.68 m)	**1:1,000**	Stage 3	Discharge less than or equal to **336,096 ML/d** (All gates fully open at an estimated discharge of **233,676 ML/d**)
		Above **EL 217.11 m** and approaching **EL 218.09 m**	**1:10,000**	Stage 4	Discharge less than or equal to **452,822 ML/d**
		Above **EL 218.09 m** and approaching **EL 219.24 m** Dam Crest Level	**1:100,000**	Stage 5	DCL = EL 219.24 m STORAGE AT CRITICAL SAFETY LEVEL
		EL 216.264 m Gate 2 (centre pair) is designed to open at EL 216.259 m)			EMERGENCY GATE CONTROL Gate 2 fails to open automatically
		EL 216.264 m (Gates 1 & 3 are designed to open) at EL 216.407 m)			EMERGENCY GATE CONTROL Gate 2 fails to open automatically Emergency Pump failure

2.1.10.3 Communications Plan

The EAP contains a communications plan, tabulating the required communications associated with each Alert Level. Refer to Table 2-3 for the Communications Plan up to and including Stage 4.

Table 2-3 Communications Plan from EAP (up to and including Stage 4)

Alert Level	Impact Stage	Group to contact	Notification Method	Message *	Frequency/ Trigger
Flood Scenario					
Stage 1A	Send SW Incident and Near-Miss Alert when EAP activated				
Stage 1A	N/A	LDMG/ Police	Phone	PF1	SWL=215.50, spilling imminent.
Stage 1A	N/A	D/S Residents	SMS	SF1	
Stage 1A	N/A	Owner or Owner's Area Representative	Phone	PF1	
Stage 1A	N/A	LDMG/ Police	Phone	SF1A	SWL >215.50, Discharge up to 23,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1A	N/A	D/S Residents	SMS	SF1A	SWL >215.50, Discharge up to 23,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1A	N/A	Owner or Owner's Area Representative	Phone	SF1A	SWL >215.50, Discharge up to 23,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1A	N/A	All on SMS list	SMS	SF1A	Weekly update
Stage 1B	N/A	LDMG/ Police	Phone	SF1B	SWL >215.50, Discharge = 50,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1B	N/A	D/S Residents	SMS	SF1B	SWL >215.50; Discharge = 50,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1B	N/A	Owner or Owner's Area Representative	Phone	SF1B	SWL >215.50; Discharge = 50,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 1B	N/A	All on SMS list	SMS	SF1B	Weekly update
Stage 1B	Minor	N/A			
Stage 1B	Minor				
Stage 1B	Moderate				
Stage 1B	Moderate				
Stage 2	N/A	LDMG/ Police/ Owner	Phone	PF2	SWL approaching 216.4, Discharge up to 131,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 2	N/A	D/S Residents	SMS	SF2	SWL approaching 216.4, Discharge up to 131,000 ML/d, and inflows to storage Manual gate openings – 1 pair
Stage 2	N/A	All on SMS list	SMS	SF2	Weekly update
Stage 3	N/A	LDMG/ Police/ Owner	Phone	PF3	SWL=216.4, Discharge = 336,096 ML/d, and inflows to storage Automatic gate operations begin
Stage 3	N/A	D/S Residents	SMS	SF3	SWL=216.4; Discharge = 336,096 ML/d, and inflows to storage Automatic gate operations begin
Stage 3	N/A	All on SMS list	SMS	SF3	Weekly update
Stage 4	N/A	LDMG/ Police/ Owner	Phone	PF4	SWL=217.11
Stage 4	N/A	D/S Residents	SMS	SF4	SWL=217.11
Stage 4	N/A	All on SMS list	SMS	SF4	Weekly update

2.1.11 Callide Dam Emergency Event Report – 20-22 February 2015 (SunWater, 2015)

If the dam activation level has enters Stand-up mode during an event, an *Emergency Event Report* (EER) is required to be prepared and submitted following the event. This EER was prepared by SunWater following the February 2015 event. The EER contains the following:

- Description of the event
- General comments and/or EAP recommendations
- Damage
- Instrument readings, inspection sheets and level data
- SunWater internal incident report
- Photos of the event
- Communications (EEC, DDO, DSTDM and Owner)
- Situation reports
- Flood damage inspection report
- Lessons learnt
- LDMG meeting minutes.

The content of the EER has been reviewed in detail. Various aspects of the EER are discussed under the relevant Section headings throughout this report.

2.2 February 2015 Tropical Cyclone Marcia Event Data

2.2.1 Observations and Forecasts

2.2.1.1 Rainfall Observations

Rainfall observations have been sourced from SunWater, BoM and DNRM for the various gauges throughout the Callide Creek catchment and surrounding areas. Sub-daily and daily rainfall records have been provided and used in the analysis.

Refer to Section 4.2.1 for analysis of rainfall observations.

2.2.1.2 Radar Rainfall Observations

Radar 'Rainfields' data have been sourced from the BoM for the event. The Rainfields product is radar observed rainfall, corrected to ground based rainfall observations. There is uncertainty associated with radar rainfall estimates, therefore use for hydrologic modelling is not considered to be reliable. The radar rainfall can, however, provide insight to the spatial distribution of rainfall, particularly where the coverage of rain gauges is limited.

Rainfields data are available every 10 minutes, and are provided in NetCDF4 format.

Refer to Section 4.2.1.3 for review of the radar rainfall associated with the February 2015 event.

2.2.1.3 Dam and River Level Observations

Dam and river level observations have been sourced from SunWater and DNRM for the various gauges throughout the Callide Creek catchment and surrounding areas.

Refer to Section 4.2 for analysis of dam and river level observations.

2.2.1.4 Wind observations

Wind speed and direction observations have been provided by the BoM for the Thangool Airport site (039089). Wind speed at this location is recorded every minute.

2.2.1.5 Rainfall Forecasts

The following three forecast rainfall products have been provided by the BoM for the February 2015 event:

- ACCESS-G
- ACCESS-R
- Nowcast

These data have been used to confirm the estimated depth of rainfall forecast for the event.

2.2.2 Warnings

2.2.2.1 BoM

The following list summaries the warnings issued by the BoM in relation to flood events:

- Weather Warnings
  - Severe Weather Warning

    'The Bureau of Meteorology issues Severe Weather Warnings whenever severe weather is occurring in an area or is expected to develop or move into an area. The warnings describe the area under threat and the expected hazards. Warnings are issued with varying lead-times, depending on the weather situation, and range from just an hour or two up to about 24 hours.' (www.bom.gov.au).
  - Severe Thunderstorm Warning

    'A Severe Thunderstorm Warning is issued when a severe thunderstorm is reported, or there is strong evidence of a severe thunderstorm, and it is expected to persist.

    Also, Severe Thunderstorm Warning is issued when existing thunderstorms are likely to develop into a severe thunderstorm.

    Severe thunderstorms can be quite localised and develop quite quickly. The exact location of severe thunderstorms can be hard to predict. The warnings are usually issued without much lead-time before the event.' (www.bom.gov.au).
- Flood Warnings
  - Flood Alert, Watch or Advice

    'An Alert, Watch or Advice of possible flooding is issued if flood producing rain is expected to happen in the near future. The general weather forecasts can also refer to flood producing rain.' (www.bom.gov.au)
  - Generalised Flood Warning

    'A Generalised Flood Warning that flooding is occurring or is expected to occur in a particular region. No information on the severity of flooding or the particular location of the flooding is provided.' (www.bom.gov.au).
- Tropical Cyclone Warnings

  Tropical Cyclone Advices are issued whenever a tropical cyclone is expected to cause winds in excess of 62 km/h (gale force) over land in Australia (refer to map). A tropical cyclone advice may be a watch and/or a warning, depending on when and where the gales are expected to develop.

  – *A tropical cyclone watch is issued for coastal communities when the onset of gales is expected within 48 hours, but not within 24 hours.*

  – *A tropical cyclone warning is issued for coastal communities when the onset of gales is expected within 24 hours, or are already occurring*

Each advice issued for a particular cyclone will be numbered sequentially, starting at number 1 for the first advice. A tropical cyclone advice may contain a combined watch and warning, that is it will provide information on the area under watch status and the area under warning status.

While the threat remains, a tropical cyclone advice will be issued every six hours, increasing to every three hours when cyclone warnings are required. In some circumstances, when a cyclone approaching the coast is under radar surveillance, the advices may be issued hourly.

The BoM has provided all flood watches, flood warnings and tropical cyclone warnings for the February 2015 event. These are provided in Appendix C.

2.2.2.2 SunWater

Throughout the event, SunWater communicated messages and warnings via:

- Email to other agencies including Council, LDMG, BoM and DEWS;
- Twitter (refer to Table 2-4);
- SMS – flood warnings following commencement of dam release; and
- Phone calls to affected residents at the start of the release.

Table 2-4 Twitter messages sent by SunWater

Time and Date	Message
18 February 16:39	We're prepared for severe weather as #TCMarcia approaches #Qld coast. Operational teams onsite & standby. More here: http://on.fb.me/1vlzx7Q
18 February 16:47	SunWater is preparing for severe weather in Central #Qld after @BOM_Qld issued cyclone watch. http://www.qldalert.com for latest info #bigwet
20 February 10:39	Our dams aren't for flood mitigation. They're designed to store water to full capacity + safely divert further inflows thru spillway #bigwet
20 February 10:40	We continue to monitor #TCMarcia + have operational teams on standby. More info on how we manage dams during floods: http://bit.ly/1w2UZdr
20 February 16:54	Callide Dam gates currently closed. We advise local disaster group + immediately downstream residents of releases
20 February 21:22	Current flood alert for Callide Dam. SunWater commencing releases from gates. http://bom.gov.au + Local Emergency Mgt Groups for more
20 February 21:35	SunWater is making releases through the gates at Callide Dam, however reports the gates have burst are not accurate. #TCMarcia
21 February 16:45	Preliminary estimates indicate #TCMarcia rainfall was a 1 in 10,000 year unprecedented event exceeding water levels during TC Oswald in 2013

SunWater distributed the following SMS warnings to subscribed residents living within a 10km of the dam (along the river channel):

- 20 February 20:39 - '*SunWater Callide Dam flood ALERT NOTIFICATION: D/S flooding expected – rapid rises. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'*
- 20 February 22:37 - *'SunWater Callide Dam flood ALERT NOTIFICATION: Flood Stage 4 current flow = 298,000ML/day. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'*

2.2.2.3 LDMG

The Banana LDMG distributed the following SMS warning:

- 20 February 21:40 - *'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'*

The Banana LDMG also pushed the following voice message:

- 20 February 21:40 – '*Emergency Emergency. This is a flood warning message from Banana Local Disaster Management Group. Sun Water advise of extensive outflow of water occurring from Callide Dam. Areas in Jambin and Goovigen are likely to experience rapidly rising water levels over the next 2 to 3 hours posing a danger to residence. You should move to high ground now. For more information listen to local radio.'*

2.2.3 Telecommunications

On 15 April 2015 representatives from IGEM had a meeting with representatives from Telstra. The following points were noted by Telstra in relation to the February 2015 event:

- Biloela is located on the north – south optic fibre route. There are multiple loops in the route to act as redundancy.
- During the event, 3.5km of optic fibre was damaged, which led to service disruption of 89 fixed line voice services, 1212 ADSL services, 4 business data services, and loss of coverage from 7 mobile base stations.

Telstra issued a report to IGEM dated 13 April 2015 summarising the network damage and issues sustained during the event. The Telstra report states:

> *'In regards to the incident in question (Optical Fibre Damage between 19:22 AEST 20/02/15 and 12:44 AEST 23/02/15) it was assessed by Telstra as being due to the unscheduled release of water from Callide Dam.'*

The Telstra report identifies the cable damage to have occurred at 19:22 on 20 February. The time is based on the activation time of a network failure alarm. It should be noted that at 19:22, the water level in Callide Dam was at 214.991m AHD, and at this time, no water was being released from Callide Dam. Therefore, damage is assumed to have occurred from stormwater runoff.

2.2.4 Flood Survey

Following the event, Banana Shire Council undertook a flood mark survey, identifying high water marks, ground levels and flood extents. The coverage of the survey is included on Map 2-1. Review of the survey data showed the following issues:

- Inconsistent high water mark levels for points within a close proximity. With a steep slope of the flood surface and complex flow patterns, this may not be incorrect;
- Many high water marks had corresponding ground levels at the same point location. Visual inspection of a sample of points showed the high water marks to be lower than the ground level; and
- Comparison of ground survey levels to the LiDAR survey showed unexpected variability.

No further analysis on the data was undertaken, and Council has been asked to reissue the corrected survey. At the time of writing this report, the revised survey had not been received.

2.2.5 Resident Survey

Immediately following the event, IGEM visited the Callide Creek catchment and conducted interviews with flood affected residents. The interview notes contain valuable information relating to:

- Availability, timing and accuracy of warnings (used for assessment of warnings); and
- Flood behaviour (used for verification of the flood modelling).

In addition to the above information, the resident survey has provided insight into the concerns that residents have in relation to flood management in the Callide Valley. These concerns mostly relate to SunWater, although Council's role in flood management is commonly raised.

Residents' responses included the following:

- The flood behaviour was unusual, possibly due to unusually high water levels in Callide Creek;
- Received the SMS alerts from SunWater at 20:39, which was after the release had commenced;
- Did not receive an SMS alert;
- Unaware of the SMS alert subscription;
- The SunWater alert SMS noted to refer to the BoM website, however, no information was available on the BoM website;
- Received an SMS message from the disaster centre at approximately 21:50;
- Only notified by friends and relatives;
- SunWater has the responsibility for warnings within a 10km radius[6] of the dam, and Council outside this area;
- No information from Council regarding flood risk;

[6] The reference to the 10km radius noted by some residents is incorrect. SunWater has the responsibility for warnings within 10km of the dam (along the channel), and Council warning the entire disaster area.

- Poor planning practice by Council;
- Farmers have reacted to latest flooding by building up levee banks, so now you cannot predict what is going to happen;
- Insufficient time to move possessions;
- Some residents in the Biloela area described flood waters originating from Kroombit;
- Callide Creek was full so other creeks backed up;
- Callide Dam release aggravated flooding;
- If Kroombit Creek overflows, flow enters Washpool Gully but the Callide release pushed water back;
- Bell Creek flooded at 10:00 on 21 February;
- The flood took 30 minutes to reach Biloela from the dam spillway; and
- The flood took 16-18 hours to reach Jambin and Goovigen.

2.2.6 Rapid Damages Assessments

Rapid Damages Assessments were completed for all damaged properties along Callide Creek. Refer to Map 2-2 for location of RDA's and mapping whether damage was considered minor, moderate or severe.

3 Dam Description and Operation

3.1 Dam Description

Some statistics regarding the dam are listed below:

- Main Dam Type - Rock and Earthfill Dam
- Full Supply Level (FSL) - 215.50m AHD (from Jan 2015 until further notice)
- Maximum Storage Level – 216.18m
- Minimum Operating Level - 185.45m
- Storage Capacity at FSL - 136,370 ML
- Storage Area at FSL - 1,240 hectares
- Dam Length - 2,008m
- Dam Crest Level - 219.24m AHD
- Height of Dam above downstream toe level - 37.24m (approx.)
- Spillway Crest Level - 207.65m AHD
- Spillway Crest Length - 79.2m
- Spillway Capacity for DCF – 5,888 m^3/sec
- DCF Annual Exceedance Probability - 1:100,000
- Max. Spillway Capacity (Model testing) – 5,470 m^3/s
- Max. Spillway AEP - 1:90,000
- Outlet Pipes - 2 x 1,220mm diameter MSCL.

3.2 Full Supply Level

Following the heavy rainfall in late 2010 / early 2011, Callide Dam filled to its full supply level of 216.100m AHD for the first time. Following the event, leakage was observed through the left embankment, which initiated an investigation into the dam wall stability. The preliminary analysis showed that with water stored to the FSL of 216.100m, the embankment did not comply with the normally accepted factor of safety (ref. *Callide Dam – Dam Break 2012*, SunWater, 2012).

Subsequently the Dam Safety Regulator agreed to SunWater's recommendation to reduce the FSL from 216.100m to 214.000m AHD until further investigations and analysis had been undertaken. The recommended further investigations included a dam break model assessment. In 2012, SunWater undertook the dam break assessment of the Callide Dam left bank. Refer to Section 2.1.3 for a summary of the assessment.

In January 2015, following completion of investigations, the FSL was raised from 214.000m to 215.500m AHD. The O& M Manual and EAP were subsequently updated and reissued.

3.3 Gate Description

Construction of Stage 1 of Callide Dam was completed in 1965. The dam outlet for Stage 1 had a fixed 'ogee' type weir and spillway with a crest level of 207.65m AHD. When dam water levels rose above the spillway crest, water would have freely flowed over the spillway.

In 1988, the radial gates were added to the dam as part of Stage 2 of the dam construction. The addition of gates increased the full supply level from 207.65m to 216.10m AHD. There are six gates, arranged as three pairs. Each pair is 25.60m long and 9.14m high.

Figure 3-1 Photo of Callide Dam radial gates (source O&M Manual, Jan 2015)

The gates are operated in one of two ways:

- Automatic operation – when the water level in the dam reaches a certain level, water flows into a float well, subsequently lifting the float, which lowers the gates counterweight and opens the gates.
- Manual operation – the gates can be operated manually by pumping water into the float wells to simulate a rising water level in the dam.

3.4 Spillway Capacity

The *Callide Dam – Dam Break Analysis - Based on Revised PMP Design Flood Hydrology* (2003) report identifies the Callide Dam spillway to have the capacity to pass a 110,000 year ARI flood event, assuming the dam was at the original FSL of 216.100m at the start of the event. The *Callide Dam EAP* lists the spillway to have a 90,000 year ARI capacity.

When the water level exceeds the dam crest level of 219.24m, the dam will be subject to failure. The rating curve included in the Callide Dam EAP is shown in Figure 3-2. From this figure, a water level of 219.240m would equate to a spillway discharge of approximately 5,325m^3/s. This is lower than the inflow into the dam during the February 2015 event.

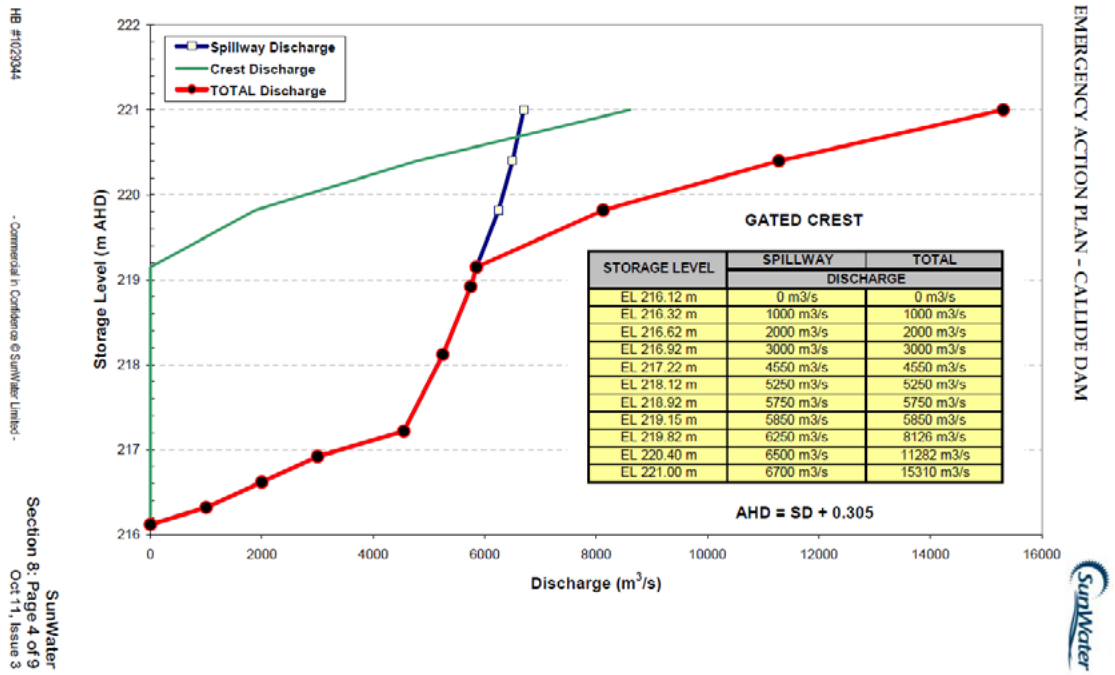

Figure 3-2 Spillway capacity rating curve

3.5 Gate Operation

The Callide Dam gates are configured to respond to rising storage levels. The gates have a series of chambers and counter weights that are connected to the water in the dam. Once the water level rises above FSL the gates will begin to open; the middle pair of gates will open at 216.259[7]m and the outer pairs will open at 216.407m.

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

[7] Levels inferred from Section 2.5.2 of the *Callide Dam Operation and Maintenance Manual* (SunWater, Jan 2015) where it states *"The middle gate begins to open at EL 216.259m, and the two outer gates at EL 216.407m."*

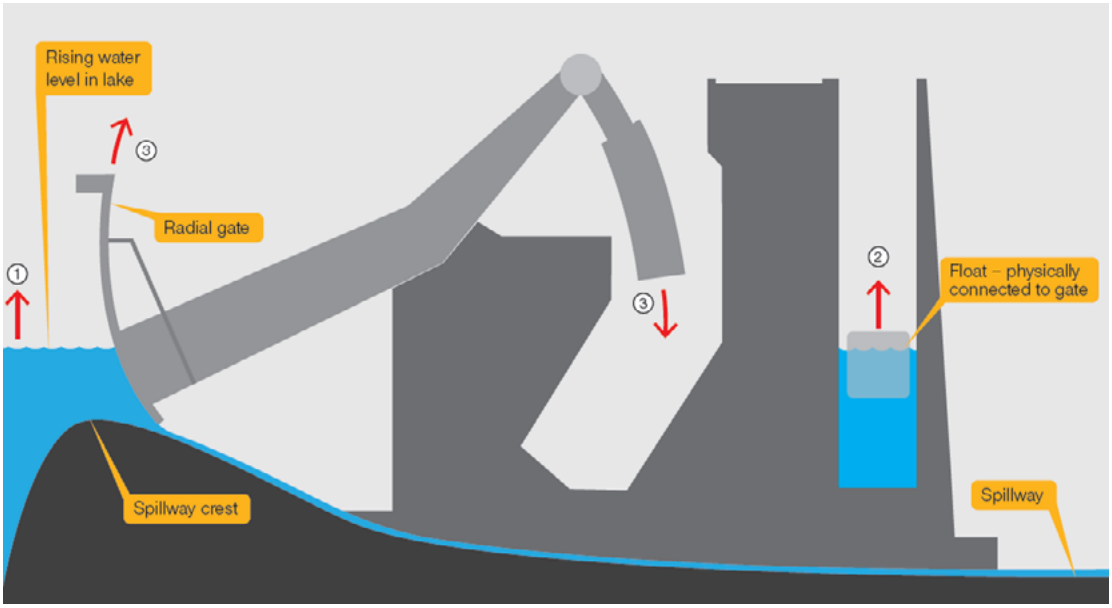

Figure 3-3 Gate operation schematic (gates in closed position)

When the spillway gates need to be opened at a time when the storage level is too low to activate the gates automatically, a pump is used to artificially raise the water level in (2), thus simulating rising water levels in the dam. This manual operation also applies to manual control during flood operations.

When the water level in the dam exceeds 217.200[8]m, all three pairs of gates are configured to open to their maximum opening. This is a failsafe mechanism to prevent the dam filling and overtopping the dam embankment, which would cause failure of the dam.

[8] Level taken from Figure 26, Section A.4 of the *Callide Dam Operation and Maintenance Manual* (SunWater, Jan 2015) and Table 5 from Section A.1.1 which states that all gates go to fully open at EL 217.20m, and all gates are fully open at EL 217.24m.

4 Event Description

4.1 Event Timeline

The event timeline has been split into two groups for ease of interpretation:

- Rainfall, water levels, and gate operation timeline; and
- Warnings timeline.

4.1.1 Rainfall, water levels and gate opening timeline

This section should be read in conjunction with the rainfall, water levels and gate operation timeline presented on Figure 4-1.

In the two days until 09:00 on 20 February 2015, some minor rainfall had been recorded across the Callide Creek catchment, with two day rainfall totals of up to 74mm having been recorded in the Upper Kroombit Creek catchment. At 09:00 on 20 February 2015, Callide Dam water level was 214.286m, or 89%[9] of the reduced FSL of 215.500m.

Heavy rainfall occurred across the catchment between 09:00 and 15:00 on 20 February, with the most extreme rainfall occurring between 15:00 and 21:00.

At 19:55 on 20 February 2015, the reduced FSL of 215.500m was reached. At this point, the cyclone was passing to the east of Biloela. The dam operators took shelter at this time, thus were unable to manually operate the gates in accordance with the O&M Manual.

No further readings were received from the Callide Creek 96km gauge after 19:45, so there was no indication of inflows after this time.

At 20:28[10] the water level in the dam had exceeded the theoretical middle gate trigger level of 216.260m. It is expected that the middle gates began to open at this time. It is possible the gates could have opened slightly earlier or later, depending on the exact configuration of the gate opening mechanism. Refer to gate opening timeline presented on Figure 4-1.

Within 6 minutes by 20:34[11], the water level had exceeded the outer gate trigger level of 216.410m. It is expected that the outer gates began to open at this time.

Based on the track maps, TC Marcia passed to the east of Biloela at approximately 22:00 on 20 February. Soon after the eye of the cyclone had passed, the rainfall ceased. By 21:00 on 20 February, 90% of the three day total rainfall for the event had fallen across most of the catchment.

The first time the gates were observed to be open was at approximately 21:30, when the water level was at 217.162m. The middle gates were observed to be open to 4.0m and the outer gates to 3.0m. The water level in the dam was still rising, although was nearing the peak. The discharge is calculated to be 2,185m^3/s at this time, based on the observed gate opening.

The next time the gates were observed, was 30 minutes later at 22:00, when the water level was at 217.192m. Although not significantly higher than the 21:30 observation, the middle gates had

[9] There are media references to the dam being at 84% capacity prior to the event. This is based on the original FSL of 216.100m.
[10] Time calculated from linear interpolation of recorded water levels at 20:15 and 20:30.
[11] Time calculated from linear interpolation of recorded water levels at 20:30 and 20:45.

opened to 7.0m and the outer gates to 6.0m. The discharge is calculated to be 3,480m^3/s at this time, based on the observed gate opening. This is considered to be the peak water level in the dam and the corresponding peak discharge.

From this time onwards, the Dam Duty Operator was able to manually observe and record water levels and gate openings every 30 minutes.

All three pairs of gates slowly started to close as the water level in the dam fell throughout the night of 20-21 February. By 10:00 on 21 February, the outer pairs of gates were closed. At this time the water level was 216.366m. The middle pair of gates were open by 1.0m. In accordance with the *O&M Manual*, the test pump was activated to maintain the middle gate opening at approximately 1.0m until the dam water level had been reduced to the FSL of 215.500m. A decision was made to reduce the level to 215.400m to allow for some minor inflows from Callide Creek. The middle gates were fully closed by 14:00 on 21 February.

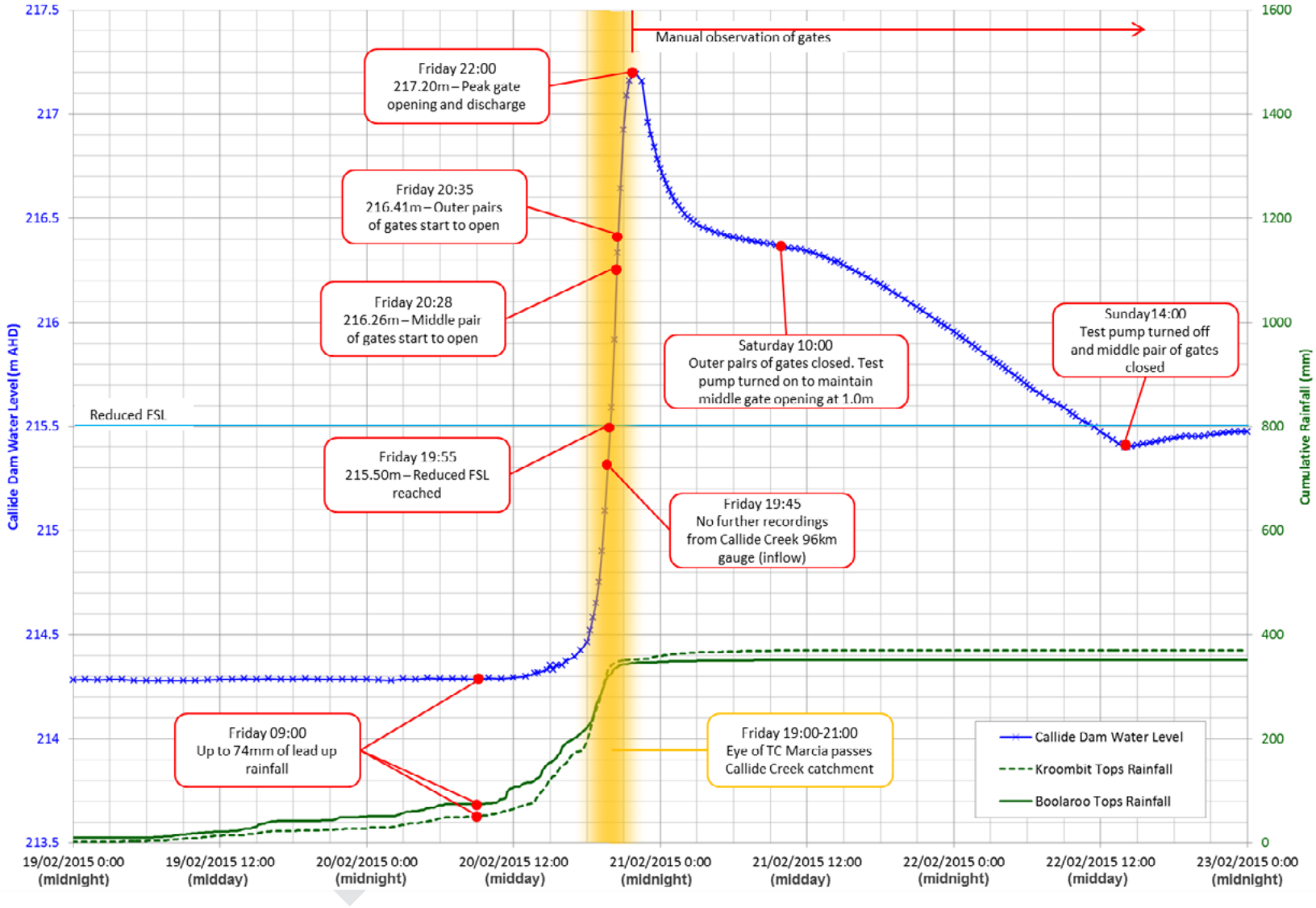

Figure 4-1 Rainfall, water level and gate operation timeline

4.1.2 Warnings timeline

This section should be read in conjunction with the warnings timeline presented on Figure 4-6.

The first notification of potential adverse weather was issued by the BoM via Flood Watch #1 at 15:47 on 17 February (Tuesday). The Flood Watch noted the potential for 200-300mm of rainfall between Rockhampton and the NSW border from Thursday through to Saturday. The Flood Watch also noted that higher localised falls were likely.

The first Tropical Cyclone Warning was issued at 04:48 on 18 February (Wednesday). The track map associated with the warning shows a category 1 cyclone at landfall, soon weakening into a low, as it continues to track southwards from Gladstone and across the Callide Creek area.

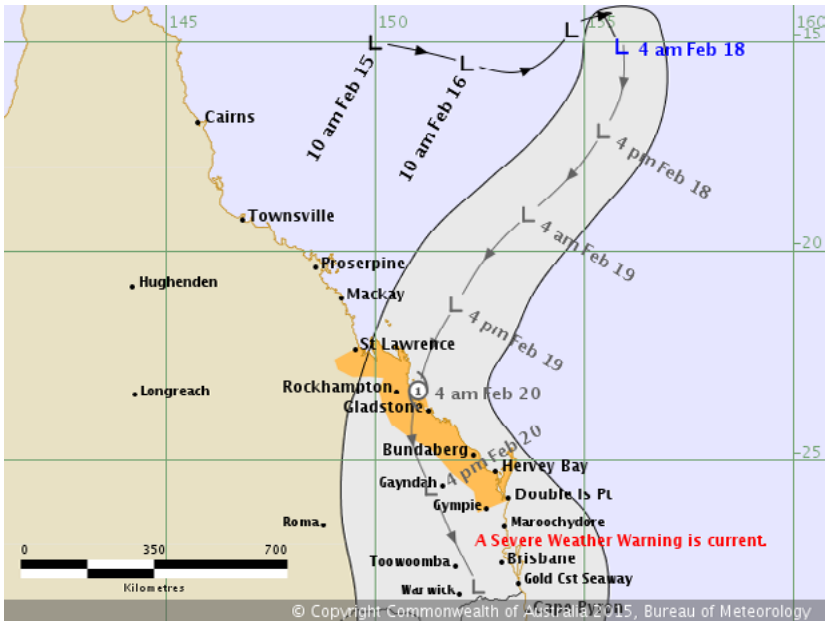

Figure 4-2 Tropical Cyclone Warning #1 track map

The BoM issued the second Flood Watch at 11:54 on 18 February (Wednesday), with revised rainfall estimates of 200-400mm.

Until the morning of 20 February when the cyclone made landfall (between 07:00 and 08:00), the BoM continued to monitor the situation and provided updates to the Tropical Cyclone Warnings and Flood Watches. Refer to complete list of all Flood Watches, Flood Warnings and Tropical Cyclone Warnings in Appendix C.

The expected rainfall depths remained unchanged until Flood Watch #4 at 11:34 on 20 February where the Friday and Saturday total was revised to a further 200-300mm. This accounted for the rainfall that had already fallen until that time.

At 22:03 on 20 February, the BoM issued the first Flood Warning. The warning stated:

'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.

DON AND DEE RIVERS 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.'

This warning was not updated until 05:55 on 21 February.

From 17:03 on 18 February (Wednesday), the BoM issued revised Tropical Cyclone Warnings every three hours until 13:51 on 19 February (Thursday).

From 15:57 on 19 February (Thursday) the frequency was changed to every hour until 19:51 on 20 February when the cyclone was a category 2 system, located northeast from Biloela. Tropical Cyclone Warning #16 was issued at 20:58 on 19 February, which showed a category 2 system expected to pass immediately to the west of Biloela.

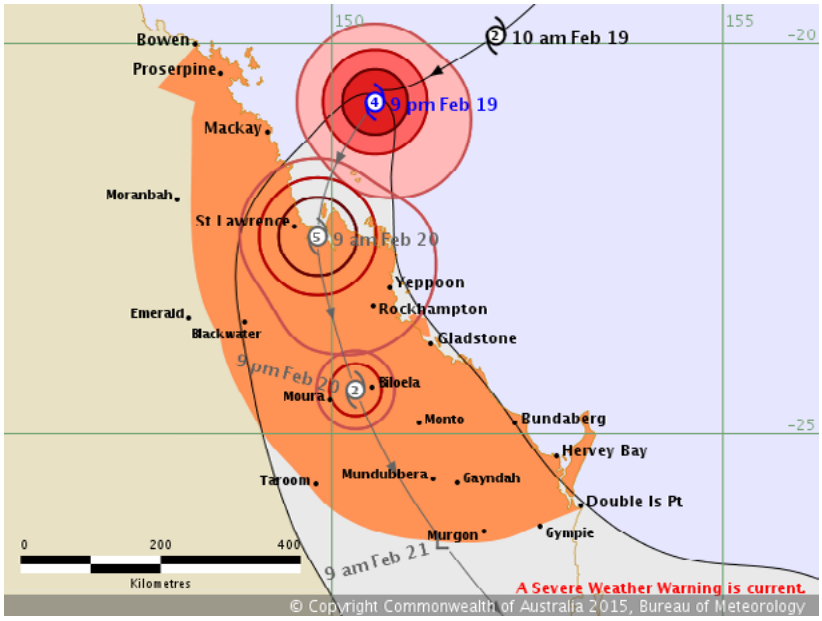

Figure 4-3 Tropical Cyclone Warning #16 track map

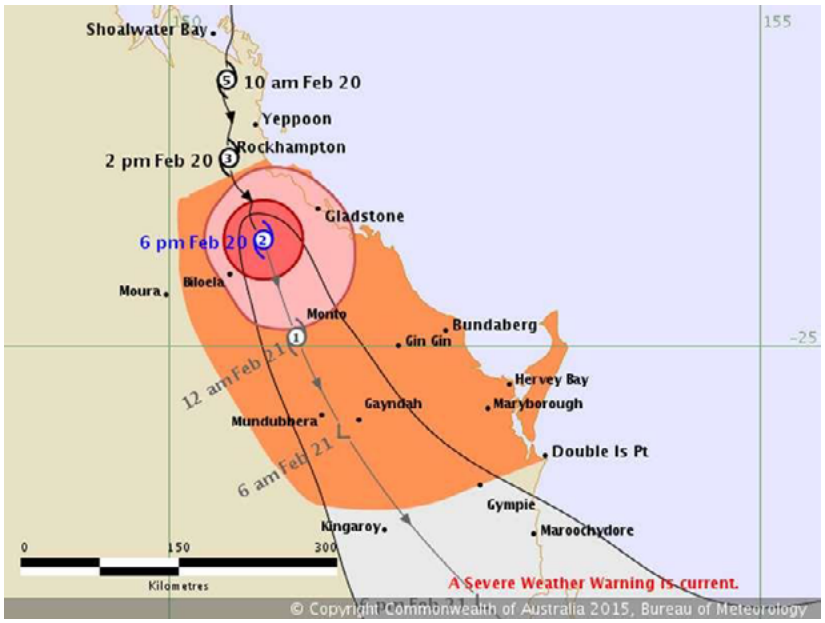

Figure 4-4 Tropical Cyclone Warning #37 track map

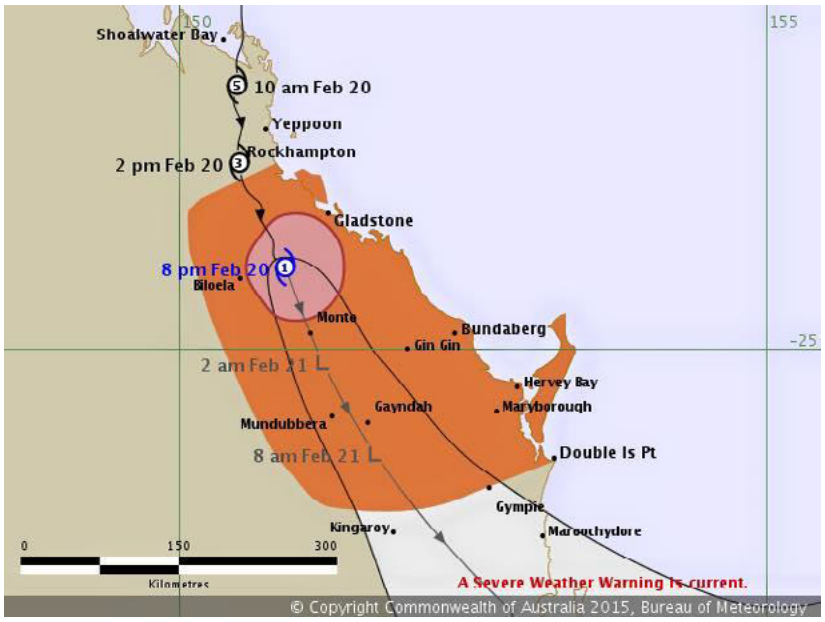

Figure 4-5 Tropical Cyclone Warning #40 track map

The next Tropical Cyclone Warning was issued at 23:02 on 20 February (#40), showing the eye had passed Biloela and had weakened to a category 1 system.

SunWater distributed the following SMS to the subscribed residents at 20:39 on 20 February:

> *'SunWater Callide Dam flood ALERT NOTIFICATION: D/S flooding expected – rapid rises. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'*

The LDMG issued the following SMS and voice messages to all residents at 21:40 on 20 February:

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

The final SMS was sent by SunWater to the subscribed residents at 22:37 on 20 February:

> *'SunWater Callide Dam flood ALERT NOTIFICATION: Flood Stage 4 current flow = 298,000ML/day. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'*

A final Tropical Cyclone Warning was issued by the BoM at 01:55 on 21 February (#41), where the system was shown to have weakened into a low pressure system.

The second Flood Warning, issued at 05:55 on 21 February, stated:

> *'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.*
>
> *DON AND DEE RIVERS AND CALLIDE CREEK:*
>
> *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 morning.*

Event Description

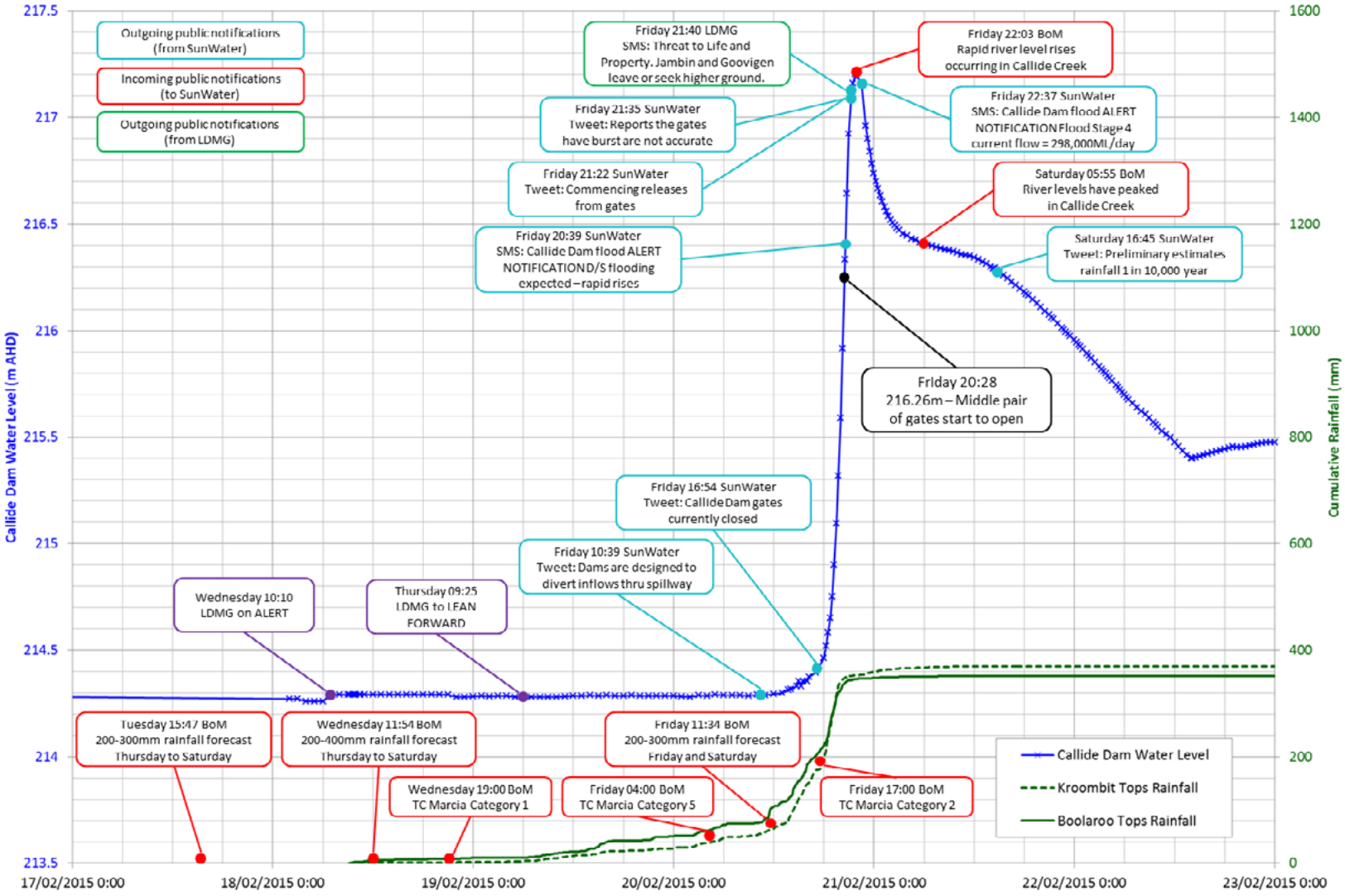

Figure 4-6 Warnings timeline

4.2 Rainfall and river levels

4.2.1 Rainfall

4.2.1.1 Sub-Daily Rainfall

Within and immediately surrounding the Callide Creek catchment, 53 sub-daily reporting rain gauges have been identified. Gauges are owned and operated by a variety of authorities including SunWater, DNRM and local Councils. Of the 53 identified gauges, data for the February 2015 event are available for 28 of the gauges. The 25 remaining gauges have either been decommissioned or were out of service during the event. Refer to Map 4-1 for distribution of rain gauges and Appendix D for a list of gauges, including identification of which gauges were reporting during the event.

Shown on Figure 4-7 are the cumulative rainfall totals for the 10 gauges located within the catchment for the period from 09:00 on 20 February until 09:00 on 21 February. Three gauges (Callide Creek at Goovigen, Callide Dam Inflow TM and Bell Creek at Craiglands) are not shown as they have similar readings to a secondary gauge at these sites.

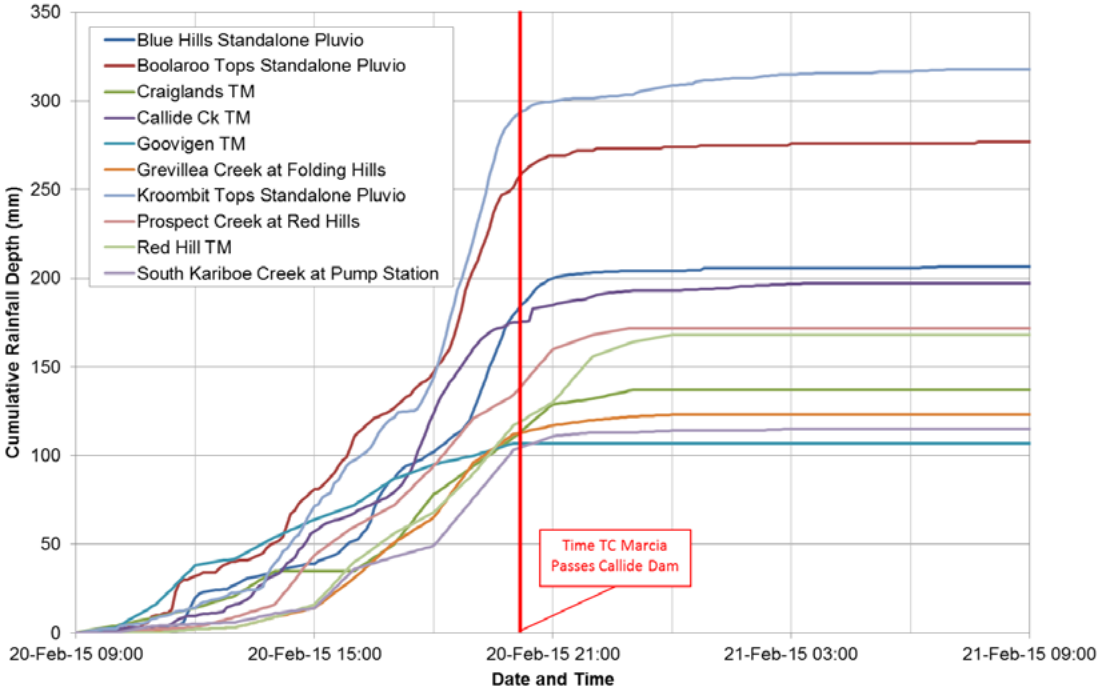

Figure 4-7 Cumulative rainfall chart (09:00 20-Feb to 09:00 21-Feb)

The highest recorded rainfall in the Callide Creek catchment was in the upper Kroombit Creek catchment at Boolaroo Tops (351.0mm) and Kroombit Tops (368.5mm), recorded over the three day period from 09:00 on 18 February until 09:00 on 21 February. For the 12 hour period between 09:00 and 21:00 on 20 February these gauges had reported 269.0mm and 299.6mm of rainfall

respectively. These gauges are the closest to the Upper Callide Creek catchment. Further downstream along Callide Creek, the Callide Ck TM gauge received 213.0mm over the same three day period, and 187.0mm during the 12 hour period between 09:00 and 21:00 on 20 February. Three day and 12 hour totals for each gauge are listed in Table 4-1 and shown spatially on Figure 4-8.

Table 4-1 Rainfall totals – sub-daily gauges

Gauge ID	Gauge Name	12 hour total (mm)	3 day total (mm)
130319A	Bell Creek at Craiglands	171.0	225.0
1303P006	Blue Hills Standalone Pluvio	200.2	255.3
1361P002	Boolaroo Tops Standalone Pluvio	269.0	351.0
539071	Callide Ck TM	185.0	212.6
130327A	Callide Creek at Goovigen	106.0	151.0
539111	Callide Dam Inflow TM	187.0	213.0
539107	Craiglands TM	129.0	173.0
539068	Goovigen TM	107.0	143.0
130336A	Grevillea Creek at Folding Hills	112.0	133.0
1303P003	Kroombit Tops Standalone Pluvio	299.6	368.5
130348A	Prospect Creek at Red Hills	160.0	191.0
539100	Red Hill TM	130.0	187.0
130334A	South Kariboe Creek at Pump Station	111.0	127.0
539106	South Kariboe Creek TM	96.0	117.0

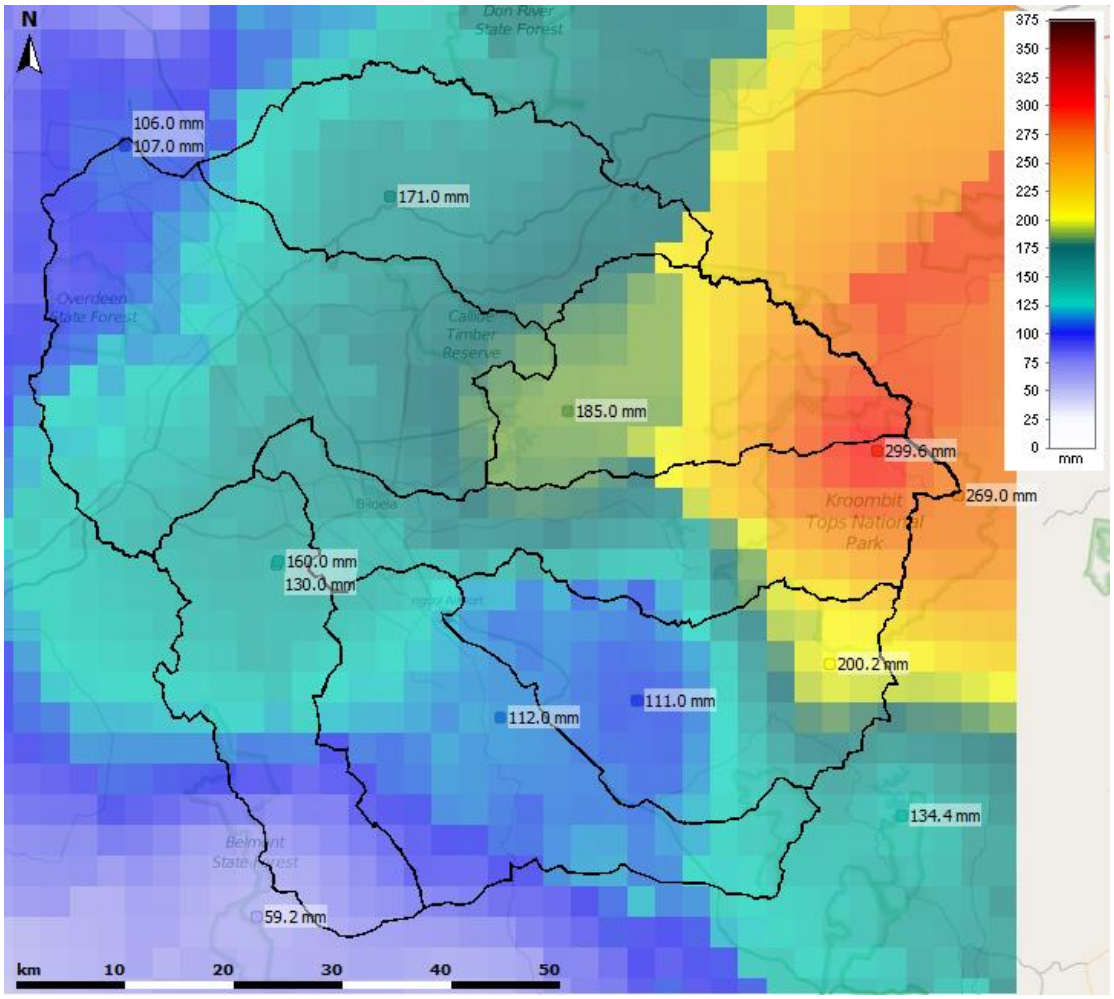

Figure 4-8 Cumulative rainfall map (09:00 to 21:00 20-Feb)

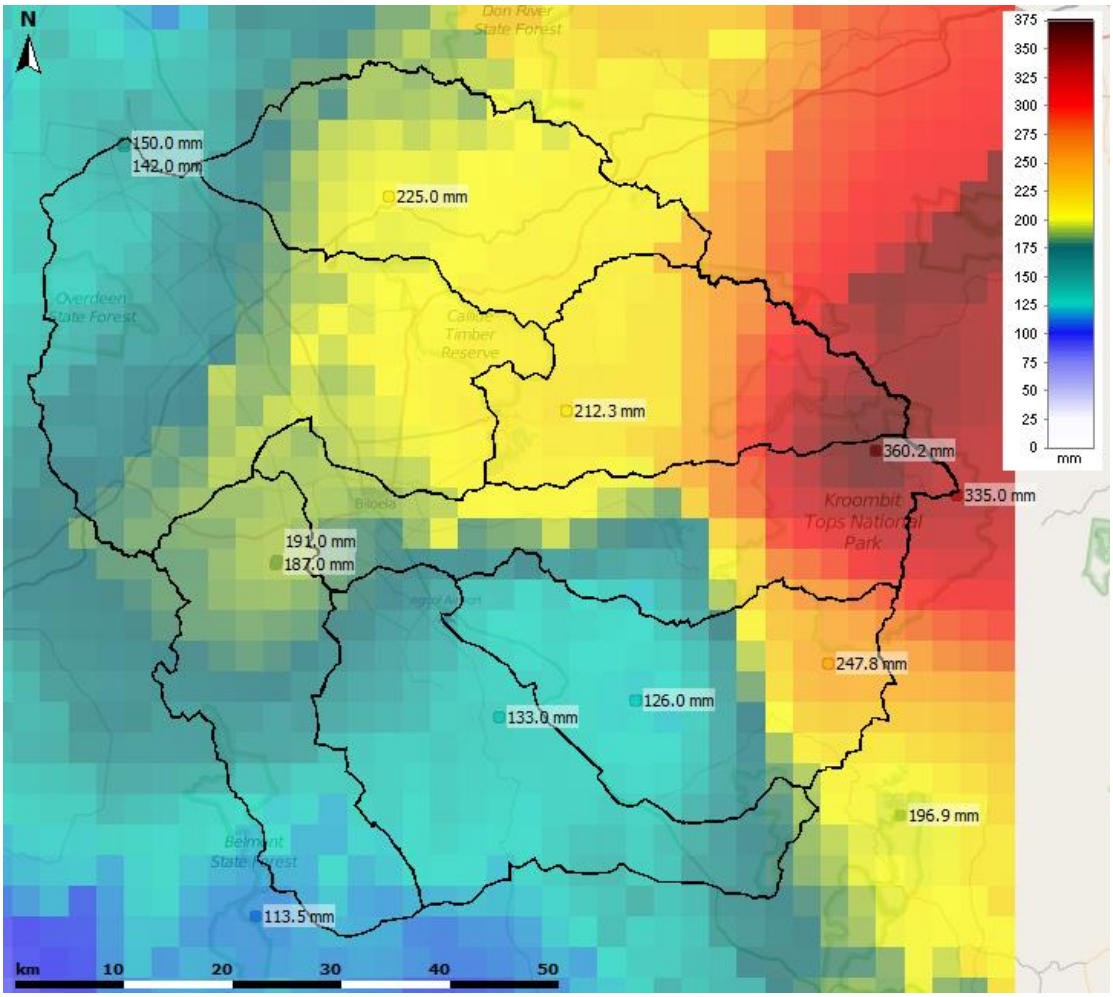

Figure 4-9 Cumulative rainfall map (09:00 18-Feb to 09:00 21-Feb)

To compare the pattern of rainfall (temporal distribution) across the various gauges, the cumulative rainfall totals are presented on Figure 4-10 as a percentage of the total rainfall for each gauge. The plot shows the intense rainfall commencing at the Goovigen TM gauge from 10:00 on 20 February 2015. As the cyclone travels southwards, the intense rainfall the other gauges to the south commences from about 12:00 on 20 February 2015. Other than at the Goovigen TM gauge, the rainfall pattern is consistent across the catchment, and is shown to occur at the same time. At most gauges 80% - 100% of the rainfall occurs as TC Marcia approaches the catchment. Refer to Figure 4-11 for the track map of TC Marcia at 19:51 on 20 February 2015, as the eye of the cyclone passes to the east of Biloela and the Callide Creek catchment.

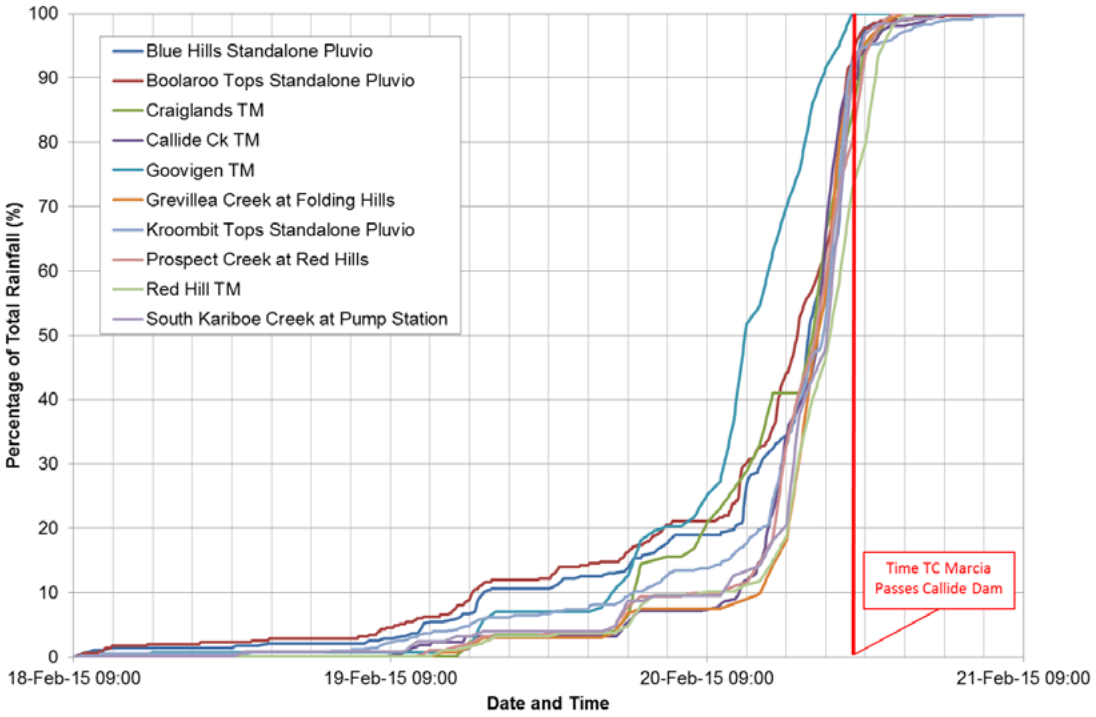

Figure 4-10 Cumulative normalised rainfall chart (09:00 20-Feb to 09:00 21-Feb)

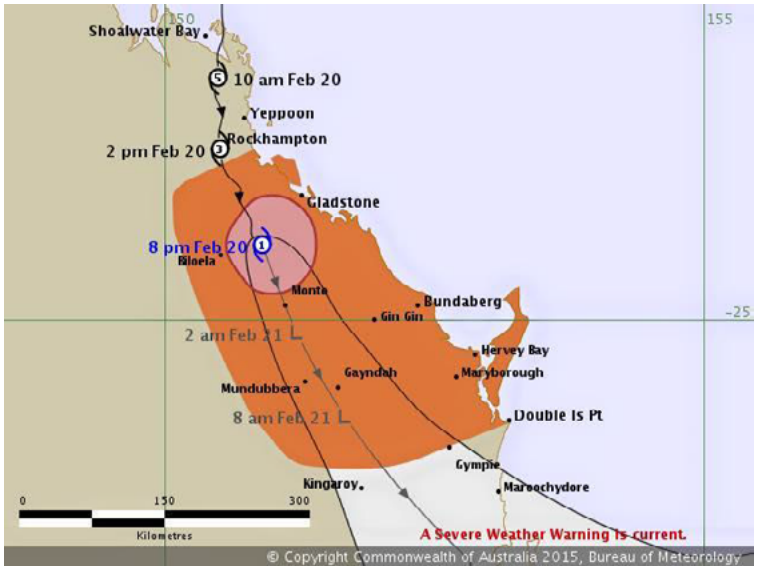

Figure 4-11 TC Marcia track map for 19:51 20 February 2015 (source BoM)

A final cumulative rainfall map for the period between 09:00 on 18 February and 09:00 on 21 February is shown on Figure 4-12. The purpose of showing this figure is to highlight the rainfall that occurred during the two days prior to the day of the cyclone. At the Boolaroo Tops gauge, 74mm of

rainfall had been recorded in the two days before 09:00 on 20 February 2015. This would have saturated the ground prior to the main rainfall burst, resulting in more of the main rainfall burst becoming surface runoff, rather than infiltrating to the ground.

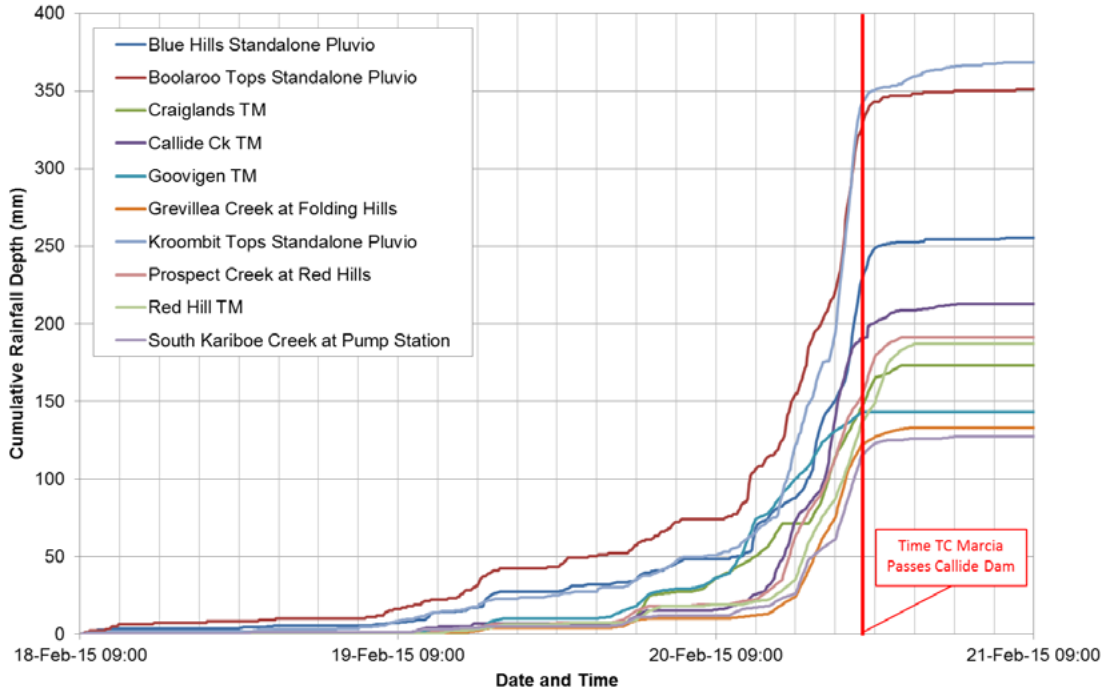

Figure 4-12 Cumulative rainfall chart (09:00 18-Feb to 09:00 21-Feb)

4.2.1.2 Daily Rainfall

Within and immediately surrounding the Callide Creek catchment, 14 daily reporting rain gauges have been identified. Gauges are owned and operated by the Bureau of Meteorology. Data for the February 2015 event are available for 12 gauges. Thangool and Theodore gauges have been excluded due to reporting little or no rainfall over the event. Additionally, the rainfall that occurred between 09:00 on Friday 20 February and 09:00 the following day at the Biloela – Valbona gauge was likely measured on Monday morning, and subsequently averaged over the Saturday and Sunday. For consistency with the surrounding gauges, the rainfall at this gauge has been reassigned to 09:00 on 21 February.

Refer to Map 4-2 for distribution of rain gauges, Appendix D for a list of gauges and Table 4-2 for three day rainfall totals for the period between 09:00 on 18 February and 09:00 on 21 February. The rainfall totals are shown spatially on Figure 4-13.

The spatial distribution of rainfall accumulations is similar for the sub-daily and daily gauges, with higher rainfall depths along the eastern boundary of the catchment (Upper Callide and Kroombit Creeks). The map of daily rainfall stations shows an unusual ‘spike’ at the Biloela-Valbona gauge, having a total of 369.8mm. Given the variability shown between the gauges, it is possible that localised areas of higher intensity rainfall could have occurred, although there is also a possibility

that the recorded rainfall was not accurately recorded due to the cyclonic winds experienced towards the end of the rainfall event as the cyclone approached.

Table 4-2 Rainfall totals –daily gauges

Gauge ID	Gauge Name	3 day total (mm)
39149	Barfield	105.9
39290	Biloela - Valbona	369.8
39019	Callemondah Station	271.0
39222	Cania Gorge Park	234.9
39204	Colodan	108.2
39197	Fig Tree	198.2
39048	Goovigen	153.0
39334	Hazeldean	219.0
39172	Hillview	211.3
39054	Jambin Post Office	144.2
39240	Kroombit	158.4
39106	Mount Kroombit	179.0
39089	Thangool Airport	-
39158	Theodore	-

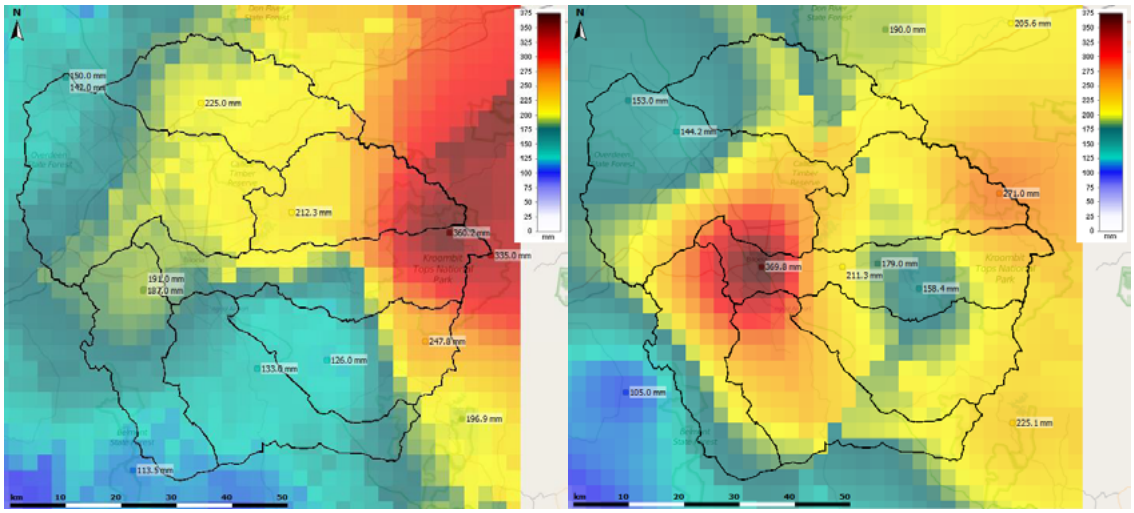

Figure 4-13 Cumulative rainfall map (09:00 18-Feb to 09:00 21-Feb) sub-daily gauges on left; daily gauges on right

The rainfall distribution based on sub-daily rainfall (shown on left in Figure 4-13) was subsequently adopted for modelling.

4.2.1.3 Radar Rainfall

The radar rainfall estimates from the Gladstone radar station are significantly lower than recorded at the ground gauges. Review of the radar rainfall shows significant shadowing of the rainfall estimates. Shadowing appears to occur close to the radar (top right of Figure 4-14), however, the ridge line forming the Callide Valley's north eastern boundary (Kroombit Tops range) appears to worsen the shadowing effect.

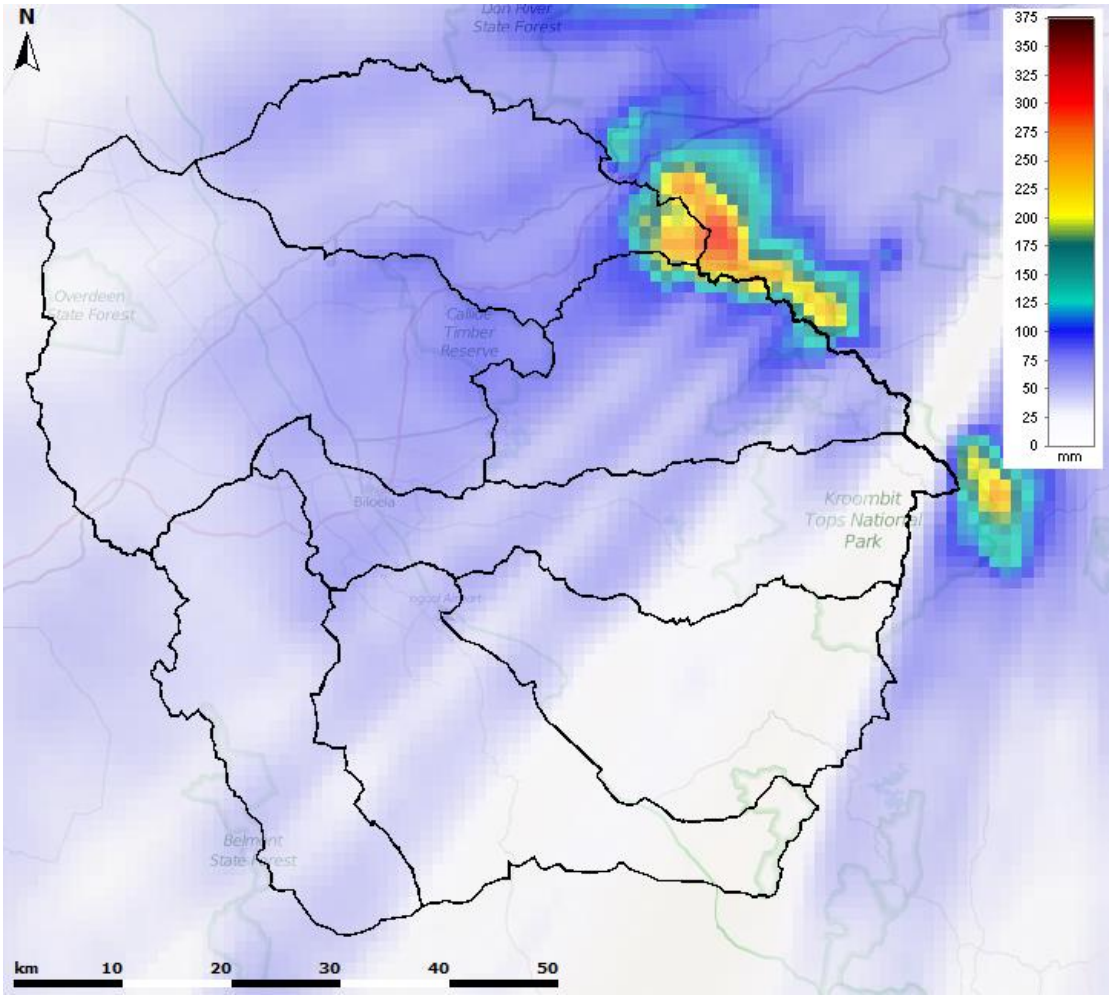

Figure 4-14 Cumulative radar rainfall map (09:00 18-Feb to 09:00 21-Feb)

The three day rainfall totals for the period between 09:00 on 18 February and 09:00 on 21 February at the Boolaroo Tops and Blue Hills gauges are shown on Figure 4-15. Less than 5mm is shown at the Blue Hills gauge location which is located within the shadow shown on Figure 4-14.

These data are considered unreliable and have therefore been excluded from further analysis.

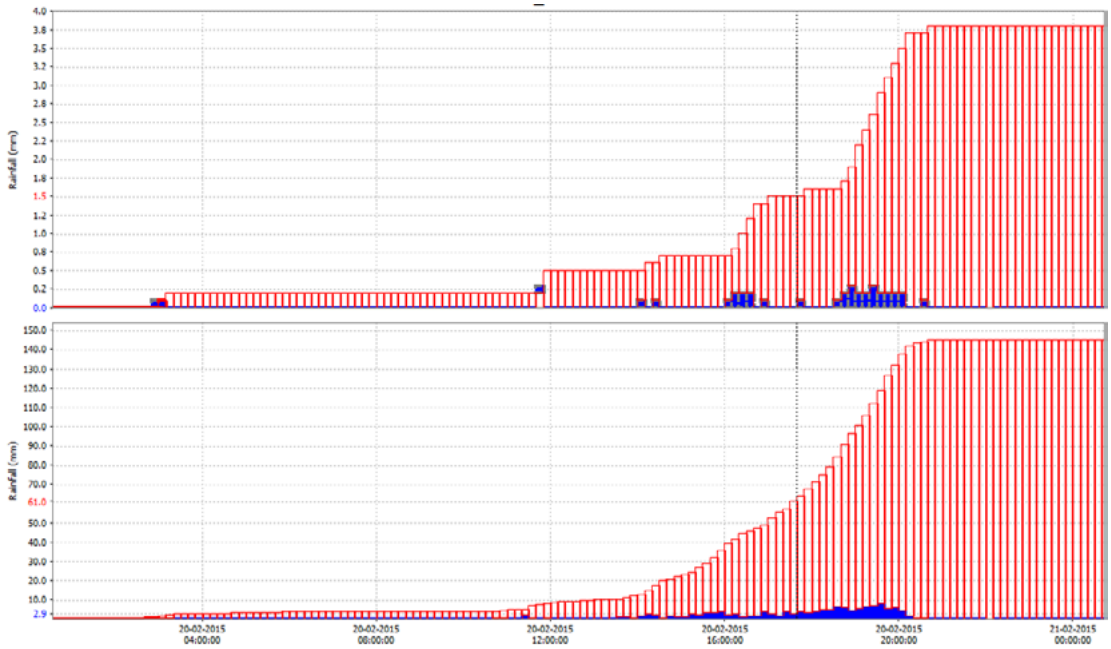

Figure 4-15 Cumulative radar rainfall at Blue Hills (upper) and Boolaroo Tops (lower) gauges

4.2.2 Dam and River Levels

Refer to Map 4-3 for location of water level gauges throughout the Callide Valley.

4.2.2.1 Callide Dam Observations

Water level observations for Callide Dam are good, with regular sampling and little noise or missing data.

The Callide Dam Headwater gauge provides a good record of water levels throughout the event. The gauge is located away from the spillway, so is not expected to be influenced by drawdown at the spillway. The sampling rate is every 15 minutes, which is appropriate to a dam of this scale. More frequent sampling (i.e. every 5 minutes) would have provided greater resolution at the peak, although would not have influenced operation of the gate under automatic or manual control.

At 21:45 on 20 February, the recorded water level was 217.203m. Based on the observed, and slowing, rate of rise prior to 21:45, it is not expected the water level rose much above 217.203m.

4.2.2.2 Kroombit Dam and River Levels

Water level observations for Kroombit Dam are good, with regular sampling and little noise or missing data. The Kroombit Dam Tailwater gauge complements the Kroombit Dam Headwater gauge with a good record of spills from the dam.

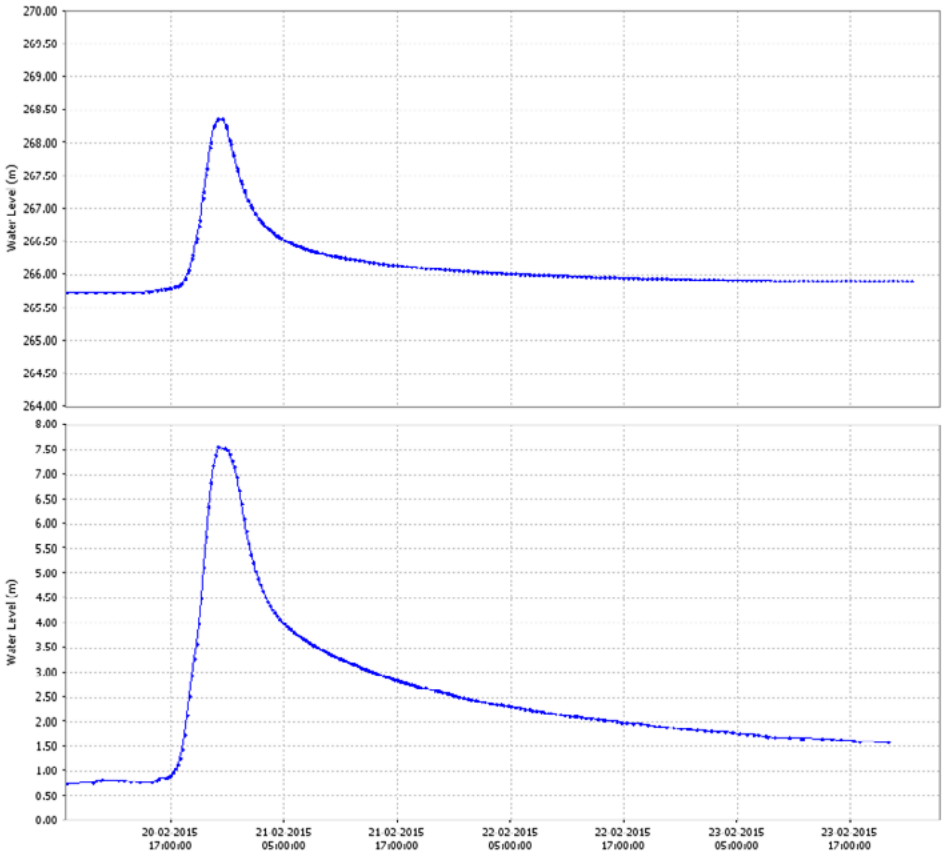

Figure 4-16 Kroombit Dam Headwater (upper) and Tailwater (lower) water levels

Water level records for other locations around the Callide Creek catchment are:

- Callide Creek 96km gauge – This gauge reported well until 19:45 on 20 February 2015 when it is understood that the gauge hut was flooded. SunWater estimate the water level at the gauge reached 11.1m gauge datum based on flood debris lines.
- Callide Dam Tailwater – This gauge ceased operation during the event. The gauge is located at the pipe outlet for monitoring low flows, rather than at the spillway for monitoring major discharges.
- Bell Creek at Craiglands – A complete record is available for the event, although the observations exhibit a stepped pattern with a prolonged period after the peak where the level 'flat lined'. This has since been confirmed by DNRM as being due to communications issues with the satellite telemetry system.
- Grevillea Creek at Folding Hills - A complete and reliable record is available at this gauge for the event.
- Callide Creek at Goovigen – A complete and reliable record is available at this gauge for the event. The rating curve at this location is not appropriate for use during large events. Refer to Section 4.2.3 for further discussion.

- Kariboe Creek at Pump Station - A complete record is available for the event, although the observations exhibit a stepped pattern.
- Prospect Creek at Red Hill - A complete and reliable record is available at this gauge for the event.

The gauge on Callide Creek, close to Biloela named Stepanoffs TM would have provided an excellent dataset for model calibration, as well as potentially having a flood forecast and warning role. However this gauge was not operational prior to the event, and the gauge was washed away during the event.

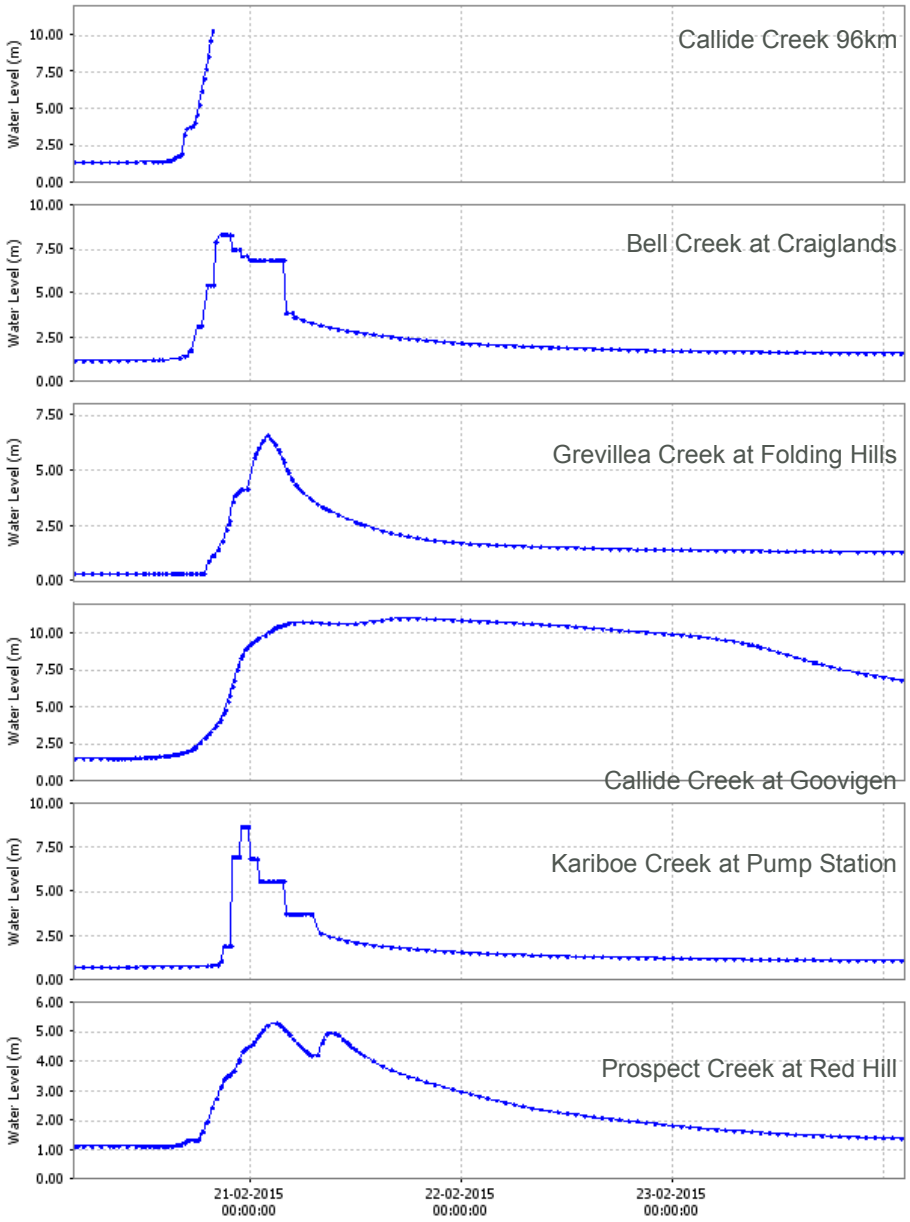

Figure 4-17 Callide Creek catchment observed water levels

4.2.3 Rating Tables

Rating curves, or rating tables, are the relationship between water level and a discharge at a particular river gauge location. Rating curves are produced from the measured or modelled discharge. Rating curves are usually developed for one of two reasons:

- Water Resource Management - measured water levels are converted into discharges. The focus is often on low flows; and
- Flood Management – during flood forecasting operations, models are used to predict the amount of discharge that is expected at a particular gauge. This is then converted into a level for the interpretation of consequences of such a flood. The focus is mostly on high flows. Rating curves are also important for statistical analysis of past discharges, particularly for the estimation of design flood discharges associated with a particular frequency of occurrence (i.e. the 1% annual exceedance probability (AEP) or 100 year average recurrence interval (ARI) event).

In many cases, there is limited opportunity for field personnel to measure discharges during a flood. This means that rating curves are extrapolated (or extended) beyond their maximum measurement for the purpose of flood management.

The river gauges throughout the Callide Valley are primarily used for water resource management rather than for flood forecasting sites. Therefore, the measurements have not been undertaken for large floods.

Table 4-3 Highest gauged discharges at Callide Valley river gauges

Station No.	Name	Highest Gauged Discharge (m^3/s)
130315C	Callide Creek at Stepanoff	$270m^3/s$ (4.23m)
130319A	Bell Creek at Craiglands	
130327A	Callide Creek at Goovigen	$280m^3/s$ (8.33m)[12]
130334A	South Kariboe Creek at Pump Station	
130336A	Grevillea Creek at Folding Hills	
130347A	Callide Creek at 96km	$9m^3/s$ (2.04m)
130348A	Prospect Creek at Red Hill	

The primary river gauge that has historically been used for verification of flood modelling is the Callide Creek at Goovigen gauge (station no. 130327A), owned and operated by DNRM. The maximum gauged discharge at this gauge is $280m^3/s$, although it has been noted that the rating is poor above $100m^3/s$.

To provide some context to the accuracy of past and present flood modelling in the Callide Valley, an investigation into the validity of flood records at the Goovigen gauge is provided here. Below is a summary of the key flood investigations at Goovigen.

[12] Rating is noted as poor above 110m3/s (6.5m) (Water Solutions, 2013)

- **Callide Valley Flood Risk Study (AECOM, 2014)**

  This study includes an analysis of the Goovigen rating curve and its suitability for use in high flow events. The study identifies that the official DNRM rating curve is inaccurate for higher flow rates, and a hybrid rating curve was developed using the official DNRM rating curve for lower water levels, and a rating curve derived using hydraulic modelling for high flows. The intention of the modelled rating curve was to account for flow across the floodplain, not just within the Callide Creek channel which the DNRM rating curve is based upon.

  Discharge estimates at Goovigen for the February 1978 event vary between different models used. The table below lists the different discharges, showing the significant variability.

Table 4-4 February 1978 calculated discharge at the Goovigen gauge

Calculation Approach	Calculated Discharge (m^3/s)
DNRM rating curve	751
Modified rating using hydraulic modelling	3,590
URBS hydrologic modelling	4,700
Mike11 Hydraulic modelling	3,500

- **Review of Callide Dam Gate Operations in the January 2013 Flood Event (Water Solutions, 2013)**

  This study did not investigate design floods in the Callide Valley, but rather focussed on the January 2013 event. The Goovigen gauge was used during calibration of the hydrologic modelling, although a poor calibration was achieved. The report noted:

  'At Goovigen the timing of the fit is good, and the modelled and recorded events are both essentially single peak events at this point which is good. However the size of the flows are considerably different. As per Table 2.1 the discharge at Goovigen is not well rated above a flow rate of about 110m^3/s. Also, the Callide Valley Water Supply Scheme is a groundwater recharge scheme, and thus you would expect a strong interaction between flow and groundwater. With the dry conditions before the event, it is expected that a fair proportion of the flood flow is entering groundwater and thus would not appear in the surface flow at Goovigen.'

  The estimated discharge at the Goovigen gauge during the January 2013 event is in the order of 4,300m^3/s from this study. This discharge is estimated using a WBNM hydrologic model.

- **Goovigen Flood Hazard Mapping Study (WRM, 2013)**

  There is also significant uncertainty associated with the calculated discharge at Goovigen within this study. Peak discharges for design events are compared to other studies and tabulated in Section 5.3.1.

Despite past attempts made to enhance the rating curve at Goovigen (specifically during the Callide Valley Flood Risk Study, AECOM 2014), there remains significant uncertainty in the relationship between water level and discharge at the Goovigen gauge.

Shown in Figure 4-18 are the results of a hydraulic model simulation in the Goovigen area. The figure shows that once the water levels within Callide Creek (locations A and B) exceed the respective bankfull levels 123.4m and 121.8m AHD, flood waters break out of the Callide Creek channel and bypass the Goovigen river gauge. At that time, the corresponding water level at the Goovigen gauge is approximately 120.9m AHD (9.0m gauge datum). As the water level in Callide Creek exceeds the approximate bank level of 121.9m AHD (10.1m gauge datum) at the Goovigen gauge, water will also spill from the watercourse onto the floodplain (location C).

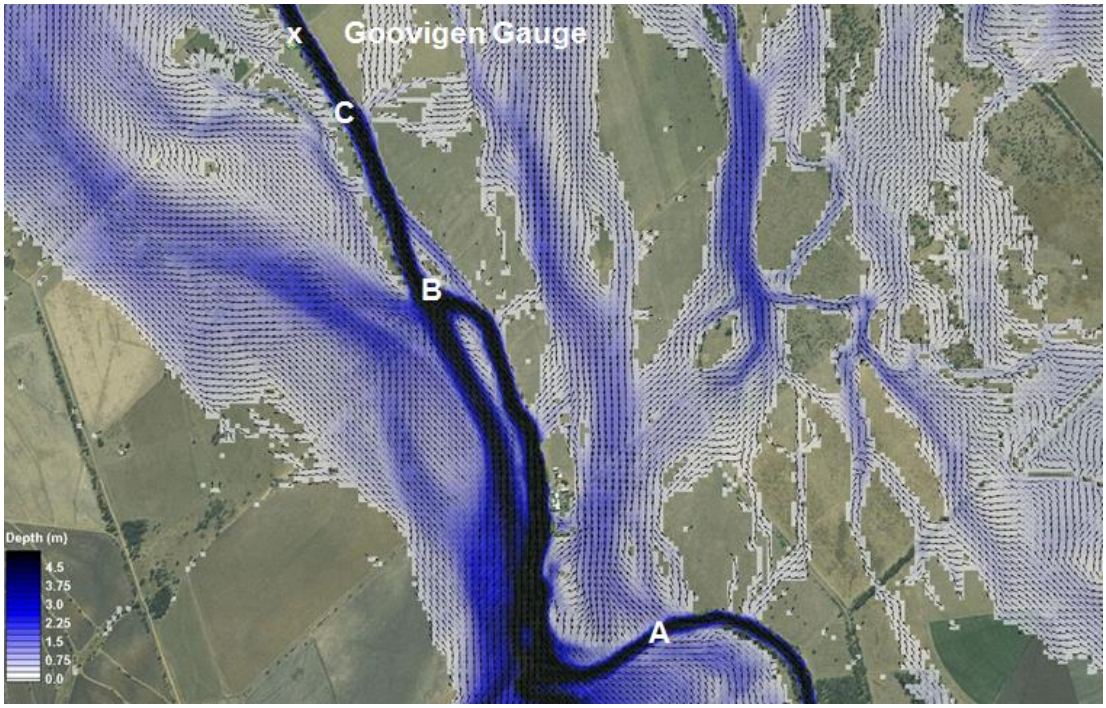

Figure 4-18 Flow bypass around the Goovigen river gauge

Shown in Figure 4-19 is a cross section of the floodplain at the Goovigen gauge, with the modelled water surface profile corresponding to 9,100m^3/s. At this point in the simulation, the water level at the Goovigen gauge is 122.4m AHD (10.55m gauge datum). It is important to recognise that a significantly greater discharge can occur via the floodplain, with minimal further increase in level at the Goovigen gauge.

Refer to Figure 4-20 for a recreation of the DNRM, AECOM and hybrid rating curves at the Goovigen gauge, as presented in the Callide Valley Flood Risk Study (AECOM, 2014). Also shown on this plot is the discharge and level associated with the hydraulic simulation described above.

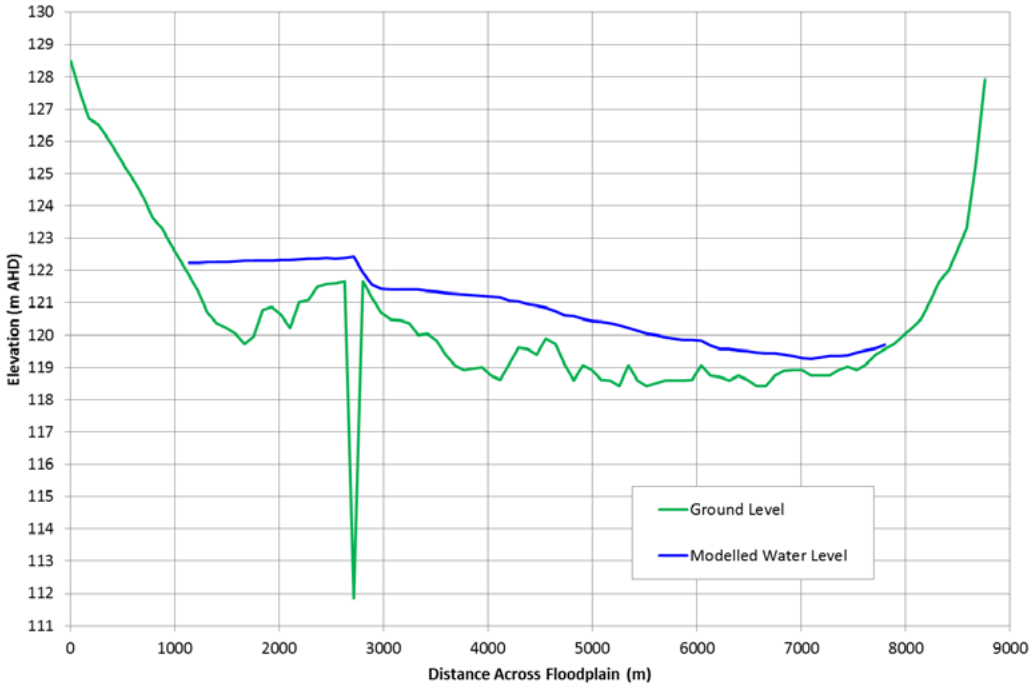

Figure 4-19 Floodplain cross section at Goovigen

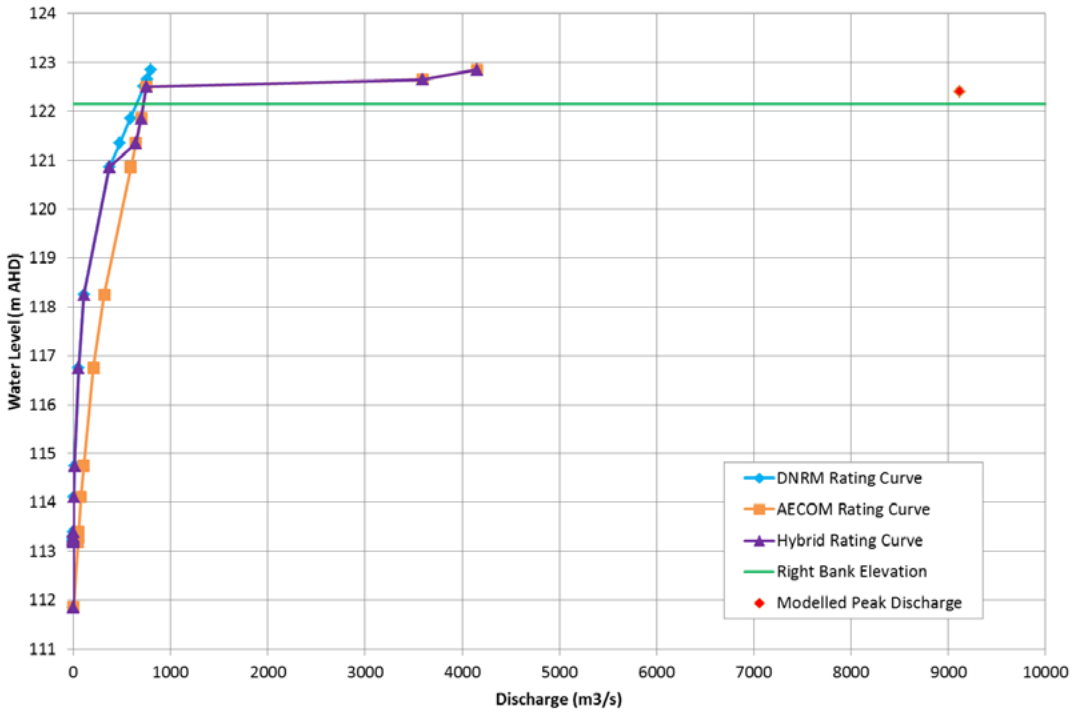

Figure 4-20 Goovigen rating curves

Since the beginning of records at Goovigen in 1971, there have been nine floods that have recorded over 121.9m AHD (10.0m gauge datum) at the Goovigen gauge. The peaks of these events are shown on Figure 4-21, together with the left bank level. There is a common theme of a 'flattening' of the flood peak after the approximate bankfull level of 121.9m AHD. This supports the above analysis that there is a significant diversion of water upstream, and across the bank along the stretch of Callide Creek where the Goovigen gauge is located, which is preventing the flood peak from rising much higher. The three flood peaks of 2011, 2013 and 2015 are the highest on record. All three exhibit a minor first peak as floodwaters start to divert around the gauge, and then a further slower rate of rise as floodwaters spill across the bank in the vicinity of the gauge.

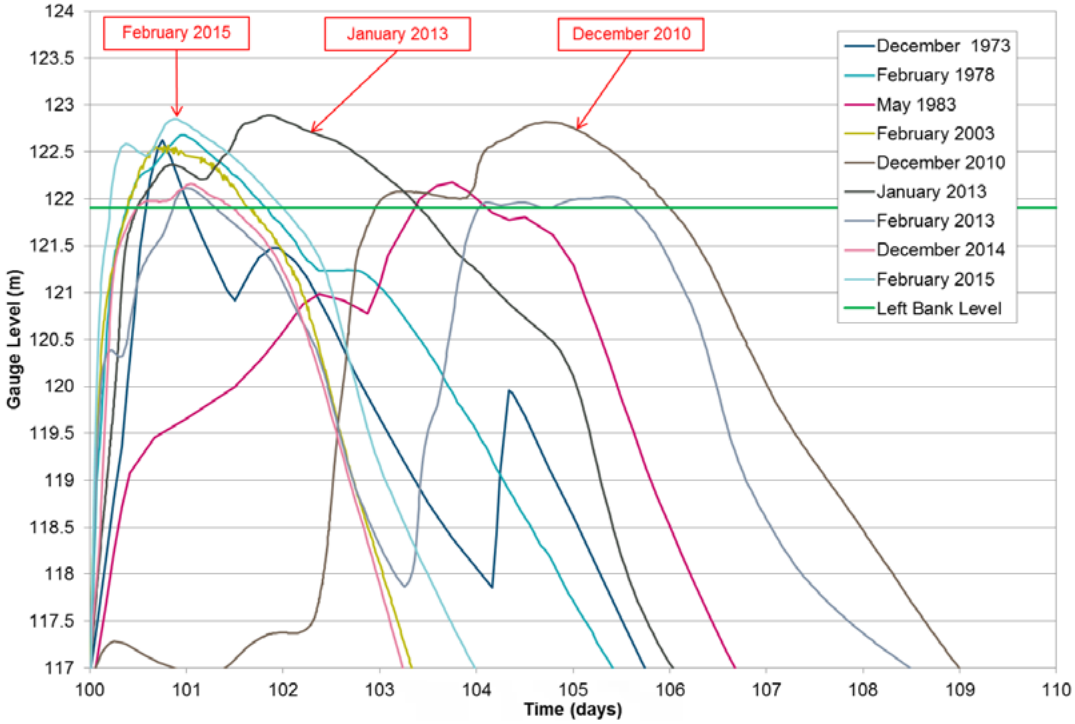

Figure 4-21 Past flood peaks at the Goovigen gauge

This analysis has demonstrated that the rating curve at the Goovigen gauge is only applicable to levels lower than 120.9m AHD (9.0m gauge datum). Above this level, there is significant bypassing of flows, which the rating curves (DNRM or AECOM) cannot account for. The significance of this finding is that the Goovigen gauge cannot be used for calibration of flood models, or as a future flood forecasting location.

4.3 Impacts of Flooding

Flooding along the Callide Valley was widespread following the February 2015 rainfall. The following damages have been identified during this review:

- Private property:
  - Rapid Damages Assessment (QRA) - The rapid Damages Assessment identified 243 properties that received some sort of damage or need for assessment caused by the February 2015 event. These properties were potentially damaged by either inundation of water or wind or both. The assessment included private residential, commercial and industrial as well as schools.
    - 9 school buildings were damaged with 7 by flood waters
    - 176 residential properties (houses or townhouses or units) were damaged with 134 by flood waters
    - 11 Industrial properties were damaged with all by flood waters

    The assessment also included 42 properties that had no damage type associated with them. Of those, 32 were damaged by flood waters
  - SES - The Biloela SES responded to 236 requests for assistance (RFA) from 20 February until 4 March in relation to the February 2015 event
  - Flood related tasks. Total of 63 broken up as follows from 20 February until 4 March:
    - Flood evacuation - 5 (1 as Flood evacuation, 4 as Flood threatening Priority 1)
    - Flood boat response - 2
    - Flood threatening - 3
    - Flooded - 23
    - Sandbags - 6
    - Other - flood related - 8
    - Flood recovery/assistance - 6
    - Debris clean-up - 10
  - The percentage of flood jobs out of total jobs 26.7%.
  - Locations included:
    - Biloela - 30 tasks
    - Valentine Plains - 7
    - Smoky Creek - 5
    - Goovigen - 3
    - Thangool, Wowan, Dululu, Lawgi Dawes, Dixalea, Jambin - 2 each
    - Argoon, Orange Creek, Dumgree, Mt Murchison, Dakenba, Callide - 1 each

- Infrastructure:
  - Significant damage to infrastructure was sustained during the event. Records of all damage have not been made available to this review.

Figure 4-22 Eroded abutment of the Dawson Highway bridge over Callide Creek

- Environment:
  - The primary environmental damage is the erosion cased along watercourses, and the associated loss of flora and habitat.

Figure 4-23 Erosion along Callide Creek

4.4 Magnitude

4.4.1 Rainfall

Intensity frequency duration (IFD)[13] analysis of the gauges throughout the Callide catchment has shown that at some locations the intensity of the rainfall over certain durations exceeded the 200 year average recurrence interval (ARI), or 0.5% annual exceedance probability (AEP) event. In the case of Kroombit Tops the 6 hour duration average intensity was similar to that of a 500 year ARI for the 6 hour duration (refer to Figure 4-24, Figure 4-25 and Figure 4-26).

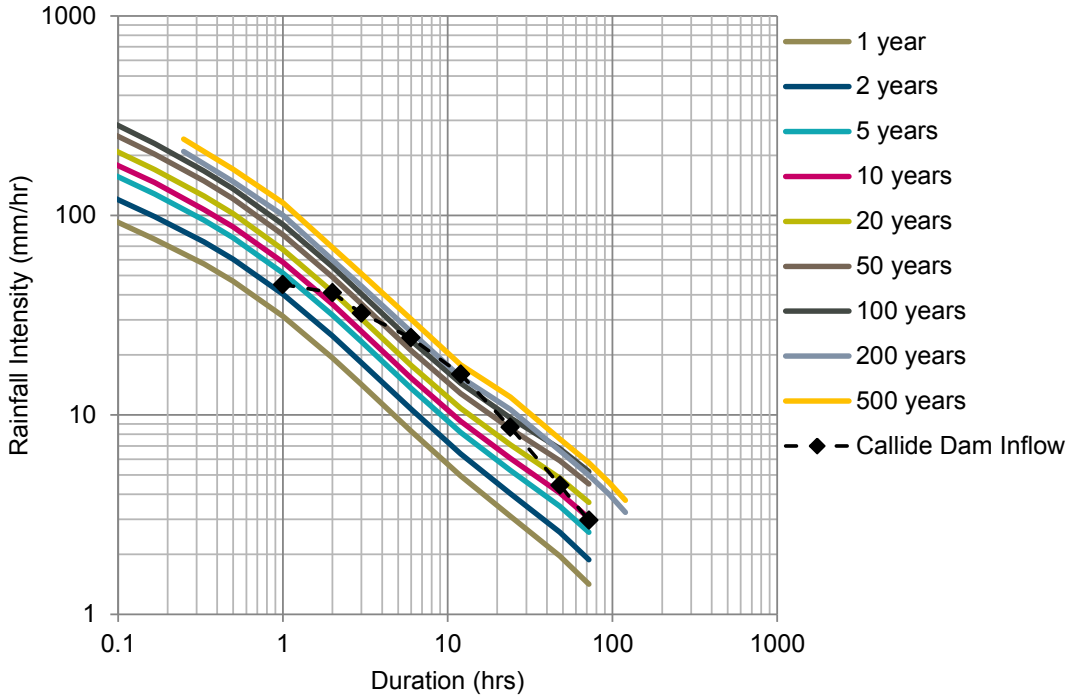

Figure 4-24 Callide Dam 96km (Inflow) IFD curve

[13] IFD data for 1 to 100 years ARI is based upon data published on the BoM website. For events greater than 100 year ARI, CRC Forge data have been used.

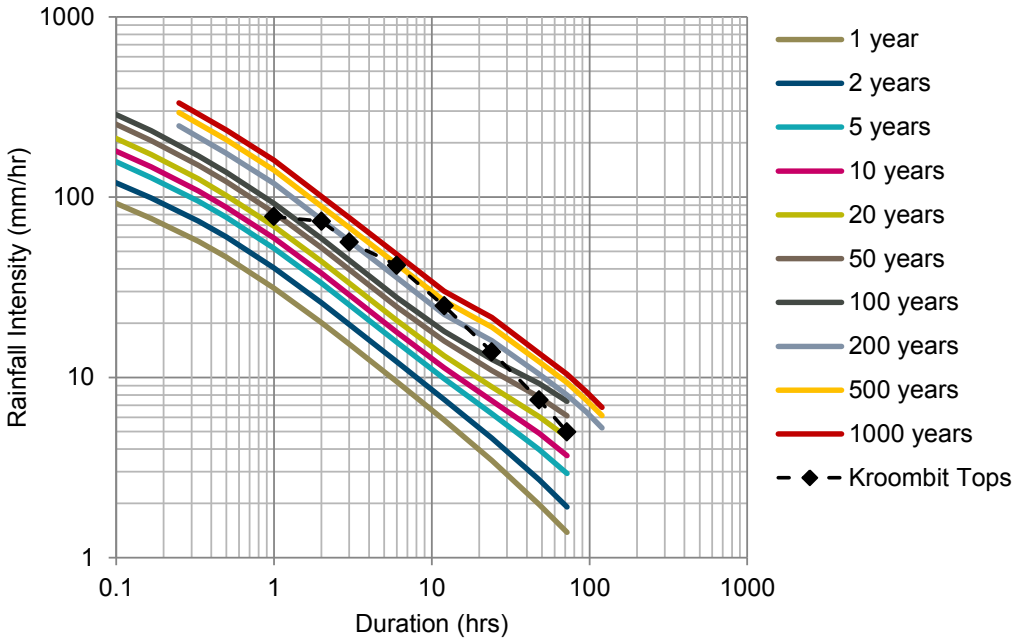

Figure 4-25 Kroombit Tops IFD curve

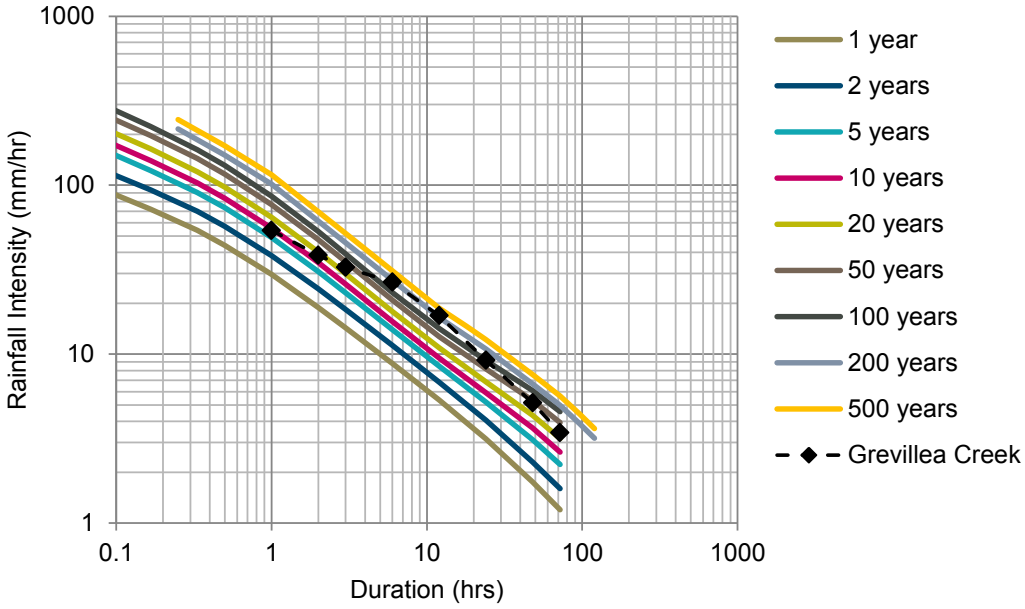

Figure 4-26 Blue Hills IFD curve

The eastern side of the catchment received greater intensity and total rainfall depths than the southern part as is shown in Figure 4-27 and Figure 4-28 where the maximum ARI reached was equivalent to the 20 year event.

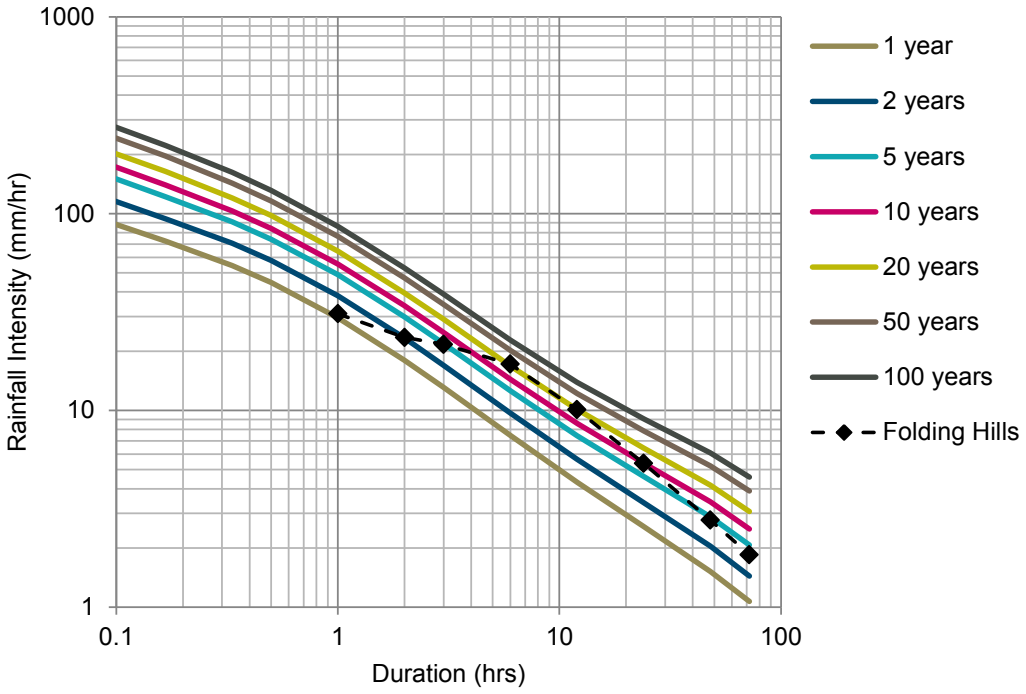

Figure 4-27 Folding Hills IDF curve

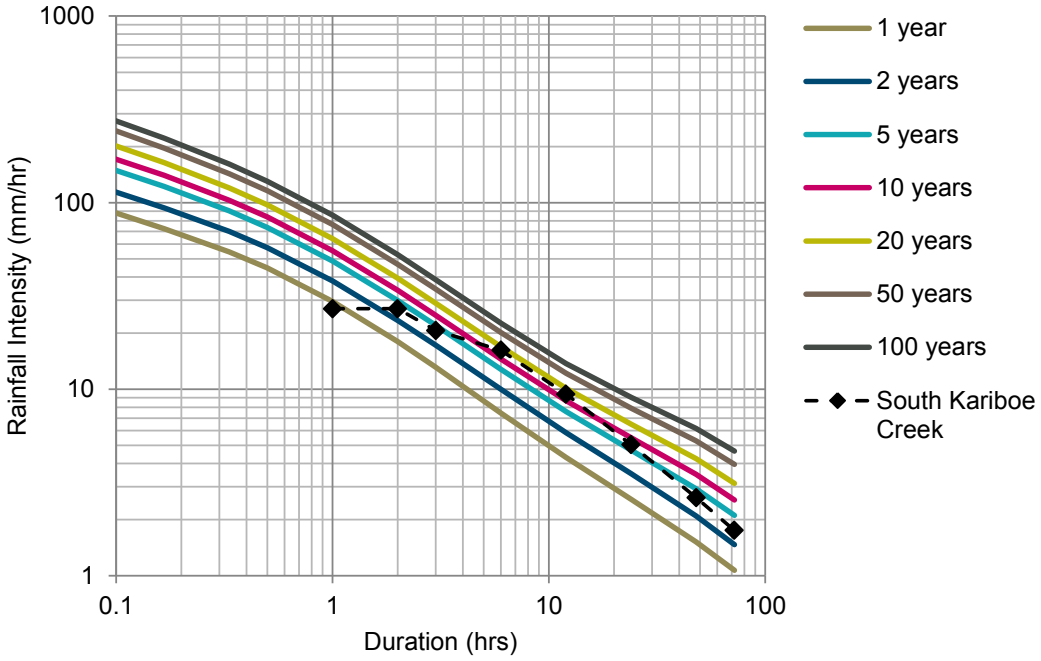

Figure 4-28 South Kariboe Creek

4.4.2 Water levels and discharge

Use of water levels and associated discharge to establish a return period for the event would not be reliable due to the short duration of records available and the poor rating curves at each river gauge.

The EAP identifies water levels in the dam having exceeded 217.11m AHD as having a 10,000 year return period. In addition, Twitter messages from SunWater on 21 February and subsequent media reports made reference to the event having a possible return period of 10,000 years. Based on the maximum rainfall intensity having a 200-500 year return period, it is unlikely the event was a 10,000 year magnitude return period. However, it is plausible that the water levels experienced in the dam and the flooding experienced throughout the Callide Valley could have been more than a 500 year return period.

5 Flood Modelling and Mapping

5.1 Types of Model

Flood modelling typically involves two key components. Firstly, a hydrologic model is used to estimate the rate of runoff from a given storm event. Historical or design rainfall are applied to the hydrologic model and algorithms used to convert the rainfall to runoff. These runoff-routing models are often simplistic representations of the catchment, generally requiring minimal geographical input data.

Secondly, a hydraulic model is used to simulate the passage of water through the catchment. Inflow hydrographs, estimated using the hydrologic modelling, are applied at the upstream ends of waterways and floodplains. Hydraulic models are generally more complex and data intensive.

5.2 Hydrologic Modelling

5.2.1 Existing Models

Over the numerous studies that have been undertaken throughout the Callide Valley, an equal amount of hydrologic models have been developed. Hydrologists have had limited success calibrating the respective hydrologic models, which is primarily associated with the limited information available, and in particular the poorly defined rating curves for flood events.

The Goovigen river gauge is used in most studies as a calibration point at the downstream end of the Callide Creek catchment. With the exception of the Callide Creek Flood Risk Study (AECOM, 2010), little investigation into the applicability of the Goovigen rating curve has been undertaken. As shown in Section 4.2.3 of this report, use of the Goovigen river gauge for calibration of flood discharges is not possible. This explains the poor calibration achieved during the Review of Callide Dam Gate Operations in the 2013 Flood Event report (Water Solutions, 2013). Refer to Figure 5-1 for the calibration plot from that investigation. Note also the similar shape of the Stepanoff gauge, although the magnitudes are not well matched. This also suggests the Stepanoff rating curve was inaccurate for large discharges.

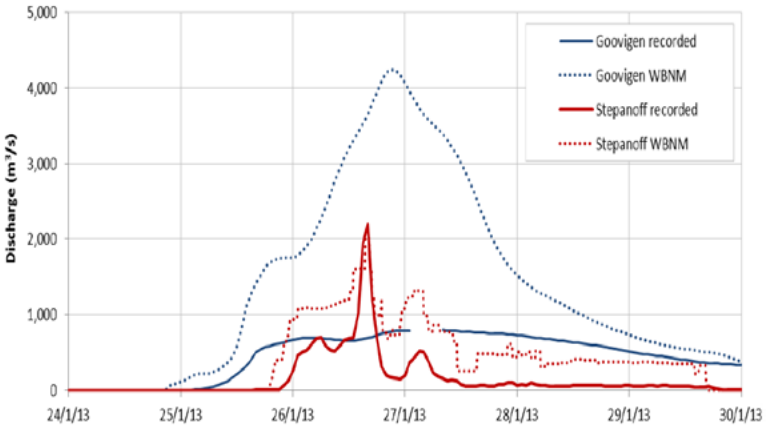

Figure 5-1 Calibration graph extracted from the 2013 event review (source: Water Solutions, 2013)

To compare the estimated discharge from the 2015 event to previous events and design flood discharges, the peak discharges estimated during past studies for different locations along Callide Creek are listed in the following tables.

Table 5-1 Peak discharges for Kariboe Creek

Average Recurrence Interval (ARI) (years)	Annual Exceedance Probability (AEP)	Peak Discharge (m^3/s)		
		QRA Estimate	KBR Estimate	DHI Scaled NRM Gauge
5	20%			
10	10%	200		
20	5%	320		
50	2%	480	444	998
100	1%	600	612	1,248
200	0.5%	720		
500	0.2%	860	1,464	1,789
PMF	PMF			
Feb 1978				
Feb 2003				
Dec 2010		312	489	651

Table 5-2 Peak discharges for Grevillea Creek

Average Recurrence Interval (ARI) (years)	Annual Exceedance Probability (AEP)	Peak Discharge (m^3/s)		
		QRA Estimate	KBR Estimate	DHI Scaled NRM Gauge
5	20%			
10	10%	179		
20	5%	486		
50	2%	869	352	998
100	1%	1,297	497	1,248
200	0.5%	1,887		
500	0.2%	3,007	1,239	1,789
PMF	PMF			
Feb 1978				
Feb 2003				
Dec 2010		510	406	959

Table 5-3 Peak discharges at Jambin

Average Recurrence Interval (ARI) (years)	Annual Exceedance Probability (AEP)	Peak Discharge (m^3/s)		
		QRA Estimate	KBR Estimate	DHI Scaled NRM Gauge
5	20%			
10	10%			
20	5%			
50	2%	1,300	3,601	1,595
100	1%	1,700	4,709	2,220
200	0.5%			
500	0.2%	2,900	8,032	4,949
PMF	PMF			
Feb 1978				
Feb 2003				
Dec 2010		790		

Table 5-4 Peak discharges at Goovigen

Average Recurrence Interval (ARI) (years)	Annual Exceedance Probability (AEP)	Peak Discharge (m^3/s) (lower / upper limits)	
		Callide Valley Flood Study[14]	Goovigen Flood Mapping Study
5	20%	555	
10	10%		
20	5%	1570	880 (512/1514)
50	2%	2325	1338 (657/2727)
100	1%	3130	1741 (735/4120)
200	0.5%		2190 (789/6080)
500	0.2%		2855 (827/9863)
PMF	PMF	14086	
Feb 1978		3500	
Feb 2003		1580	

As can be seen from the tables above, there is significant uncertainty associated with estimated discharges throughout the catchment. This is mostly attributed to the use of the gauged data and associated rating curves.

[14] Mike 11 modelled flow rates

5.2.2 Hydrologic Model Development

URBS was used as the hydrologic model to determine the inflow to the hydraulic model. URBS was embedded within the Delft-FEWS environment to aid in the calibration of the model and for data management.

The catchment was divided up into two model areas:

- The Upper Callide model covers the 517km^2 Upper Callide catchment, upstream form Callide Dam. The catchment was sub-divided into 15 sub-catchments; and
- The broader Callide Creek model covers the remainder of the catchment, sub-divided into 74 sub-catchments.

Refer to Map 5-1 for the model and sub-catchment layout.

There were a total of 32 sub-daily and 14 daily rainfall gauges that were used to provide spatial representation of the rainfall that occurred during the February 2015 event (Cyclone Marcia).

5.2.3 Hydrologic Model Calibration

Joint calibration has been undertaken between the hydrology models and the hydraulic model. There were a total of 32 rainfall gauges that were used to provide spatial representation of the rainfall that occurred during the February 2015 event.

Calibration of the model required that two rainfall gauges be removed from the model due to their data being unreliable; the Upper Lonesome Alert and the Kroombit Dam TM. The Upper Lonesome Alert contained a long period (18:48 on 20 February through to 12:24 on 22 February) of rainfall at the same intensity (2mm/hour). This would have skewed the rainfall to the nearby catchments. The Kroombit Dam TM gauge was removed due to it recording a reading much lower than the surrounding gauges; approximately 50mm over the event compared to others in the order of 200mm

Calibration of the Callide URBS model was undertaken through the manipulation of the alpha and beta parameters, and initial and continuing losses in an attempt to mimic observed water levels and flows at gauges throughout the catchment. The most reliable gauge was the Kroombit Dam HW gauge as it is a known cross section and has reliable rating curve as it is a man-made structure. Calibration at the Kroombit Dam was seen to be acceptable as the level achieved and the timing were both similar to that of the observed data. There was a slight difference in the overall shape of the hydrograph

5.2.3.1 Parameters

The URBS model has the following parameters that can be adjusted in order to achieve calibration of the model the catchment/channel routing:

- Alpha – channel lag parameter;
- Beta – catchment lag parameter; and
- Exponent m – catchment non-linearity exponent.

For these models a number of combinations of these parameters were tested although m was kept constant at 0.8 in accordance with the industry tested and accepted approach. Alpha was tested for the range of between 0.05 through to 0.25 and a good fit was found at 0.18. Beta was tested for the range of between 0.3 and 0.8 and found that 0.5 was a good fit with Alpha of 0.18.

5.2.3.2 Losses

Losses used in the URBS models have be tested along with the model parameters to achieve the best fit calibration. The URBS model makes use of initial loss, continuing loss and maximum soil storage. During calibration a number of combinations of the initial and continuing losses were tested in conjunction with combinations of the alpha and beta parameters. Initial loss was varied between 0 mm and 100 mm with continuing loss varied between 0 mm/hour and 2.5 mm/hour. Maximum soil storage was kept at 200mm. For the Callide Creek URBS model the most appropriate losses were found to be initial loss of 100mm with a continuing loss of 2.0mm/hour. Event baseflow has been applied to Callide Dam, which reintroduces a proportion of the infiltrated water back into the dam. This fits well with the water balance calculations undertaken on average catchment rainfall, dam discharge volume and change in dam storage, which shows 59mm of losses.

Table 5-5 Water balance calculation for losses

Total volume in	**98,556,929m^3**
Catchment area	516.8km^2
Average runoff depth	191mm
Catchment average rainfall	250mm
Losses	59mm

5.3 Hydraulic Modelling

5.3.1 Existing Models

The following hydraulic models have previously been developed for various parts of the Callide creek system. Review of the associated reports determined that none of the existing models were fit-for-purpose for this current assessment. Existing models are listed in Table 5-6.

Table 5-6 Existing hydraulic models of Callide Creek and tributaries

Developed for	Developed by	Software Used	Comments
SunWater	Engeny	TUFLOW	This model covers Callide Creek from the Callide Dam to Goovigen. This model has been made available to the project team, although has not been used due to the considerable simulation time (~20 hours).
QRA Flood Mapping – Thangool (2013)	DHI	Mike21	This model only covers the Thangool area.
QRA Flood Mapping – Jambin (2013)	DHI	Mike21	This model only covers the Jambin area.
QRA Flood Mapping – Goovigen (2013)	WRM	TUFLOW	This model only covers the Goovigen area.
Thangool Aerodrome Levee Assessment		TUFLOW	This model only covers the Thangool area.
Callide Valley Flood Risk Study (2010)	AECOM	Mike 11	This model is one-dimensional and is considered to have insufficient ability to represent the complex flood behaviour of Callide Creek, in particular the interaction between the various braided channels of the system.

5.3.2 Modelling Approach

A new hydraulic model has been developed for this investigation. To meet the tight timeframe of the project, the TUFLOW GPU software has been used. The GPU version of TUFLOW uses the graphics processor within a purpose built modelling computer to complete the simulations at high speed. For comparison, the model developed for this assessment simulates in approximately one hour, compared to the classic TUFLOW model developed for SunWater which takes more than 20 hours to simulate. The high speed modelling means numerous runs can be undertaken to expedite model calibration and verification. The only current limitation of the TUFLOW GPU software, compared to the classic TUFLOW software, it that hydraulic structures cannot be modelled as 1D elements. However, using a sufficiently small grid cell size and form losses where structures are located, provides a reasonable representation of energy losses associated with structures. In the broader context of flooding along Callide Creek, the absence of detailed structures makes no noticeable difference.

The model extent has been determined to assess flood behaviour:

- Along Callide Creek between the Callide Dam and Goovigen, including Jambin;
- Between Goovigen and the confluence with the Don River to ensure boundary effects do not influence modelled flood behaviour at Goovigen; and
- Along Kariboe, Grevillea and Kroombit Creeks to ensure appropriate interaction of floodwaters between the braided channels of these creeks, including the interaction with Callide Creek at Biloela (via Washpool Creek).

The creek channel and floodplain areas are represented by a 2D grid of 10m by 10m grid cells. The size of grid cell is selected based on modelling objectives and computer simulation time. During the model verification process, a 20m grid cell size was used to reduce simulation times. To accurately represent the narrow channels of some of the minor watercourses, the 10m grid was used for the final model simulations. The resolution defined by the 10m grid cell size is considered sufficient to meet the objectives of this review.

5.3.3 Topography

Topography across the 2D model domain is represented in the following manner.

- Each 2D grid cell is assigned a single elevation initially interrogated from the DEM at the cell centre;
- The sides of each grid cell are also assigned an elevation initially interrogated from the DEM at the mid-point of the cell side; and
- Cell centre or cell side elevations can then be adjusted to represent topographic features, such as road embankments, which were not initially accurately defined by the DEM.

The elevation assigned to a cell centre affects the storage applied to the cell. The elevation applied to the cell sides controls the flow of water from one cell to another.

5.3.4 Surface Roughness

Ground surface roughness can have a significant influence on the flow of water. Ground roughness is represented in the model by assigning Manning's 'n' values for different land uses. Land use is determined from aerial photography along with on-site ground truthing.

Values of Manning's 'n' for different land uses are selected based on industry accepted values, which are subsequently refined during the model verification phase. Refer to Section 5.5 for model verification Manning's 'n' values.

5.3.5 Boundary Conditions

The term 'boundary conditions' relates to the application of hydraulic boundaries to the model. Two types of boundary conditions have been used for this model:

- Discharge over time boundaries at the upstream ends of each major creek and at the downstream end of Callide Creek; and
- Rainfall depth over time across the main model area.

Locations of boundary conditions are shown on Map 5-3.

5.4 Calculation of Inflows

The peak inflow to the dam has been calculated using the following approach:

- Conversion of observed dam levels to storage volume
- Calculation of the incremental change in storage from one timestep to the next

- Conversion of the observed dam levels to discharge through the spillway
- Calculation of inflow volume using outflow volume and change in storage for each timestep
- Conversion of incremental outflow to rate of discharge.

The calculated inflow hydrograph is shown on Figure 5-2. The peak inflow is estimated to be 5,937m^3/s. By comparing the inflow to the outflow on Figure 5-2, it is possible to see the attenuation provided by the dam. The peak discharge has been reduced from 5,937m^3/s to 3,480m^3/s (reduction of 41% of peak discharge). In addition, the volume of water released by the dam has been reduced by the available storage volume at the start of the event (i.e. the difference between the starting storage of 89% and the FSL storage at 100%).

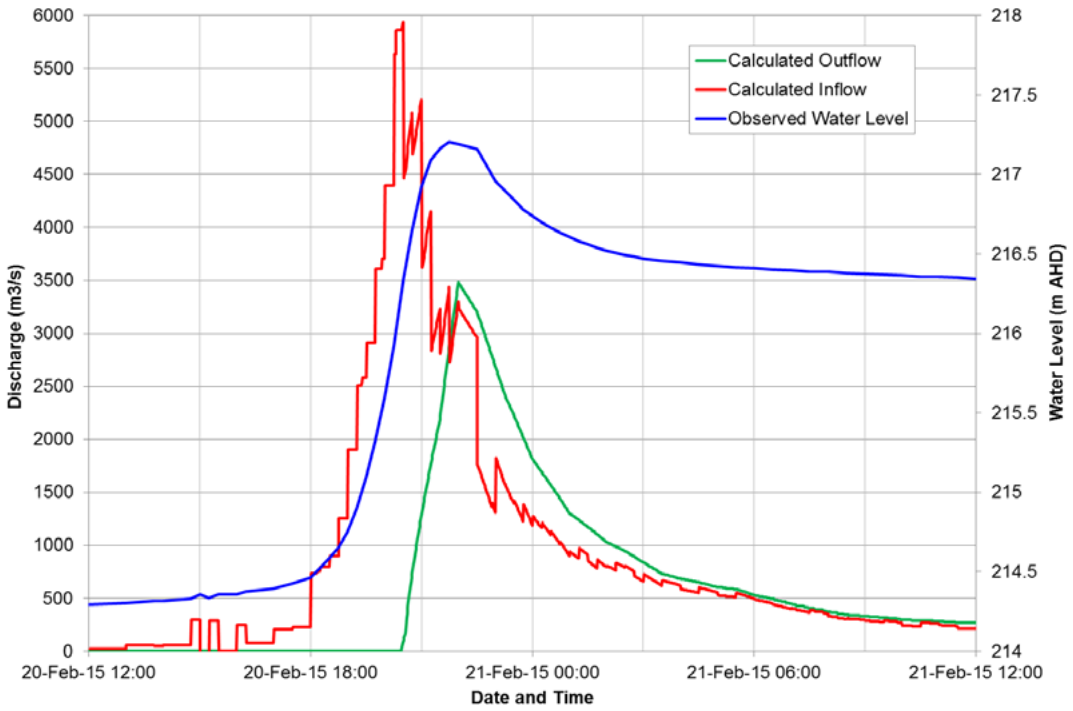

Figure 5-2 Callide Dam inflow and outflow (calculated)

5.5 Model Calibration and Verification

To establish a degree of confidence that the models are suitably representing actual site conditions, the model has been verified against observed and anecdotal evidence. Detailed model calibration has not been possible due to the limited data available, and short timeframe associated with this review.

Model verification involves adjusting model parameters and inputs using industry acceptable values, until the model suitably replicates recorded flood behaviour. The performance of the model has been assessed against the following information:

- River gauges (low flow and timing only, due to poor rating curve definition for high flows);

- Estimated flood levels from the QRA Rapid Damages Assessment forms;
- Anecdotal evidence of flood behaviour, including time of peak; and
- Photographs captured by Banana Shire Council.

Verification plots for Callide and Kroombit Dams, and the Goovigen river gauge are presented in the figures below.

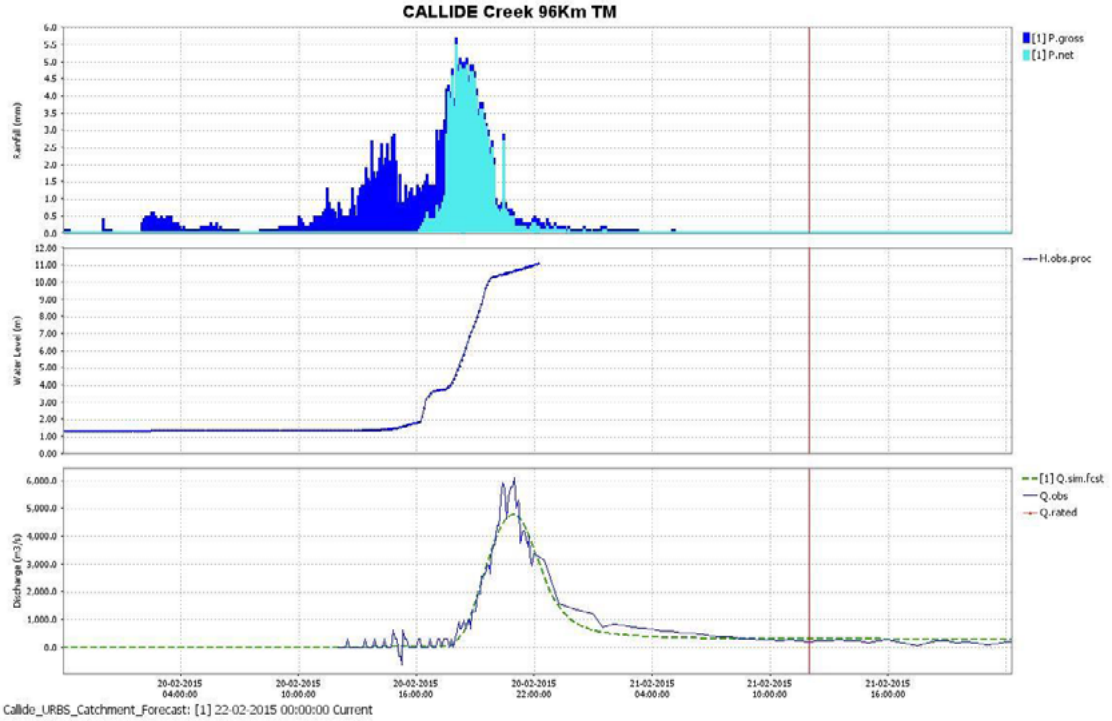

Figure 5-3 Verification of Callide Dam inflows (top: rainfall, middle: observed water level, bottom: calculated (blue) and simulated (green) dam inflows)

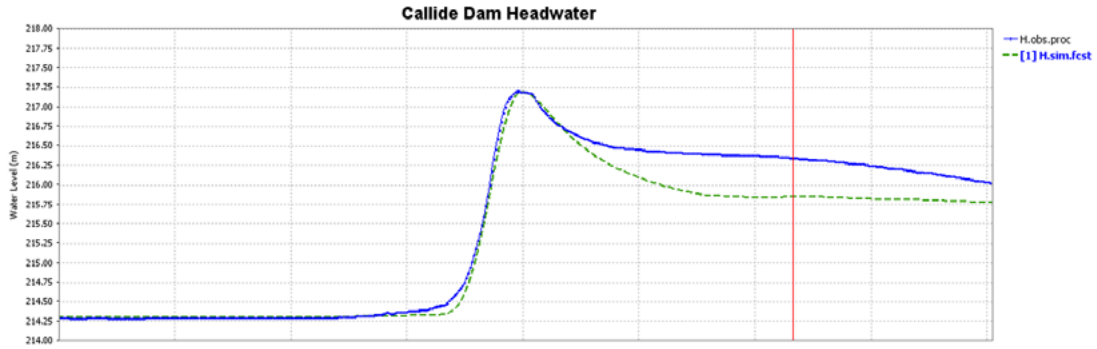

Figure 5-4 Verification of Callide Dam water levels (observed (blue) and simulated (green))

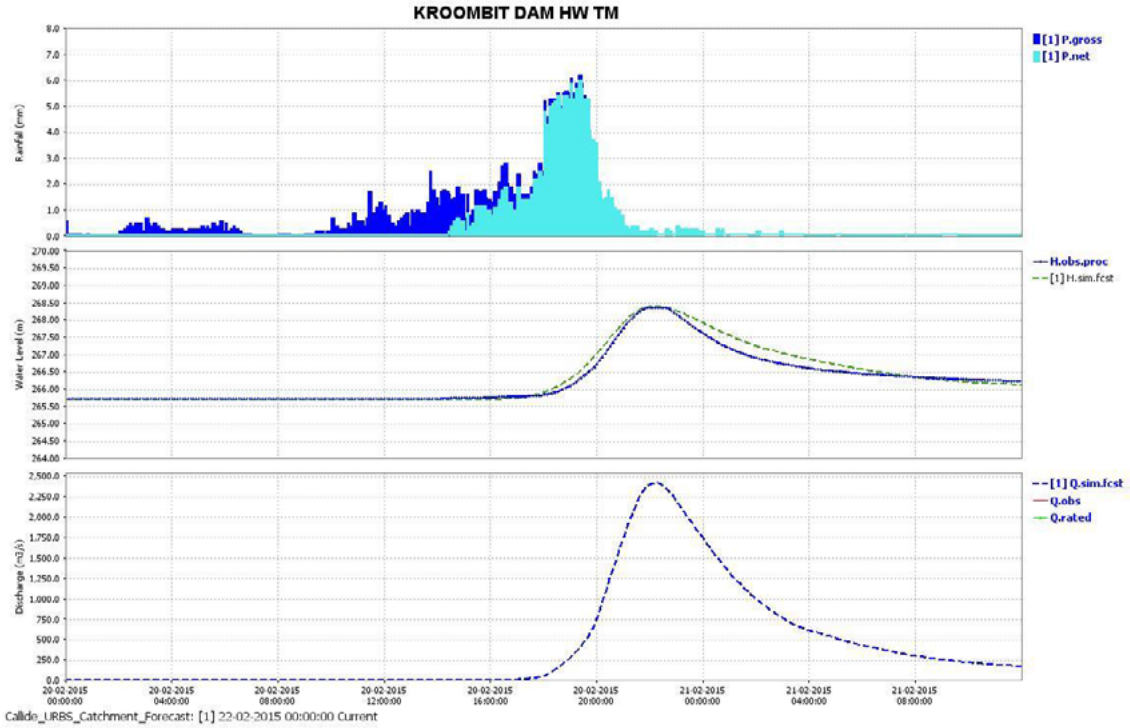

Figure 5-5 Verification of Kroombit Dam water levels (top: rainfall, middle: observed (blue) and simulated (green) water level, bottom: calculated discharge)

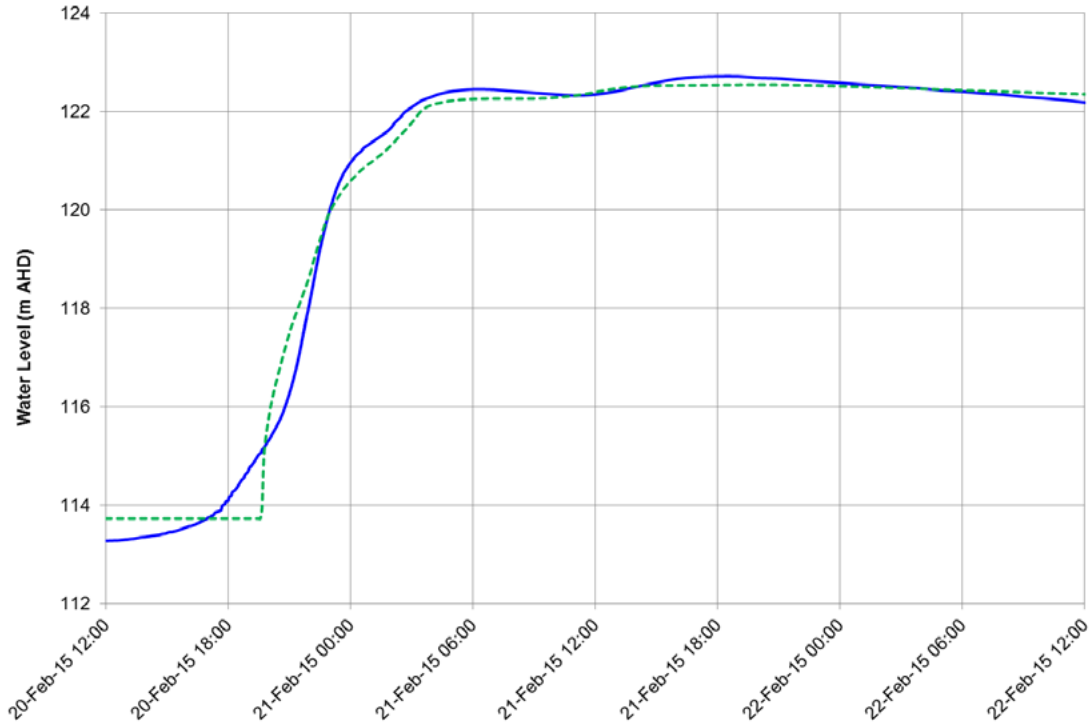

Figure 5-6 Verification of Goovigen Gauge water levels (observed (blue) and simulated (green))

In general, a reasonable verification has been achieved. This is based upon anecdotal evidence of flood behaviour (levels, direction and timing), and comparison of photographs taken on the morning of 21 February 2015, as the flood levels receded. A sample of photos are shown on Maps 6-3 to 6-6.

Hydraulic modelling surface roughness coefficients adopted in the final simulations are presented in Table 5-7.

Table 5-7 Mannings 'n' surface roughness adopted during model verification

Land Use	Mannings 'n'
Pasture / Agriculture	0.070
Light Vegetation	0.080
Medium Vegetation	0.100
Dense Vegetation	1.500
Roads	0.025
Urban Block	1.000
Water Bodies	0.040

5.6 Sensitivity Analysis

Sensitivity analysis of the surface roughness applied to the hydraulic model has been undertaken. The analysis involved increasing the Mannings 'n' roughness coefficient from 0.07 to 0.09 for all pasture and agricultural land, which is applicable to the majority of the floodplain. The analysis showed a minor delay to the peak flood and attenuation of peak levels at the downstream end of the model.

6 Scenarios

6.1 Summary

A range of scenarios have been assessed to understand the impact that alternate operation of the dam would have had on downstream flooding. Each scenario is compared to the actual event to determine impacts in terms of:

- Discharge;
- Peak flood level and flood extents; and
- Time of peak flood levels.

There are uncertainties associated with flood modelling. The flood mapping presented for the February 2015 event in Section 6.2 is the best estimate of flood behaviour based on the limited data available for calibration and verification of the model.

The scenario assessments presented here are relative assessments. Therefore, inaccuracies associated with modelling will be present within the February 2015 event model **and** the scenario model simulations. The relevance of this is that any potential inaccuracies will have little, or no, influence on the impacts that are presented. Impacts should be assessed on a regional scale, and the mapping should not be used to assess changes in flood behaviour on an individual lot scale.

The following scenarios have been assessed:

- February 2015 event – As it Happened
- Scenario 2 - What if dam operators could have manually operated the gates?
- Scenario 3 - What if there was no Callide Dam?
- Scenario 4 - What if Callide Dam had been lowered to 50% capacity before the event?
- Scenario 5 - What if Callide Dam was full before the event?
- Scenario 6 - What if there was improved prediction and warning?

Refer to the following sections where each scenario is described and the impacts discussed.

6.2 February 2015 event – As it Happened

6.2.1 Description

The timeline of the event is provided in Section 4.1. This simulation is provided as the baseline for comparison of the scenarios.

6.2.2 Flooding Timeline

Simulated peak discharges for Callide Creek and the major tributaries are shown on Figure 6-1.

Simulated discharge hydrographs at key locations are shown on Figure 6-4. The figure shows the relative timing of flooding in Callide and Kroombit Creeks.

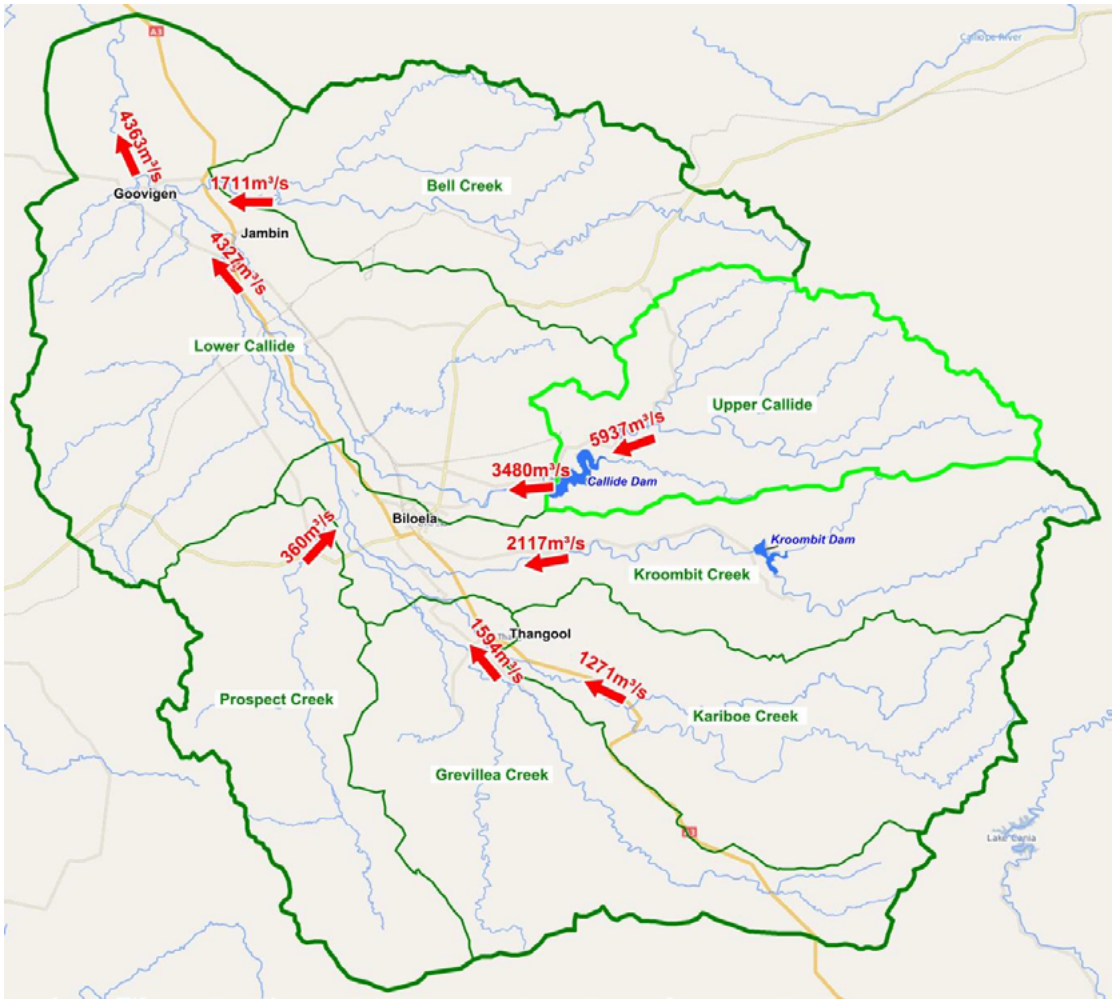

Figure 6-1 Simulated peak discharges for February 2015 event

Simulated times to peak water level shown on Map 6-1 and Map 6-2. The timeline of flooding is summarised here:

- At 20:28 the water level in the dam reached the theoretical middle gate trigger level of 216.260m. It is expected that the middle gates began to open at this time. It is possible the

gates could have opened slightly earlier or later, depending on the exact configuration of the gate opening mechanism.

- Between 20:50 and 21:45, residents on the south side of Biloela noted significant rises in Kroombit Creek. By 21:45, the level had reached the 2013 peak level.
- At 21:20 on 20 February, residents along Callide Creek, immediately upstream of Biloela noted water entering their property.
- At 22:00 on 20 February, the peak discharge of 3,480m^3/s occurred at Callide Dam. At this same time, the peak water level was reached in Kroombit Dam, with an estimated discharge of 2,267m^3/s.
- By 22:00, residents along Callide Creek immediately upstream of Biloela were experiencing significant flooding.
- Between 02:30 and 03:00 on 21 February, residents along Kroombit Creek to the southeast of Biloela described the flood as being “like a tsunami”.
- At 03:00 on 21 February, residents along Washpool Gully on the north side of Biloela noted water entering their property. Although residents reported this as Callide Creek discharge, this was actually from Washpool Gully as the Kroombit Creek passed Biloela, overflowing along Washpool Gully.
- At Jambin, the flood peaked around 17:00 on 21 February (19 hours after the peak release). This is consistent with resident comments that the flood takes about 12-18 hours to travel from Callide Dam to Jambin.

The times of peak flood level at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-1.

Table 6-1 Time of peak flood level – February 2015 event

Location	Watercourse	Time of peak
Linkes Road	Callide Creek	23:15 (20 Feb)
Dawson Highway	Callide Creek	23:45 (20 Feb)
Jambin Dakenba Road	Callide Creek	01:30 (21 Feb)
Hodgetts Road	Callide Creek	03:00 (21 Feb)
Callide Road	Callide Creek	03:15 (21 Feb)
Rail Crossing & Burnett Hwy	Callide Creek	15:00 (21 Feb)
Jambin (Callide)	Callide Creek	16:45 (21 Feb)
Goovigen Connection Road	Callide Creek	19:15 (21 Feb)
Goovigen Gauge	Callide Creek	20:00 (21 Feb)
Harchs Road	Kroombit Creek	11:15 (21 Feb)
Dawson Highway	Kroombit Creek	10:00 (21 Feb)
Dawson Highway	Washpool Gully	06:00 (21 Feb)
Burnett Highway	Kroombit Creek	04:15 (21 Feb)
Thangool	Kariboe Creek	05:30 (21 Feb)

6.2.3 Flood Behaviour

Simulated peak flood depths are presented on the Maps 6-3 to 6-6.

Simulated peak flood levels are presented on Map 6-7 and 6-8.

Peak flood levels at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-2. Refer also to hydrograph timeline presented as Figure 6-4.

Table 6-2 Peak flood levels – February 2015 event

Location	Watercourse	Peak Flood Level (mAHD)
Linkes Road	Callide Creek	179.24
Dawson Highway	Callide Creek	174.42
Jambin Dakenba Road	Callide Creek	168.34
Hodgetts Road	Callide Creek	160.14
Callide Road	Callide Creek	155.63
Rail Crossing & Burnett Hwy	Callide Creek	142.88
Jambin (Callide)	Callide Creek	134.36
Goovigen Connection Road	Callide Creek	126.73
Goovigen Gauge	Callide Creek	122.53
Harchs Road	Kroombit Creek	157.66
Dawson Highway	Kroombit Creek	168.20
Dawson Highway	Washpool Gully	174.22
Burnett Highway	Kroombit Creek	185.55
Thangool	Kariboe Creek	194.25

Some key points of interest are:

- Flooding of properties along Callide Creek, upstream from Biloela, commenced within one hour of the gates opening.
- At 22:00 (the time of peak discharge), properties along Callide Creek from the dam to Biloela were experiencing major flooding. Peak flood levels at Linkes Road occurred around 23:00.
- Properties on the south side of Biloela Town first experienced flooding from Kroombit Creek, approximately 3-4 hours later (02:00 to 03:00 on 21 February) than the peak flooding from Callide Creek to the north of Biloela. This was the peak of the flood passing through Kroombit Creek, breaking out across the floodplain towards Biloela.
- At the same time (02:00 to 03:00 on 21 February), properties along Washpool Gully on the north side of Biloela were experiencing peak flood levels. This water originated from Kroombit Creek, since the water levels in Callide Creek had already dropped by about 1.5m from the peak, 3-4 hours before.

6.2.4 Comparison of Actual Operation to Design

There is no information relating to the actual time the gates began to operate, so the opening is assumed to have commenced when the levels of 216.259m and 216.407m were reached for the middle and outer pairs of gates respectively. These levels relate to the levels which trigger the automatic opening (see Section 3.5).

SunWater's Dam Duty Officer first observed the gates to be open at approximately 21:30 on 20 February 2015. The gates were estimated to be open by 4.0m and 3.0m for the middle and outer pairs respectively. The next observation was not until 22:00 when all gates had opened to 7.0m and 6.0m for the respective pairs.

The following comments are provided on the comparison between observed gate openings and the estimated openings based on the recorded water level in the dam (refer also to Table 6-3 and Figure 6-2):

- At 21:30 when the gates were first observed to be open; the estimated opening was not as much as expected given the water level.
- At 22:00 when the next observation was recorded, approximately at the peak water level, the gates were open slightly more than expected given the water level.
- In theory, the degree of which the gates were observed to be open at 22:00, is not expected to have occurred until after the dam water level had exceeded 217.200m[15]. As discussed in Section 4.2.2.1, dam water levels are not expected to have risen much higher than the observed 217.203m at 21:45, so the gates are not expected to have opened as much as they did. This may have been due to the speed of opening in response to the rising water level, and there having been significant momentum causing over opening.
- There is insufficient evidence to determine whether the gates opened any more than 6.0m and 7.0m as observed at the peak water level.

Table 6-3 Comparison of observed to theoretical gate openings

Time	Water Level (m AHD)	Gate Opening			
		Middle Pair		Outer Pairs	
		Observed	Theoretical	Observed	Theoretical
21:30	217.162	4.0m	6.3m	3.0m	5.2m
22:00	217.192	7.0m	6.5m	6.0m	5.4m

To summarise, during the February 2015 event, assuming the 21:30 estimate of heights the gates were open by were accurate, the gates were not open as much as expected when dam levels were rising. The lower discharge associated with the gates having not opened as much as expected contributed to the dam water levels rising slightly higher. This in turn would have caused the gates

[15] At 217.200m the 'failsafe' weir is overtopped, completely filling the float chamber and automatically opening the gates to their maximum opening of 9.8m. Refer to Section 3.5.

to open more than the theoretical operation. Therefore, at the peak, there was slightly higher discharge than expected. Refer to Figure 6-3.

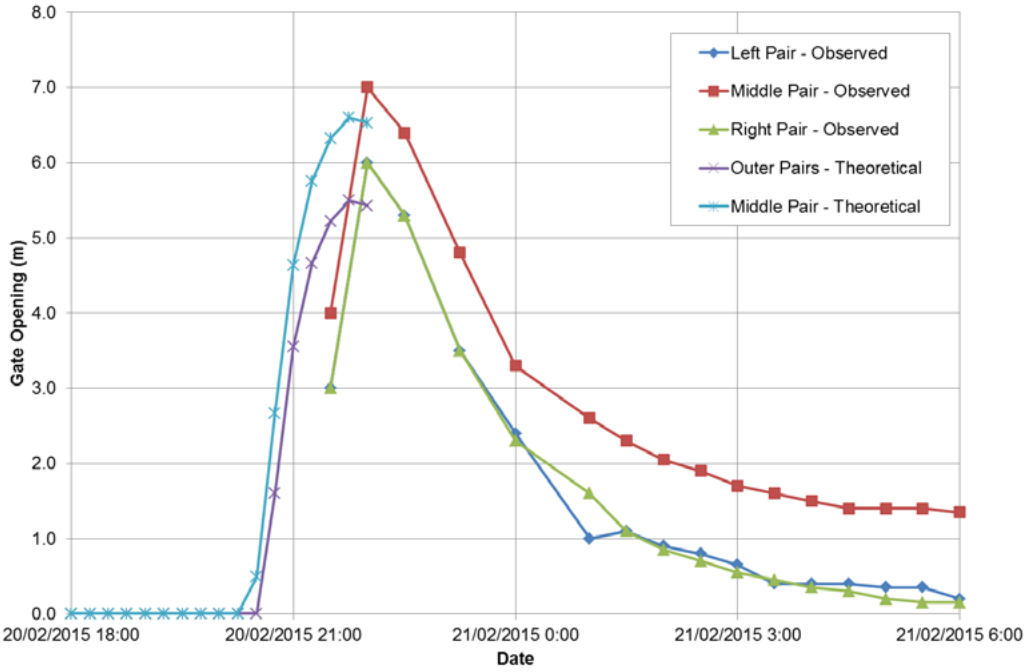

Figure 6-2 Comparison of observed to theoretical gate openings

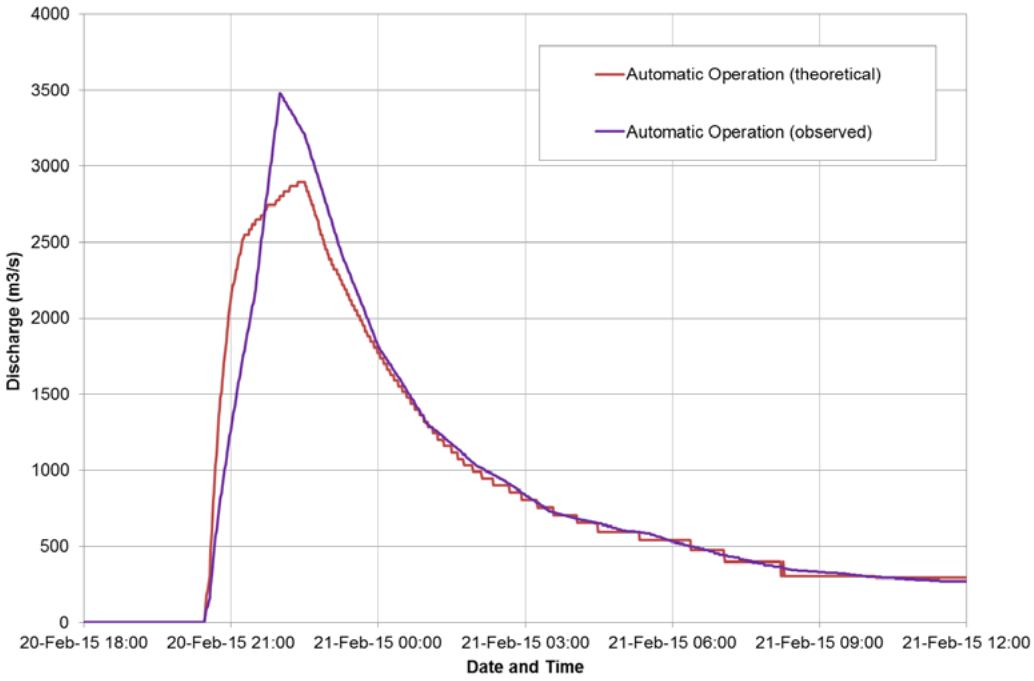

Figure 6-3 Observed versus theoretical discharge during automatic operation

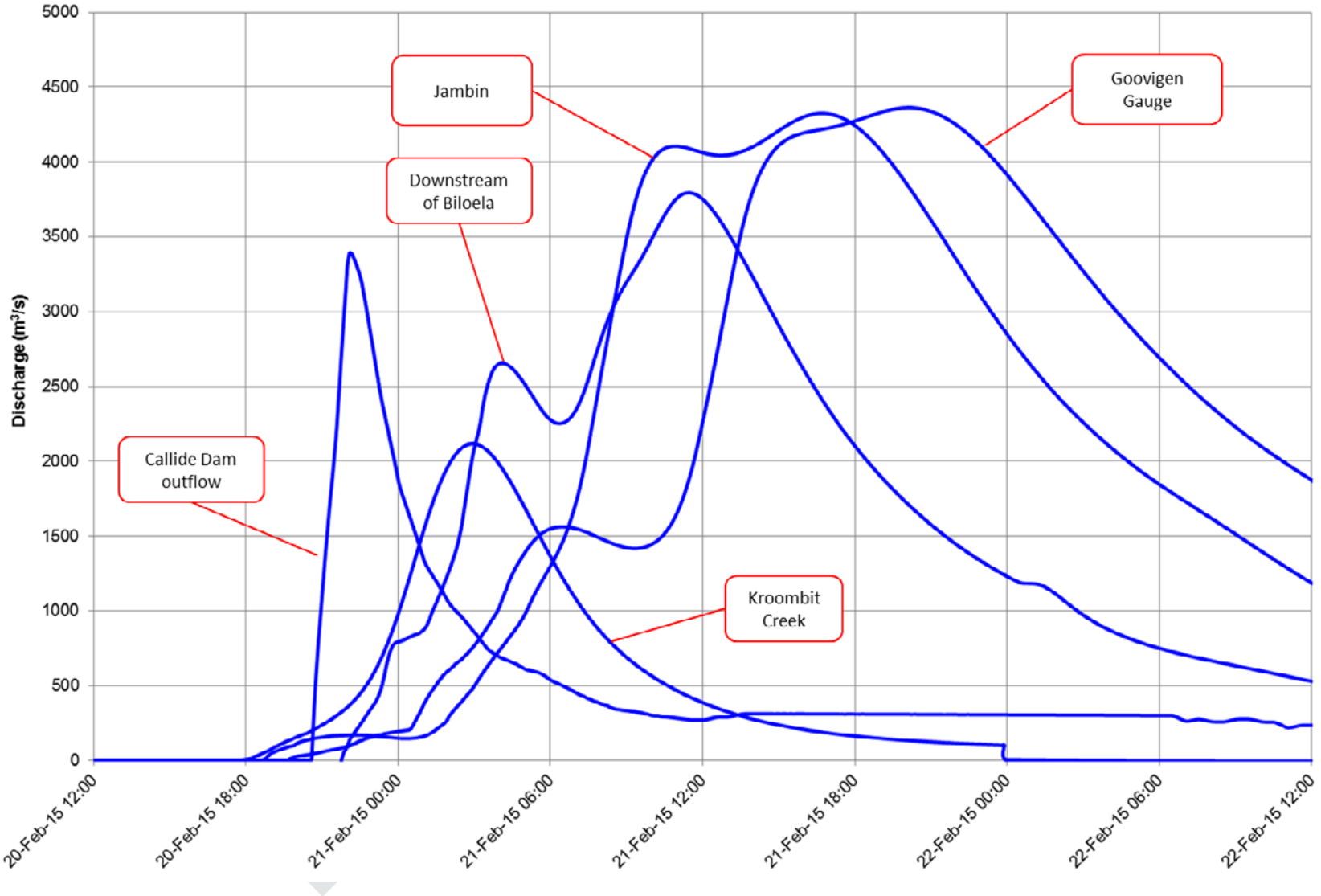

Figure 6-4 February 2015 event – hydrograph timeline

6.3 What if dam operators could have manually operated the gates? (Scenario 2)

6.3.1 Description

The *Callide Dam O&M Manual* identifies the need for manual operation of the gates during flood events, triggered by the dam water level exceeding the reduced FSL of 215.500m. Gate opening is managed using the test pump to pump water into the float chambers. The amount to which the gates are to be opened is to be based upon matching inflows to outflows using the observed water levels and corresponding discharges at the Callide Creek 96km river gauge.

As the cyclone passed the Callide Creek catchment, SunWater dam operators were advised to take shelter in the Callide Dam site office. Therefore manual operation of the dam gates was not possible as activation of the test pump requires access to the dam wall.

This scenario has been included to assess the difference in flooding should manual operation of the dam gates have been possible. Presented in Figure 6-5 is a comparison of calculated discharge for the manual operation and automatic operation scenarios. The graph shows a small early release as the middle gates are opened when the water level reached 215.500m. This early release makes a small difference to the peak discharge, although results in a reduction in peak dam levels by 0.170m.

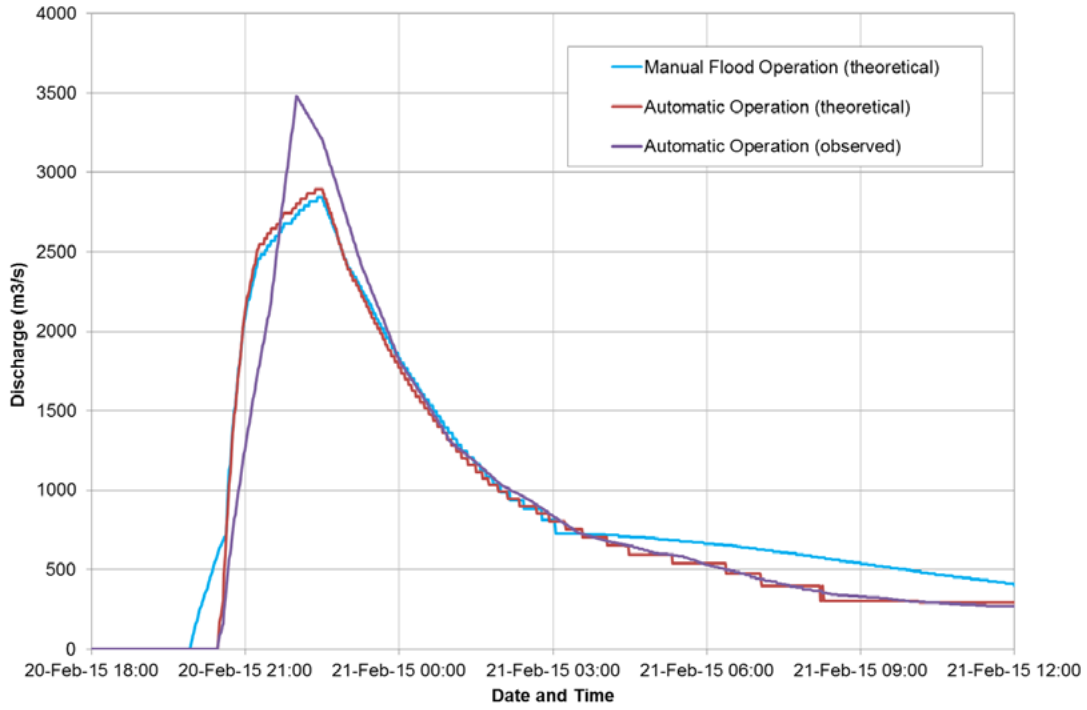

Figure 6-5 Comparison of discharge for manual versus automatic operation

Note that this scenarios has not factored in the time taken to manually operate the gates.

6.3.2 Flood Impacts

The difference between the actual event peak flood levels and this scenario are presented on Map 6-10.

Simulated peak discharges are presented on Figure 6-6.

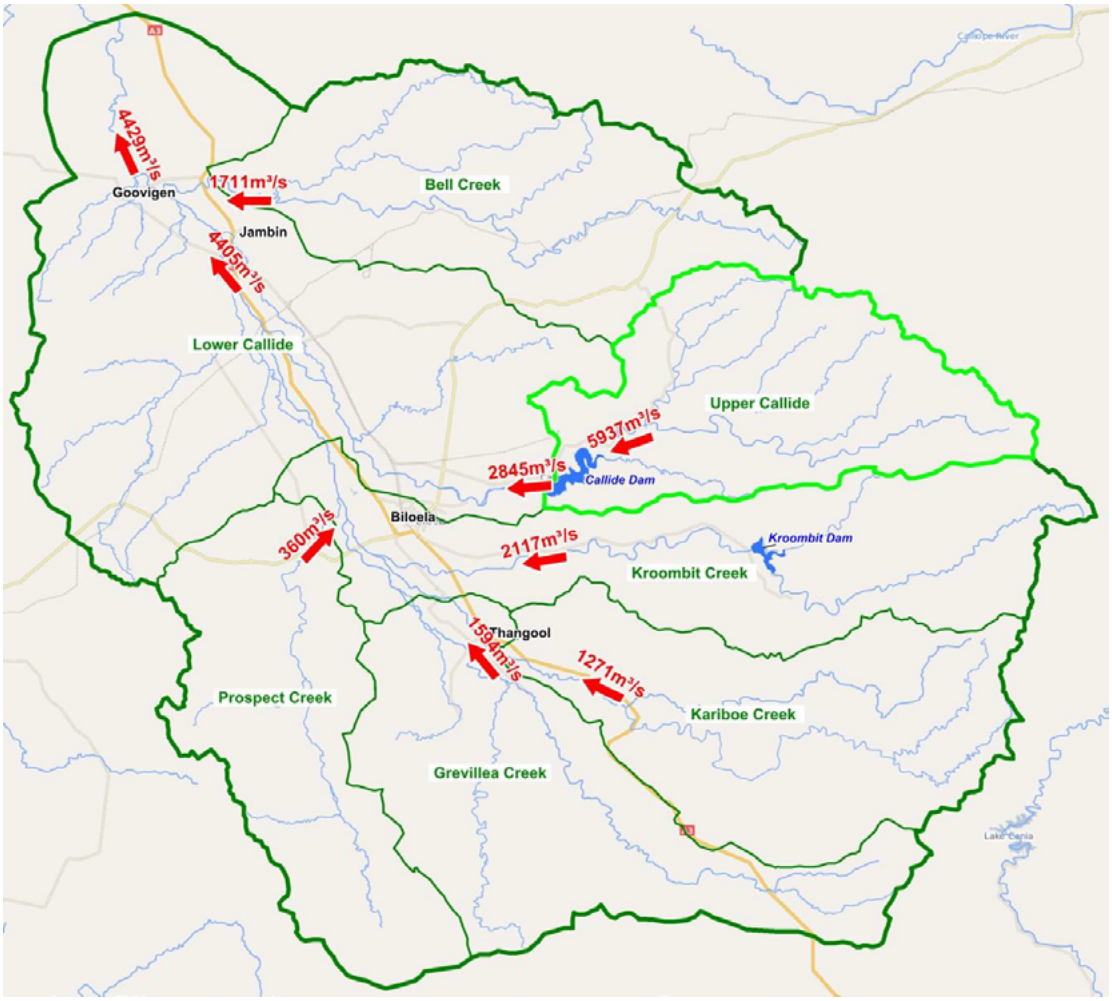

Figure 6-6 Simulated peak discharges for Scenario 2

Peak flood levels at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-4. Refer also to hydrograph timeline presented as Figure 6-5.

Between the Callide Dam and Biloela, peak flood levels are expected to have been up to 0.13m lower had manual operation been possible. Downstream from Biloela, there is expected to have been less than 0.05m change in peak flood levels.

Table 6-4 Peak flood levels – Scenario 2 – Manual gate operation

Location	Watercourse	Peak Flood Level (mAHD)	Change in peak flood level relative to Feb 2015 event (m)
Linkes Road	Callide Creek	179.11	-0.13
Dawson Highway	Callide Creek	174.40	-0.02
Jambin Dakenba Road	Callide Creek	168.32	-0.02
Hodgetts Road	Callide Creek	160.14	0.00
Callide Road	Callide Creek	155.63	0.00
Rail Crossing & Burnett Hwy	Callide Creek	142.93	0.05
Jambin (Callide)	Callide Creek	134.37	0.01
Goovigen Connection Road	Callide Creek	126.75	0.02
Goovigen Gauge	Callide Creek	122.53	0.00
Harchs Road	Kroombit Creek	157.71	0.05
Dawson Highway	Kroombit Creek	168.20	0.00
Dawson Highway	Washpool Gully	174.22	0.00
Burnett Highway	Kroombit Creek	185.55	0.00
Thangool	Kariboe Creek	194.25	0.00

6.3.3 Flooding Timeline

The time of peak and relative change to the February 2015 event are listed in Table 6-5 for the various locations along Callide, Kroombit, Kariboe and Grevillea Creeks.

There is less than 15 minutes change in the time to peak flood levels between the automatic and manual gate operation scenarios.

Table 6-5 Time of peak flood level – Scenario 2 – Manual gate operation

Location	Watercourse	Time of peak	Change in time to peak relative to Feb 2015 event (hours)
Linkes Road	Callide Creek	23:15 (20 Feb)	0.00
Dawson Highway	Callide Creek	23:45 (20 Feb)	0.00
Jambin Dakenba Road	Callide Creek	01:30 (21 Feb)	0.00
Hodgetts Road	Callide Creek	03:00 (21 Feb)	0.00
Callide Road	Callide Creek	03:00 (21 Feb)	-0.25
Rail Crossing & Burnett Hwy	Callide Creek	15:15 (21 Feb)	0.25
Jambin (Callide)	Callide Creek	17:00 (21 Feb)	0.25
Goovigen Connection Road	Callide Creek	19:30 (21 Feb)	0.25
Goovigen Gauge	Callide Creek	20:15 (21 Feb)	0.25
Harchs Road	Kroombit Creek	11:15 (21 Feb)	0.00
Dawson Highway	Kroombit Creek	09:45 (21 Feb)	-0.25
Dawson Highway	Washpool Gully	06:00 (21 Feb)	0.00
Burnett Highway	Kroombit Creek	04:15 (21 Feb)	0.00
Thangool	Kariboe Creek	05:30 (21 Feb)	0.00

Note the negative numbers in the right column refer to flood peaks occurring sooner than during the February 2015 event.

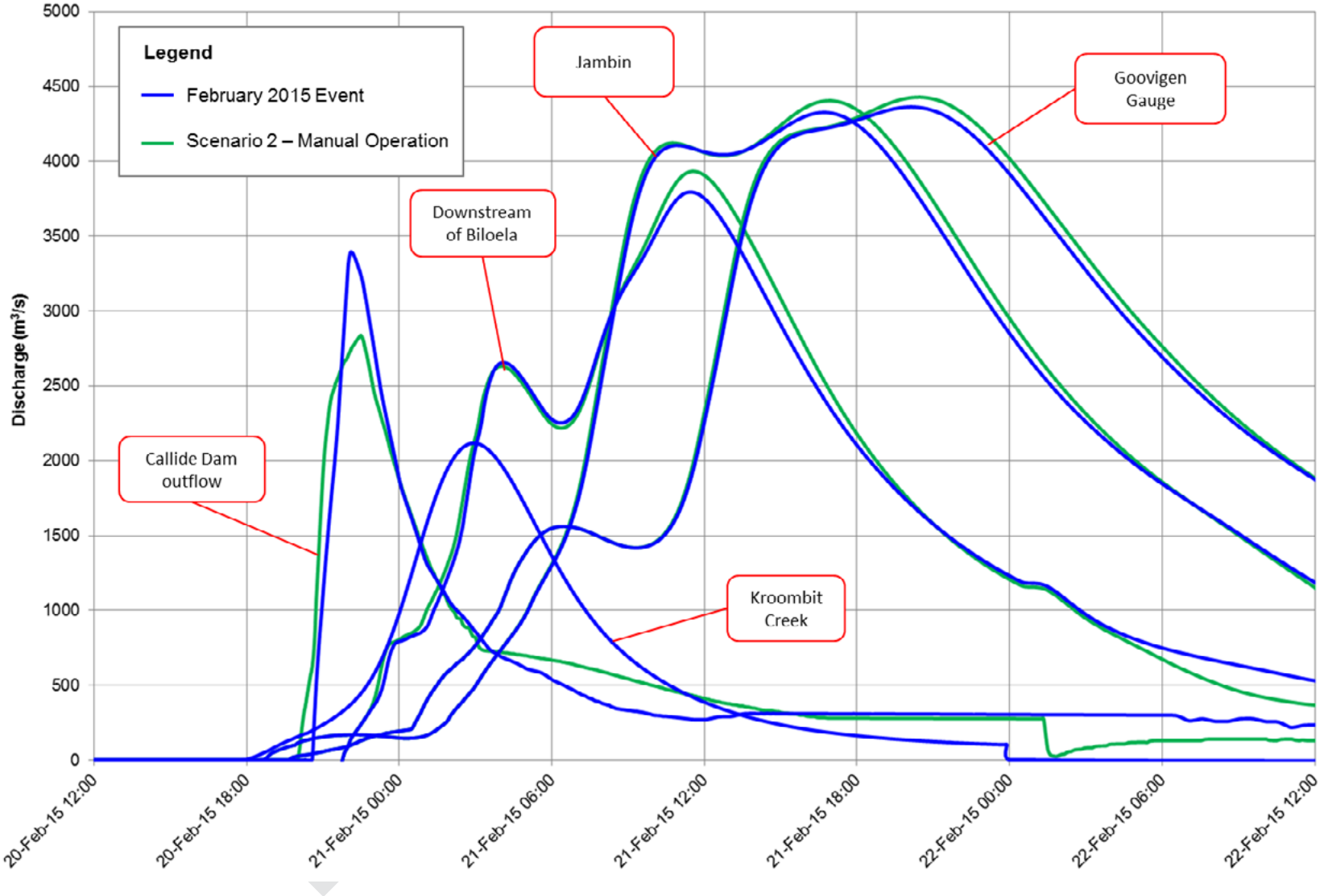

Figure 6-7 Scenario 2 comparison to February 2015 event – hydrograph timeline

6.4 What if there was no Callide Dam? (Scenario 3)

6.4.1 Description

To assess the flood attenuation provided by the Callide Dam, removal of the dam from Callide Creek has been simulated. For this scenario, the Callide Dam inflow hydrograph has been applied to the hydraulic model at the location of the dam spillway. The peak discharge is therefore 5,937m^3/s compared to 3,480m^3/s in the actual event.

6.4.2 Flood Impacts

The difference between the actual event peak flood levels and this scenario are presented on Map 6-10.

Simulated peak discharges are presented on Figure 6-8.

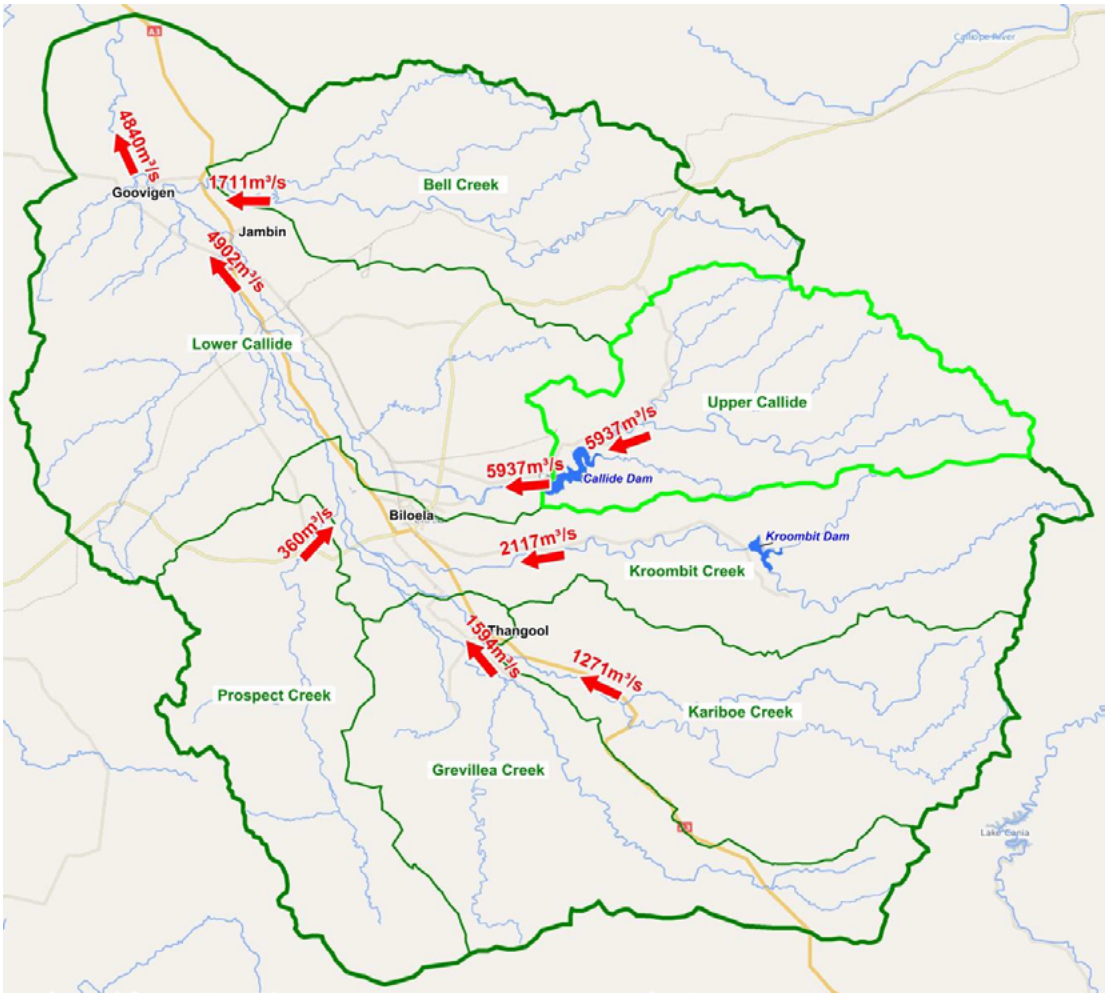

Figure 6-8 Simulated peak discharges for Scenario 3

Peak flood levels at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-6. Refer also to hydrograph timeline presented as Figure 6-9.

Between the Callide Dam and Biloela, peak flood levels are expected to have been up to 0.33m higher if there was no Callide Dam and the entire flood originating from Upper Callide Creek was able to pass through the system unattenuated.

Downstream from Biloela, there is expected to have been up to 0.29m increase in peak flood levels.

At Jambin, the peak discharge and flood level is lower, with a minor difference shown at Goovigen.

Table 6-6 Peak flood levels – Scenario 3 – No dam

Location	Watercourse	Peak Flood Level (mAHD)	Change in peak flood level relative to Feb 2015 event (m)
Linkes Road	Callide Creek	179.57	0.33
Dawson Highway	Callide Creek	174.74	0.32
Jambin Dakenba Road	Callide Creek	168.56	0.22
Hodgetts Road	Callide Creek	160.16	0.02
Callide Road	Callide Creek	155.64	0.01
Rail Crossing & Burnett Hwy	Callide Creek	143.17	0.29
Jambin (Callide)	Callide Creek	134.46	0.10
Goovigen Connection Road	Callide Creek	126.82	0.09
Goovigen Gauge	Callide Creek	122.55	0.02
Harchs Road	Kroombit Creek	157.75	0.09
Dawson Highway	Kroombit Creek	168.20	0.00
Dawson Highway	Washpool Gully	174.22	0.00
Burnett Highway	Kroombit Creek	185.55	0.00
Thangool	Kariboe Creek	194.25	0.00

6.4.3 Flooding Timeline

The modelling indicates flooding between Callide Dam and Biloela occurs quicker than during the actual event. Peak flood levels are also higher and the velocities are faster. This scenario represents a significant worsening of flooding, with flood hazard increasing.

The time of peak and relative change to the February 2015 are listed in Table 6-7 for the various locations along Callide, Kroombit, Kariboe and Grevillea Creeks.

Flooding would generally occur significantly earlier should there be no dam to attenuate flows.

Table 6-7 Time of peak flood level – Scenario 3 – No dam

Location	Watercourse	Time of peak	Change in time to peak relative to Feb 2015 event (hours)
Linkes Road	Callide Creek	23:15 (20 Feb)	-2.00
Dawson Highway	Callide Creek	23:45 (20 Feb)	-1.50
Jambin Dakenba Road	Callide Creek	01:30 (21 Feb)	-2.50
Hodgetts Road	Callide Creek	03:00 (21 Feb)	-0.50
Callide Road	Callide Creek	03:15 (21 Feb)	-0.25
Rail Crossing & Burnett Hwy	Callide Creek	15:00 (21 Feb)	-8.00
Jambin (Callide)	Callide Creek	16:45 (21 Feb)	-7.75
Goovigen Connection Road	Callide Creek	19:15 (21 Feb)	-7.00
Goovigen Gauge	Callide Creek	20:00 (21 Feb)	-6.50
Harchs Road	Kroombit Creek	11:15 (21 Feb)	-9.75
Dawson Highway	Kroombit Creek	10:00 (21 Feb)	0.00
Dawson Highway	Washpool Gully	06:00 (21 Feb)	0.00
Burnett Highway	Kroombit Creek	04:15 (21 Feb)	-0.25
Thangool	Kariboe Creek	05:30 (21 Feb)	0.00

Note the negative numbers in the right column refer to flood peaks occurring sooner than during the February 2015 event.

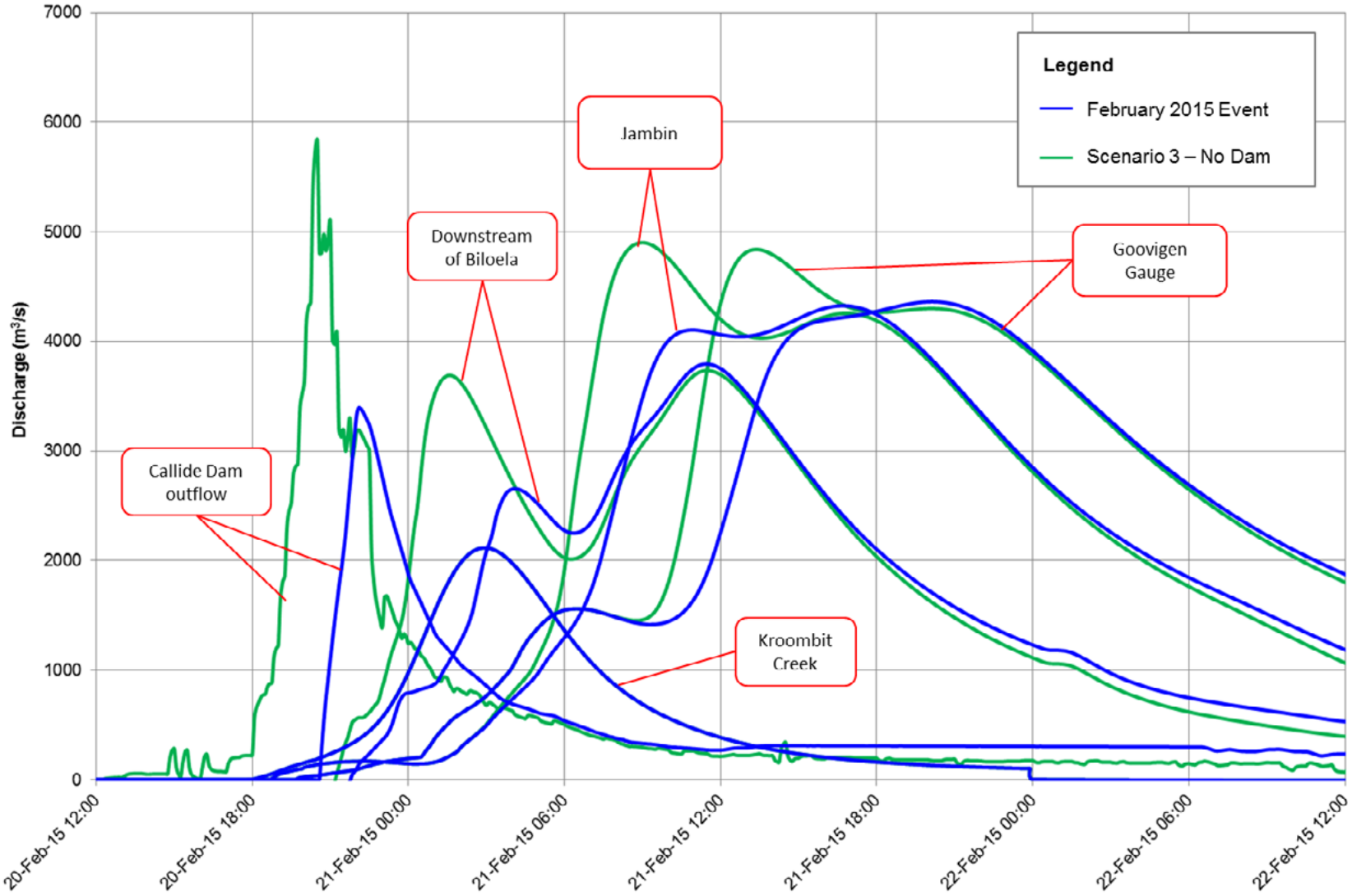

Figure 6-9 Scenario 3 comparison to February 2015 event – hydrograph timeline

6.5 What if water levels in Callide Dam had been lowered before the event? (Scenario 4)

6.5.1 Description

A common question posed by the community during the resident surveys conducted by IGEM is why the storage in the dam was not reduced prior to the event, to provide greater storage. Pre-release of water from Callide Dam is not part of the operational rules for Callide Dam. It is beyond the scope of this review to establish whether or not a pre-release should have been made, or to determine the triggers that would initiate a pre-release. However, this review does include a scenario assuming the dam was at 50% capacity[16] at the start of the event.

6.5.2 Flood Impacts

The difference between the actual event peak flood levels and this scenario are presented on Map 6-11.

Simulated peak discharges are presented on Figure 6-10.

[16] The reference to 50% capacity is related to the reduced FSL of 215.500m.

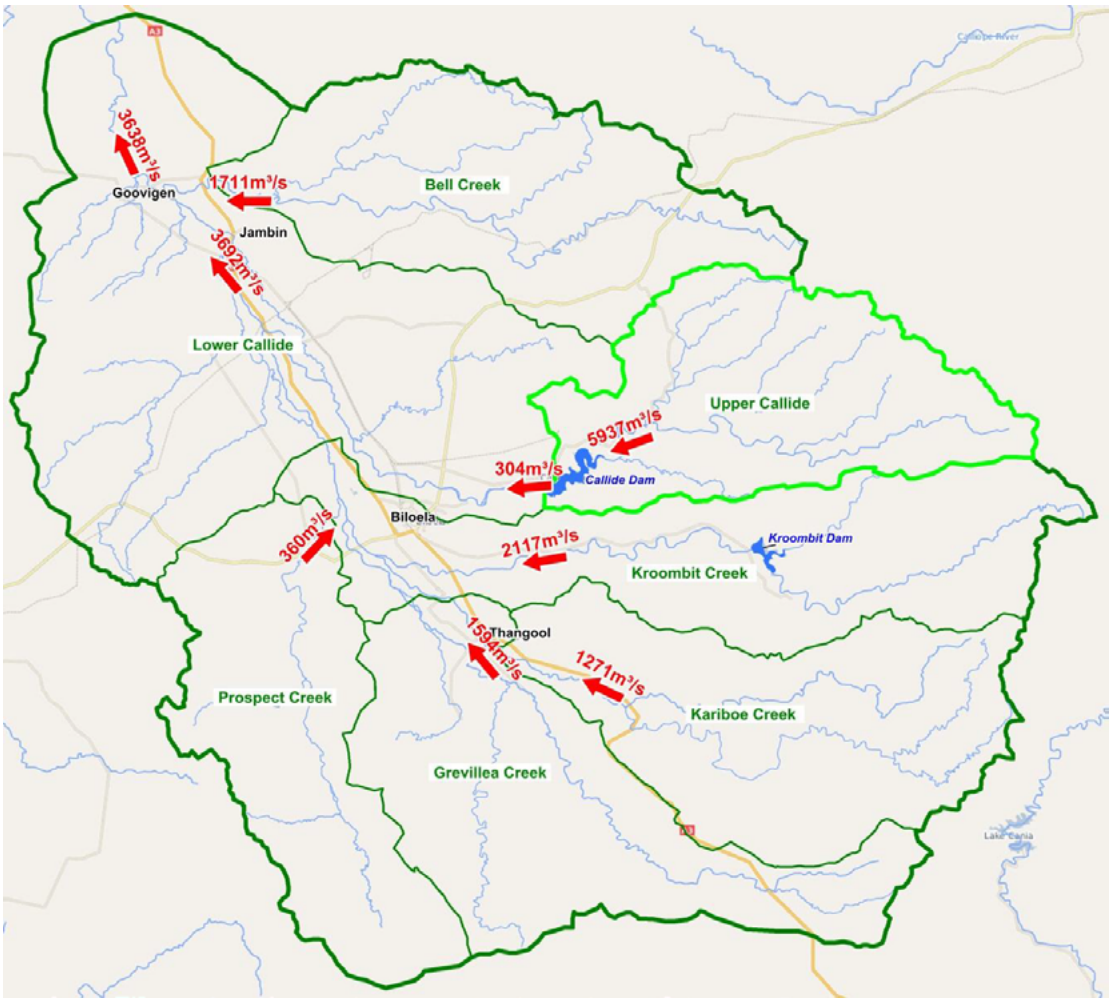

Figure 6-10 Simulated peak discharges for Scenario 4

Peak flood levels at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-8. Refer also to hydrograph timeline presented as Figure 6-11.

Between the Callide Dam and Biloela, peak flood level are expected to have been up to 4.67m lower if Callide Dam had been at 50% capacity at the start of the event. Approximately 61% of the runoff originating from Upper Callide Creek is able to be attenuated by the dam in this scenario, resulting in a 91% decrease in peak discharge.

Table 6-8 Peak flood levels – Scenario 4 - Callide Dam 50%

Location	Watercourse	Peak Flood Level (mAHD)	Change in peak flood level relative to Feb 2015 event (m)
Linkes Road	Callide Creek	174.57	-4.67
Dawson Highway	Callide Creek	170.24	-4.18
Jambin Dakenba Road	Callide Creek	166.13	-2.21
Hodgetts Road	Callide Creek	159.98	-0.16
Callide Road	Callide Creek	155.62	-0.01
Rail Crossing & Burnett Hwy	Callide Creek	142.56	-0.32
Jambin (Callide)	Callide Creek	134.23	-0.13
Goovigen Connection Road	Callide Creek	126.57	-0.16
Goovigen Gauge	Callide Creek	122.49	-0.04
Harchs Road	Kroombit Creek	157.61	-0.05
Dawson Highway	Kroombit Creek	168.20	0.00
Dawson Highway	Washpool Gully	174.22	0.00
Burnett Highway	Kroombit Creek	185.55	0.00
Thangool	Kariboe Creek	194.25	0.00

6.5.3 Flooding Timeline

As expected, the modelling indicates a significant reduction in discharge along Callide Creek from the dam to Goovigen. In most locations the peak occurs slightly later during this scenario, due to the dominance of the flood from Kroombit Creek.

The time of peak and relative change to the February 2015 are listed in Table 6-9 for the various locations along Callide, Kroombit, Kariboe and Grevillea Creeks.

Modelling has shown that the change in time to peak flood levels vary across the catchment due to the significant change in flood behaviour experienced for this scenario.

Table 6-9 Time of peak flood level – Scenario 4 - Callide Dam 50%

Location	Watercourse	Time of peak	Change in time to peak relative to Feb 2015 event (hours)
Linkes Road	Callide Creek	23:15 (20 Feb)	-2.25
Dawson Highway	Callide Creek	23:45 (20 Feb)	-2.00
Jambin Dakenba Road	Callide Creek	01:30 (21 Feb)	-3.00
Hodgetts Road	Callide Creek	03:00 (21 Feb)	-0.25
Callide Road	Callide Creek	03:15 (21 Feb)	-0.25
Rail Crossing & Burnett Hwy	Callide Creek	15:00 (21 Feb)	1.50
Jambin (Callide)	Callide Creek	16:45 (21 Feb)	1.50
Goovigen Connection Road	Callide Creek	19:15 (21 Feb)	2.25
Goovigen Gauge	Callide Creek	20:00 (21 Feb)	2.50
Harchs Road	Kroombit Creek	11:15 (21 Feb)	0.50
Dawson Highway	Kroombit Creek	10:00 (21 Feb)	-0.25
Dawson Highway	Washpool Gully	06:00 (21 Feb)	0.25
Burnett Highway	Kroombit Creek	04:15 (21 Feb)	0.00
Thangool	Kariboe Creek	05:30 (21 Feb)	0.00

Note the negative numbers in the right column refer to flood peaks occurring sooner than during the February 2015 event.

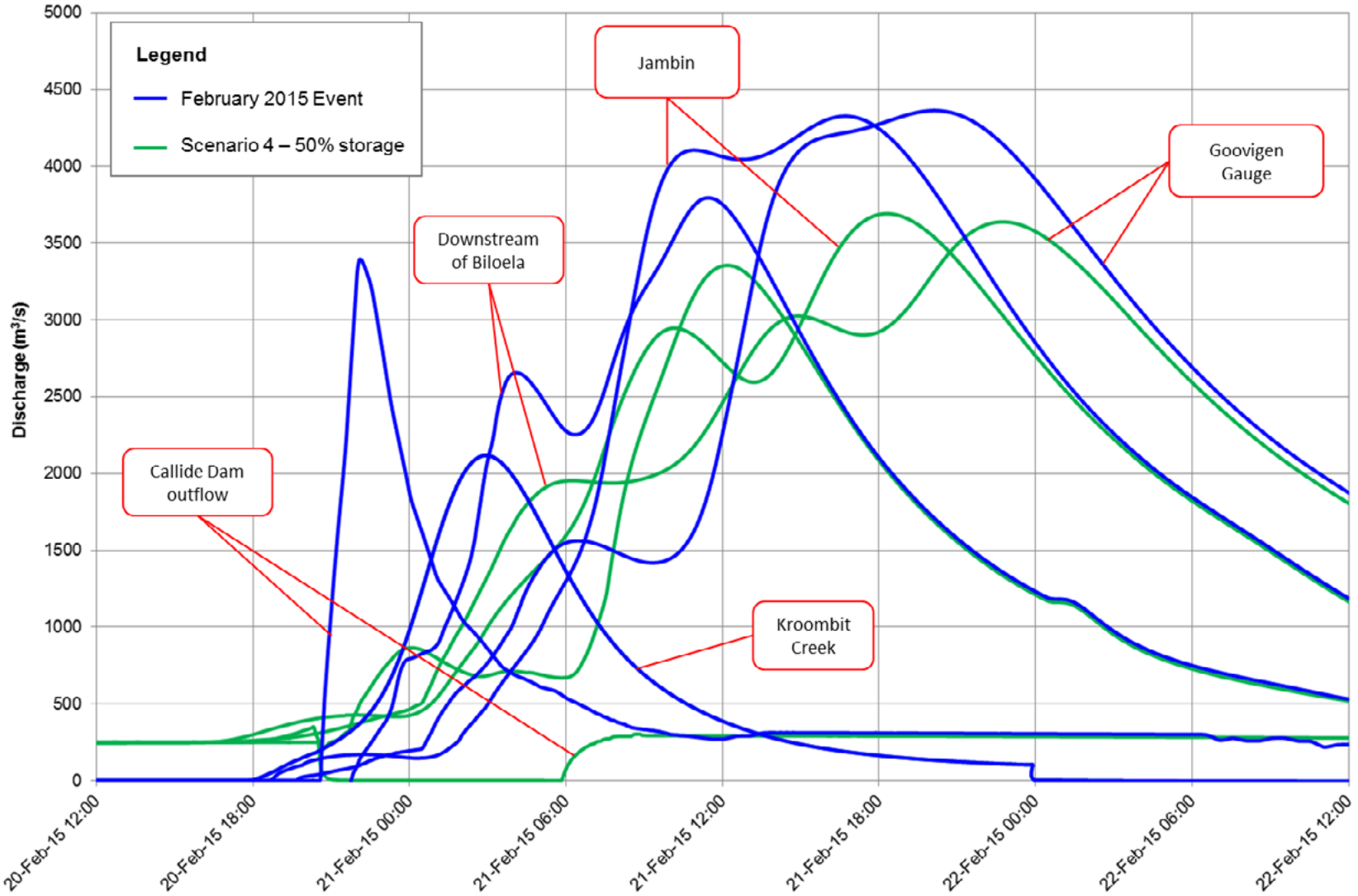

Figure 6-11 Scenario 4 comparison to February 2015 event – hydrograph timeline

6.6 What if Callide Dam was full before the event? (Scenario 5)

6.6.1 Description

To assess the relative difference in flooding should Callide Dam have been full[17] at the start of the event, Scenario 5 has been simulated. Unlike the previous scenario which represents a condition that is outside of the current operational rules of Callide Dam, this scenario could have occurred.

6.6.2 Flood Impacts

The difference between the actual event peak flood levels and this scenario are presented on Map 6-12.

Simulated peak discharges are presented on Figure 6-12.

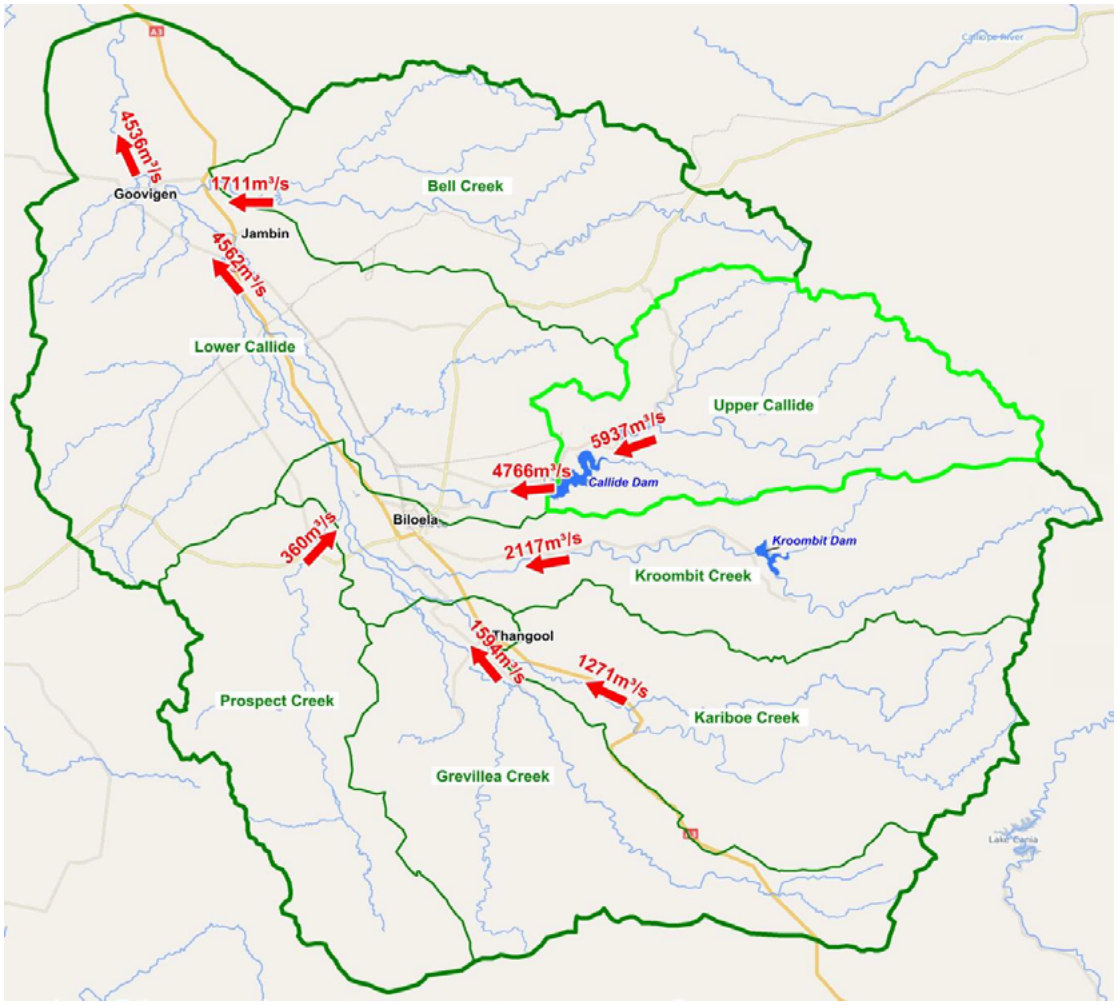

Figure 6-12 Simulated peak discharges for Scenario 5

[17] The reference to 50% capacity is related to the reduced FSL of 215.500m.

Peak flood levels at various locations along Callide, Kroombit, Kariboe and Grevillea Creeks are listed in Table 6-10. Refer also to hydrograph timeline presented as Figure 6-13.

Between the Callide Dam and Biloela, peak flood levels are expected to increase by to 0.11m had the dam been at full capacity at the start of the event. The rate of discharge would have been 4,766m^3/s, which is 37% higher than the February 2015 discharge.

Downstream from Biloela, peak flood levels are expected to increase by up to 0.10m, with 0.05m increase expected at Jambin and 0.01m at Goovigen.

Table 6-10 Peak flood levels – Scenario 5 - Callide Dam 100%

Location	Watercourse	Peak Flood Level (mAHD)	Change in peak flood level relative to Feb 2015 event (m)
Linkes Road	Callide Creek	179.35	0.11
Dawson Highway	Callide Creek	174.53	0.11
Jambin Dakenba Road	Callide Creek	168.45	0.11
Hodgetts Road	Callide Creek	160.16	0.02
Callide Road	Callide Creek	155.65	0.02
Rail Crossing & Burnett Hwy	Callide Creek	142.98	0.10
Jambin (Callide)	Callide Creek	134.39	0.03
Goovigen Connection Road	Callide Creek	126.78	0.05
Goovigen Gauge	Callide Creek	122.54	0.01
Harchs Road	Kroombit Creek	157.66	0.00
Dawson Highway	Kroombit Creek	168.19	-0.01
Dawson Highway	Washpool Gully	174.22	0.00
Burnett Highway	Kroombit Creek	185.55	0.00
Thangool	Kariboe Creek	194.28	0.03

6.6.3 Flooding Timeline

As expected, the modelling indicates a significant increase in discharge along Callide Creek from the dam to Goovigen. At Jambin and Goovigen the peak occurs slightly earlier during this scenario, due to the higher early discharge affecting the interaction of flows between Callide and Kroombit Creeks.

The time of peak and relative change to the February 2015 are listed in Table 6-11 for the various locations along Callide, Kroombit, Kariboe and Grevillea Creeks. Generally, modelling has shown flooding would have occurred sooner should Callide Dam have been at FSL prior to the event.

Table 6-11 Time of peak flood level – Scenario 5 - Callide Dam 100%

Location	Watercourse	Time of peak	Change in time to peak relative to Feb 2015 event (hours)
Linkes Road	Callide Creek	23:15 (20 Feb)	-1.00
Dawson Highway	Callide Creek	23:45 (20 Feb)	-0.25
Jambin Dakenba Road	Callide Creek	01:30 (21 Feb)	-1.00
Hodgetts Road	Callide Creek	03:00 (21 Feb)	-0.25
Callide Road	Callide Creek	03:15 (21 Feb)	-0.25
Rail Crossing & Burnett Hwy	Callide Creek	15:00 (21 Feb)	-7.00
Jambin (Callide)	Callide Creek	16:45 (21 Feb)	-6.75
Goovigen Connection Road	Callide Creek	19:15 (21 Feb)	-5.75
Goovigen Gauge	Callide Creek	20:00 (21 Feb)	-5.25
Harchs Road	Kroombit Creek	11:15 (21 Feb)	0.00
Dawson Highway	Kroombit Creek	10:00 (21 Feb)	0.00
Dawson Highway	Washpool Gully	06:00 (21 Feb)	0.00
Burnett Highway	Kroombit Creek	04:15 (21 Feb)	0.00
Thangool	Kariboe Creek	05:30 (21 Feb)	0.00

Note the negative numbers in the right column refer to flood peaks occurring sooner than during the February 2015 event.

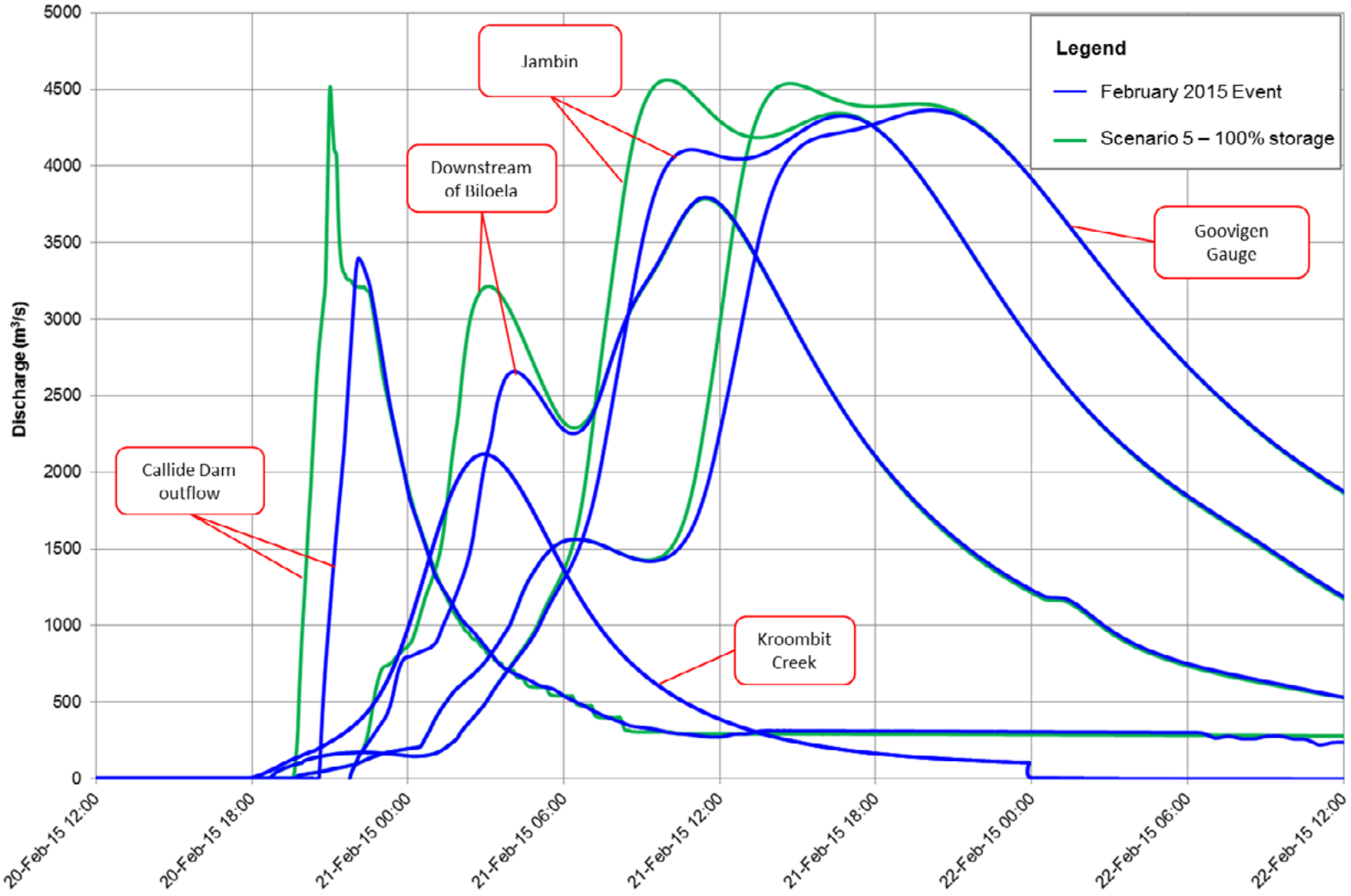

Figure 6-13 Scenario 5 comparison to February 2015 event – hydrograph timeline

6.6.4 Other Pre-release Scenarios

Following issue of the Draft Report, IGEM requested simulation of additional scenarios representing different pre-release scenarios. To complement the 50% and 100% of capacity scenarios presented in the previous sections, scenarios have been simulated representing 60%, 70% and 80% of full capacity prior to the event. Each scenario has been simulated allowing for water to be drawn down to the respective level, commencing at midday on Wednesday 18 February. This time corresponds to the release of the second BoM Flood Watch.

The change to peak flood level at the various locations throughout the catchment is presented in Table 6-12. Modelling shows a significant reduction to peak flood levels between Callide Dam and Biloela for all scenarios involving lowering the water levels in Callide Dam prior to the event. Downstream of Biloela, modelling shows there is only a small reduction to peak flood levels (generally less than 0.30m).

However, this analysis should be considered in the context of volumetric runoff. The February 2015 event was a short duration event, with a significantly lower volume of runoff compared to other longer duration events such as the 2013 event. Therefore, the reduction to peak flood levels shown here would not be achieved during other longer duration events.

Table 6-12 Change to peak flood levels based on different pre-release scenarios

Location	Watercourse	Change in peak flood level relative to Feb 2015 event (m)					
		50% FSL	60% FSL	70% FSL	80% FSL	89% FSL	100% FSL
Linkes Road	Callide Creek	-4.67	-3.74	-2.16	-0.72	0.00	0.11
Dawson Highway	Callide Creek	-4.18	-2.96	-1.16	-0.20	0.00	0.11
Jambin Dakenba Road	Callide Creek	-2.21	-1.40	-0.55	-0.25	0.00	0.11
Hodgetts Road	Callide Creek	-0.16	-0.17	-0.08	-0.05	0.00	0.02
Callide Road	Callide Creek	-0.01	-0.01	-0.01	0.00	0.00	0.02
Rail Crossing & Burnett Hwy	Callide Creek	-0.32	-0.13	-0.07	-0.03	0.00	0.10
Jambin (Callide)	Callide Creek	-0.13	-0.06	-0.04	-0.02	0.00	0.03
Goovigen Connection Road	Callide Creek	-0.16	-0.08	-0.04	-0.02	0.00	0.05
Goovigen Gauge	Callide Creek	-0.04	-0.02	-0.01	-0.01	0.00	0.01
Harchs Road	Kroombit Creek	-0.05	-0.02	-0.01	0.00	0.00	0.00
Dawson Highway	Kroombit Creek	0.00	0.00	0.00	0.00	0.00	-0.01
Dawson Highway	Washpool Gully	0.00	0.00	0.00	0.00	0.00	0.00
Burnett Highway	Kroombit Creek	0.00	0.00	0.00	0.00	0.00	0.00
Thangool	Kariboe Creek	0.00	0.00	0.00	0.00	0.00	0.03

6.7 What if there was improved prediction and warning?

In various parts of this review, the prediction and warning process is discussed in terms of could earlier and more accurate warnings have been provided to downstream residents. The review has shown that the community were not forewarned of a release, and SMS and phone call alerts were only provided once releases had commenced.

Should prediction and warning have been improved, flooding experienced along the Callide Creek would not have been any different under the current operating rules of Callide Dam. However, the following points are noted, which form basis for the recommendations from this review:

- Based on regional rainfall estimates provided by the BoM via Flood Watches, improved prediction methods, including rainfall forecasts, models and spreadsheets could have been used to predict that a spill was possible 2 days in advance of the actual spill. It should, however, be recognised that rainfall estimates from forecast rainfall (which form the basis for Flood Watches) are subject to significant uncertainty.
- SunWater could then have pre-emptively advised the LDMG and local residents of the possible spill, so that preparations could have been made.
- Having additional lead time for warning, would have allowed more of the community to have been warned. For residents that were unreachable by phone, door knocking could have occurred. This could only have been possible before the cyclone approached the catchment.
- In the scenario where a spill from the dam was unexpected and at short notice (as occurred on 20 February 2015), a more robust method of disseminating warnings would have benefited some residents. This could include sirens or individual household warning systems activated remotely by telemetry.

7 Review of Response during the Event

7.1 Access to Data

During discussions with SunWater the availability of data was discussed. SunWater advised that at some points during the event there was no data available from some of the rainfall and river gauges due to telecommunications network outage. Throughout the logs, the only references to unavailability of data are:

- 19 February 17:00 'Potential for loss of comms to 96k in strong winds/debris'
- 20 February 21:26 '96k inflow is gone. Inflows are above 2013 levels'

The latter record relates to the Callide Creek 96km gauge upstream of Callide Dam, which was inundated at 19:45 on 20 February.

Telstra have issued a report identifying the following network problems on 20 February. The report identifies network outage associated with the optic fibre damage which occurred at 19:22 (approximately one hour before any water was released from Callide Dam). The report also identifies other infrastructure such as mobile phone towers which lost service during the event.

Despite the insufficient information relating to the availability of data during the event, various logs and resident surveys indicate that the mobile phone network was inconsistent and sometimes unavailable during the event.

7.2 Use of Available Data

7.2.1 Rainfall and Runoff Estimates

From review of the communications logs, there appears to have been an error made during calculation of the rainfall and runoff required to cause a spill from Callide Dam. The first Flood Watch for the event was issued by the BoM at 15:47 on Tuesday 17 February. The expected rainfall for the area between Rockhampton and the NSW border was advised to be 200-300mm. This estimate was revised to 200-400mm in the second Flood Watch issued at 11:54 on Wednesday 18 February. At 07:27 on Thursday 19 February, SunWater's Flood and Stream Manager (Brisbane) sent some estimates of rainfall required to fill the various dams to SunWater's Service Manager Central (Bundaberg). The estimates indicated 270mm of runoff would have been required to fill Callide Dam to the reduced FSL of 215.500m. Based on volumetric calculations, a more appropriate figure is 27mm[18]. The same factor is evident in all calculations relating to if and when Callide Dam may spill.

Based on the current operational rules associated with the dam, this would not have had an effect on downstream flooding. However, should the correct rainfall depth have been assessed on 19 February, then SunWater would have known there was a high likelihood that the dam would have spilled.

[18] Note, this value relates to the average depth of runoff across the catchment area, required to fill the dam from 89% to 100% of the 215.500m FSL. Actual rainfall depth would have to be significantly higher to account for losses.

Communications relating to rainfall estimates, modelling and weather warnings are listed in Table 7-1. The key logs relating to estimates of when the dam may spill are:

- 20 February 17:41 – 'Advised URBS model doesn't predict spill tonight. This is dependent on rainfall.'
- 20 February 18:37 – 'Update on conditions. Potential for dam to fill tonight based on current inflow but not certain with current rainfall. This should be conveyed to LDMG.'
- 20 February 18:55 – 'Callide may spill tonight'
- 20 February 19:03 - (to Council) '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.'
- 20 February 19:10 – 'Advice that if inflows continue gate operation could be by 23:30.'
- 20 February 19:39 – Wmodel predicting gate opening by 9pm on the 20th Feb and asking re conditions - safe to operate gates?'
- 20 February 19:52 – 'Won't be able to open the gates manually - too dangerous. Expect auto gate operation within hours. 96k 120,000 and rising.'

7.2.2 River Levels

The Callide Creek 96km gauge is the single point of reference for inflows into the dam, and is used to inform manual releases. During manual release, the dam operator has to match outflows to inflows recorded at this gauge, to maintain a static water level.

The last data received form the Callide Creek 96km gauge was at 19:45 on 20 February. From this point onwards SunWater had no indication of further inflows to Callide Dam.

7.2.3 Modelling

The following points summarise the key events associated with modelling, as determined from the communication logs:

- 19 February 07:27 – 'preliminary rainfall estimates were provided'
- 19 February 11:17 – 'preliminary rainfall estimates were provided'
- 20 February 16:23 – 'request to get URBS model running as spreadsheet was problematic'
- 20 February 19:03 – 'URBS model was understating flows, so advice to proceed with the spreadsheet model.'

SunWater has advised that forecast rainfall is not used in the spreadsheet model. Review of the spreadsheet model or URBS model has not been undertaken for this review, so it is unknown whether the URBS model would have better informed the operators.

Table 7-1 Communication logs – rainfall, modelling and weather warnings

	From	Recipient/Sender	Details/Message
18/02/2015 10:10	SunWater (EEC1)	Council	LDMG on alert
19/02/2015 7:27	SunWater (EEC1)	SunWater (FOC)	sent through some estimates for rainfall
19/02/2015 9:25	SunWater (EEC1)	Council (ISS)	LDMG to LEAN FORWARD and meeting advice for 13:00 today
19/02/2015 11:17	SunWater (EEC1)	SunWater (FOC)	Revised rainfall for Callide
19/02/2015 13:00	SunWater (EEC1)	BSC LDMG	Attended meeting via phone. Callide stable. 96k very minor rise. Kroombit stable but could fill overnight. Next mtg @ 5pm.
20/02/2015 16:23	SunWater (DSTDM)	SunWater (FOC)	Asked SunWater (FOC) to get Callide URBS model running as am having troubles with S/Sheet model
20/02/2015 16:44	SunWater (EEC1)	SunWater (FOC)	96k inflow estimate
20/02/2015 16:44	SunWater (DSTDM)	SunWater (FOC)	Preliminary Callide URBS model - less than 4m peak at 96km
20/02/2015 16:46	SunWater (DSTDM)	SunWater (FOC)	Discussion re Callide URBS modelling. I suggested that most recent rain ~35mm may be missing from the current run
20/02/2015 16:46	SunWater (DSTDM)	SunWater (FOC)	URBS inflow prediction 120 cumecs
20/02/2015 16:53	SunWater (EEC1)	SunWater (FOC)	Inflow estimate
20/02/2015 16:53	SunWater (DSTDM)	SunWater (FOC)	Updated URBS Callide - height less than 4m
20/02/2015 16:54	SunWater (EEC1)	SunWater (FOC)	Discharge estimate
20/02/2015 16:54	SunWater (DSTDM)	SunWater (FOC)	Updated URBS Callide inflow 175 Cumecs
20/02/2015 17:29	SunWater (DSTDM)	SunWater (FOC)	SunWater (FOC) discussion over results of URBS model for Callide. SunWater (FOC) suggested peak inflow of 150 cumecs. BoM predicting maximum of ~ 100mm future rainfall and needs 250mm to cause Callide to spilll
20/02/2015 17:41	SunWater (EEC1)	SunWater (DSTDM)	Advised URBS model doesn't predict spill tonight. This is dependant on rainfall.
20/02/2015 17:41	SunWater (DSTDM)	SunWater (EEC)	Current prediction for Callide is no spill but could change if TC slows
20/02/2015 18:21	SunWater (DSTDM)	SunWater (FOC)	Callide URBS model with 6pm rainfall showing 96km to peak at less than 5m
20/02/2015 18:22	SunWater (DSTDM)	SunWater (FOC)	Callide URBS model showing peak inflow of less than 370 cumecs

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20/02/2015 18:37	SunWater (EEC1)	SunWater (DSTDM)	Update on conditions. Potential for dam to fill tonight based on current inflow but not certain with current rainfall. This should be conveyed to LDMG.
20/02/2015 18:55	SunWater (EEC1)	SunWater (SMCA & SDM)	Callide may spill tonight
20/02/2015 18:55	SunWater (DSTDM)	SunWater (FOC)	Callide URBS model showing peak inflow of less than 540 cumecs
20/02/2015 19:03	SunWater (EEC1)	Council (CEO)	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.
20/02/2015 19:03	SunWater (DSTDM)	SunWater (FOC)	SunWater (FOC) confirmed URBS was understating inflows and should proceed with just the s/sheet model
20/02/2015 19:10	SunWater (EEC1)	SunWater (DSTDM)	Advice that if inflows continue gate operation could be by 23:30.
20/02/2015 19:10	SunWater (DSTDM)	SunWater (EEC1)	SunWater (DSTDM) forecast from Callide s/sheet model suggesting Callide gate operations by 23:30 on 20th Feb
20/02/2015 19:14	SunWater (EEC1)	SunWater (DSTDM)	Replied I had advised LDMG of a potential for a spill tonight
20/02/2015 19:30	SunWater (EEC1)	SunWater (FOC)	URBS possible understating estimate
20/02/2015 19:39	SunWater (DSTDM)	SunWater (EEC1)	RK model predicting gate opening by 9pm on the 20th Feb and asking re conditions - safe to operate gates?
20/02/2015 19:40	SunWater (EEC1)	SunWater (DSTDM)	Gates ops may be as early as 9pm
20/02/2015 19:47	SunWater (MS)	SunWater (OM)	Notify SunWater (OM) of model now has gates opening at 9PM SunWater (OM) is going to ring back
20/02/2015 19:52	SunWater (EEC1)	Council (CEO)	Won't be able to open the gates manually - too dangerous. Expect auto gate operation within hours. 96k 120,000 and rising.
20/02/2015 20:18	SunWater (EEC1)	Council	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.

7.3 Operation of Callide Dam

The *O&M Manual* requires manual operation of the gates when the reduced FSL of 215.500m is exceeded. However, manual operation was not possible during the event due to strong wind which made manual operation unsafe, therefore the gates operated automatically.

From this review of the *O&M Manual*, the *Emergency Event Report* and the *Emergency Action Plan*, BMT WBM has found no evidence to suggest that SunWater did not operate the dam in accordance with the operational rules.

7.4 Warnings Issued

SunWater provided Twitter messages during the lead up to, and during the event. It is not understood what proportion of the community received the Twitter messages.

After SunWater confirmed gate operation was 'imminent' the instruction was given to notify subscribed downstream residents to 10km from the dam. SunWater sent the following messages:

- 20 February 20:39 - 'SunWater Callide Dam flood ALERT NOTIFICATION: D/S flooding expected – rapid rises. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'
- 20 February 22:37 - 'SunWater Callide Dam flood ALERT NOTIFICATION: Flood Stage 4 current flow = 298,000ML/day. REFER: www.bom.gov.au and Local Emergency Mgt Groups for more info'

The following points are noted:

- The 20:39 alert SMS was sent 11 minutes after the gates are assumed to have opened;
- The reference to the BoM website was not informative, as the website contained little information on flooding in Callide Creek, and was not updated regularly; and
- SunWater advised Banana Shire Council at 19:52 that the gates would be open "within hours".

8 Conclusions

8.1 Responses to the Scope of Works

The statement of work for this independent review raised four key questions:

- ***An assessment of the impact of discharges from Callide Dam on the overall flooding in the Callide Valley, including the impacts on Biloela, Jambin and Goovigen townships within the Valley.***

  Data relating to the flooding which occurred during the February 2015 flood event has been collated and analysed in detail as part of this review. The data includes rainfall, river level and wind observations, rainfall forecasts, event logs, past flood studies and mapping, emergency management documents relating to Callide Dam, damages assessments, photographs, and notes from interviews held between IGEM and flood affected residents.

  The information has been examined and cross checked to verify accuracy, and time lines have been established to show when events occurred and actions were undertaken by all personnel and agencies involved in the management of the event. This includes the lead-up to the cyclone, during the rainfall and cyclone, and when flood waters started to recede.

  Discharge from the dam has been calculated and applied to a flood model, purposely developed for this review. The flood model also receives flows from the other tributaries in the Callide Creek system, and routes the flood flows through the valley to the confluence with the Don River downstream from Goovigen. Although minimal data are available for calibration of the flood model, the model performance has been checked against photographic and anecdotal evidence of flooding within the valley. A reasonable match between actual and simulated flood behaviour has been achieved.

  To assess the impact of discharges from Callide Dam, assessment has been undertaken to determine the relative portion of discharge from the dam, against discharge occurring from the other major tributaries of Callide Creek, as well as rainfall within the lower Callide Creek and its minor tributaries.

  The Callide Dam catchment area (517km^2) is 11% of the Callide Creek catchment (4,648km^2) flowing into the Don River and 17% of the Callide Creek catchment upstream from Biloela (2,962km^2).

  The calculated peak discharge from Callide Dam was 3,480m^3/s. At the same time, water levels were at their highest in Kroombit Dam with a calculated peak discharge of 2,553m^3/s.

  At 23:40, within 100 minutes of the peak discharge from Callide Dam, the flood model simulation estimates a peak discharge of 3,339m^3/s was flowing along Callide Creek on the northern side of Biloela. At the same time, 1,149m^3/s has been simulated as passing along Kroombit Creek on the southern side of Biloela. The peak discharge in Kroombit Creek occurred at 05:00 on 21 February. The combined Kroombit, Kariboe and Grevillea Creek peak discharge was 4,356m^3/s as it passed Biloela. The significant increase in flows beyond the 2,553m^3/s discharge from

Kroombit Dam was mostly due to additional inflows from Kariboe Creek (peak of 1,573m^3/s) and Grevillea Creek (peak of 783m^3/s).

Floodwaters from Kroombit Creek flowed along Washpool Gully past the eastern side of Biloela, discharging into Callide Creek. At the time flood levels peaked along Washpool Gully on the northern side of Biloela, water levels in Callide Creek had dropped by around 1.5m. The peak flood levels along Washpool Gully were not influenced by flows within Callide Creek.

Downstream from Biloela, the flows from Prospect Creek, Kroombit Creek and Callide Creek merged before reaching the town of Jambin. Between Biloela and Jambin the floodplain was inundated across a width of up to 5km. Local residents report seeing "water as far as the eye can see". The floodwaters continued on past Jambin to the town of Goovigen, and on to the Don River.

The assessment has shown that significant flooding would have occurred throughout the Callide Valley regardless of how the Callide Dam was operated. In response to community suggestions relating to pre-releases from the dam, scenarios have been assessed assuming water levels in the dam had been reduced from 89% to 50% (as well as intermediate levels) prior to the event. The 50% capacity scenario results in 68% of the inflow volume being stored in the dam, and a 91% reduction of peak discharge from 3,480m^3/s to 304m^3/s. This scenario provides an indication of the flooding that would have occurred throughout the Callide Valley between Biloela and Goovigen with minimal water discharging from Callide Dam. It is emphasised that the current dam operating rules do not allow for such a scenario.

The mapping from this scenario is presented. The outcome is that peak flood levels would have been up to 1m lower along Callide Creek on the north side of Biloela, and 0.2m - 0.3m lower between Biloela and Goovigen. In terms of peak flood levels, properties in Biloela, and along Washpool Gully would not have benefitted from any pre-release scenario during the February 2015 flood.

The review describes the impacts caused by the floods and attempts to quantify the impacts that Callide Dam flows have had on the floodplain.

- ***An assessment of whether SunWater operated Callide Dam in accordance with the relevant dam operating procedures and specifications, and the relevant aspects of the Callide Dam Emergency Action Plan (EAP).***

  The *Emergency Event Report for the February 2015 Event* was prepared by SunWater following the event. The report contains log book records of observations, logs of emails and SMS correspondence and phone calls, and includes Situation Reports and Local Disaster Management Group meeting minutes. The EER has been reviewed and cross checked against the other data made available to this review by various authorities.

  The conditions during the event were difficult and SunWater employees were faced with a particularly challenging task of managing Callide Dam, whilst also attending to other storages. Key complicating factors were the loss of data from the Callide Creek 96km (inflow) gauge, the inability to manually operate the dam when the water level reached the reduced full supply level of 215.500m due to the cyclonic winds

experienced at the time, the lack of automatic monitoring equipment to monitor when the gates were open, and the rudimentary modelling tools available.

Despite the challenges faced, from this review, BMT WBM has found no evidence to suggest that during the February 2015 event, SunWater did not operate Callide Dam in accordance with the operating rules. However, the following points are noted:

- An error in the calculation of the catchment rainfall required to fill the dam resulted in a delay in prediction by SunWater that the dam would exceed the full supply level and begin to discharge into Callide Creek during the event. Based on the current operational rules associated with the dam, this would not have had an effect on downstream flooding.
- Although the process to start notifying downstream residents of a release from the dam was commenced at 20:23, five minutes before the gates are estimated to have started to open, the SMS notification was not logged as being sent to residents until 20:39, 11 minutes after the gates are estimated to have opened at 20:28. Phone calls to residents commenced from this time.
- Manual operation of the dam gates was not possible during the event due to the extreme wind at the time the trigger level for manual release was reached. Modelling has shown that manual operation of the gates would have only marginally affected downstream flood levels or the time of peak.

To summarise, whilst SunWater appear to have operated Callide Dam in accordance with the relevant documentation, including initiation of alerts, the likelihood of the dam gates opening could have been predicted earlier if the storage estimates had been accurate or based on more robust modelling tools.

- ***An assessment of the possible flooding impacts on communities downstream of the dam if different dam operation rules and specifications were adopted, with the aim of providing a greater degree of flood mitigation.***

  Various scenarios have been simulated to assess how different operating conditions would have affected downstream flooding. Of particular relevance to this requirement are the scenarios representing a range from 50% to 100% storage volumes in Callide Dam at the start of the event.

  The pre-release scenarios, as discussed above, are shown to have reduced peak flood levels at Biloela, Jambin and Goovigen, although not significantly. The analysis, as discussed above, shows that regardless of how Callide Dam, was operated during the February 2015 event, the communities along the Callide Valley would still have experienced a major flood. Further, this scenario has been assessed in response to the scope of works as outlined above and it should be noted that this or other flood mitigation operations may not be feasible from a water security or public safety viewpoint. Such scenarios would be in breach of the current approved dam operation manual and any change to the manual would require approval from the State's Dam Safety Officer.

- ***An assessment of the extent to which recommendations of the 2013 review of Callide Dam operations were implemented, and did, or would have if implemented, alter the impact to the community.***

The recommendations from the *Review of Callide Dam Gate Operations in the 2013 Flood Event* (Water Solutions, 2013) have been assessed in terms of their implementation. The following table summarises the actions against the recommendations from the 2013 report.

No.	2013 Recommendation	2015 Comments
1	The specified temporary FSL rules proved to be impractical in this event. Revised rules need to be developed based on experience gained in this event, including both the ramp up and drain down phases and gate sequencing. Consideration should be given to allowing some dam level increase before releases are increased. Documentation should then be updated, and training provided.	Following the 2013 review, SunWater revised the manual gate operating procedures to simplify operation, improve the transition from manual to automatic operation, and to improve the gate closure sequence.
2	The infrastructure issues discovered in this event need to be investigated and appropriate action taken. This includes the pump capacity restrictions and the severe oscillation of the left hand gate pair.	There was no issue related to pump capacities, due to the inability for an operator to control the pumps. Oscillation of gates were observed again during this event, despite a root cause analysis into the issue following the 2013 review. It is noted that SunWater has undertaken a range of maintenance activities on the gates since the 2013 review. This would not have affected flooding in the February 2015 event.
3	The manual method of controlling gates using the back-up pump is somewhat rudimentary. Investigations into methods to improve control, and for appropriate transitions to automatic control for larger floods, are recommended.	Following the 2013 review, SunWater revised the manual gate operating procedures to simplify operation, improve the transition from manual to automatic operation, and to improve the gate closure sequence. There have been no changes to the manual method of controlling the gates, using the back-up pump. This would have affected operations during the February 2015 event, but would not have significantly affected flooding.
4	Current modelling of inflows focuses on gauged flows at the 96km GS, and the rating curve at this site is poor for high flows. Improvements in instrumentation and modelling of the Callide Dam catchment would likely improve the accuracy and lead time on projected releases.	No improvements to instrumentation have been implemented, although SunWater has advised that such activities are in progress, and additional gauges are budgeted for 2015/2016. SunWater has advised that the 2013 event rating has been added to the 96km gauge rating curve. SunWater has advised that the spreadsheet models have been enhanced and an URBS hydrologic model is under development. Failure to implement this recommendation in whole may have resulted in reduced warning time to downstream residents.

5	A more centralised and standardised approach to maintaining logs during flood events should be considered.	The approach to maintaining logs is not centralised. SunWater has advised staff training has been undertaken and iPads purchased for maintaining logs. However, networking was considered and rejected due to not being suitable for purpose. This would not have affected flooding in the February 2015 event.
6	In an actual event little time is available to adjust flood operation rules. Hence it is recommended that SunWater endeavours to test proposed changes to rules thoroughly. Brainstorming sessions, live training exercises, and/or failure reviews may assist in identifying impractical or suboptimal procedures before being needed in a real event.	SunWater has advised workshops, reviews and tests have been held. The outcomes would not have affected flooding in the February 2015 event.
7	There are also a number of minor recommendations contained within the body of this report. A number of actions could be taken to enable Callide Dam to provide more active flood mitigation than its original design, such as pre-releases, changes to the FSL and altered gate operation rules. However it is highlighted that such changes should not be undertaken without a detailed understanding of: • the effect on the performance of allocations in the Callide Valley Water Supply Scheme, • implications for the safety of the dam, • the actual flood mitigation benefit downstream, considering the full range of events that can occur, • additional costs associated with implementation of the change, and • alternate actions that may be taken downstream to provide similar benefits at reduced costs, such as improvements to land use planning.	Although changes to the manual operation of the dam have been implemented, there have been no changes to the dam having a more active flood mitigation role. These recommendations are the responsibility of DEWS. This could have affected flooding in the February 2015 event.
8	It appears that SunWater provided timely and appropriate advice to the LDMG in this event. The LDMG may wish to improve the information and resources available to it, such as damage-stage tables or pre-modelled event surfaces, to enable the consequences of Callide Dam gate releases to be assessed in conjunction with other downstream flows. There may be some improvements that either SunWater, the LDMG, or other parties may be able to take to improve advice to residents. Finally, with some improved modelling and/or instrumentation, better estimates of future conditions may be made, providing longer lead times for advice to residents.	No progress appears to have been made. Refer above for SunWater responsibilities regarding monitoring and modelling. This could have affected flood response in the February 2015 event.

8.2 Key Findings

From this review, BMT WBM has found no evidence to suggest that SunWater did not operate the dam in accordance with the operational rules. However, the tools available for SunWater to carry out reliable and accurate flood forecasting are considered inadequate, particularly given the flood risk that the downstream communities face. This includes:

- Rainfall observations:
  - The distribution of rain gauges throughout the catchment is insufficient. The only operational gauge within the Upper Callide catchment during the February 2015 event was the Callide Creek 96km gauge.
  - Reliance upon the telecommunications network is inadequate, since network outages are common during extreme weather events.
- Dam and spillway observations:
  - There is no automated logging of the gate openings.
  - There is no tailwater gauge on the spillway to monitor spills.
- River level observations:
  - The upstream (inflow) gauge at Callide Creek 96km is flood prone and should be moved. Communications with this gauge are noted to be problematic during windy conditions.
  - There is no redundancy for upstream inflows.
  - There are no gauges downstream of the Callide Dam until Goovigen.
  - The ratings associated with most gauges in the Callide Creek catchment are only rated for low flows, so are inappropriate for use during flood events.
- Gate operations:
  - There is no mechanism to remotely control the gate openings.
- Models and spreadsheets (flood forecasting):
  - The spreadsheet used for calculation of rainfall and runoff required to fill the storages appears to be in error.
  - The spreadsheet model does not allow for forecast rainfall as an input.
  - The hydrologic models are only in developmental phase, and are currently not fit-for-purpose.
- Flood warning system:
  - Based on BoM's estimated rainfall and the level in the dam prior to the event, pre-emptive warning could have been undertaken that a spill was possible.
  - Based on BoM's estimated rainfall and the level in the dam prior to the event, the process for sending SMS notifications could have been coordinated in advance, so that when the spill was imminent, there would have been no delay to sending messages.
  - The SMS notification system is noted to have experienced issues on Saturday 21 February. Given the risk to life for not warning residents of significant discharges, a more reliable and faster system is required, with appropriate redundancy.
  - Notification of residents solely by SMS and telephone is inadequate given the risk to life.

- The information provided to residents via SMS is not informative. Reference to the BoM website should only be provided if the BoM provide specific and current information to the area. Further, advice relating to the alert level of the dam release (i.e. Stage 4) does not relate to anything for the public.

In addition to the findings relating to SunWater operations, additional findings are noted here in relation to Council and the LDMG:

- Land use planning:
  - The Callide Valley is subject to considerable flood risk as seen during the recent events. During the resident survey, a common theme was the inadequate land use planning by Banana Shire Council.
- Flood awareness:
  - Based on resident surveys and a review of publicly available information, the community appear to have very little information relating to their risk of flooding.
  - Banana Shire Council has a responsibility to provide local residents timely and accurate information and warnings relating to flood events. Only one SMS is noted as having been sent by the LDMG during the event.

8.3 Recommendations

The following recommendations are provided following this review.

Ref.	Recommendation	Action by
	Monitoring	
M1	Install additional rain gauges in the Callide Creek catchment. Rain gauges should be Event Reporting Radio Telemetry (ERRTS), or similar to maintain redundancy from the telecommunications network. Consideration should be given to ensure there are sufficient gauges in or immediately surrounding the Upper Callide Creek catchment reporting via each communication method.	SunWater
M2	Relocate the Callide Creek 96km river gauge to higher ground. Consider using ERRTS for redundancy.	SunWater
M3	Install a tailwater gauge on the Callide Dam spillway. Consider redundancy.	SunWater
M4	Install a river gauge at Biloela on Callide Creek. Install gauge boards to be linked with community awareness program relating to consequences of flood levels.	SunWater, Council and LDMG
M5	Consider a river gauge at Jambin. Install gauge boards to be linked with community awareness program relating to consequences of flood levels.	SunWater, Council and LDMG
M6	Install primary and redundant base stations for ERRTS network.	SunWater
	Prediction	
P1	Develop predictive tools that automatically interact with observations and BoM forecasts to allow 'what-if' scenarios to be simulated.	SunWater
P2	Improve reliability of rating curves using numerical modelling. Identify gauges for which rating curves should not be used.	SunWater

Ref.	Recommendation	Action by
	Control	
S1	Install logger and telemetry module on gates to monitor gate openings.	SunWater
S2	Consider automation of pumping systems for remote control of gates	SunWater
	Warning	
W1	Improve warning dissemination approach for properties up to 10km downstream from Callide Dam. This could include individual warning systems for properties exposed to high risk.	SunWater, Council and LDMG
W2	Improve warning dissemination approach for all other properties.	Council and LDMG
W3	Improve information provided in alert notifications. Do not refer to BoM website, unless a specific link is provided to up-to-date, and catchment specific information.	SunWater
	Communications	
C1	Improve telecommunications network redundancy	Telstra
C2	Improve notifications system within SunWater to avoid delays with initiation of alerts.	SunWater
C3	Improve communications between SunWater, Council and LDMG to maintain consistency and improve timeliness of warnings and alerts.	SunWater, Council and LDMG
	Flood Planning	
F1	Revise Callide Valley Flood Study to consolidate pasts studies and provide a single point of reference, and best estimate, of flood mapping, including dam break scenarios.	Council and LDMG
F2	Link the flood mapping developed for F1 to flood awareness campaigns, flood warnings and alerts, and gauges.	Council and LDMG
F3	Link the flood mapping developed for F1, for interpretation of flood impacts, to flood alerts.	SunWater
	Flood Awareness	
A1	Undertake flood awareness campaign, following the principles of the Total Flood Warning System.	Council, LDMG and SunWater
	General	
G1	Implement remaining recommendations from Review of *Callide Dam Gate Operations in the January 2013 Flood Event*, where not otherwise noted here.	SunWater

9 References

The following documents have been referenced in this review:

- Callide Dam Stage II Radial Gates – Gate Operating Principle (Queensland Water Resources Commission, 1984)
- Callide Valley Flood Risk Study – Phase 1 Flood Study (AECOM, 2010)
- Callide Dam – Dam Break 2012 (SunWater, 2012)
- Review of Callide Dam Gate Operations in the January 2013 Flood Event (Water Solutions, 2013)
- Flood Hazard Mapping – Thangool – Bundle 9 – Final Report (DHI, 2013)
- Flood Hazard Mapping – Jambin – Bundle 9 – Final Report (DHI, 2013)
- Goovigen Flood Hazard Mapping Study (WRM, 2013)
- Emergency Action Plan - Callide Dam (SunWater, 18 December 2013)
- Callide Dam Emergency Event Report – 20-22 February 2015 (SunWater, 2015)
- Emergency Action Plan - Callide Dam (SunWater, 30 January 2015)

10 Qualifications

There are uncertainties associated with flood modelling. The flood mapping presented is the best estimate of flood behaviour based on the limited data available for calibration and verification of the model at the time of the review. With additional data, refinements and improvements to the modelling may be possible.

The scenario assessments presented here are relative assessments. Therefore, uncertainties associated with modelling will be present within the February 2015 event model and the scenario model simulations. The relevance of this is that any potential inaccuracies will have little, or no, influence on the impacts that are presented. Impacts should be assessed on a regional scale, and the mapping should not be used to assess changes in flood behaviour on an individual lot scale. Insufficient field water level data has been recovered to date to allow a high degree of confidence in flood levels predicted by modelling.

There is uncertainty in rainfall across the Callide Valley due to limitations in the number and location of rainfall stations. Hence, there is uncertainty in the accuracy of rainfall / runoff predictions, and associated flood predictions. All floods can be different and future observed flooding characteristics may vary from model predictions presented.

The report has assessed various scenarios for alternate dam situations from a theoretical viewpoint to provide information on the range of potential effects of the dam on the broader Callide Valley. Some of these options may not be feasible from a water security or public safety viewpoint, and this report should not be seen as an endorsement of such alternate scenarios assessed. Some scenarios would be in breach of the current approved dam operation manual and any change to the manual would require approval from the State's Dam Safety Officer.

The review has relied upon an extensive amount of data and information provided by IGEM, SunWater, DNRM, DEWS, the Bureau of Meteorology, Telstra, SES and Council. The accuracy of our report is limited to the accuracy and completeness of this data and information.

The report has been specifically prepared to address the Statement of Works (Appendix A), which defined specific questions to be addressed, and as such may be unsuitable for other purposes. Any third party should seek clarification from BMT WBM Pty Ltd as to whether the report is suitable for the proposed use.

Appendix A Statement of Work Request

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STATEMENT OF WORK REQUEST

For the Provision of a Technical Report for Callide Creek Flood.

1.1 INTRODUCTION

The Inspector-General Emergency Management (IGEM) is responsible for providing the Premier, Government and people of Queensland an assurance of public safety, through the establishment and implementation of an assurance framework to direct, guide and focus work of all agencies, across all tiers of Government to the desired outcomes of the disaster and emergency management arrangements for Queensland.

The functions of the Inspector-General Emergency Management and the Office of the Inspector-General Emergency Management are prescribed in the Disaster Management Act 2003.

Section 16C of the *Disaster Management Act 2003* provides the Inspector-General Emergency Management with functions including:

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

In accordance with these functions, the Inspector-General Emergency Management is to review the circumstances of the Callide Creek flood event during Tropical Cyclone Marcia to determine whether disaster management arrangements and Callide Dam planning and operations were effective, and identify opportunities to improve disaster management outcomes.

1.2 SCOPE

The IGEM requires the services of a suitably qualified supplier to prepare a report on the impact of rainfall associated with Tropical Cyclone Marcia and the effect, if any, of the operations of the Callide Dam had on associated flooding.

The supplier should ensure they include an assessment of the performance of Callide Dam in the lead-up to, and during, the February 2015 flood event and the impact the dam's operations had on flooding at various locations in the Callide Valley.

The supplier must ensure their personnel are qualified and capable of undertaking the report independently. The IGEM require the supplier to demonstrate and warrant complete independence from SunWater. The IGEM's preference is that the supplier should not have previously undertaken any work for SunWater and preferably not have had any employee previously engaged by SunWater as either an employee, contractor or subcontractor.

1.3 BACKGROUND

On the 2nd of March 2015 the IGEM released to the Media a statement for a *Callide Creek Flood Review.* This document confirms the intent of the IGEM to seek an independent review into the flooding of Callide Creek during the Ex Tropical Cyclone event. This review has been generated following public concerns surrounding the timing of the release of water from Callide Dam and claims that the water released exacerbated flooding.

The IGEM has committed to delivering the report to Minister Jo-Ann Miller, Minister for Police, Fire and Emergency Services on 22 May 2015 with the report reporting on the following:

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

The statement affirms that the review team will engage with a range of relevant parties, including Government and non-Government organisations, and would include an independent hydrological assessment.

It is therefore imperative that the supplier demonstrates and warrants complete independence of SunWater.

1.4 RESPONSE

The Supplier must prepare their proposal ensuring they provide sufficient detail in how they will undertake and meet the below requirements detailed in cluses **1.5 to 1.13** and include any other relevant information they believe will support their response.

Proposals must ensure they submit their response to the Procurement Contact, Michelle McManis via email: michelle.mcmanis@psba.qld.gov.au

Responses must be received by **12.00pm, midday, Monday 9th of March 2015.**

Any clarifications or requests for extensions must be received in writing, via email to the Procurement Contract, Michelle McManis, email: michelle.mcmanis@psba.qld.gov.au

1.5 MANDATORY REQUIREMENTS

The IGEM require the supplier to put forward a review team and the necessary governance around that team that demonstrates and warrants complete independence from SunWater. The governance around the team should be fully documented and include CVs of the team members and any prior relationship for the supplier with Sunwater should be fully disclosed. It is IGEM's preference that the supplier has not previously undertaken any work for SunWater and not have had any staff member previously engaged by SunWater as either an employee, contractor or subcontractor.

The supplier must ensure they provide and maintain for the duration of the engagement the following insurances:

Public Liability cover of $ 10,000,000 per claim
Professional Indemnity/errors or omissions insurance in a minimum of $5,000,000 per claim and in aggregate;

Workers Compensation cover in accordance with current legislation requirements

The supplier will be engaged in accordance with Standing Offer Arrangement (SOA) DSITIASD01 under which the organisation is an approved supplier for: Category 6 – Aquatic, riparian, floodplain and groundwater ecology services; impact assessments; restoration projects; environmental monitoring and Sub-Categories:

a. A. Data Gathering;
b. B. Data manipulation;
c. E. Aquatic, riparian, floodplain, estuarine and coastal spatial analysis;
d. J. Auditing;
e. K. Quality Assurance; and
f. L. Scientific review.

1.6 LIST OF RELEVANT DOCUMENTS

1. SOA DSITIASD01
2. Appendix A – Callide Creek Flood Review

1.7 REQUIREMENTS

The supplier must provide a report to IGEM on the impact of rainfall associated with TC Marcia and any effect operations of the Callide Dam had on associated flooding.

The supplier should assess the performance of Callide Dam in the lead-up to, and during, the February 2015 flood event and the impact the dam's operations had on flooding at various locations in the Callide Valley. They should specifically deliver:

1. An assessment of the impact of discharges from Callide Dam on the overall flooding in the Callide Valley, including the impacts on Biloela, Jambin and Goovigen townships within the Valley.
2. An assessment of whether SunWater operated Callide Dam in accordance with the relevant dam operating procedures and specifications, and the relevant aspects of the Callide Dam Emergency Action Plan (EAP).
3. An assessment of the possible flooding impacts on communities downstream of the dam if different dam operation rules and specifications were adopted, with the aim of providing a greater degree of flood mitigation.
4. An assessment of the extent to which recommendations of the 2013 review of Callide Dam operations were implemented, and did, or would have if implemented, alter the impact to the community.
5. A report on the outcomes of the assessments which includes details of the:
    - Methodologies applied in undertaking the assessment
    - Data which was incorporated into the assessment
    - Results and conclusions of the assessment and the facts and evidence on which these conclusions were based.

The information provided will be used to inform consultation with local communities and stakeholders. The report provided by the supplier may be subject to Right to Information legislation and the supplier is made aware of this possibility.

1.8 EXPERIENCE, PERSONNEL AND SKILLS

The Supplier must provide the names and contact details for all Key Personnel that the Supplier intends to use, and summarise the role of each Key Personnel and key obligations they will be responsible for. The Supplier must separately provide a copy of all Key Personnel CVs.

The supplier must ensure that any changes to their nominated Key Personnel are replaced ensuring a consistent level of suitably qualified staff are tasked for the report to ensure quality is maintained for the duration of the engagement.

1.9 METHOD

The supplier is to provide detail on their proposed methodology to complete the services required under clause **1.7 Requirements**. For example detail on the method for:

- data collection,
- preparation of reports,
- how they will conduct any required progress meetings.

1.10 PROGRESS REPORTING

The IGEM may require the supplier to provide the Project Manager with a progress report on the services being delivered under this agreement. This will be negotiated and mutually agreed to by both parties should this be a requirement. The Supplier must detail how they would meet any progress reporting if this were to be either:

- Verbally once a week on a mutually agreed day and time, by teleconference if required, for outlining progress made in previous weeks and planned activities for the week ahead.

OR

- In Writing on the fourth (4) week of engagement, for documenting progress made in the previous four (4) weeks and to aid compilation of the Final Report.

1.11 TIMEFRAME

In order for the IGEM to meet the commitment for delivering the report to the Minister for Police, Fire and Emergency Services, Minister Jo-Ann Miller on the 22 May 2015 the supplier must ensure they can complete the works within 6 weeks of formalisation of the Schedule A Order. The Supplier must provide a detailed breakdown of how the services will be completed, including proposed/projected dates for completion of items detailed under clause **1.7 Requirements** and how resources will be allocated to meet these projected completion dates.

The Supplier must ensure they provide detail in their proposal as to when they can start this engagement, should they be successful.

1.12 WARRANTY AND SUPPORT

As provided for under the SOA DSITIASD01 terms and conditions.

1.13 PRICING

The supplier is requested to confirm their pricing for the provision of the above mentioned services detailed under **clause 1.7 Requirements**. Any variations in pricing due to weekend rates and public holiday rates are to be advised in the supplier's response.

Appendix B Event Chronology

	From	Recipient/Sender	Details/Message
18/02/2015 10:10	SunWater (EEC1)	Council	LDMG on alert
18/02/2015 10:13	SunWater (EEC1)	Council (ISS)	LDMG meeting advice for 3pm today. LDMG on ALERT
18/02/2015 17:44	SunWater (EEC1)	Council (CEO)	Sent copy of Callide Dam Spillway Gate Operation during Flood Events
19/02/2015 7:27	SunWater (EEC1)	SunWater (FOC)	sent through some estimates for rainfall
19/02/2015 9:25	SunWater (EEC1)	Council (ISS)	LDMG to LEAN FORWARD and meeting advice for 13:00 today
19/02/2015 11:17	SunWater (EEC1)	SunWater (FOC)	Revised rainfall for Callide
19/02/2015 13:00	SunWater (EEC1)	Council LDMG	Attended meeting via phone. Callide stable. 96k very minor rise. Kroombit stable but could fill overnight. Next mtg @ 5pm.
19/02/2015 14:26	SunWater (EEC1)	Council (CEO)	Sent copies of sections 3 and 5A to Ray to replace existing section in EAP. Formal copies in the mail.
19/02/2015 14:27	SunWater (EEC1)	SunWater (EEC support)	Replacement sections 5A and 3 for Callide EAP.
19/02/2015 14:29	SunWater (EEC1)	SunWater (DDO1)	Discussed preparations for TC Marcia
19/02/2015 14:50	SunWater (EEC1)	SunWater (DDO1), SunWater (DDO3)	Sent copies of replacement sections 3 and 5A for their EAP.
19/02/2015 16:31	SunWater (EEC1)	SunWater (DDO2)	Discussed potential for wind hazards due to cyclone and the potential for this to be present if the gates need to be operated. Consider appropriate risk management for staff should this occur.
19/02/2015 16:37	SunWater (EEC1)	SunWater (DSTDM)	Agreed that if conditions are unsafe then would have to revert to auto gate operation. Need to confirm if screens are clear.
19/02/2015 16:45	SunWater (EEC1)	SunWater (DDO1)	Asked SunWater (DDO1) to confirm if screens are clear - Yes. Inspected today. Monitor regularly.
19/02/2015 17:00	SunWater (EEC1)	BSC LDMG	Potential for loss of comms to 96k in strong winds/debris.
19/02/2015 19:17	SunWater (EEC1)	SunWater (FOC)	Cyclone Cat 5 now
20/02/2015 11:00	SunWater (EEC1)	Council (CEO)	Document relating to Callide Dam trigger points drafted by the LDMG
20/02/2015 11:22	SunWater (DSTDM)	SunWater (EEC1)	SunWater (EEC1) forwarded an email from Banana Shire with draft emergency alert trigger point for their communications
20/02/2015 11:59	SunWater (EEC1)	BSC LDMG	Discussed the draft trigger points. Advised the levels may be a bit low but would be for the LDMG to decide.
20/02/2015 15:31	SunWater (DDO1)	BoM	100mm of rain a still raining up top of Callide

20/02/2015 16:10	SunWater (DSTDM)	SunWater (EEC1)	Partial State disaster declaration for Rockhampton, Gladstone, Bundaberg, Maryborough and Gympie Disaster Districts
20/02/2015 16:13	SunWater (EEC1)	Council (CEO)	Ray advised of Facebook reports that gates at Callide were open. I advised this wouldn't be correct but would verify.
20/02/2015 16:14	SunWater (EEC1)	SunWater (DDO1)	False report of gates open. Can you confirm they are closed? Yes
20/02/2015 16:15	SunWater (DDO1)	SunWater (EEC1)	Ray from BSC had heard on Facebook that the gates at dam were opening. Ask if and I said no
20/02/2015 16:23	SunWater (DSTDM)	SunWater (FOC)	Asked SunWater (FOC) to get Callide URBS model running as am having troubles with S/Sheet model
20/02/2015 16:32	SunWater (EEC1)	SunWater (DDO1)	Photo of centre gates
20/02/2015 16:34	SunWater (EEC1)	SunWater (DDO1)	Second photo of gates
20/02/2015 16:38	SunWater (EEC1)	SunWater (DDO1)	Spillway photo
20/02/2015 16:43	SunWater (EEC1)	SunWater (DDO1)	Additional spillway photo
20/02/2015 16:44	SunWater (EEC1)	SunWater (FOC)	96k inflow estimate
20/02/2015 16:44	SunWater (DSTDM)	SunWater (FOC)	Preliminary Callide URBS model - less than 4m peak at 96km
20/02/2015 16:46	SunWater (DSTDM)	SunWater (FOC)	Discussion re Callide URBS modelling. I suggested that most recent rain ~35mm may be missing from the current run
20/02/2015 16:46	SunWater (DSTDM)	SunWater (FOC)	URBS inflow prediction 120 cumecs
20/02/2015 16:53	SunWater (EEC1)	SunWater (FOC)	Inflow estimate
20/02/2015 16:53	SunWater (DSTDM)	SunWater (FOC)	Updated URBS Callide - height less than 4m
20/02/2015 16:54	SunWater (EEC1)	SunWater (FOC)	Discharge estimate
20/02/2015 16:54	SunWater (DSTDM)	SunWater (FOC)	Updated URBS Callide inflow 175 Cumecs
20/02/2015 16:58	SunWater (EEC1)	SunWater (OCH)	Asked to increase polling rate for Callide
20/02/2015 17:29	SunWater (DSTDM)	SunWater (FOC)	SunWater (FOC) discussion over results of URBS model for Callide. SunWater (FOC) suggested peak inflow of 150 cumecs. BoM predicting maximum of ~ 100mm future rainfall and needs 250mm to cause Callide to spilll
20/02/2015 17:36	SunWater (EEC1)	SunWater (OCH)	Advised polling rate at 30min
20/02/2015 17:41	SunWater (EEC1)	SunWater (DSTDM)	Advised URBS model doesn't predict spill tonight. This is dependant on rainfall.
20/02/2015 17:41	SunWater (DSTDM)	SunWater (EEC)	Current prediction for Callide is no spill but could change if TC slows
20/02/2015 17:45	SunWater (DDO1)	****	He has rang all D/S residents police council
20/02/2015 18:21	SunWater (DSTDM)	SunWater (FOC)	Callide URBS model with 6pm rainfall showing 96km to peak at less than 5m
20/02/2015 18:22	SunWater	SunWater (FOC)	Callide URBS model showing peak inflow of less than

	(DSTDM)		370 cumecs
20/02/2015 18:37	SunWater (EEC1)	SunWater (DSTDM)	Update on conditions. Potential for dam to fill tonight based on current inflow but not certain with current rainfall. This should be conveyed to LDMG.
20/02/2015 18:40	SunWater (EEC1)	****	Media release
20/02/2015 18:55	SunWater (EEC1)	SunWater (SMCA), SunWater (DSTDM)	Callide may spill tonight
20/02/2015 18:55	SunWater (DSTDM)	SunWater (FOC)	Callide URBS model showing peak inflow of less than 540 cumecs
20/02/2015 19:03	SunWater (EEC1)	Council (CEO)	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.
20/02/2015 19:03	SunWater (DSTDM)	SunWater (FOC)	SunWater (FOC) confirmed URBS was understating inflows and should proceed with just the s/sheet model
20/02/2015 19:10	SunWater (EEC1)	SunWater (DSTDM)	Advice that if inflows continue gate operation could be by 23:30.
20/02/2015 19:10	SunWater (DSTDM)	SunWater (EEC1)	RK forecast from Callide s/sheet model suggesting Callide gate operations by 23:30 on 20th Feb
20/02/2015 19:14	SunWater (EEC1)	SunWater (DSTDM)	Replied I had advised LDMG of a potential for a spill tonight
20/02/2015 19:30	SunWater (EEC1)	SunWater (FOC)	URBS possible understating estimate
20/02/2015 19:39	SunWater (DSTDM)	SunWater (EEC1)	RK model predicting gate opening by 9pm on the 20th Feb and asking re conditions - safe to operate gates?
20/02/2015 19:40	SunWater (EEC1)	SunWater (DSTDM)	Gates ops may be as early as 9pm
20/02/2015 19:47	SunWater (EEC2)	SunWater (DDO3)	Notify SunWater (DDO3) of model now has gates opening at 9PM SunWater (DDO3) is going to ring back
20/02/2015 19:47	SunWater (DSTDM)	SunWater (EEC1)	Confirming unsafe to operate gates
20/02/2015 19:52	SunWater (EEC1)	Council (CEO)	Won't be able to open the gates manually - too dangerous. Expect auto gate operation within hours. 96k 120,000 and rising.
20/02/2015 20:18	SunWater (EEC1)	Council (LDMG)	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.
20/02/2015 20:23	SunWater (EEC1)	SunWater (DSTDM)	Advised SunWater (DSTDM) of discussion with Council (LDMG). Asked for assistance to notify DS residents so that I can maintain focus on Dam and LDMG. He will get [redacted] to assist.
20/02/2015 20:23	SunWater (DSTDM)	SunWater (EEC1)	SunWater (EEC1) discussed conversation with Council (LDMG) who was concerned. Message to Council (LDMG) was that we were seeing flows much greater than experienced in 2013. SunWater (EEC1) requested assistance with notifications given urgency. I said I would contact SunWater (EEC support) to do d/s residence whilst SunWater (EEC1) concentrates on disaster mgt groups. I would also do internal notifications

20/02/2015 20:33	SunWater (EEC support)	SunWater (DSTDM)	SunWater (DSTDM) phoned to ask that I arrange for a SMS message to be sent urgently for Callide Dam. The message should be the SF1A modified to include the words Rapid Increases expected. I asked if follow up phone calls were required. SunWater (DSTDM) said yes and that I could state the flood would be bigger than the 2013 event, but we did not know how big as it had not peaked at the upstream gauge as yet. SunWater (DSTDM) informed me that SunWater (EEC1) would inform the LDMG/Police etc.
20/02/2015 20:33	SunWater (DSTDM)	SunWater (EEC support)	Told SunWater (EEC support) to immediately commence d/s resident notifications with message that event would be much greater than 2013
20/02/2015 20:35	SunWater (EEC1)	SunWater (DDO2)	Winds strongest they have been all evening. No one would be safe outside.
20/02/2015 20:35	SunWater (EEC support)	****	I phoned **** and arranged for the SMS message to be sent.
20/02/2015 20:37	SunWater (EEC1)	SunWater (DDO2)	Asked SunWater (DDO2) if he could tell if gates were open. He said it was very noisy from the wind and rain but would check. Held on the line whilst he opened the door. Believes there may be a rumble in the spillway now. Assume it is the gates opening.
20/02/2015 20:39	SunWater (EEC support)	Resident	Follow up EAP message regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 20:41	SunWater (EEC support)	Resident	Did not answer phone. Message left on answering service: Follow up EAP message regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 20:42	SunWater (EEC support)	Resident	No answer, but as this is a mobile would have received SMS.
20/02/2015 20:43	SunWater (EEC support)	Resident	EAP message given regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 20:45	SunWater (EEC support)	Resident	EAP message given regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.

20/02/2015 20:48	SunWater (EEC support)	Resident	Resident answered the phone. I explained that I was following up the SMS message that was just sent. Resident asked which mobile it had been sent to. I read out the number to her. She indicated it would be better to send it to her mobile. I then asked for her number which she gave me as **********. I said that I would not remove the other number, but have this included as an additional contact number. I then gave her the same follow up EAP message regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked. Resident expressed disappointment and complained that it was the same as last time and that we had left the notifications till too late when it was dark. I indicated that we were following protocols in our Emergency Action Plan and apologised that I would have hang up to continue to inform other residents as quickly as possible.
20/02/2015 20:51	SunWater (EEC2)	SunWater (DDO3)	Gates have opened - hear water down the spillway
20/02/2015 20:52	SunWater (EEC support)	Resident	EAP message given regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 20:54	SunWater (EEC1)	****	FOC stood up. Callide matters refer to SunWater (FOC) or SunWater (DSTDM)
20/02/2015 20:55	SunWater (EEC support)	Resident	EAP message given regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 20:57	SunWater (EEC support)	Resident	EAP message given regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked.
20/02/2015 21:00	SunWater (EEC support)	Resident	I spoke with both Residents as I was placed on speaker phone. I gave same EAP message regarding expected rapid rise in Callide Creek and that the event was going to be larger than the 2013 event, although we could not confirm how high as the upstream gauge had not peaked. Both Residents hoped that everyone would be ok.
20/02/2015 21:18	SunWater (EEC1)	SunWater (DSTDM)	Can't confirm if gates are open
20/02/2015 21:18	SunWater (DSTDM)	SunWater (EEC1)	SunWater (EEC1) advised that staff on site think that the gates were open. At 21:00 storage level was 216.92 but TW gauge was not showing any release

20/02/2015 21:21	SunWater (DSTDM)	SunWater (GM)	Discussed with SunWater (GM) that was not safe outside on site and had concerns that gates may not have opened based on how high the storage had risen.
20/02/2015 21:26	SunWater (EEC1)	SunWater (FOC)	96k inflow is gone. Inflows are above 2013 levels
20/02/2015 21:26	SunWater (EEC2)	SunWater (DDO1)	SunWater (DDO1) can confirm that the gates are open, he has sighted them
20/02/2015 21:26	SunWater (DSTDM)	SunWater (FOC)	SunWater (FOC) confirmed lost Comms to 96km. SunWater (FOC) spoke to BOM Flood Warning Centre to advise Callide and Kroombit greater than 2013 and likely other catchment affected
20/02/2015 21:28	SunWater (DSTDM)	DEWS	Rang DEWS to discuss my concerns at how quickly storage had risen and could not confirm that gates had opened. Storage at 216.92 at 21:00 and 96km had risen to 10.2 but think site flooded and not recorded. We discussed top of gate level, crest level and whether spillway could pass AFC if gates opened. I confirmed it could. DEWS stated that there was a report just on ABC that Callide Gates failing.
20/02/2015 21:36	SunWater (DSTDM)	SunWater (FOC)	Ch 9 Headline "Callide Gates Fail"
20/02/2015 21:37	SunWater (EEC1)	SunWater (DDO2)	Advised estimated gate openings at 21:30 - centre @ 4m, outers @ 3m. Wind reducing. SunWater (DDO2) going to see what it's like on the wall.
20/02/2015 21:38	SunWater (DSTDM)	SunWater (EEC1)	Confirmation that Callide Gates were open. At 9.30 centre gates were estimated 4m open and outer gates 3m open.
20/02/2015 21:42	SunWater (EEC1)	SunWater (CRM)	Update on media reports
20/02/2015 21:42	SunWater (DSTDM)	SunWater (CRM)	OK to SDCC, Minister and DEWS confirming Callide releasing but gate failure reports not accurate
20/02/2015 21:44	SunWater (DSTDM)	SunWater	Callide Stage 4 EAP
20/02/2015 21:45	SunWater (EEC1)	SunWater (OCH)	Spillway ratings not suitable
20/02/2015 21:56	SunWater (EEC1)	SunWater (DDO2)	SunWater (DDO2) advised gates were open, 7m centre, 6m outers. HW 217.16m. Checked tables and discharge calc is 3482cumecs.
20/02/2015 21:59	SunWater (EEC1)	SunWater (DSTDM)	Advised gate openings, 7m centre and 6m outers. Calculated discharge was 3482cumecs. SunWater (DSTDM) corrected and discharge was 3460cumecs. 298,000ML/d. 2013 peak 2000cumecs.
20/02/2015 21:59	SunWater (DSTDM)	SunWater (EEC1)	Discussed status with SunWater (EEC1). SunWater (EEC1) reported centre gates 7m open, outer gates 6m opening. I calculated discharge of 3460Cumecs. I referred to 2013 model and confirmed 2013 was just over 2000cumecs. Discussed need to inspect embankment when safe
20/02/2015 22:18	SunWater (DSTDM)	SunWater (CRM)	SunWater (CRM) stating that Banana Mayor had stated to the media that he doesn't have any information on Callide so people should contact SunWater

20/02/2015 22:19	SunWater (EEC support)	SunWater (EEC1)	I rang SunWater (EEC1) to discuss if the EAP SMS message should be sent. He confirmed this. He then gave a general update and we discussed handover of EEC duties from himself and ****. I finished the call by confirming I would have the SMS sent and then go to sleep until he phoned and handed over.
20/02/2015 22:30	SunWater (EEC support)	****	I phoned **** and arranged for the SMS message to be sent.
20/02/2015 22:38	SunWater (EEC2)		Stage 4
20/02/2015 23:06	SunWater (EEC1)	SunWater (DSTDM)	Preliminary estimate on inflows and outflows
20/02/2015 23:07	SunWater (DSTDM)	EEC, SunWater (GM), SunWater (FOC)	Plot of rapid rise of inflow and gate opening
20/02/2015 23:20	SunWater (EEC1)	SunWater (DDO2)	Discussed events of the night and conditions now. Gate openings 3.6m outers, 4.8 Centre, HW 216.88m. One team going off shift for a rest and other team to monitor during the night.
20/02/2015 23:27	SunWater (DSTDM)	SunWater (EEC1)	Conversation re media reports of a failed SMS alert
21/02/2015 0:01	SunWater (EEC1)	DDMG Gladstone	DDMG Gladstone chasing an update. I advised of current level and she asked about travel times for flood peaks. I advised that our EAP states about 1 hour to start rise at Jambin and 12 hours to peak. This doesn't consider other flows in the streams below Callide.
21/02/2015 8:30	SunWater (DSTDM)	SunWater (DDO2)	Request call back. Callide gates started to bounce.
21/02/2015 8:38	SunWater (EEC2)	SunWater (DDO2)	Gate vibrating. Like last time
21/02/2015 9:16	SunWater (EEC2)	SunWater (DSTDM)	5&6 close to closing. 5&6 now closing. 1&2 nearly closed
21/02/2015 11:20	SunWater (EEC2)	****	Report EAP activation
21/02/2015 11:45	SunWater (DSTDM)	EEC	Instruction on transition to manual gate operation
21/02/2015 11:52	SunWater (EEC1)	SunWater (EEC2)	Advice to SunWater (DDO2) to proceed lowereing the storage as per SunWater (DSTDM) advice.
21/02/2015 11:57	SunWater (DSTDM)	SunWater (EEC2)	Confirmation centre gates operating manually
22/02/2015 6:39	SunWater (EEC1)	SunWater (DDO2)	SunWater (DDO2) advised that they were aiming to release until 215.40m then close gates to allow for some settling of the storage and inflows. Possible gate closure by 2pm.
22/02/2015 12:40	SunWater (DDO1)	SunWater (EEC1)	I say getting too big a difference between CV v recorder. Ask me to ring SunWater (EEC Support)
22/02/2015 13:00	SunWater (EEC support)	SunWater (DDO1)	SunWater (DDO1) explained that there was a difference between the recorder (HW gauge) and the gauge board.
22/02/2015 13:46	SunWater (EEC support)	SunWater (DDO1)	SunWater (DDO1) said they had been going up and down a bit as they were getting closer to closing.

22/02/2015 14:15	SunWater (EEC support)	SunWater (DDO1)	SunWater (DDO1) phoned to confirm that the gates at Callide Dam were now closed and the gauge reading was now 215.4. He will closely monitor to see what the gauge is doing and open the cone valves when he has to. I asked if he had safe access to be able to operate the gates and he confirmed it was fine. After this he would be going to Kroombit Dam to do another inspection.
22/02/2015 14:26	SunWater (DSTDM)	SunWater (EEC Support)	Callide gates now closed
22/02/2015 14:38	SunWater (DDO1)	SunWater (OCH)	Recorder might be caught as it is flat lineing
22/02/2015 15:41	SunWater (EEC1)	Council (CEO)	Gates at Callide closed at 2:30pm
20/02/2015 20:54	SunWater (EEC support)	****	I tried the phone number at two different times and the message was that this number was not connected.
20/02/2015 20:54	SunWater (EEC support)	****	I tried the phone number three different times and the message was that this number was not connected.

Appendix C Event Warnings

Table C-1 BoM tropical cyclone warnings

Issue Number	Issue Time and Date
1	04:48 EST on 18 February 2015
2	11:12 EST on 18 February 2015
3	17:03 EST on 18 February 2015
4	19:48 EST on 18 February 2015
5	22:59 EST on 18 February 2015
6	01:46 EST on 19 February 2015
7	04:50 EST on 19 February 2015
8	07:51 EST on 19 February 2015
9	10:58 EST on 19 February 2015
10	13:51 EST on 19 February 2015
11	15:57 EST on 19 February 2015
12	16:56 EST on 19 February 2015
13	17:52 EST on 19 February 2015
14	18:57 EST on 19 February 2015
15	19:42 EST on 19 February 2015
16	20:58 EST on 19 February 2015
17	22:05 EST on 19 February 2015
18	22:54 EST on 19 February 2015
19	23:58 EST on 19 February 2015
20	00:55 EST on 20 February 2015
21	01:56 EST on 20 February 2015
22	02:56 EST on 20 February 2015
23	04:01 EST on 20 February 2015
24	04:58 EST on 20 February 2015
25	05:56 EST on 20 February 2015
26	06:58 EST on 20 February 2015
27	08:03 EST on 20 February 2015
28	09:01 EST on 20 February 2015
29	09:58 EST on 20 February 2015
30	11:00 EST on 20 February 2015
31	12:01 EST on 20 February 2015
32	12:59 EST on 20 February 2015

33	14:10 EST on 20 February 2015
34	14:58 EST on 20 February 2015
35	15:59 EST on 20 February 2015
36	17:02 EST on 20 February 2015
37	17:59 EST on 20 February 2015
38	18:56 EST on 20 February 2015
39	19:51 EST on 20 February 2015
40	23:02 EST on 20 February 2015
41	01:55 EST on 21 February 2015

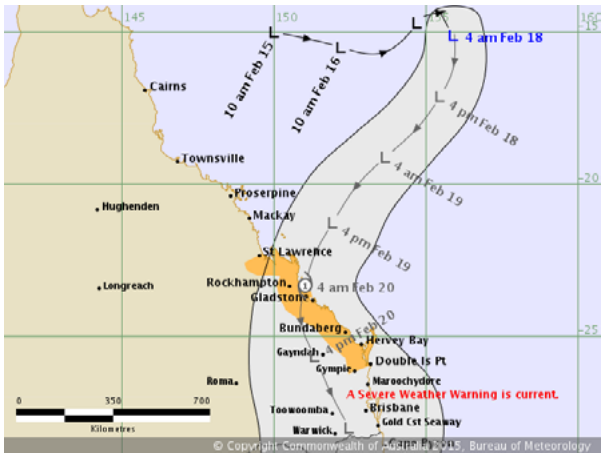

Figure C-1 TC Marcia Track Map – 04:48 18 Feb

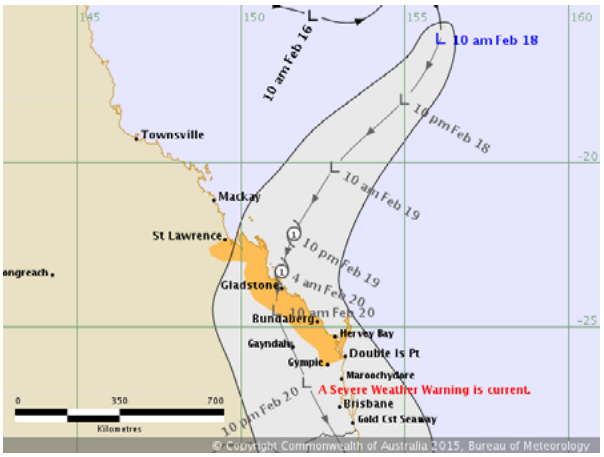

Figure C-2 TC Marcia Track Map – 11:12 18 Feb

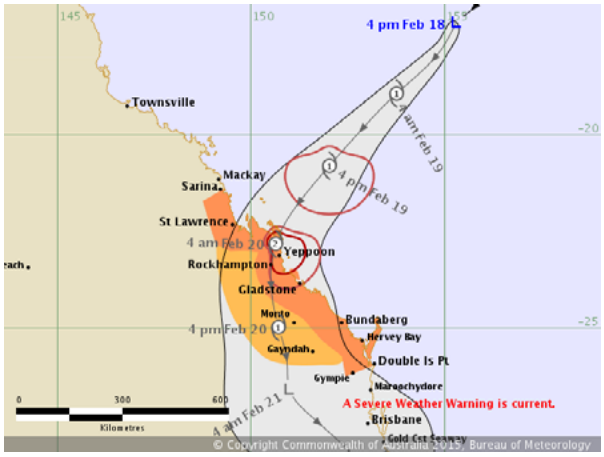

Figure C-3 TC Marcia Track Map – 17:03 18 Feb

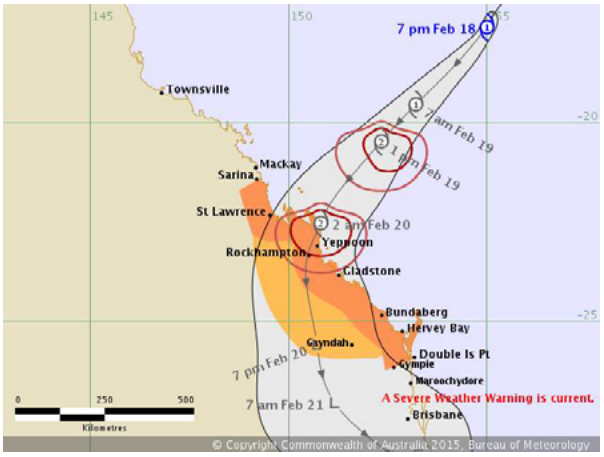

Figure C-4 TC Marcia Track Map – 19:48 18 Feb

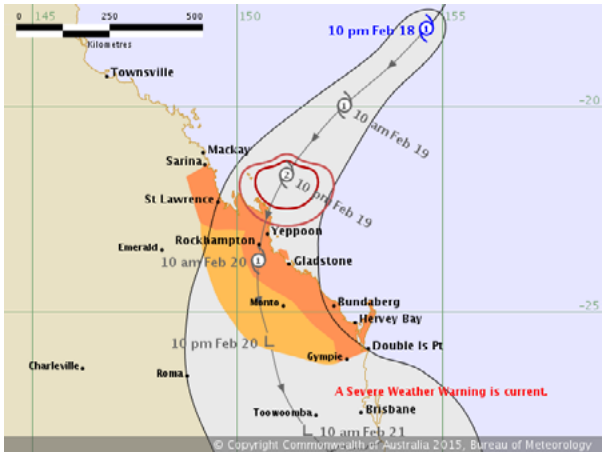

Figure C-5 TC Marcia Track Map – 22:59 18 Feb

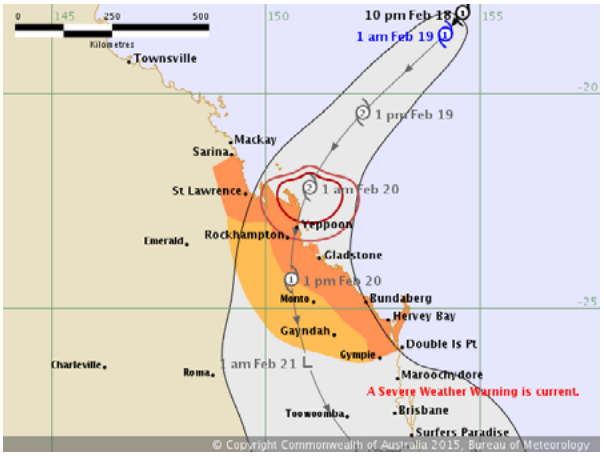

Figure C-6 TC Marcia Track Map – 01:46 19 Feb

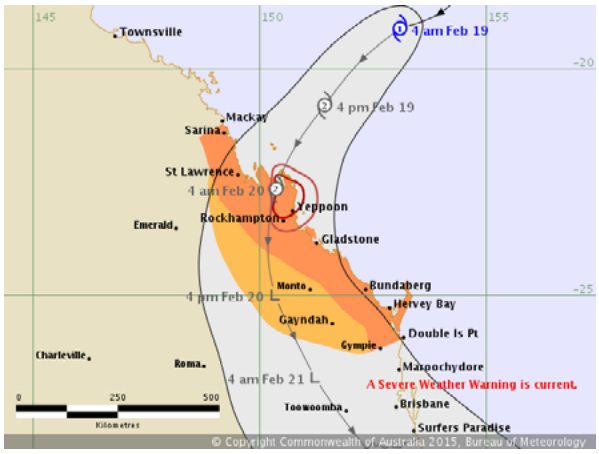

Figure C-7 TC Marcia Track Map – 04:50 19 Feb

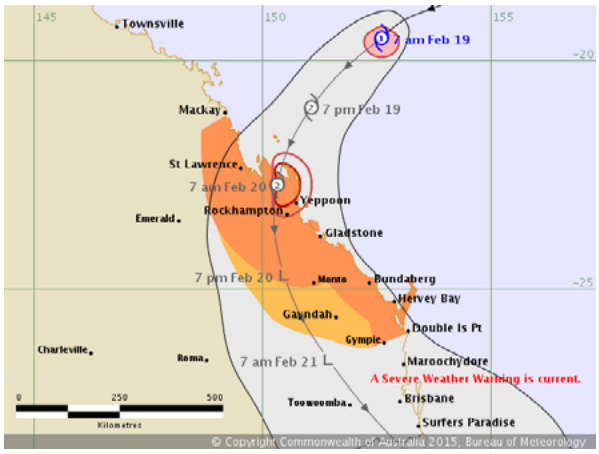

Figure C-8 TC Marcia Track Map – 07:51 19 Feb

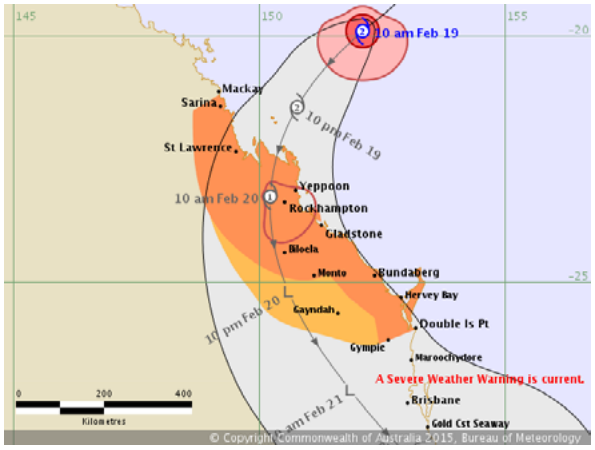

Figure C-9 TC Marcia Track Map – 10:58 19 Feb

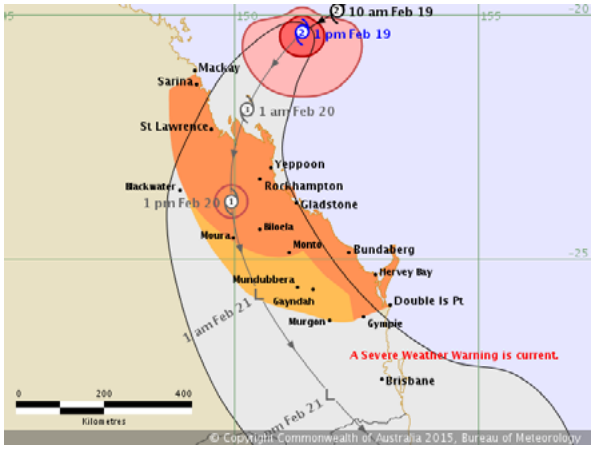

Figure C-10 TC Marcia Track Map – 13:51 19 Feb

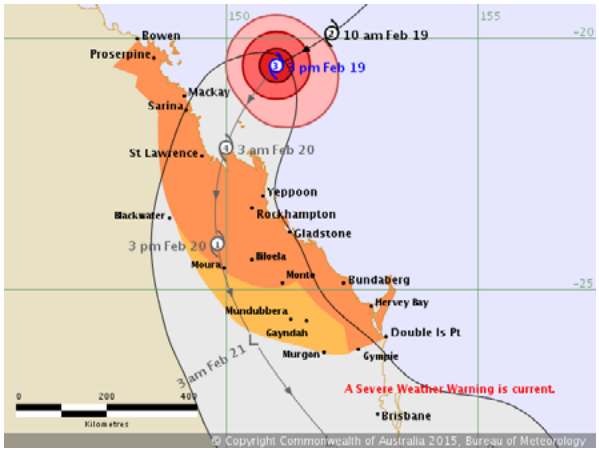

Figure C-11 TC Marcia Track Map – 15:57 19 Feb

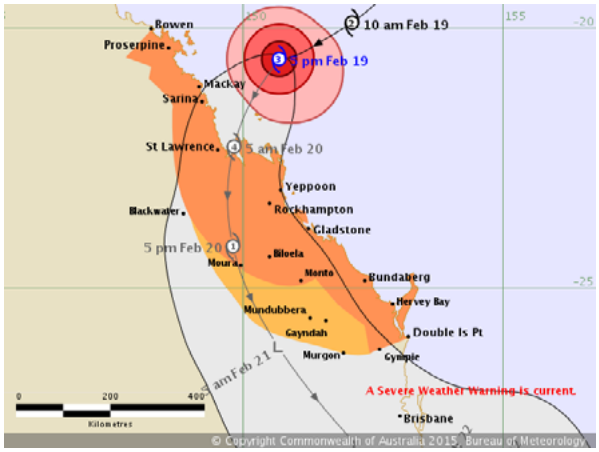

Figure C-12 TC Marcia Track Map – 16:56 19 Feb

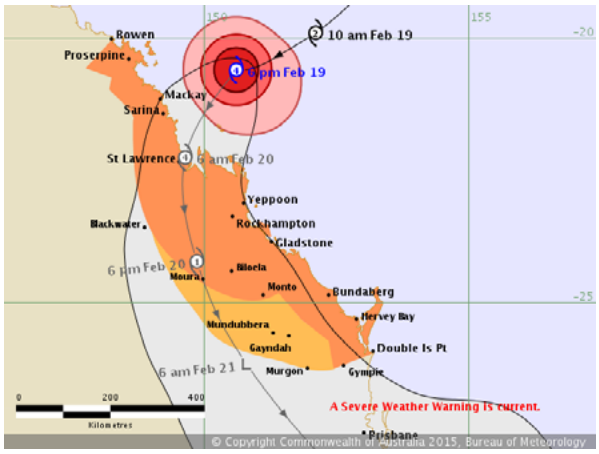

Figure C-13 TC Marcia Track Map – 17:52 19 Feb

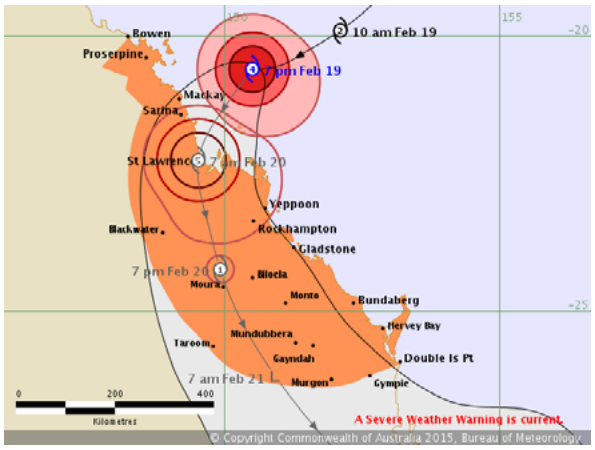

Figure C-14 TC Marcia Track Map – 18:57 19 Feb

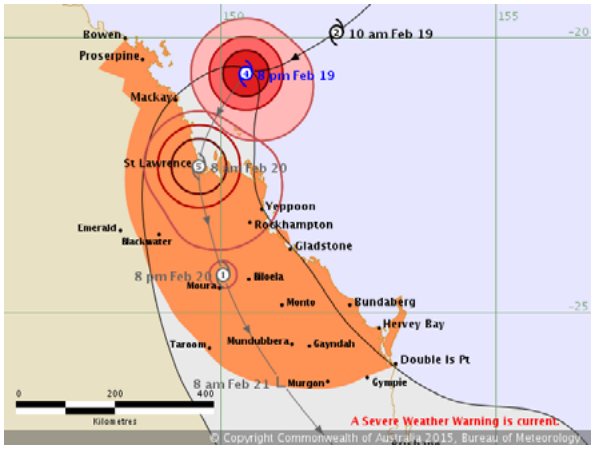

Figure C-15 TC Marcia Track Map – 19:42 19 Feb

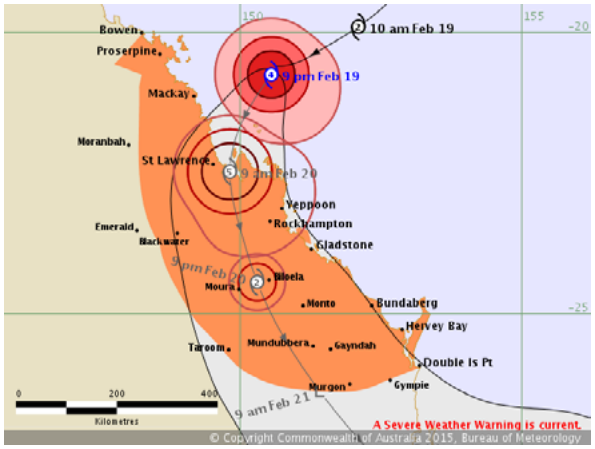

Figure C-16 TC Marcia Track Map – 20:58 19 Feb

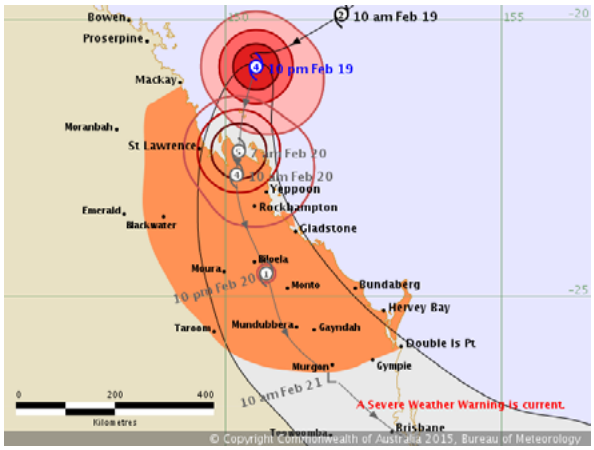

Figure C-17 TC Marcia Track Map – 22:05 19 Feb

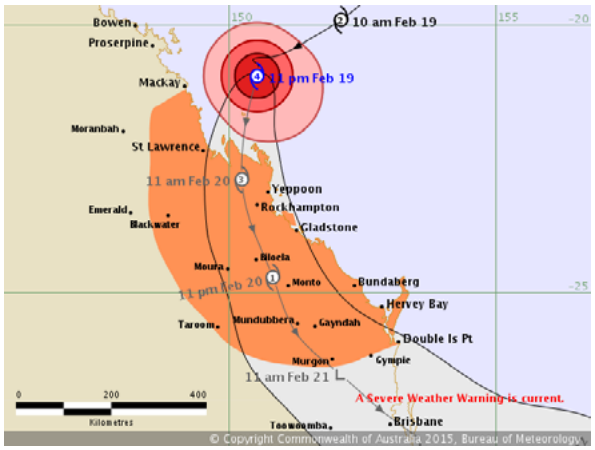

Figure C-18 TC Marcia Track Map – 22:54 19 Feb

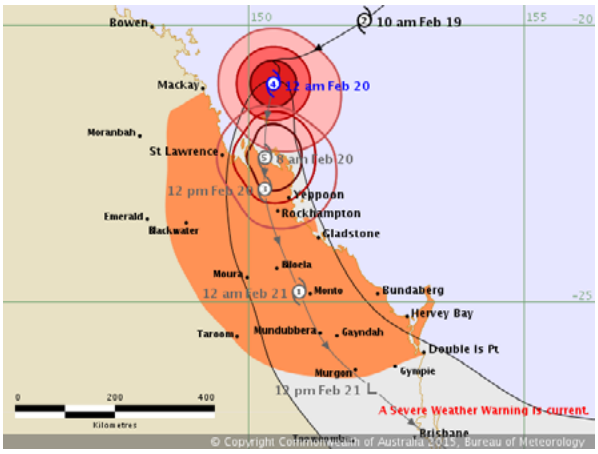

Figure C-19 TC Marcia Track Map – 23:58 19 Feb

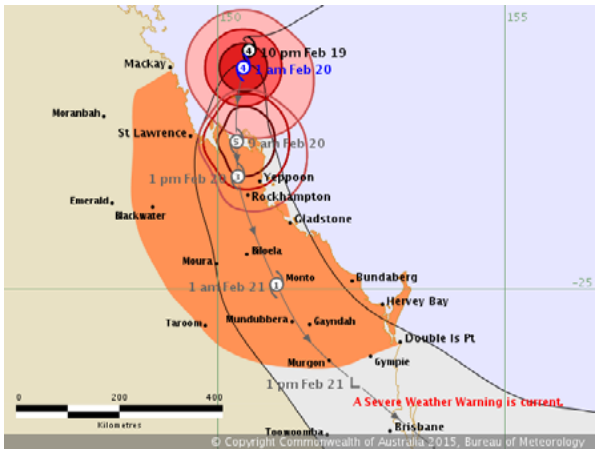

Figure C-20 TC Marcia Track Map – 00:55 20 Feb

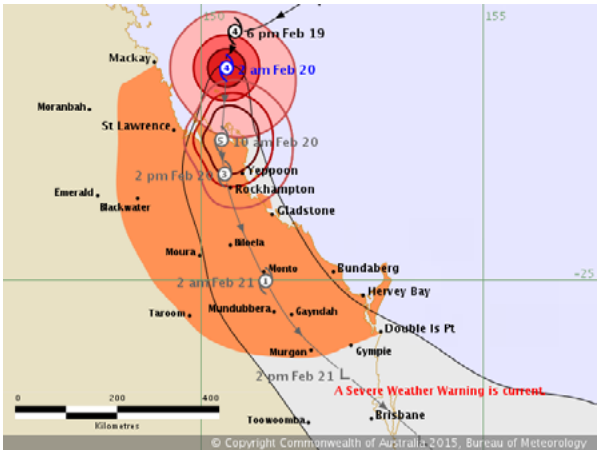

Figure C-21 TC Marcia Track Map – 01:56 20 Feb

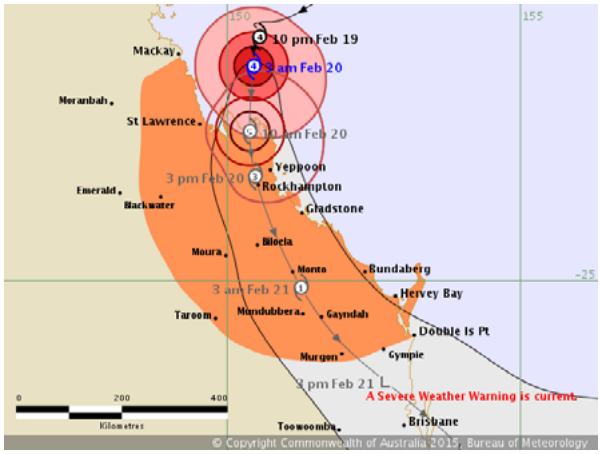

Figure C-22 TC Marcia Track Map – 02:56 20 Feb

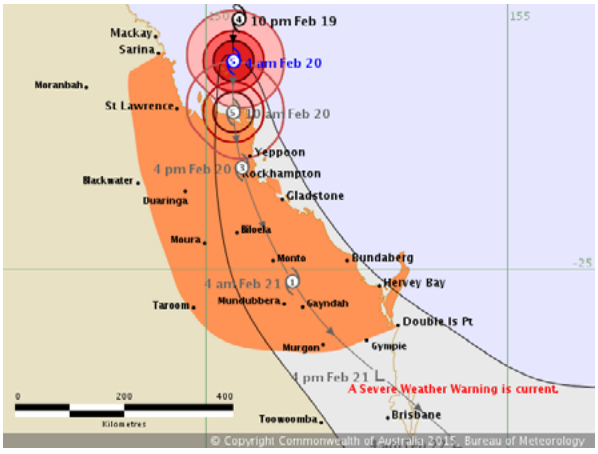

Figure C-23 TC Marcia Track Map – 04:01 20 Feb

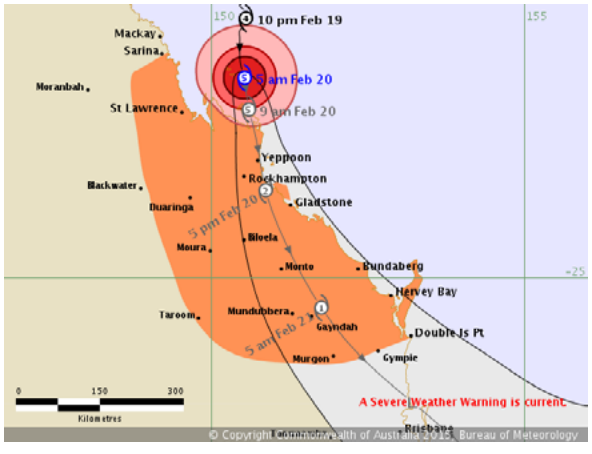

Figure C-24 TC Marcia Track Map – 04:58 20 Feb

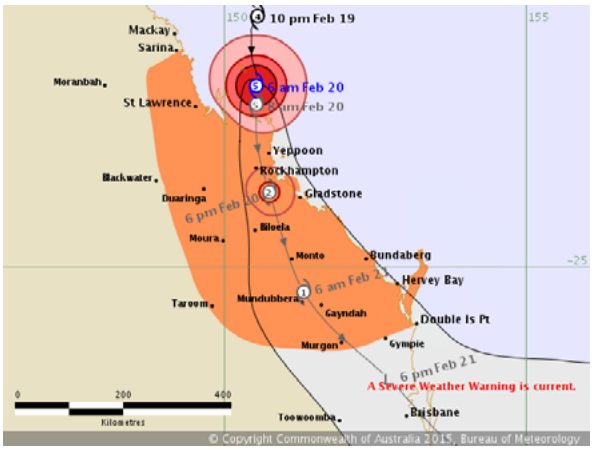

Figure C-25 TC Marcia Track Map – 05:56 20 Feb

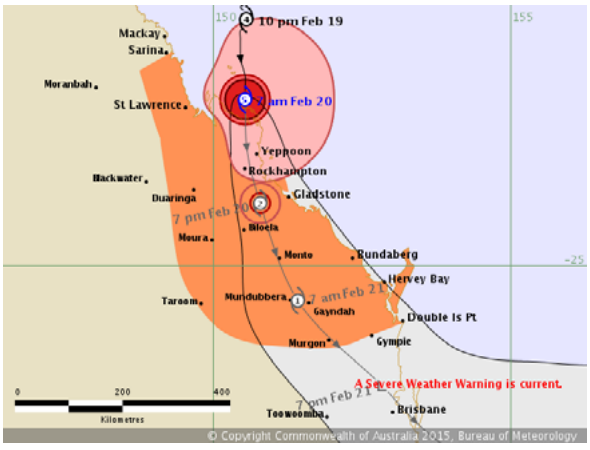

Figure C-26 TC Marcia Track Map – 06:58 20 Feb

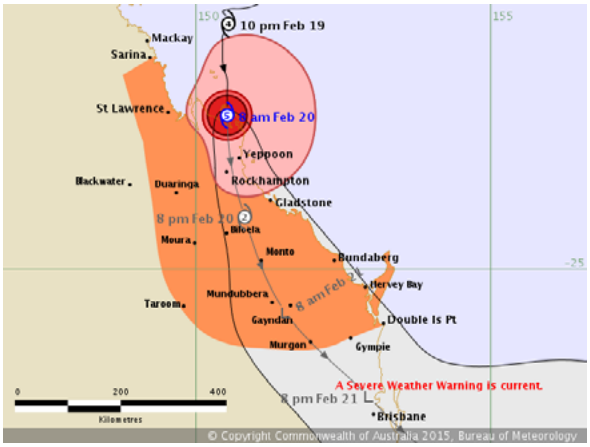

Figure C-27 TC Marcia Track Map – 08:03 20 Feb

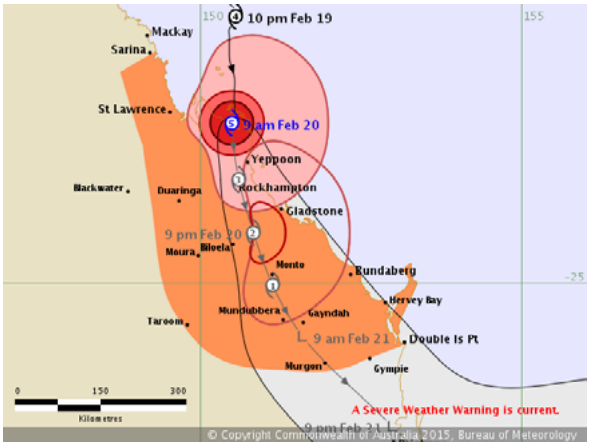

Figure C-28 TC Marcia Track Map – 09:01 20 Feb

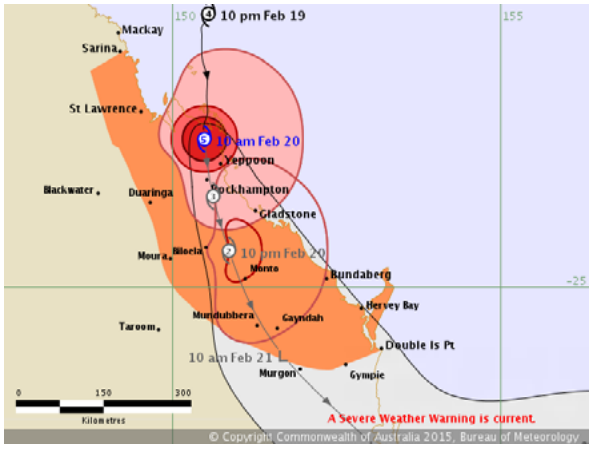

Figure C-29 TC Marcia Track Map – 09:58 20 Feb

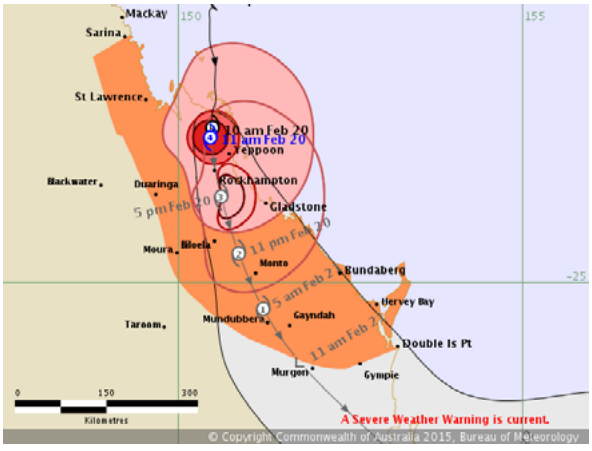

Figure C-30 TC Marcia Track Map – 11:00 20 Feb

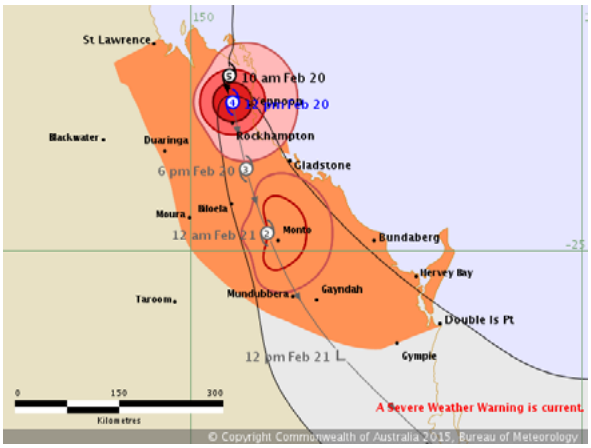

Figure C-31 TC Marcia Track Map – 12:01 20 Feb

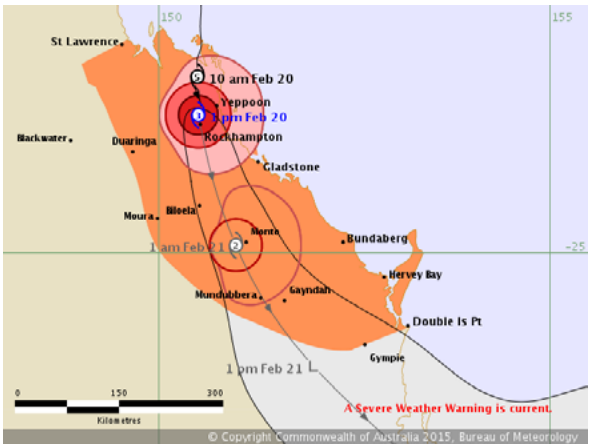

Figure C-32 TC Marcia Track Map – 12:59 20 Feb

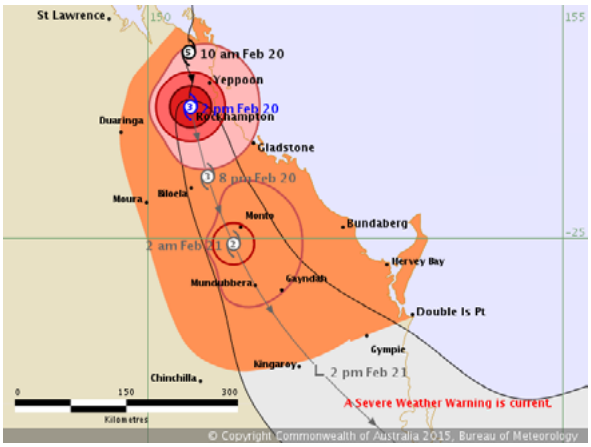

Figure C-33 TC Marcia Track Map – 14:10 20 Feb

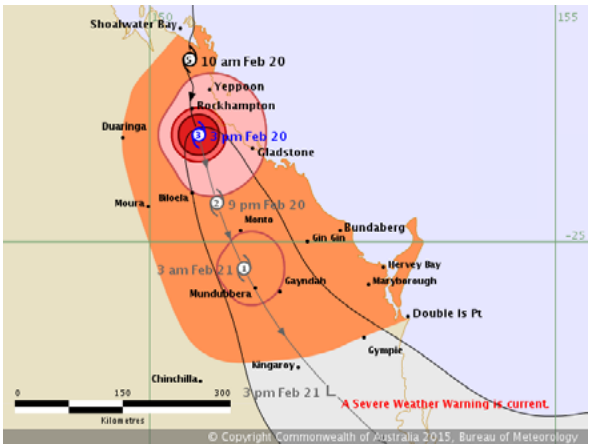

Figure C-34 TC Marcia Track Map – 14:58 20 Feb

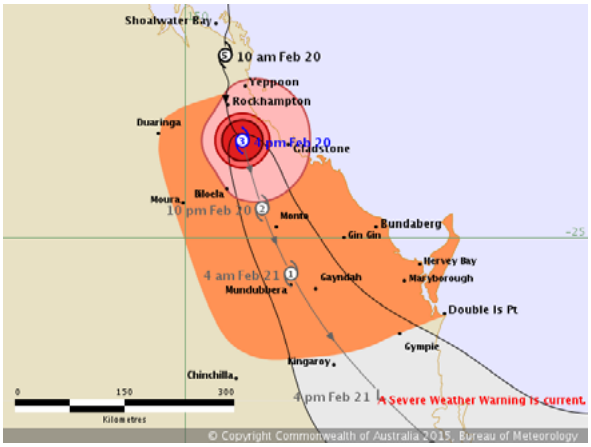

Figure C-35 TC Marcia Track Map – 15:59 20 Feb

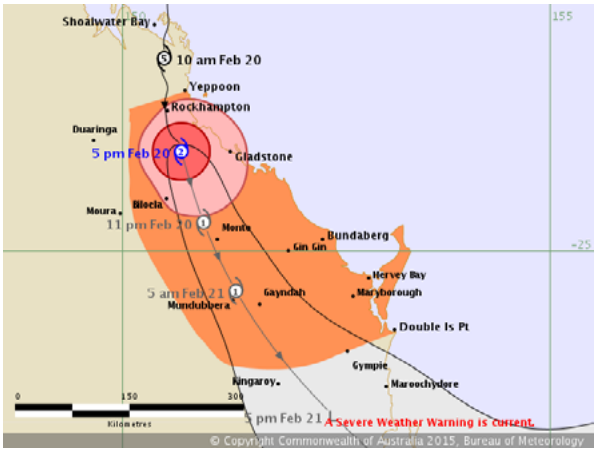

Figure C-36 TC Marcia Track Map – 17:02 20 Feb

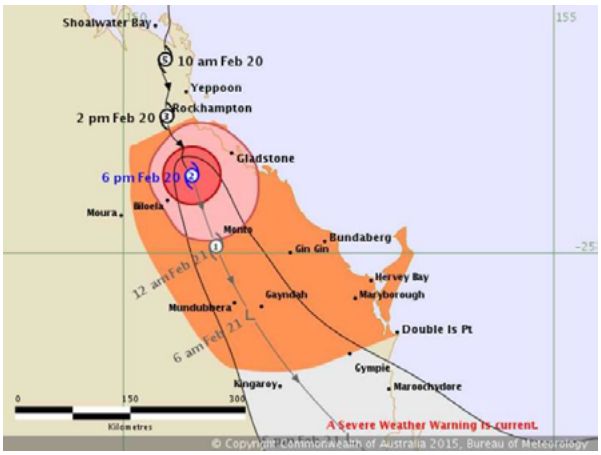

Figure C-37 TC Marcia Track Map – 17:59 20 Feb

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Figure C-38 TC Marcia Track Map – 18:56 20 Feb

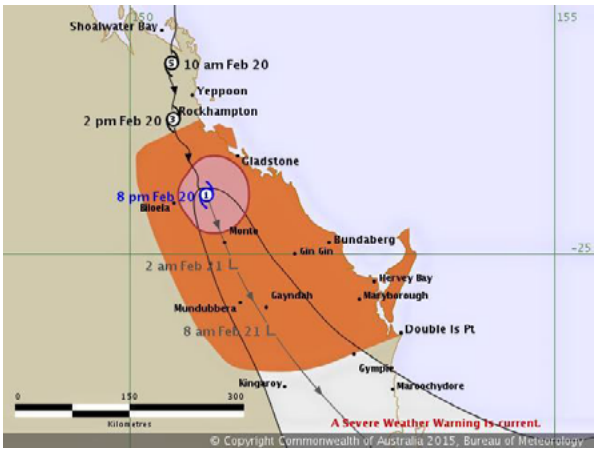


Figure C-39 TC Marcia Track Map – 19:51 20 Feb

Missing from BoM archive

Figure C-40 TC Marcia Track Map – 23:02 20 Feb

Figure C-41 TC Marcia Track Map – 01:55 21 Feb

Table C-2 BoM Flood Watches

Issue #	Issued on	Warning
1	3:47 pm EST on Tuesday 17 February 2015	Heavy rainfall associated with a trough is forecast to affect catchments between Rockhampton and the NSW border from Thursday through to Saturday. Widespread rainfall totals of 200-300 mm are forecast, with locally higher rainfall likely. A severe weather warning for damaging winds, heavy rainfall, abnormally high tides and dangerous surf is current. River level rises above the minor flood level are expected. Heavy rainfall may also lead to localised flash flooding. Catchments at risk within the Flood Watch area include the Dawson, Calliope, Boyne, Baffle, Kolan, Burnett, Cherwell-Burrum, Mary, Noosa, Maroochy, Mooloolah, Brisbane, Logan, Albert and Gold Coast rivers and creeks.
2	11:54 am EST on Wednesday 18 February 2015	Heavy rainfall associated with a trough is forecast to affect catchments between Rockhampton and the NSW border from Thursday through to Saturday. Widespread rainfall totals of 200-400 mm are forecast, with locally higher rainfall likely. The heaviest rainfall is expected to fall within coastal catchments. A severe weather warning and tropical cyclone advice are current for parts of the Flood Watch area. River level rises above the minor flood level are expected. Heavy rainfall may also lead to localised flash flooding. Catchments at risk within the Flood Watch area include the Dawson, Calliope, Boyne, Baffle, Kolan, Burnett, Cherwell-Burrum, Mary, Noosa, Maroochy, Mooloolah, Brisbane, Logan, Albert, Gold Coast rivers and creeks, Upper Condamine, Border Rivers and Moonie.
3	11:46 am EST on Thursday 19 February 2015	Heavy rainfall associated with a trough is forecast to affect catchments between Rockhampton and the NSW border from Thursday through to Saturday. Widespread rainfall totals of 200-400 mm are forecast, with locally higher rainfall likely. The heaviest rainfall is expected to fall within coastal catchments. A severe weather warning and tropical cyclone advice are current for parts of the Flood Watch area. River level rises above the minor flood level are expected. Heavy rainfall may also lead to localised flash flooding. Catchments at risk within the Flood Watch area include the Dawson, Calliope, Boyne, Baffle, Kolan, Burnett, Cherwell-Burrum, Mary, Noosa, Maroochy, Mooloolah, Brisbane, Logan, Albert, Gold Coast rivers and creeks, Upper Condamine, Border Rivers and Moonie.
4	11:34 am EST on Friday 20 February 2015	Heavy rainfall is forecast to continue affecting catchments between Rockhampton and the NSW border. Widespread rainfall totals of 200-300 mm are forecast for Friday and Saturday, with locally higher rainfall likely. The heaviest rainfall is expected to fall within coastal catchments. A severe weather warning and tropical cyclone advice are current. Heavy rainfall may also lead to localised flash flooding. Catchments at risk within the Flood Watch area include the Dawson, Calliope, Boyne, Baffle, Kolan, Burnett, Cherwell-Burrum, Noosa, Brisbane, Logan, Albert, Gold Coast rivers and creeks, Upper Condamine,

	Border Rivers and Moonie. Flood warnings are current. See www.bom.gov.au/qld/warnings/ to view the current flood warnings for Queensland. This Flood Watch means that people living or working along rivers and creeks should monitor the latest weather forecasts and warnings and be ready to move to higher ground should flooding develop.

Table C-3 BoM Flood Warnings

Issue #	Issued on	Warning
1	10:03 pm EST on Friday 20 February 2015	Rapid river level rises are occurring in the Don River. Minor flood levels expected at Baralaba. 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. DAWSON RIVER DOWNSTREAM FROM THEODORE: River levels are rising with minor flood levels expected at Baralaba Saturday morning. DON AND DEE RIVERS 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. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: River levels are expected to exceed the minor flood level (4.0 metres) Saturday morning.
2	5:55 am EST on Saturday 21 February 2015	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. DAWSON RIVER DOWNSTREAM FROM THEODORE: River levels are rising with minor flood levels possible at Baralaba Saturday morning. DON AND DEE RIVERS AND CALLIDE CREEK: 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 morning. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: River levels are likely to exceed the minor flood level (4.0 metres) Saturday morning.
3	11:43 am EST on Saturday 21 February 2015	Minor flood levels rising in the lower Dawson River and lower Don River. Heavy rainfall has been recorded over the Dawson and Don Rivers and the Callide Creek catchment area overnight Friday, with isolated falls to 300 mm. No significant rainfall forecast for the remainder of Saturday. DAWSON RIVER DOWNSTREAM FROM THEODORE: River levels continue to rise, with the minor flood level (4.0 metres) being exceeded at Baralaba this morning. DON AND DEE RIVERS AND CALLIDE CREEK: Minor flood levels are rising at Rannes, following peaks in the upper reaches of the Dee and Don Rivers and Callide Creek. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: Minor flood levels rising to near the

		moderate flood level (7.5 metres) overnight Saturday.
4	10:28 pm EST on Saturday 21 February 2015	Minor flood levels are rising in the lower Dawson River and lower Don River. Heavy rainfall has been recorded over the Dawson and Don Rivers and the Callide Creek catchment area overnight Friday, with isolated falls to 300 mm. No further significant rainfall is forecast for the region. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor flood levels continue to rise at Baralaba and downstream to Knebworth. DON AND DEE RIVERS AND CALLIDE CREEK: Major flood levels have peaked at Goovigen on Callide Creek Saturday night and are now slowly easing. Moderate flood levels continue to rise at Rannes on the Don River and are expected to peak overnight Saturday. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: Minor flood levels rising to near the moderate flood level (7.5 metres) overnight Saturday.
5	4:41 am EST on Sunday 22 February 2015	Minor flood levels are rising in the lower Dawson River. Heavy rainfall has been recorded over the Dawson and Don Rivers and the Callide Creek catchment area overnight Friday, with isolated falls to 300 mm. No further significant rainfall is forecast for the region. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor to moderate flood levels continue to rise between Baralaba and Knebworth. DON AND DEE RIVERS AND CALLIDE CREEK: Major flood levels peaked at Goovigen on Callide Creek Saturday night and are now slowly easing. Moderate flood levels are expected to be near a peak on the Don River at Rannes. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: Minor flood levels rising to near the moderate flood level (7.5 metres) Sunday morning.
6	12:59 pm EST on Sunday 22 February 2015	Minor flood levels at Baralaba in the lower Dawson River have peaked. No further significant rainfall is forecast for the region. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor flood levels have peaked at Baralaba and are easing. DON AND DEE RIVERS AND CALLIDE CREEK: Major flood levels continue easing at Goovigen on Callide Creek after a peak Saturday night. Moderate flood levels are expected to have peaked on the Don River at Rannes during Sunday morning. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: Minor flood levels peaked during Sunday morning and will continue easing over the next few days.
7	9:59 pm EST on Sunday 22 February 2015	Minor flood levels at Baralaba in the lower Dawson River are easing. No further significant rainfall is

		forecast for the region. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor flood levels will easing at Baralaba. DON RIVERS AND CALLIDE CREEK: Moderate flood levels are easing at Goovigen on Callide Creek and at Rannes on the Don River. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: Minor flood levels will continue easing during Monday.
8	8:55 am EST on Monday 23 February 2015	River levels on the lower Dawson River at Baralaba are expected to fall below the minor flood level during Monday morning. No further significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor flood levels are easing at Baralaba. DON RIVERS AND CALLIDE CREEK: Moderate flood levels are easing at Goovigen on Callide Creek and at Rannes on the Don River. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: River levels will fall below the minor flood level (4.0 metres) by mid-morning Monday.
9	11:43 am EST on Monday 23 February 2015	Moderate flood levels continue in the lower reaches of the Dawson River, Don River and Callide Creek. No significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: River levels fell below the minor flood level at Baralaba on Monday morning. Downstream, river levels remain above the moderate flood level between Beckers and Knebworth. DON RIVERS AND CALLIDE CREEK: Moderate flood levels are easing at Goovigen on Callide Creek and at Rannes on the Don River. Predicted River Heights/Flows: DAWSON RIVER at: BARALABA: River levels will continue to ease over the next few days.
10	6:09 pm EST on Monday 23 February 2015	River levels are falling in the lower reaches of the Dawson River, the Don River and Callide Creek. No significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor to moderate flood levels are falling between Beckers and Knebworth. DON RIVERS AND CALLIDE CREEK: Moderate flood levels are easing at Goovigen on Callide Creek and at Rannes on the Don River. Predicted River Heights/Flows:
11	8:51 am EST on Tuesday 24 February 2015	River levels are continue falling in the lower reaches of the Dawson River, the Don River and Callide Creek. No significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor to moderate flood levels continue easing between Beckers and Knebworth. DON RIVERS AND CALLIDE CREEK: Flood levels

		have eased to minor flood levels at Goovigen on Callide Creek and at Rannes on the Don River, and continue easing. Predicted River Heights/Flows:
12	10:18 am EST on Tuesday 24 February 2015	Minor flood levels are expected to develop overnight Tuesday on the Fitzroy River at Yaamba. River levels continue falling in the lower reaches of the Dawson River, the Don River and Callide Creek. No significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor to moderate flood levels continue easing between Beckers and Knebworth. DON RIVERS AND CALLIDE CREEK: River levels have eased to the minor flood level at Goovigen on Callide Creek and at Rannes on the Don River, and continue easing. FITZROY RIVER: Rises are occurring on the Fitzroy River. Minor flood levels are expected to develop at Yaamba overnight Tuesday with further rises into Wednesday. Predicted River Heights/Flows: FITZROY RIVER at: YAAMBA: River level rises to exceed the minor flood level (9 metres) overnight Tuesday with further rises into Wednesday. ROCKHAMPTON: River levels are expected to remain well below the minor flood level of 7 metres.
13	8:48 am EST on Wednesday 25 February 2015	River levels are expected to remain below the minor flood level in the Fitzroy River at Yaamba and Rockhampton. River levels continue falling in the lower reaches of the Dawson River, the Don River and Callide Creek. No significant rainfall is forecast over the next few days. DAWSON RIVER DOWNSTREAM FROM THEODORE: Minor flood levels continue to ease at Knebworth. DON RIVER AND CALLIDE CREEK: Minor flood levels continue to fall at Rannes on the Don River. Predicted River Heights/Flows: FITZROY RIVER at: YAAMBA: River level rises are now expected to remain below the minor flood level (9.0 metres). ROCKHAMPTON: River levels are expected to peak well below the minor flood level (7.0 metres) during Thursday.

Appendix D Rainfall Analysis

Table 10-4 Sub-daily rainfall gauges and data availability for February 2015

Gauge ID	Gauge Name	Sub-Basin	River Basin	February 2015 Data
539116	Alma Ck Bore TM	Don River	Fitzroy River	Yes
39003	Banana	Dawson River	Fitzroy River	-
539174	Banana Range ALERT	Callide Creek	Fitzroy River	-
39149	Barfield	Dawson River	Fitzroy River	-
130319A	Bell Creek at Craiglands	Callide Creek	Fitzroy River	Yes
39290	Biloela - Valbona	Callide Creek	Fitzroy River	-
539095	Bindaree TM	Dawson River	Fitzroy River	Yes
1303P006	Blue Hills Standalone Pluvio	Callide Creek	Fitzroy River	Yes
1361P002	Boolaroo Tops Standalone Pluvio	Callide Creek	Fitzroy River	Yes
39019	Callemondah Stn	Callide Creek	Fitzroy River	-
539071	Callide Ck TM	Callide Creek	Fitzroy River	Yes
130327A	Callide Creek at Goovigen	Callide Creek	Fitzroy River	Yes
539111	Callide Dam Inflow TM	Callide Creek	Fitzroy River	Yes
39150	Callide Open Cut	Callide Creek	Fitzroy River	-
39020	Calliope Station	Calliope River	Calliope River	-
539064	Cania Dam	Three Moon Creek	Burnett River	Yes
539182	Cania Dam HW ALERT	Three Moon Creek	Burnett River	-
539092	Cania Dam HW TM	Callide Creek	Fitzroy River	-
39222	Cania Gorge Park	Three Moon Creek	Burnett River	-
39204	Colodan	Burnett River	Burnett River	-
539107	Craiglands TM	Callide Creek	Fitzroy River	Yes
130349A	Don River at Kingsborough	Don River	Fitzroy River	Yes
539119	Doreen TM	Don River	Fitzroy River	Yes
39197	Fig Tree	Calliope River	Calliope River	-
539105	Folding Hills TM	Callide Creek	Fitzroy River	Yes
39311	Glandore	Dawson River	Fitzroy River	-
39048	Goovigen Post Office	Callide Creek	Fitzroy River	-
539068	Goovigen TM	Callide Creek	Fitzroy River	Yes
130336A	Grevillea Creek at Folding Hills	Callide Creek	Fitzroy River	Yes
39334	Hazeldean	Calliope River	Calliope River	-
39172	Hillview	Callide Creek	Fitzroy River	-
39054	Jambin Post Office	Callide Creek	Fitzroy River	-
539062	Kingsborough TM	Don River	Fitzroy River	Yes
39240	Kroombit	Callide Creek	Fitzroy River	-
539112	Kroombit Dam HW TM	Callide Creek	Fitzroy River	Yes

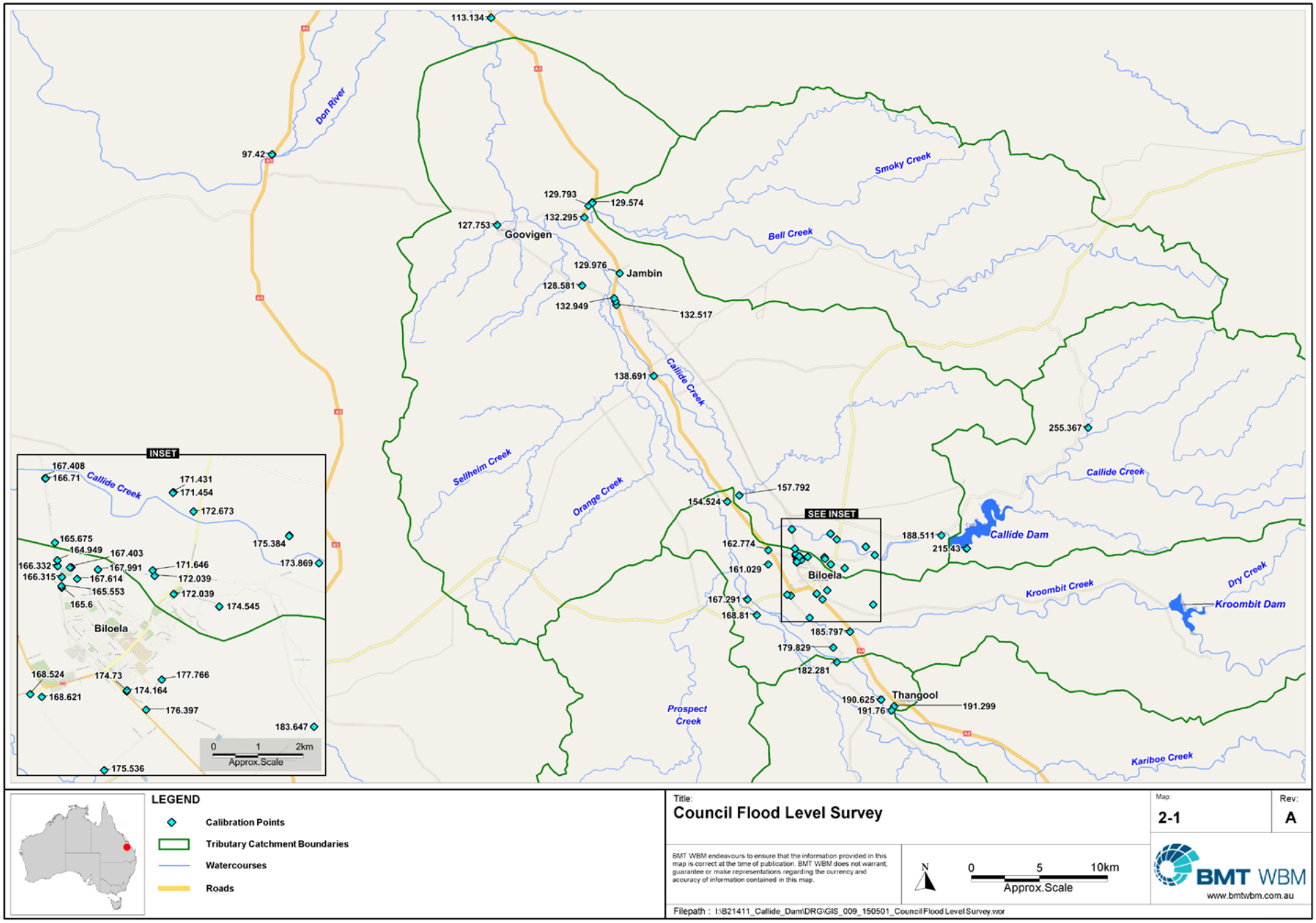
539083	Kroombit Dam TW TM	Callide Creek	Fitzroy River	-
1303P003	Kroombit Tops Standalone Pluvio	Callide Creek	Fitzroy River	Yes
539120	Kroombit Tops TM	Callide Creek	Fitzroy River	Yes
539175	Lonesome Creek ALERT	Dawson River	Fitzroy River	-
539067	Malakoff Junction TM	Callide Creek	Fitzroy River	-
39106	Mount Kroombit	Callide Creek	Fitzroy River	-
539128	Mt Seaview ALERT	Callide Creek	Fitzroy River	-
130348A	Prospect Creek at Red Hills	Callide Creek	Fitzroy River	Yes
539057	Rannes	Don River	Fitzroy River	Yes
539100	Red Hill TM	Callide Creek	Fitzroy River	Yes
130334A	South Kariboe Creek at Pump Station	Callide Creek	Fitzroy River	Yes
539106	South Kariboe Creek TM	Callide Creek	Fitzroy River	Yes
39089	Thangool (syn)	Callide Creek	Fitzroy River	-
39158	Theodore	Dawson River	Fitzroy River	-
539168	Upper Castle ALERT	Dawson River	Fitzroy River	Yes
539171	Upper Lonesome ALERT	Dawson River	Fitzroy River	Yes
539043	Woodleigh TM	Dawson River	Fitzroy River	Yes
539115	Wowan TM	Don River	Fitzroy River	Yes

Table 10-5 Daily rainfall gauges and data availability for February 2015

Gauge ID	Gauge Name	Sub-Basin	River Basin	February 2015 Data
39149	Barfield	Dawson River	Fitzroy River	Yes
39290	Biloela - Valbona	Callide Creek	Fitzroy River	Yes
39019	Callemondah Station	Callide Creek	Fitzroy River	Yes
39222	Cania Gorge Park	Burnett River	Burnett River	Yes
39204	Colodan	Burnett River	Burnett River	Yes
39197	Fig Tree	Calliope River	Calliope River	Yes
39048	Goovigen	Callide Creek	Fitzroy River	Yes
39334	Hazeldean	Calliope River	Calliope River	Yes
39172	Hillview	Callide Creek	Fitzroy River	Yes
39054	Jambin Post Office	Callide Creek	Fitzroy River	Yes
39240	Kroombit	Callide Creek	Fitzroy River	Yes
39106	Mount Kroombit	Callide Creek	Fitzroy River	Yes
39089	Thangool Airport	Callide Creek	Fitzroy River	-
39158	Theodore	Dawson River	Fitzroy River	Yes

Appendix E Maps

Map 2-1	Council Flood Level Survey
Map 2-2	Rapid Damages Assessment
Map 4-1	Rainfall Gauges – Sub-Daily
Map 4-2	Rainfall Gauges – Daily
Map 4-3	Water Level Gauges
Map 5-1	Sub-Catchments and Terrain
Map 6-1	February 2015 Event – Time to peak flood level – South Area
Map 6-2	February 2015 Event – Time to peak flood level – North Area
Map 6-3	February 2015 Event – Peak flood depth – South Area
Map 6-4	February 2015 Event – Peak flood depth – North Area
Map 6-5	February 2015 Event – Peak flood depth – Biloela
Map 6-6	February 2015 Event – Peak flood depth – Jambin and Goovigen
Map 6-7	February 2015 Event – Peak flood level – Biloela
Map 6-8	February 2015 Event – Peak flood level – Jambin and Goovigen
Map 6-9	Scenario 2 - Manual vs automatic gate operation - Difference in flood levels
Map 6-10	Scenario 3 – No Callide Dam - Difference in flood levels
Map 6-11	Scenario 4 – Initial Storage at 50% - Difference in flood levels
Map 6-12	Scenario 5 – Initial Storage at 100% - Difference in flood levels



LEGEND

- Calibration Points
- Tributary Catchment Boundaries
- Watercourses
- Roads

Title:
Council Flood Level Survey

Map: 2-1

Rev: A

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Approx.Scale

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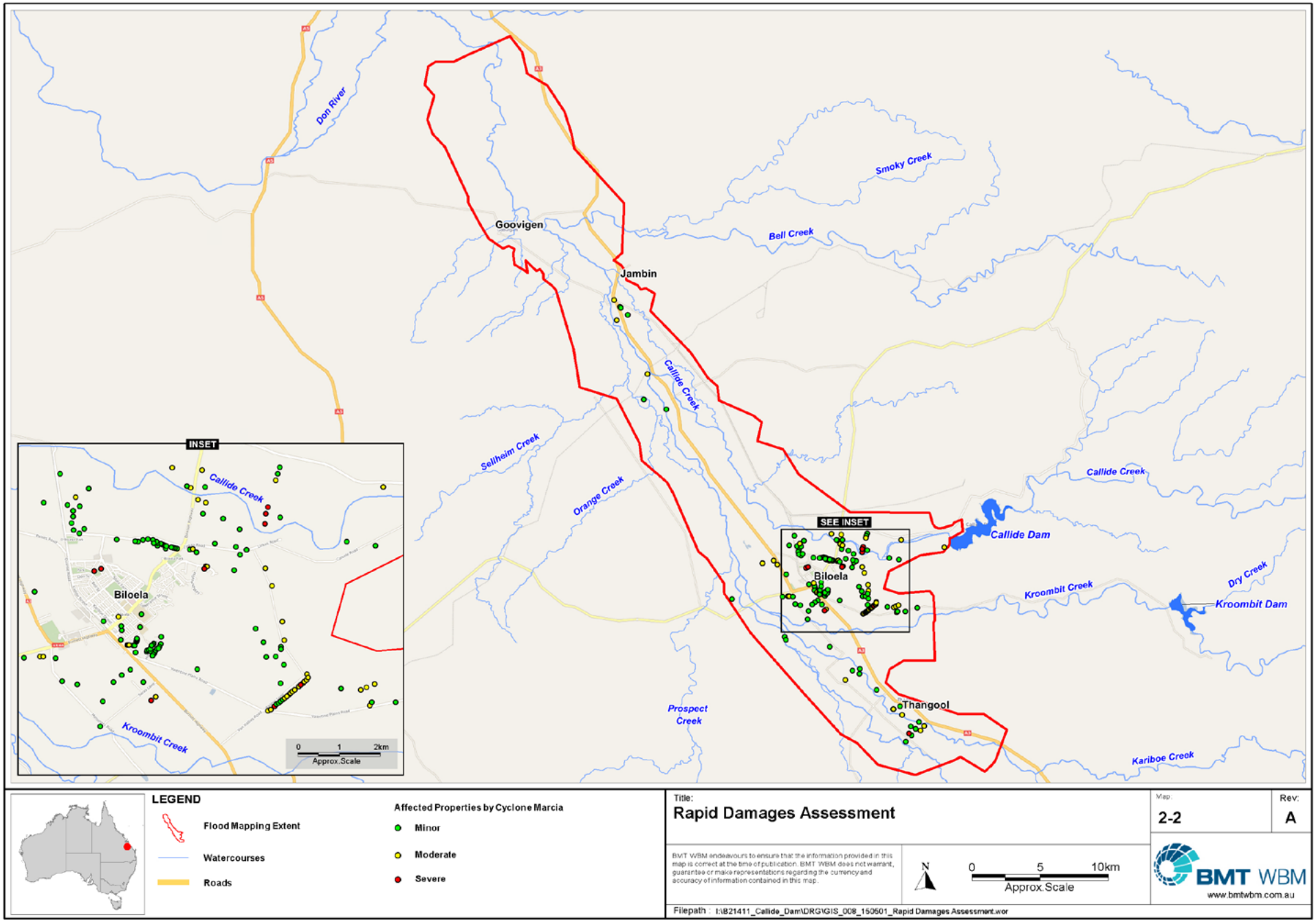
Don River
Smoky Creek
Goovigen
Bell Creek
Jambin
Callide Creek
Selheim Creek
Orange Creek
Callide Creek
SEE INSET
Callide Dam
Biloela
Kroombit Creek
Dry Creek
Kroombit Dam
Thangool
Prospect Creek
Kariboe Creek
INSET
Callide Creek
Biloela
Kroombit Creek
0 1 2km
Approx.Scale
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Flood Mapping Extent
Watercourses
Roads
Affected Properties by Cyclone Marcia
Minor
Moderate
Severe
Title:
Rapid Damages Assessment
Map:
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LEGEND

Catchment Boundary

Tributary Catchment Boundaries

Watercourses

Roads

Sub- Daily Reporting Rain Gauges

No data available for Feb 2015 / Excluded Gauge

Title:
Rainfall Gauges - Sub-Daily

Map: 4-1

Rev: A

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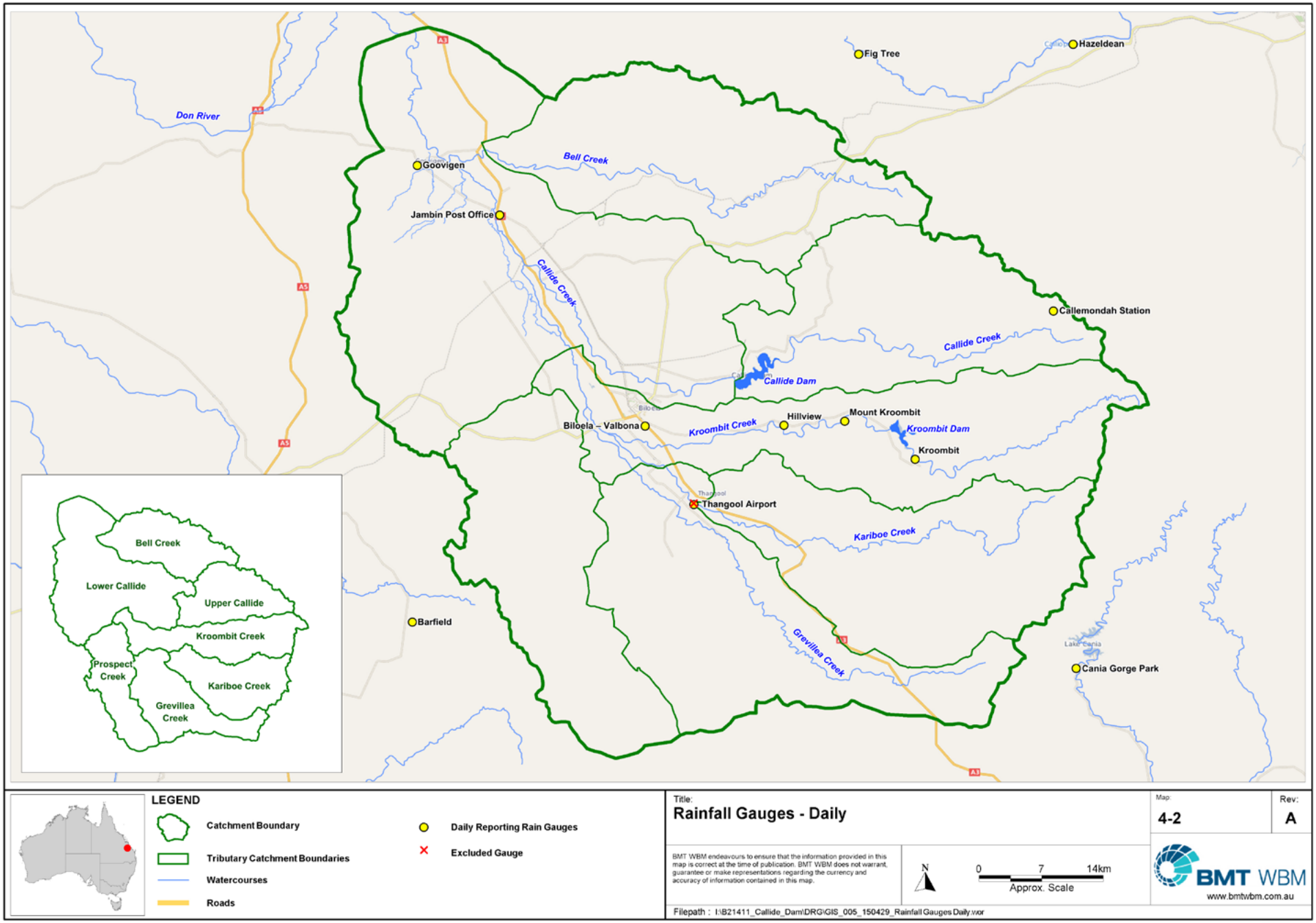
Don River
Bell Creek
Goovigen
Jambin Post Office
Callide Creek
Fig Tree
Hazeldean
Callemondah Station
Callide Creek
Callide Dam
Biloela – Valbona
Kroombit Creek
Hillview
Mount Kroombit
Kroombit Dam
Kroombit
Thangool Airport
Kariboe Creek
Barfield
Grevillea Creek
Cania Gorge Park
Bell Creek
Lower Callide
Upper Callide
Kroombit Creek
Prospect Creek
Kariboe Creek
Grevillea Creek
LEGEND
Catchment Boundary
Tributary Catchment Boundaries
Watercourses
Roads
Daily Reporting Rain Gauges
Excluded Gauge
Title:
Rainfall Gauges - Daily
Map:
4-2
Rev:
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www.bmtwbm.com.au
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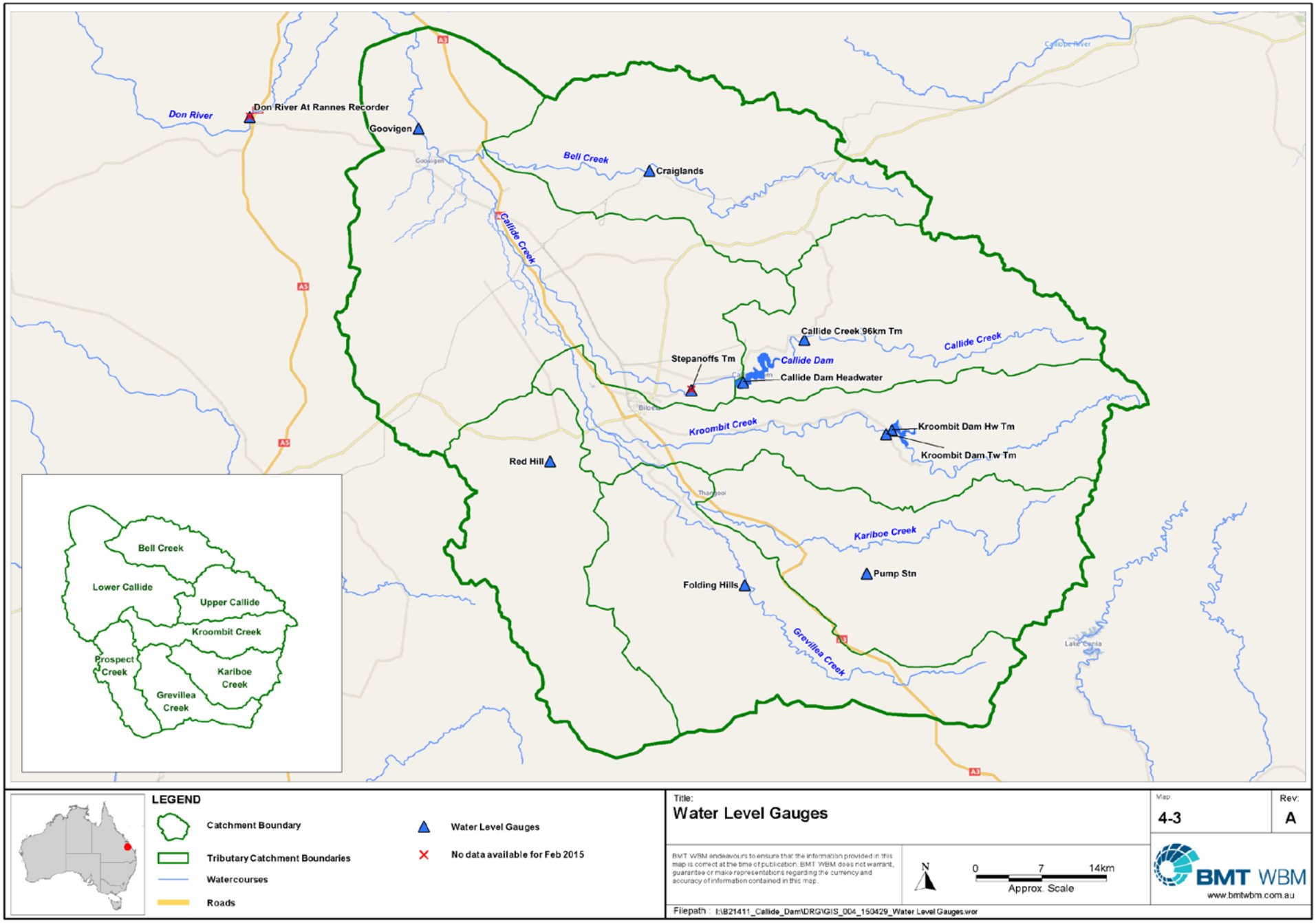
Don River
Don River At Rannes Recorder
Goovigen
Bell Creek
Craiglands
Callide Creek
Callide Creek 96km Tm
Callide Creek
Stepanoffs Tm
Callide Dam
Callide Dam Headwater
Kroombit Creek
Kroombit Dam Hw Tm
Kroombit Dam Tw Tm
Red Hill
Kariboe Creek
Pump Stn
Folding Hills
Grevillea Creek
Bell Creek
Lower Callide
Upper Callide
Kroombit Creek
Prospect Creek
Kariboe Creek
Grevillea Creek
LEGEND
Catchment Boundary
Tributary Catchment Boundaries
Watercourses
Roads
Water Level Gauges
No data available for Feb 2015
Title:
Water Level Gauges
Map:
4-3
Rev:
A
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.
N
0
7
14km
Approx. Scale
BMT WBM
www.bmtwbm.com.au
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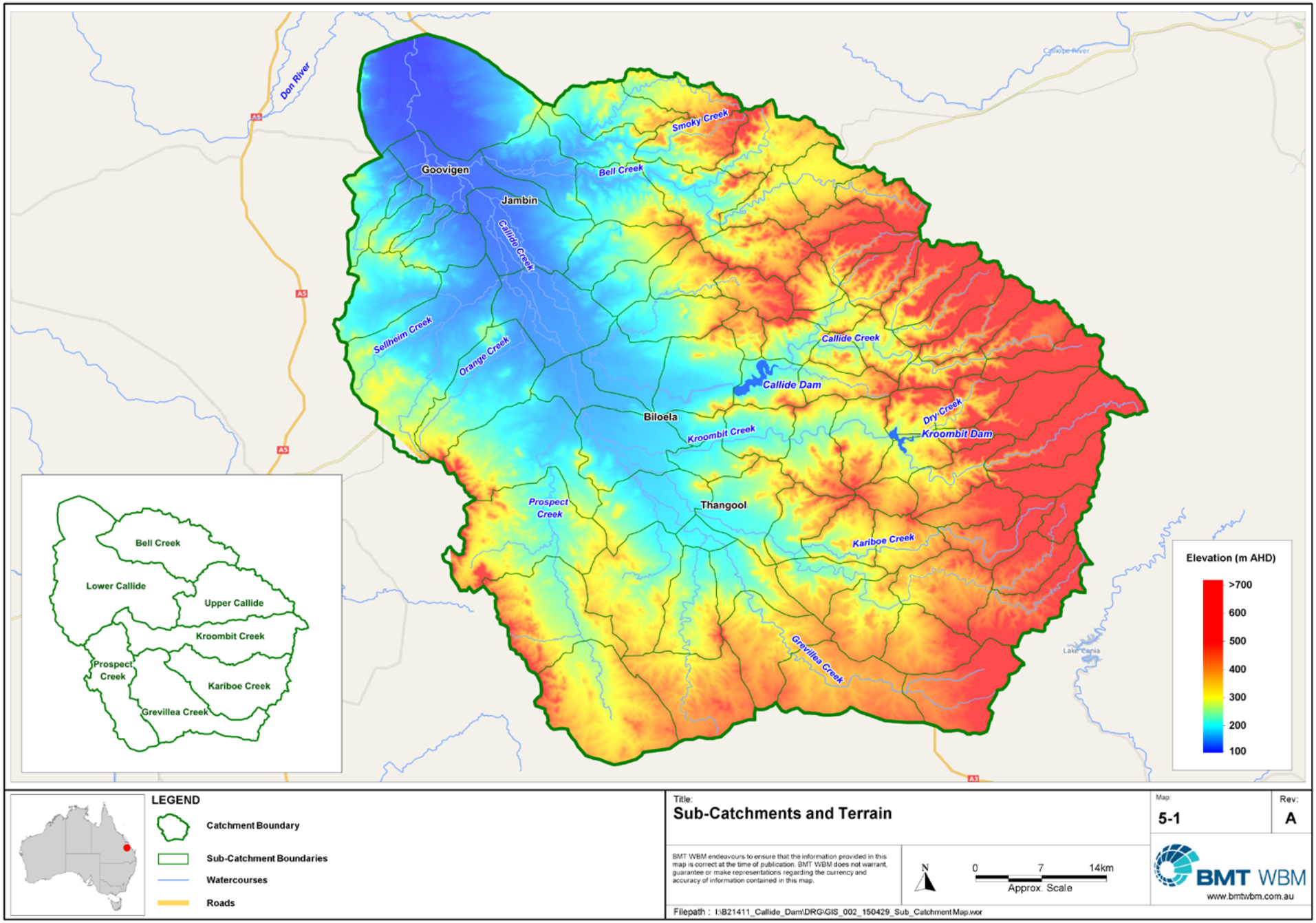
Don River
Smoky Creek
Bell Creek
Goovigen
Jambin
Callide Creek
Sellheim Creek
Orange Creek
Callide Creek
Callide Dam
Biloela
Dry Creek
Kroombit Dam
Kroombit Creek
Prospect Creek
Thangool
Kariboe Creek
Grevillea Creek
Lake Callide
Elevation (m AHD)
>700
600
500
400
300
200
100
Bell Creek
Lower Callide
Upper Callide
Kroombit Creek
Prospect Creek
Kariboe Creek
Grevillea Creek
LEGEND
Catchment Boundary
Sub-Catchment Boundaries
Watercourses
Roads
Title:
Sub-Catchments and Terrain
Map:
5-1
Rev:
A
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14km
Approx. Scale
BMT WBM
www.bmtwbm.com.au
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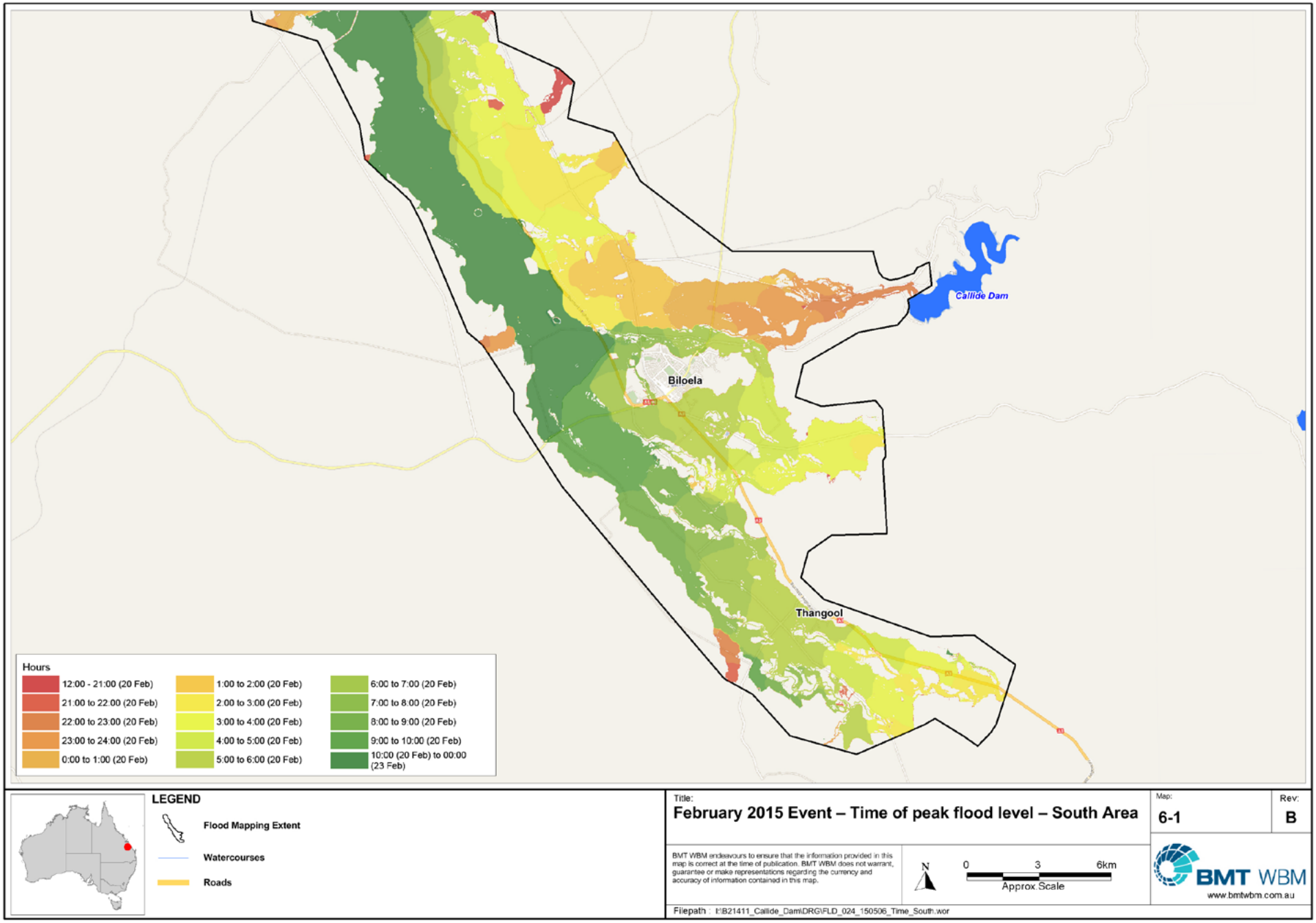
Callide Dam
Biloela
Thangool
Hours
12:00 - 21:00 (20 Feb)
21:00 to 22:00 (20 Feb)
22:00 to 23:00 (20 Feb)
23:00 to 24:00 (20 Feb)
0:00 to 1:00 (20 Feb)
1:00 to 2:00 (20 Feb)
2:00 to 3:00 (20 Feb)
3:00 to 4:00 (20 Feb)
4:00 to 5:00 (20 Feb)
5:00 to 6:00 (20 Feb)
6:00 to 7:00 (20 Feb)
7:00 to 8:00 (20 Feb)
8:00 to 9:00 (20 Feb)
9:00 to 10:00 (20 Feb)
10:00 (20 Feb) to 00:00 (23 Feb)
LEGEND
Flood Mapping Extent
Watercourses
Roads
Title:
February 2015 Event – Time of peak flood level – South Area
Map:
6-1
Rev:
B
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N
0
3
6km
Approx.Scale
BMT WBM
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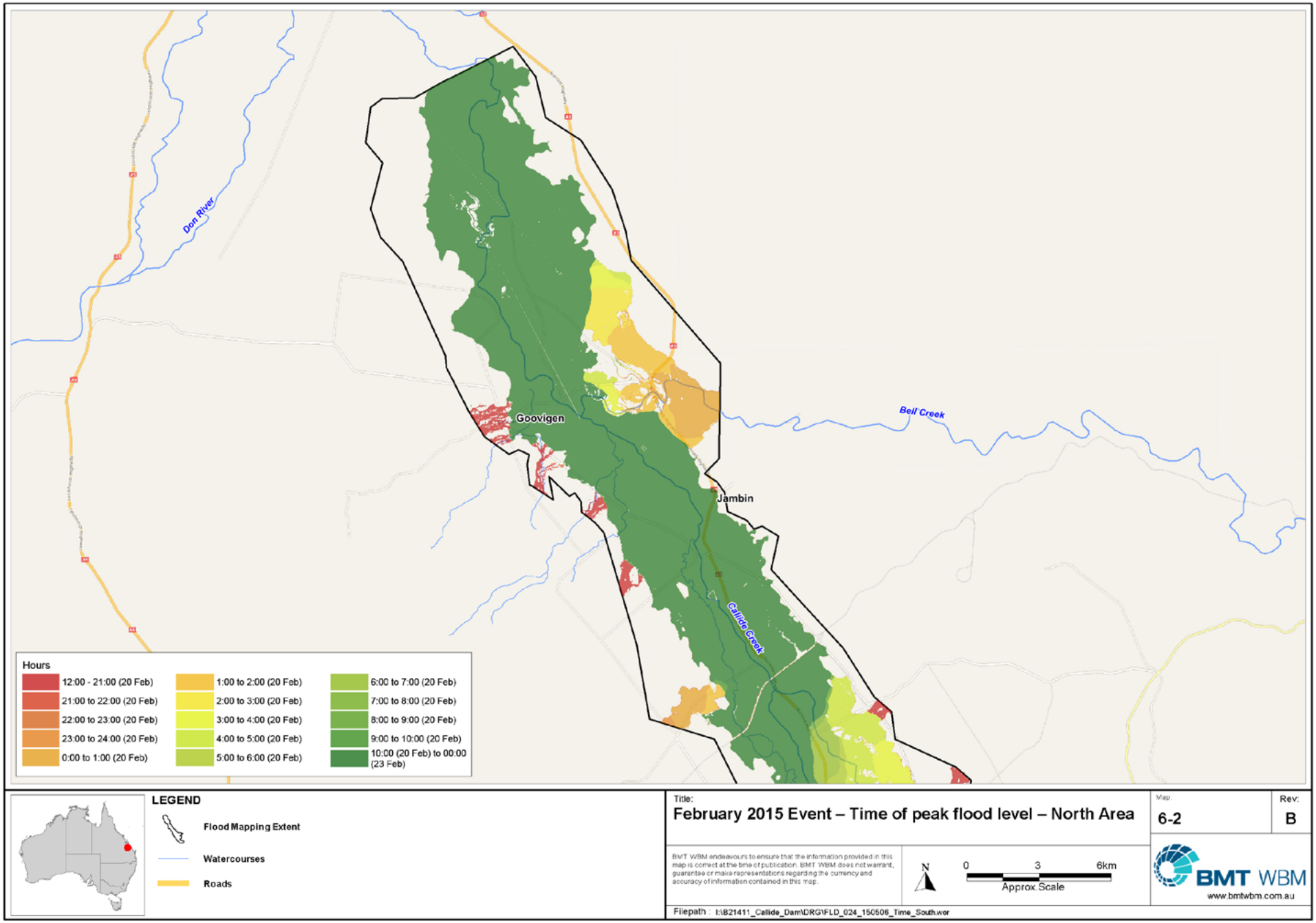
Don River
Goovigen
Bell Creek
Jambin
Callide Creek
Hours
12:00 - 21:00 (20 Feb)
21:00 to 22:00 (20 Feb)
22:00 to 23:00 (20 Feb)
23:00 to 24:00 (20 Feb)
0:00 to 1:00 (20 Feb)
1:00 to 2:00 (20 Feb)
2:00 to 3:00 (20 Feb)
3:00 to 4:00 (20 Feb)
4:00 to 5:00 (20 Feb)
5:00 to 6:00 (20 Feb)
6:00 to 7:00 (20 Feb)
7:00 to 8:00 (20 Feb)
8:00 to 9:00 (20 Feb)
9:00 to 10:00 (20 Feb)
10:00 (20 Feb) to 00:00 (23 Feb)
LEGEND
Flood Mapping Extent
Watercourses
Roads
Title:
February 2015 Event – Time of peak flood level – North Area
Map:
6-2
Rev:
B
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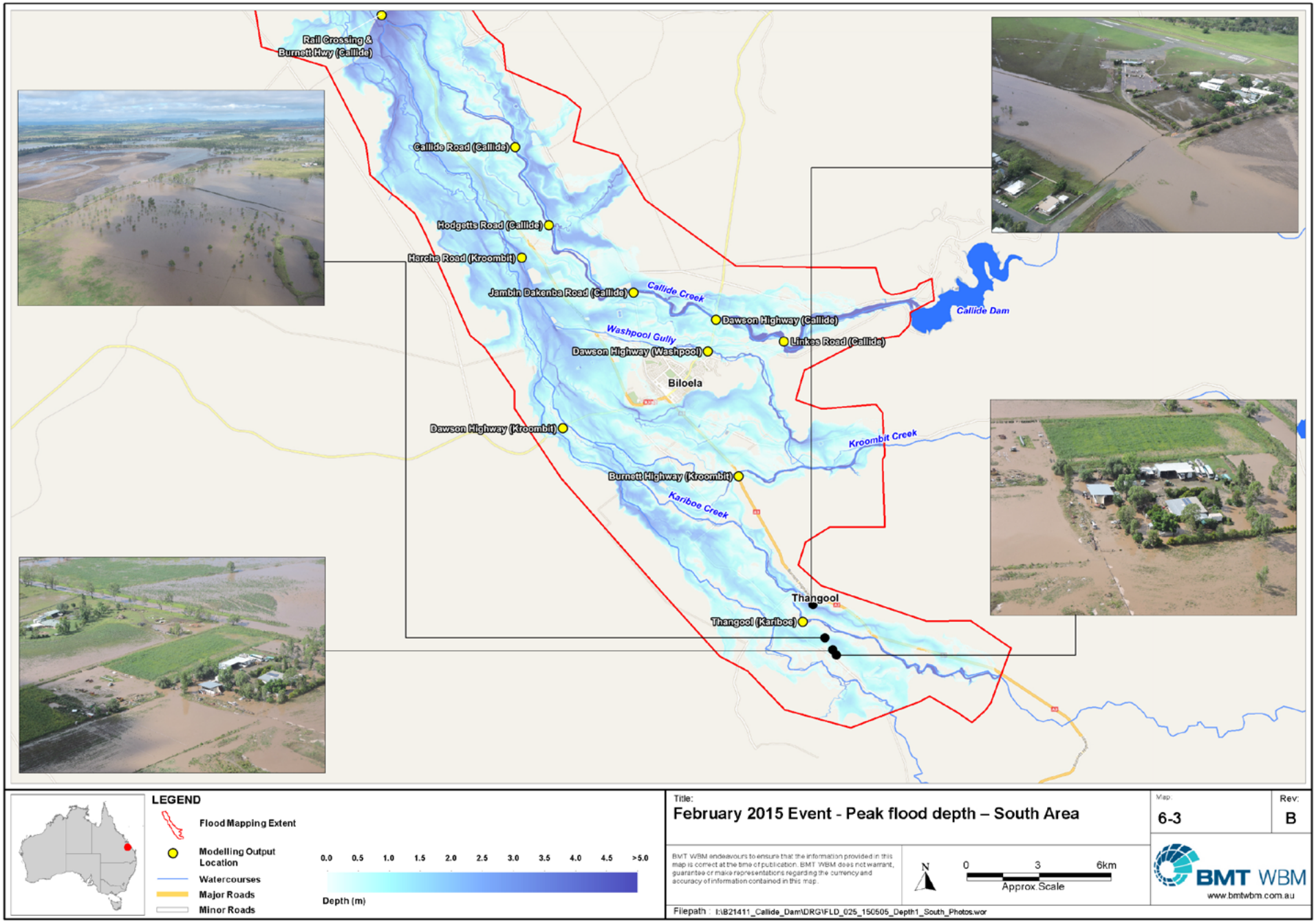
N
0
3
6km
Approx.Scale
BMT WBM
www.bmtwbm.com.au
Filepath : I:\B21411_Callide_Dam\DRG\FLD_024_150506_Time_South.wor


Rail Crossing & Burnett Hwy (Callide)
Callide Road (Callide)
Hodgetts Road (Callide)
Harchs Road (Kroombit)
Jambin Dakenba Road (Callide)
Callide Creek
Dawson Highway (Callide)
Washpool Gully
Linkes Road (Callide)
Dawson Highway (Washpool)
Callide Dam
Biloela
Dawson Highway (Kroombit)
Kroombit Creek
Burnett Highway (Kroombit)
Kariboe Creek
Thangool
Thangool (Kariboe)
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 >5.0
Depth (m)
Title:
February 2015 Event - Peak flood depth – South Area
Map:
6-3
Rev:
B
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N
0 3 6km
Approx Scale
BMT WBM
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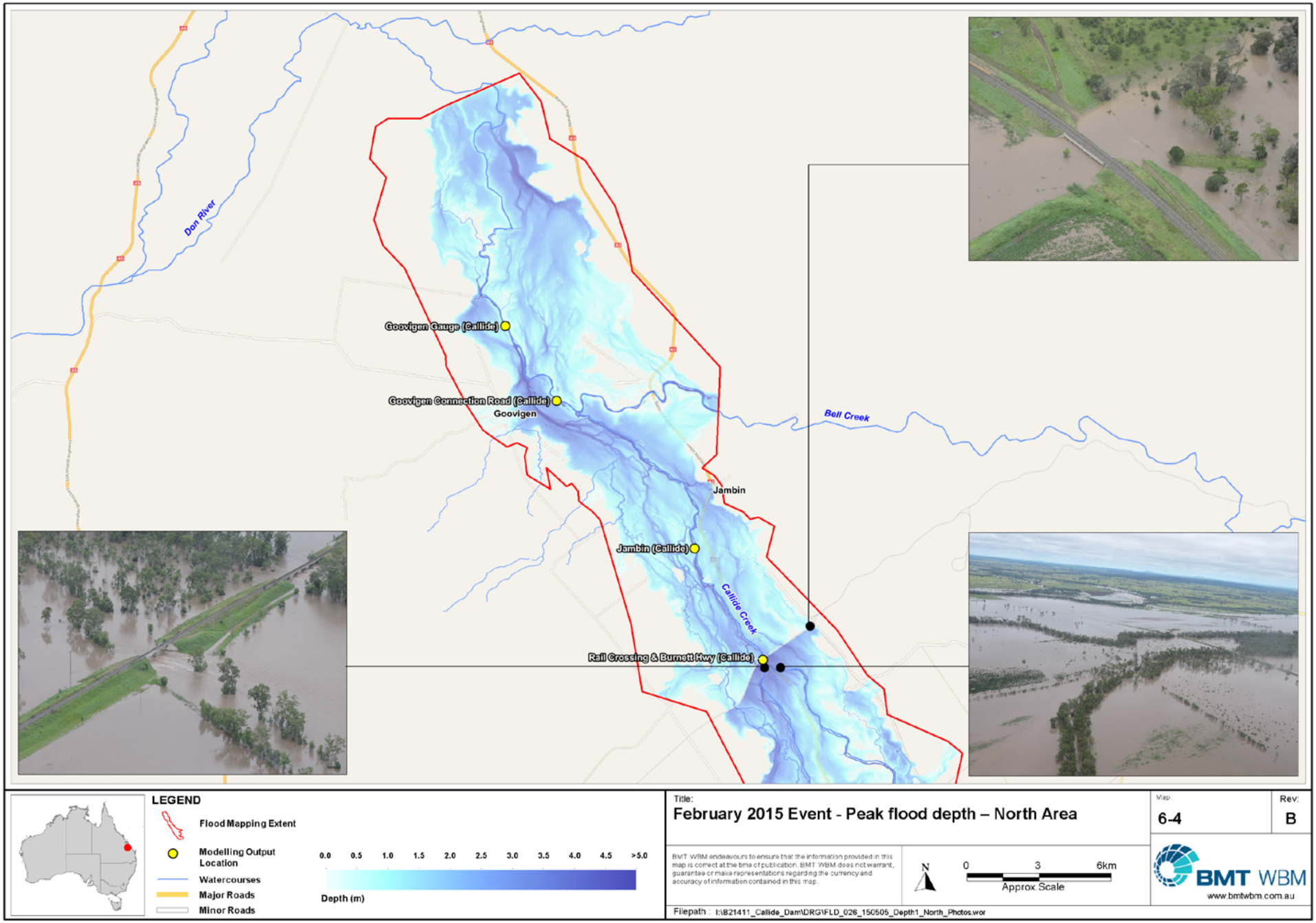
Filepath : I:\B21411_Callide_Dam\DRG\FLD_025_150505_Depth1_South_Photos.wor


Don River
Goovigen Gauge (Callide)
Goovigen Connection Road (Callide)
Goovigen
Bell Creek
Jambin
Jambin (Callide)
Callide Creek
Rail Crossing & Burnett Hwy (Callide)
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 >5.0
Depth (m)
Title:
February 2015 Event - Peak flood depth – North Area
Map:
6-4
Rev:
B
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0 3 6km
Approx.Scale
BMT WBM
www.bmtwbm.com.au
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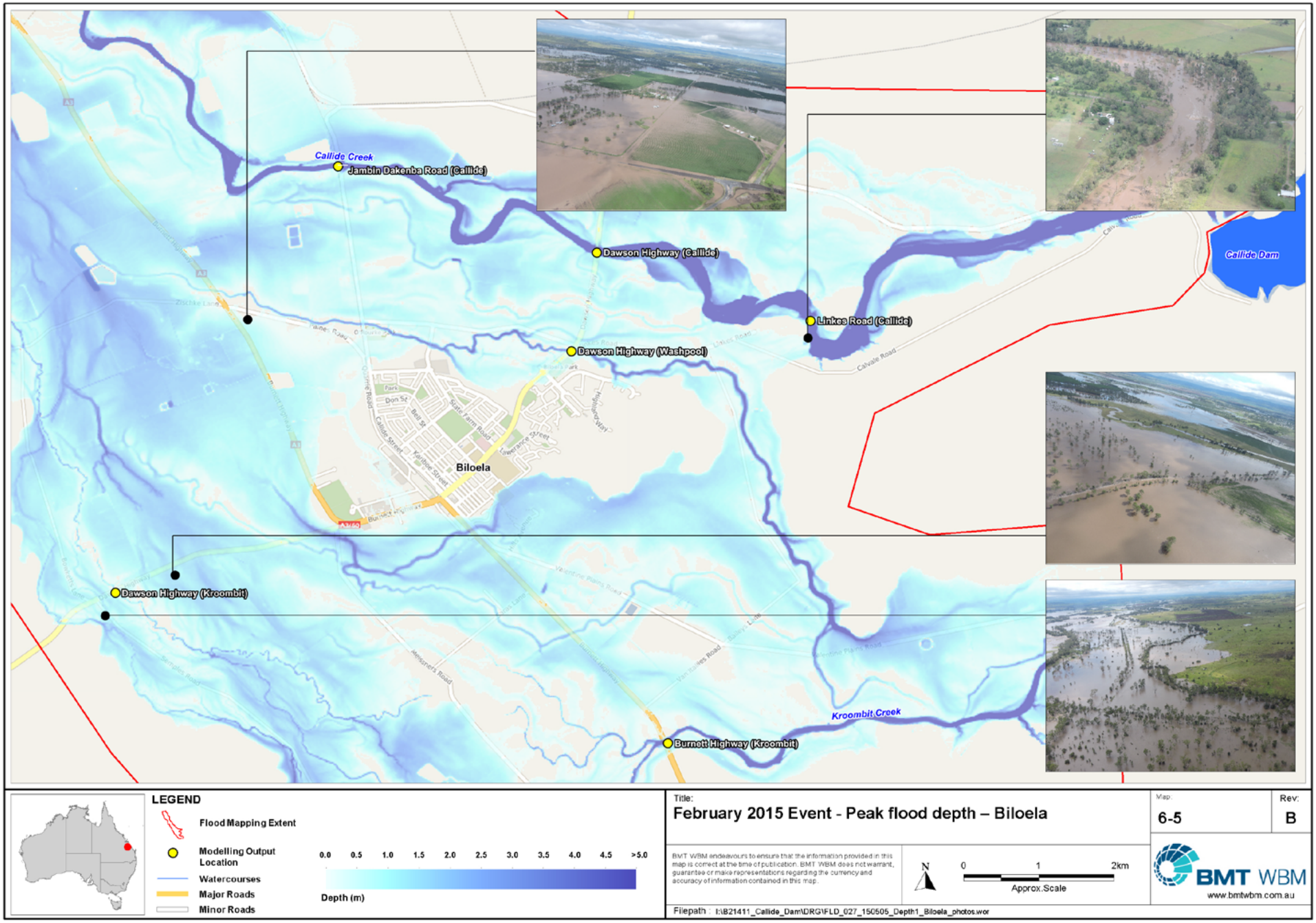
Callide Creek
Jambin Dakenba Road (Callide)
Dawson Highway (Callide)
Linkes Road (Callide)
Dawson Highway (Washpool)
Callide Dam
Biloela
Dawson Highway (Kroombit)
Kroombit Creek
Burnett Highway (Kroombit)
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 >5.0
Depth (m)
Title:
February 2015 Event - Peak flood depth – Biloela
Map:
6-5
Rev:
B
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N
0 1 2km
Approx.Scale
BMT WBM
www.bmtwbm.com.au
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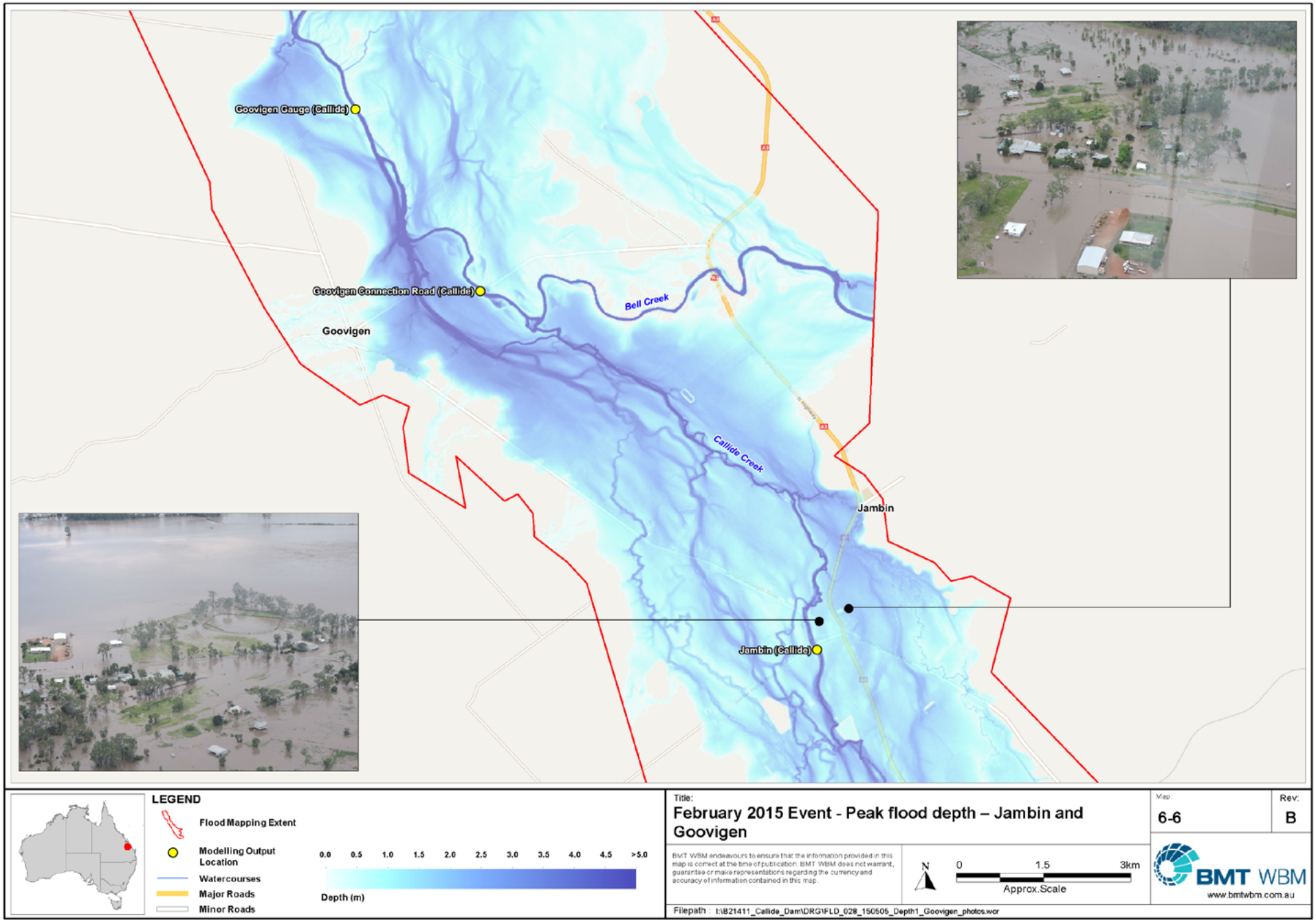
Goovigen Gauge (Callide)
Goovigen Connection Road (Callide)
Goovigen
Bell Creek
Callide Creek
Jambin
Jambin (Callide)
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 >5.0
Depth (m)
Title:
February 2015 Event - Peak flood depth – Jambin and Goovigen
Map:
6-6
Rev:
B
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N
0 1.5 3km
Approx.Scale
BMT WBM
www.bmtwbm.com.au
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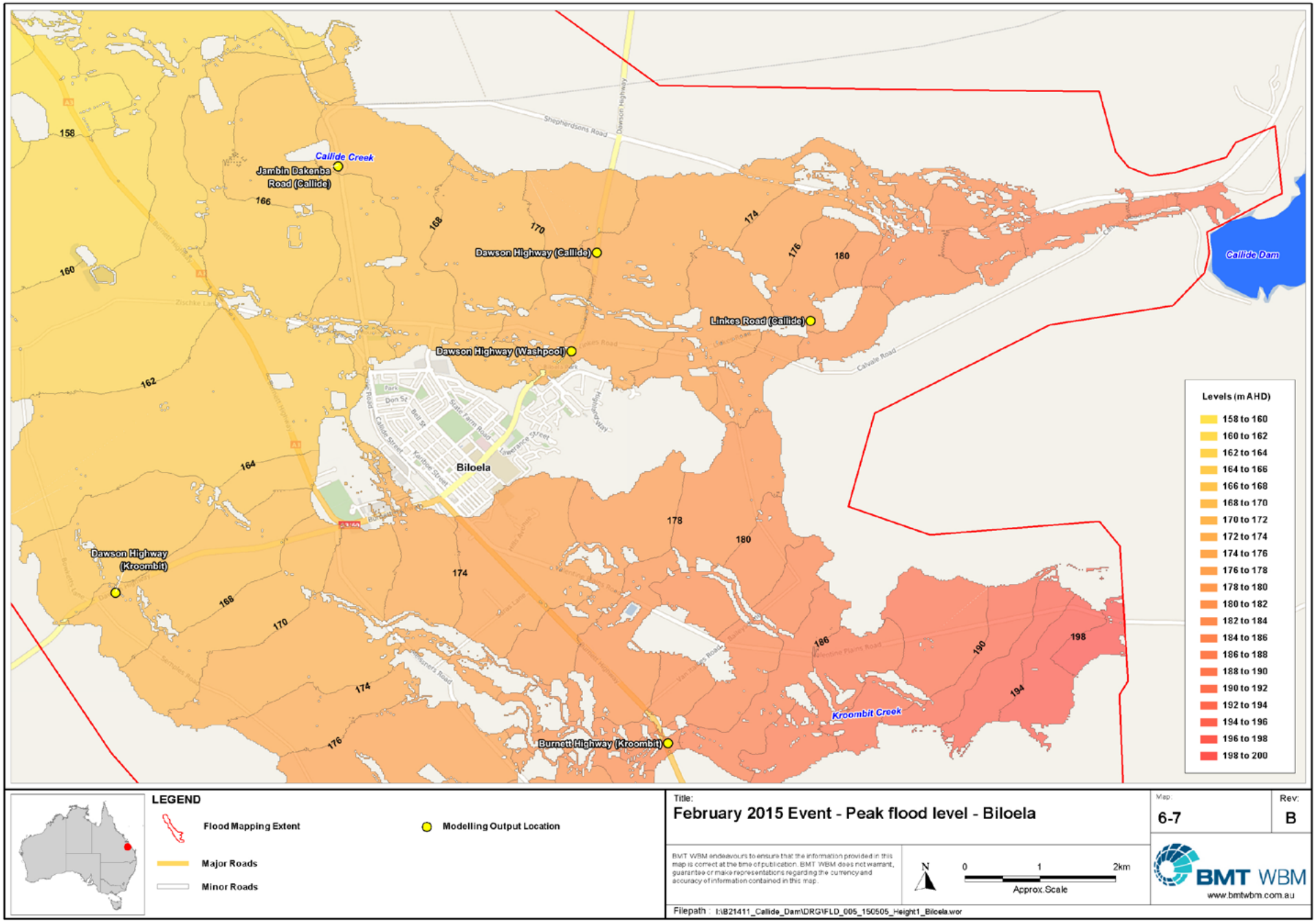
Callide Creek
Jambin Dakenba Road (Callide)
Dawson Highway (Callide)
Linkes Road (Callide)
Dawson Highway (Washpool)
Callide Dam
Biloela
Dawson Highway (Kroombit)
Kroombit Creek
Burnett Highway (Kroombit)
Shepherdsons Road
Dawson Highway
Calvale Road
Levels (m AHD)
158 to 160
160 to 162
162 to 164
164 to 166
166 to 168
168 to 170
170 to 172
172 to 174
174 to 176
176 to 178
178 to 180
180 to 182
182 to 184
184 to 186
186 to 188
188 to 190
190 to 192
192 to 194
194 to 196
196 to 198
198 to 200
LEGEND
Flood Mapping Extent
Modelling Output Location
Major Roads
Minor Roads
Title:
February 2015 Event - Peak flood level - Biloela
Map:
6-7
Rev:
B
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N
0
1
2km
Approx.Scale
BMT WBM
www.bmtwbm.com.au
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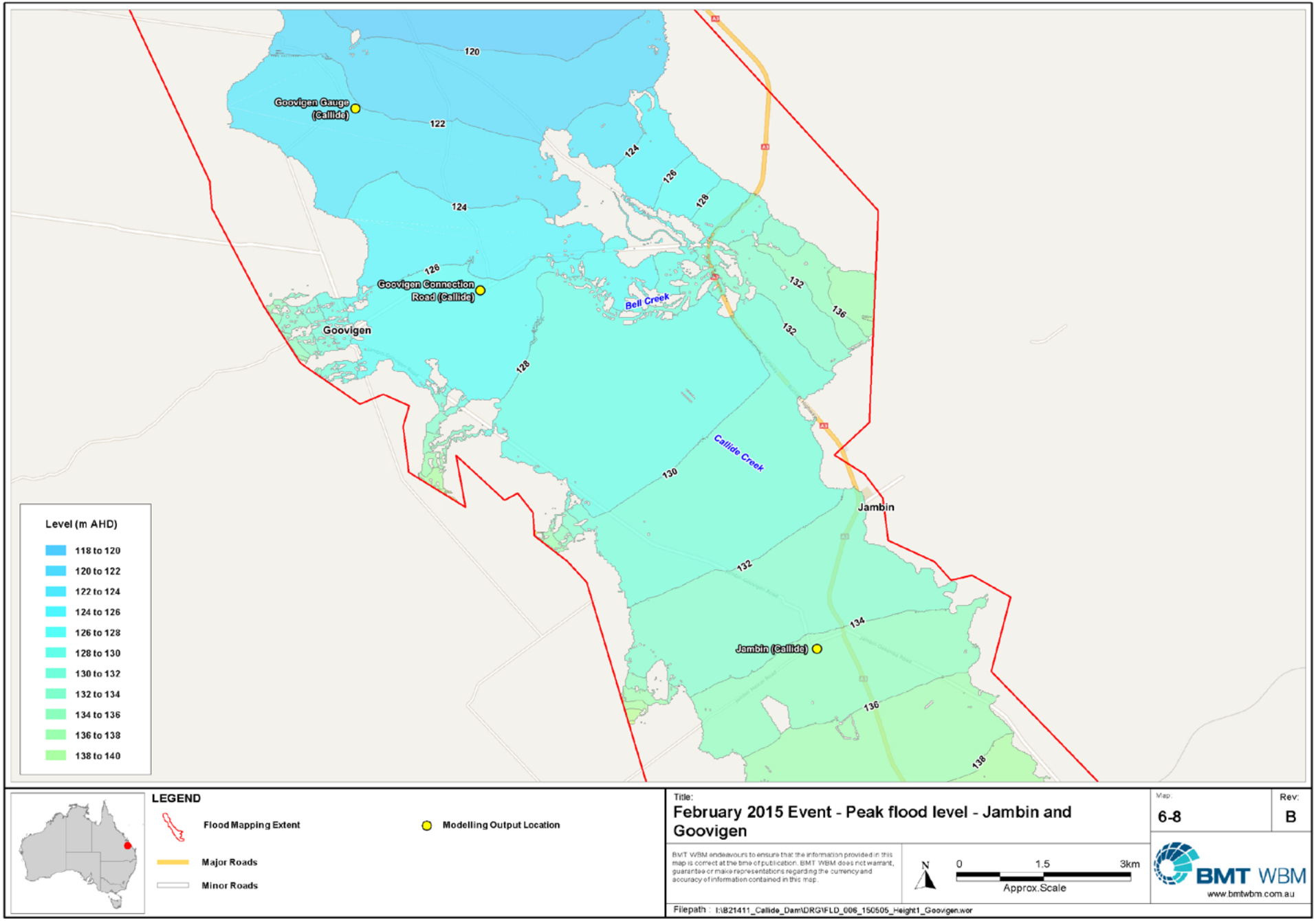
120
122
124
126
128
130
132
134
136
138
Goovigen Gauge (Callide)
Goovigen Connection Road (Callide)
Goovigen
Bell Creek
Callide Creek
Jambin
Jambin (Callide)
Level (m AHD)
118 to 120
120 to 122
122 to 124
124 to 126
126 to 128
128 to 130
130 to 132
132 to 134
134 to 136
136 to 138
138 to 140
LEGEND
Flood Mapping Extent
Modelling Output Location
Major Roads
Minor Roads
Title:
February 2015 Event - Peak flood level - Jambin and Goovigen
Map:
6-8
Rev:
B
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N
0
1.5
3km
Approx.Scale
BMT WBM
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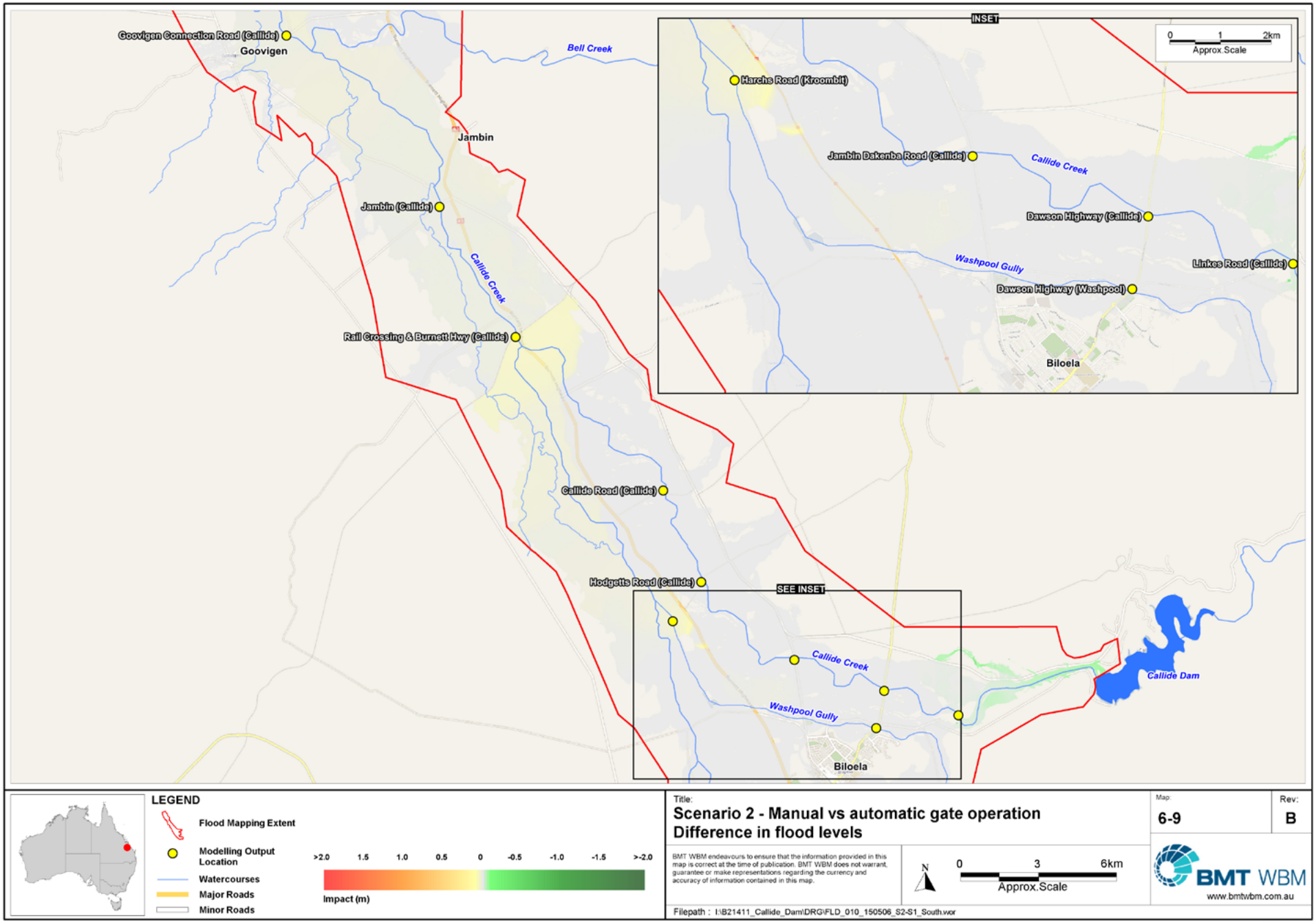
Goovigen Connection Road (Callide)
Goovigen
Bell Creek
Jambin
Jambin (Callide)
Callide Creek
Rail Crossing & Burnett Hwy (Callide)
Callide Road (Callide)
Hodgetts Road (Callide)
SEE INSET
Callide Creek
Washpool Gully
Biloela
Callide Dam
INSET
0 1 2km
Approx.Scale
Harchs Road (Kroombit)
Jambin Dakenba Road (Callide)
Callide Creek
Dawson Highway (Callide)
Washpool Gully
Linkes Road (Callide)
Dawson Highway (Washpool)
Biloela
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
>2.0 1.5 1.0 0.5 0 -0.5 -1.0 -1.5 >-2.0
Impact (m)
Title:
Scenario 2 - Manual vs automatic gate operation
Difference in flood levels
Map:
6-9
Rev:
B
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BMT WBM
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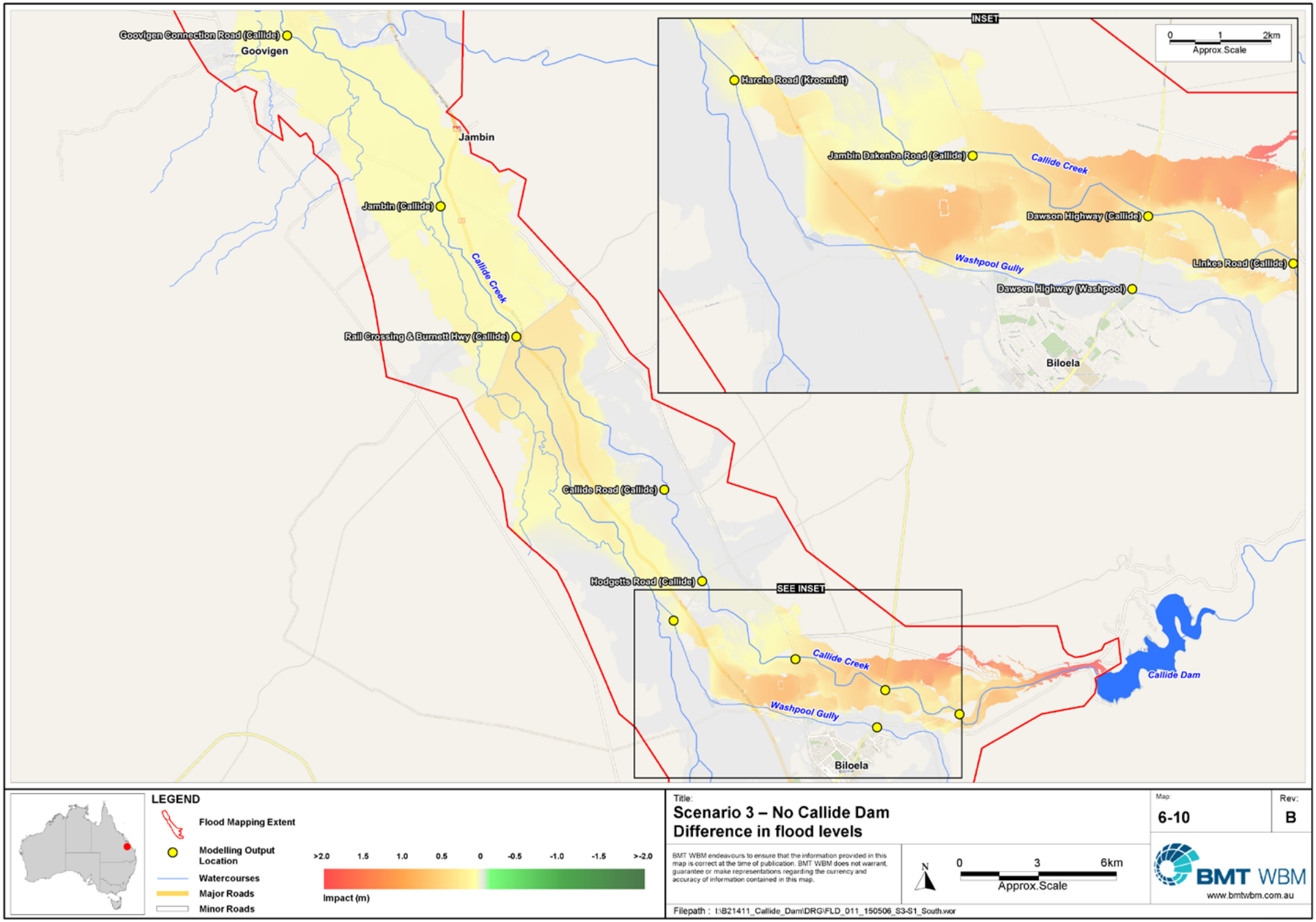
Goovigen Connection Road (Callide)
Goovigen
Jambin
Jambin (Callide)
Callide Creek
Rail Crossing & Burnett Hwy (Callide)
Callide Road (Callide)
Hodgetts Road (Callide)
SEE INSET
Callide Creek
Washpool Gully
Biloela
Callide Dam
INSET
0 1 2km
Approx.Scale
Harchs Road (Kroombit)
Jambin Dakenba Road (Callide)
Callide Creek
Dawson Highway (Callide)
Washpool Gully
Linkes Road (Callide)
Dawson Highway (Washpool)
Biloela
LEGEND
Flood Mapping Extent
Modelling Output Location
Watercourses
Major Roads
Minor Roads
>2.0 1.5 1.0 0.5 0 -0.5 -1.0 -1.5 >-2.0
Impact (m)
Title:
Scenario 3 – No Callide Dam
Difference in flood levels
Map:
6-10
Rev:
B
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Approx.Scale
BMT WBM
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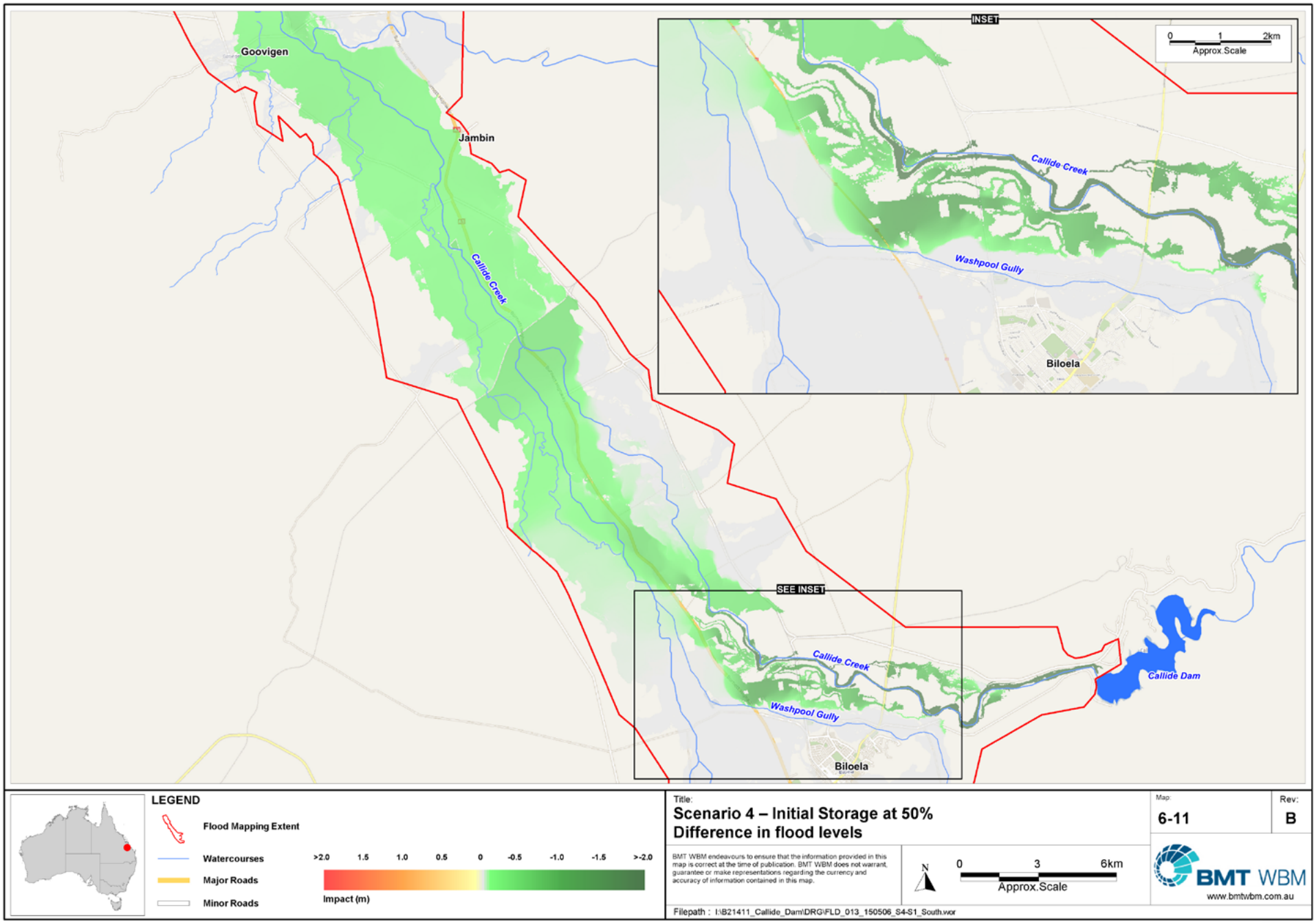
Goovigen
Jambin
Callide Creek
INSET
0 1 2km
Approx.Scale
Callide Creek
Washpool Gully
Biloela
SEE INSET
Callide Creek
Washpool Gully
Biloela
Callide Dam
LEGEND
Flood Mapping Extent
Watercourses
Major Roads
Minor Roads
>2.0 1.5 1.0 0.5 0 -0.5 -1.0 -1.5 >-2.0
Impact (m)
Title:
Scenario 4 – Initial Storage at 50%
Difference in flood levels
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.
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0 3 6km
Approx.Scale
Map:
6-11
Rev:
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BMT WBM
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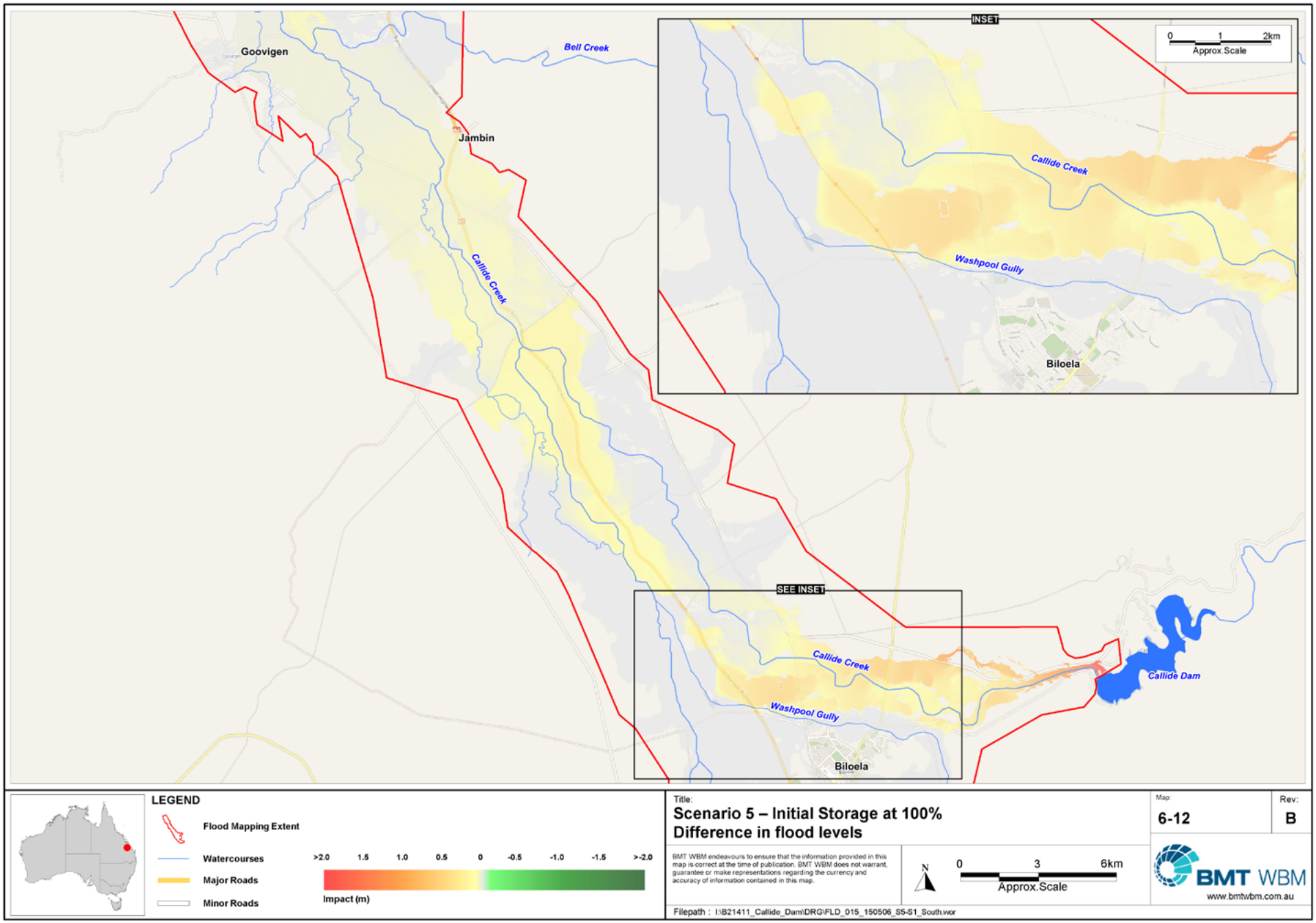
Goovigen
Bell Creek
Jambin
Callide Creek
INSET
0 1 2km
Approx.Scale
Callide Creek
Washpool Gully
Biloela
SEE INSET
Callide Creek
Washpool Gully
Biloela
Callide Dam
LEGEND
Flood Mapping Extent
Watercourses
Major Roads
Minor Roads
>2.0 1.5 1.0 0.5 0 -0.5 -1.0 -1.5 >-2.0
Impact (m)
Title:
Scenario 5 – Initial Storage at 100%
Difference in flood levels
Map:
6-12
Rev:
B
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Approx.Scale
BMT WBM
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Web www.bmtwbm.com.au

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Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

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Email denver@bmtwbm.com
Web www.bmtwbm.com

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Email london@bmtwbm.co.uk
Web www.bmtwbm.com

BMT WBM Mackay
PO Box 4447, Mackay QLD 4740
Tel +61 7 4953 5144 Fax +61 7 4953 5132
Email mackay@bmtwbm.com.au
Web www.bmtwbm.com.au

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Web www.bmtwbm.com.au

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PO Box 266, Broadmeadow NSW 2292
Tel +61 2 4940 8882 Fax +61 2 4940 8887
Email newcastle@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Perth
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Tel +61 8 9328 2029 Fax +61 8 9486 7588
Email perth@bmtwbm.com.au
Web www.bmtwbm.com.au

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PO Box 194, Leichhardt NSW 2040
Tel +61 2 8987 2900 Fax +61 2 8987 2999
Email sydney@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Vancouver
Suite 401, 611 Alexander Street
Vancouver British Columbia V6A 1E1 Canada
Tel +1 604 683 5777 Fax +1 604 608 3232
Email vancouver@bmtwbm.com
Web www.bmtwbm.com

Appendix H

SunWater response to Independent Review (Hydrologist report)

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Contact: [redacted]
Direct Line: [redacted]
Our ref: 15-000984/001 - #1724847
Your ref: CON/47995

SunWater Limited
Level 10, 179 Turbot Street
PO Box 15536 City East
Brisbane Queensland 4002
www.sunwater.com.au
ACN 131 034 985

28 May 2015

Office of the Inspector-General Emergency Management
GPO Box 1425, Mail Cluster 15.7
Brisbane QLD 4001

BY EMAIL: [redacted]

Dear Mr MacKenzie

2015 Callide Creek Flood Review
Response to the WBM BMT Hydrology Report as provided to SunWater 27 May 2015

I refer to the BMT WBM Hydrology Report, "Independent Review of Callide Creek Flooding, Tropical Cyclone Marcia, February 2015" as provided by your office on 27 May 2015. Thank you for the opportunity to review this and provide responses.

The attached table details SunWater's response to the draft BMT WBM Hydrology Report as received from the Inspector General Emergency Management on 27 May 2015.

The attached response is further to SunWater's preliminary comments that were provided on 26 May 2015 in relation to preliminary draft model calibration and outcomes of modelling carried out by BMT WBM.

This letter provides comments with respect to other matters identified in relation to the full revised hydrology report received 27 May 2015 and are not specific to the model calibration and outcomes as noted above.

The response is set out in tabular format to allow for consideration of SunWater's comments in relation to specific paragraphs, sentences or phrases within the Report.

Please contact SunWater's project manager for the Callide Review, [redacted], on (07) [redacted] via email [redacted] if SunWater can be of any assistance or offer any further explanation in relation to these matters.

Yours sincerely

Tom Vanderbyl
General Manager
Bulk Water and Irrigation Systems

Att(s)

SunWater's Responses to Draft WBM BMT's Hydrology Report as provided by the Inspector General Emergency Management on 27 May 2015

SunWater's Responses to Draft WBM BMT's Hydrology Report as provided by the Inspector General Emergency Management on 27 May 2015

Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
Gate Opening Time:				
1	Executive Summary, page (i), 2nd paragraph	"It is estimated that Just before 20:30 on Friday 20 February 2015, the gates automatically opened in response to the rising water level in the dam."	SunWater has provided separate detailed comment regarding gate opening time in SunWater's Response to the draft Review Report as provided by IGEM 18 May 2015, as issued by SunWater 21 May 2015 (refer to "Gate Opening" item). The time stated is based on a theoretical estimation, considering storage levels as recorded at the headwater gauging station, which is located approximately 370m upstream of the spillway in the direction of flood flows. This does not account for the flood slope effects (level difference at any given time) between the dam headwater gauging station and the location of the spillway and gates, and similarly considering flows entering the dam as recorded upstream at the 96k gauging station. This would result in a difference in estimated level at the gates (i.e. lower), compared to the headwater gauging station, as flood waters are entering the dam. This would result in calculation of a later gate opening time. Based on SunWater's theoretical estimations from storage levels, the Callide Dam gates opened automatically sometime between 8:30pm and 8:45pm. This also assumes that the actual gate opening occurred exactly in accordance with the design gate opening water level, and that there were no other wind or wave effects from the cyclone that may have impacted on the accuracy of gauging station measurements. SunWater suggests that when hypothesizing about the precise gate opening time, equal if not greater weight should be given to the recorded observation of the onsite operators. Between 8:37pm and 8:42pm, SunWater's onsite operators are logged as reporting via a phone call at the time: "*believes there may be a rumble in the spillway now. Assume it is the gates opening.*" This is the earliest evidence of when the gates may have commenced opening. The first positive confirmation that the gates had actually opened was when SunWater's onsite operator is logged as hearing the sound of the water flowing down the spillway at 8:51pm	Suggest more accurate words as follows replace the references in column 3: **"Based on theoretical estimations from storage levels, the Callide Dam gates opened automatically sometime after 8.30pm although the exact time of gate opening cannot be confirmed as there is no equipment connected to the gates that records this information. SunWater's operators reported from onsite that they believed hearing a rumble in the spillway between 8:37pm and 8:42pm which they assumed at the time to be from the gates opening."**
	Executive Summary, Page (iii), 1st dot point at top	"At 20:28 the water level in the dam reached the theoretical middle gate trigger level of 216.260m. It is expected that the middle began to open at this time. It is possible the gates could have opened slightly earlier or later, depending on the exact configuration of the gate opening mechanism."		
	Executive Summary, Page (iii), 2nd dot point	"… 11 minutes after the gates are estimated to have opened at 20:28."		
	Conclusions, Page 114, 2nd dot point	- text similar as above		
	Introduction, Page 3, 2nd paragraph	"It is estimated that just before 20:30 on Friday 20 February 2015, the gates automatically opened in response to the rising water level in the dam."		
	Event Description, Page 37, Section 4.1.1	"At 20:28 the water level in the dam had exceeded the middle gate trigger level of 216.260m. It is expected that the middle gates began to open at this time."		
	Event Description, Page 39, Figure 4-1	"Friday 20:28; 216.26m – Middle pair of gates start to open." and "Friday 20:35; 216.41m – Outer pairs of gates start to open."		

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Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
Modelling Predictions:				
2	Executive Summary, Page (ii), Dot point at bottom	"An error in the calculation of the rainfall required to fill the dam resulted in a delay in prediction by SunWater that the dam would exceed the full supply level and begin to discharge into Callide Creek during the event. Based on the current operational rules associated with the dam, this would not have had an effect on downstream flooding."	SunWater accepts that there was an initial calculation error for preliminary predictions as made early on 19 February 2015. However, these calculations were not an input to SunWater's spreadsheet model and were not a factor in the decisions made by SunWater's dam safety technical decision maker. SunWater continued with observing dam levels and inflows, as well as updating its spreadsheet model for forecasting storage level increases based on measured inflows, to provide guidance in accordance with SunWater's notification requirements under the EAP. SunWater provided a number of warnings on 20/05/2015 to the LDMG regarding possibility of when the dam may spill, and it is noted that the LDMG attempted to issue a warning at 4:51pm on 20/05/2015.	Suggest that the dot points on page (ii) and page 114 be updated as follows: **"Although there was an initial calculation error for preliminary predictions made early on 19 February 2015, these calculations were not an input to SunWater's spreadsheet model and were not a factor in the spreadsheet forecast modelling that guided decisions made by SunWater. Based on the current operational rules associated with the dam, this would not have had an effect on downstream flooding."** Also suggest that 1st para on page 107 be updated as follows: **"From review of the communication logs, there appears to have been an error made during calculation of the rainfall and runoff required to cause a spill from Callide Dam.** **… However should the correct rainfall depth have been assessed on 19 February, then SunWater may have considered it more likely that the dam might spill. Despite this, SunWater's view is that this information would not have changed their operations during the event."**
	Conclusions Page 114, 1st dot point	- text identical as above		
	7.2.1 Page 107 1st paragraph	"From review of the communication logs, there appears to have been an error made during calculation of the rainfall and runoff required to cause a spill from Callide Dam. … However should the correct rainfall depth have been assessed on 19 February, then SunWater would have known there was a high likelihood that the dam would have spilled."		

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Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
3	Section 7.2.3 Page 97 Bottom paragraph	"Whilst the spreadsheet model appears to have a miscalculation in the depth of runoff required to cause Callide Dam to spill, there is no reference to a simulation of the URBS model, with application of the 200-400mm rainfall forecast by the BoM throughout the event. Review of the spreadsheet model or URBS model has not been undertaken for this review, so it is unknown whether the URBS model would have better informed the operators."	This is incorrect. Forecast rainfall depth is not an input to SunWater's spreadsheet model.	Statements throughout the report that imply that the spreadsheet model used forecast rainfall as an input arte incorrect and therefore must be removed.
	Executive Summary, Page (iii), 3rd dot point, 4th sub-dot point	"Models and spreadsheets used for flood forecasting – the spreadsheet model used appears to be in error, and the more comprehensive hydrologic models are not currently fit-for-purpose."		
	Key Findings Page 117 Dot point in – Models and spreadsheets	"The spreadsheet used for calculation of rainfall and runoff required to fill the storages appears to be in error."		
4	Section 6.7 Page 106 1st dot point	"Improved prediction methods, including rainfall forecasts, models and spreadsheets would have predicted Callide Dam would have been likely to spill at least 2 days in advance of the actual spill."	This is incorrect and inconsistent with information from the Bureau of Meteorology on their "flood response timeline" (presented at ANCOLD on 28 May 2015) which indicates that there is insufficient certainty around rainfall forecasts two to three days in advance of an event. In this time window, BOM typically will only issue a flood watch that is non-specific with respect to location. Specific flood warnings are typically only issued up to 12 hours in advance of an event. In the case of the flood event in the Callide on the 20th February 2015, BOM's first flood warning was issued after 10pm.	Dotpoint 1 on page 106 is incorrect and must be deleted.

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Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
Annual Exceedance Probability:				
5	Executive Summary Page (i) 1st paragraph	"In the upper reaches of the Callide and Kroombit catchments, the rainfall is estimated to have a return period of between 200 and 500 years. The highest intensity rainfall was recorded at the Kroombit Tops gauge, having a return period of approximately 500 years.	SEQ Water first identified and recorded 200-500 year rainfall leading to 10,000 year design flows and levels at North Pine Dam in 2011. Design levels of the order of 5,000 year AEP were observed at Callide in 2015, with 200-500 year AEP rainfall. SunWater can confirm that the flow experienced at Callide in 2015 was equivalent to the original Probable Maximum Flood estimate* when the dam was constructed around 1965 showing just how extreme an event this was. It is also comparable with the maximum recorded and observed for extreme events per catchment area in the world using data from the International Association of Hydrological Sciences (IAHS). * (As per the 1960's Callide Dam Design (by A. E. Wickham))	The paras in column 3 are incorrect. The hydrology report should emphasise the uncertainty and differences regarding the calculation of annual exceedance probability for this event, depending on recorded rainfall or streamflows or dam storage level increases (inflow volumes). The hydrology report should also cite references to confirm that this was clearly an extreme event and that calculations in the range between a 200 year and 5,000 year return are plausible.
	Section 1.5 Page 16 Last dot point	"Contrary to media reports and early suggestions by SunWater, the flood event is not considered to have a 10,000 year return period. Rainfall observations suggest the return period across the Callide Dam catchment varied between a 200 year and 500 year return period event.		
	Section 4.4.2 Page 68 Last paragraph	"The EAP identifies water levels in the dam having exceeded 217.11m ADH as having a 10,000 year return period. … Based on the maximum rainfall intensity having a 200-500 year return period, it is unlikely the event was a 10,000 year magnitude return period.		

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Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
Assessment of the extent to which recommendations of the 2013 review of Callide Dam operations where implemented:				
6	Table Page 115 Item 3	Manual method of controlling the gates: "There have been no changes to the control infrastructure as recommended. This would have affected operations during the February 2015 event, but would not have significantly affected flooding"	This is not true. SunWater's procedures were changed substantially. To simplify operations and reduce the risk associated with gate oscillation the gate operation sequence was limited to only single pair manual operation which is able to eliminate gate "hunting" phenomena. This also enabled full opening of one pair of gates. Previously with all three pairs opened concurrently which was difficult to control and limited the maximum gate opening for manual operation. The flood operations manual were revised to include a transition to automatic procedure.	The statements in column 3 are incorrect and should be amended to acknowledge the work as carried out.
	Table Page 115 Item 4	Modelling of inflows, and the rating curve for the 96km gauging station for high flows. Improvements in instrumentation and modelling: "No improvements to instrumentation and modelling have been implemented. Failure to implement this recommendation resulted reduced warning time to downstream residents."	The rating curve for the 96km gauging station was extended immediately following the 2013 flood event to include higher flows - including survey of the peak 2013 heights, flood slope & cross sections. The flood model spreadsheet was also enhanced in 2013 to include measured rainfall and unit hydrograph techniques. Other activities are also in progress including working with BoM to establish access to rainfall alert station data. Budget has also been identified to establish two rain and one river height station, in addition to the existing network. SunWater is also developing an URBS model for the catchment, however this is currently of limited use without detailed rainfall stations and history of data to support it.	The statements in column 3 are incorrect and should be amended to acknowledge the changes made since 2013.
	Table Page 115 bottom item (not numbered)	"There are also a number of minor recommendations contained within the body of this report." "Little or no progress."	The recommendations related to this item were recommendations for DEWS, not for SunWater.	Responsibility for recommendations should be clarified.
	Recommendations Page 119 Item G1	"Implement recommendations from Review of Callide Dam Gate Operations in the January 2013 Flood Event, where not otherwise noted here."	SunWater has responded to DEWS in February 2015, advising of significant progress or completion of the recommendations that were SunWater's responsibility.	The recommended work as carried out, or in progress or completed, needs to be acknowledged.

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Item No.	Hydrology Report Reference	Statement / Content in Hydrology Report	SunWater Comment	Suggestion
Other General Corrections:				
7	Executive Summary, page (ii), Figure 1	Text box in the figure aligned with 22/02/2015 midday timing on the graph, states "Saturday 14:00, Test pump turned off and middle pair of gates closed" Similar references to this figure as included elsewhere in the report.	This should be "Sunday", not "Saturday", in accordance with when the gates actually closed.	Correction should be made as noted
8	Section 2.2.5 Page 31, 5th last dot point	"SunWater has the responsibility for warnings within a 10km radius of the dam, and Council outside this area"	The 10km downstream notification area is measured by distance downstream (creek distance), as it relates to duration of time for flow, and is not measured by radius from the dam. The area applicable is also limited to within a determined inundation area (i.e. by level).	Suggest words be changed to: **"SunWater has the responsibility for notifications within a 10km downstream distance from the dam (measured in terms of AMTD along the creek) and Council for warning the entire disaster area."**

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