[redacted]

From: Doongul Creek [redacted]
Sent: Thursday, 26 May 2011 2:59 PM
To: Info Flood Commission
Cc: Admin Flood Commission
Subject: FW: Lenthalls Dam QLD Gate Failure to Operate as Designed. Increased Flood Risk - QLD Govt inaction 2010/ 2011 flood events.
Attachments: Lenthalls Dam Gate Failure Research Paper2310087.17 Final.pdf.DRF; GilbertSutherland_NEW (2).pdf.DRF; Letter Lenthalls Dam 27032010 to the Honourable Stephen Roberston Minister for Natural Resources Mines Energy Minister for Trade.pdf.DRF; Emergency Action Plan escalation protocols Donna & Esther Allan & Family.pdf.DRF; Lenthalls Dam Gate assistance required- causeway at Logbridge Creek gouged out!.pdf.DRF; Lenthalls Dam Gate assistance required- causeway at Logbridge Creek gouged out!2.pdf.DRF; Peter Allen DAM SAFETY RE EAP Peter Scott Wide Bay Water.pdf.DRF; Rainfall & Dam Level April 2011.pdf.DRF; Report on Operation of Lenthalls Dam Gates.pdf.DRF; Report on Operation of Lenthalls Dam Gates cont..pdf.DRF; Report on Operation of Lenthalls Dam Gates cont.pdf.DRF

Please note: I have spoken to [redacted] regarding this submission who advised me that even though it was late in the process it was still worthwhile making a submission.

To Whom it May Concern,

Lenthalls Dam (QLD), Dam Gate Failure to Operate as Designed Increased Flood Risk, gates faulty since 2007 inaction by State Government / Local Government and Wide Bay Water Corporation (WBWC).

My rural property is upstream of Lenthalls Dam on the Burrum River in QLD (nearest township Howard – GPS coordinates [redacted]. In 2007 the Local Water Corporation Wide Bay Water (owned by Fraser Coast Regional Council) installed dam gates to increase the height of the water storage, these gates were supposed to fall automatically to reduce flood height levels upstream.

Wide Bay Water Corporation as the Lenthalls Dam developer was seeking to increase its urban water supply and has a commercial charter to do this. Fraser Coast Regional Council approved the development and DERM was the key referral agency for Dam Saftey. The Dam was approved by the staff of Peter Allen, Director Dam Safety DERM, in spite our protestations to the then minister in 2004 and later that we were concerned for our safety. The original plan had been for our homestead to be moved to high ground away from the flood risk but the Fraser Coast Regional Council and Wide Bay Water Corporation had then refused and the QLD Government in spite of letter after letter did nothing to prevent the danger we were now exposed to. **Please see the attached findings by experts Gilbert and Sutherland showing the risk**.

We can evidence the number of times we wrote to the then Minister Stephen Robertson and his staff member [redacted] and later Ministers regarding our concerns, we have also written to Premier Anna Bligh to no avail. The State in spite of being the referral and approval agency denies any responsibility or need to take action.

Since 2007 when the gates were installed they have failed to operate as designed in almost all relevant rain events, causing risk and confusion to ourselves. One of the recent faults (confirmed by WBWC) was the siltation of the inlet valves which is I believe the most common/ endemic fault with the infrastructure overseas. Many other problems have since occurred.

After much enquiry including many Freedom of Information and Right to Information Searches with the Dam Regulator (Department of Environment and Resource Management – Dam Safety Unit), Wide Bay Water Corporation has written to us admitting the risks posed to us with respect to upstream flooding, being cut off, our lack of access and offered to buy more land. This is inequitable as the land (now flood prone) would be worth less than the value of our house and stockyards etc when we build them on high ground.

We have written back and suggested that Wide Bay Water pay for our relocation with no response from them.

Since December 12 2010 – We have been subject to mid night and other calls from the Wide Bay Water staff (as required by the Emergency Action Plan EAP) alerting us to the fact that for various reasons (on different occasions) the gates aren't working and we have been issued evacuation notices. On one occasion on the 28th this caused panic and confusion as the staff member from WBW called long before the water reached evacuation levels and repeat calling frightening my partners mother to such an extent that the evacuation proceeded with out winches / torches and moving of equipment / dropping of gates for cattle etc. To get out of the farm house away from the risk it is necessary to cross flooded causeways and further increase the risk to our selves. Expert Neil Collins has explained that this is absolutely unacceptable and this was our position on the 28th December 2010 and an earlier occasion in late 2010.

The situation is extremely distressing. As you can see from the attached detail provided by Gilbert and Sutherland the risks to us are now very high. We are very lucky December 2010 and January 2011 did not provide the weather events on the Burrum experienced in Brisbane or we could have had a fatality.

Prior to the Dam being built our farm house and improvements had been above the level of all major flooding including that of the 1950s, we are in an isolated location and it is imperative that we are above flood levels as rescue is highly unlikely to be possible (Peter Allen DERM confirmed this verbally on site

visit).

Peter Allen DERM has also confirmed that our situation is rare as the dams he has been involved with at contruction or level raising have all involved moving affected parties upstream out of harms way before the infrastructure is installed/ built.

We have hired engineers who have used WBW data (undertaken by GHD obtained under Right to Information/ Freedom of Information search) to confirm the risks we now face.

In spite of all the evidence and confirmation that they are aware of the risks Peter Allen Director Dam Saftey and the officer responsibility for Water Supply (Safety & Reliability) Act 2008 and the Water Act 2000 claims his hands are tied to take action to eliminate our risk and State Ministers and the local council do nothing. It seems that DERM regulations appear that they are actually either incapable or incompetent to ensure safety in spite of being responsible for that Act and being the referral agency who approved the construction of Lenthalls Dam.

More recently even after these events and after the Cheif Executive Officer [redacted] admitted that maybe the current Emergency Action Plan for the Dam is inadequate, he admitted that the action plan had not been followed on a number of occasions and given our extreme risk Wide Bay Water had breached the operational requirement in the emergency action plan and not contacted us as waters rose in rain events.

We no longer know how to resolve this matter before any one gets hurt, we cannot seem to make the Dam Developer see the risks outline in the attached material. This issue has taken a terrible toll on our family. Do we have to wait until there is a fatality for the state to fix this problem and even then would they act given past inaction?

Thank for your taking the time to read my submission.

Kind regards

Esther Allan
[redacted]

Please see below further emails (Weather Bureau Lenthalls Dam River Height Emergency Action Plan see below email 1 & 2).
Email 1.

From: [redacted] [mailto [redacted]widebaywater.qld.gov.au]
Sent: Monday, 27 December 2010 8:55 AM
To: [redacted]
Cc: 'Allen Peter'; Peter Care; [redacted]
Subject: RE: lenthalls river heights EAP

Hello Esther,

The chronology in brief last evening is that [redacted] rang the primary mobile number to talk to [redacted] around 6.30 pm and sent a text to the secondary mobile thereafter (he rang the Brisbane number around the same time just as a further back up and I suspect that is the 10pm log?) [redacted] called back for a briefing from [redacted] before 7 pm.

As I understand [redacted] then made contact again around 8.30 via both mobiles and the same again around 9.30 pm.

The Dam peaked as per our telemetry at 2.45 am at 26.420 ([redacted] was on site nearly all night thus is at home trying to get some sleep) yet the BOM site provides 26.6.

In terms of the variance the BOM site is about 200mm higher than our electric equipment shows thus provides a buffer.

The four gates are down but as previously advised G5 isn't and we don't expect it will come down at this stage.

Clearly the way the forecast is the levels are going to rise again and perhaps substantially in the next 48 hours.

Regards.

[redacted]
Chief Executive Officer
Wide Bay Water Corporation
Phone [redacted]
Mobil
Email: [redacted]widebaywater.qld.gov.au

From: [redacted]
Sent: Monday, 27 December 2010 8:20 AM
To: [redacted]
Cc: 'Allen Peter'
Subject: RE: lenthalls river heights EAP

HI Peter,

I have just received a very odd – electronic message – to my Brisbane number – that said it was sent at 10pm last night – this would be of little or no help to any one at the farm. The phone ringing at 8.04 this morning – in Brisbane. Who sent that ? This is new?

Has any one followed procedure last night when the water was 350mm over? Further the anomalies in the plotting are really odd – See below for the same time frames. If the lower plot belongs to FCRC it should be more accurate than DERM given that FCRC feed into BOM and DERM?

Yet you tell me plot number 1 issued at 5.41 and being data supplied by FCRC is wrong and that the DERM below is correct? As I understand it the 5.41 would be more accurate as it is FCRC telemetry being fed in.

The long and the short of all of this – is that we are trying to gauge road conditions locally for example and family safety and need to make us use of the property. We have stock to feed etc. The sort of data we are receiving seems unreliable/ contradictory and delayed – there fore unusable.

Regards

Latest River Heights for Burrum R at Lenthalls Dam *

Issued at 7:41 am EST Monday 27 December 2010
About river heights plots | About this Plot
Station details: **Station Number:** 540267 **Name:** Burrum R at Lenthalls Dam * **Owner:** DERM:137303

Data from the previous 4 days.

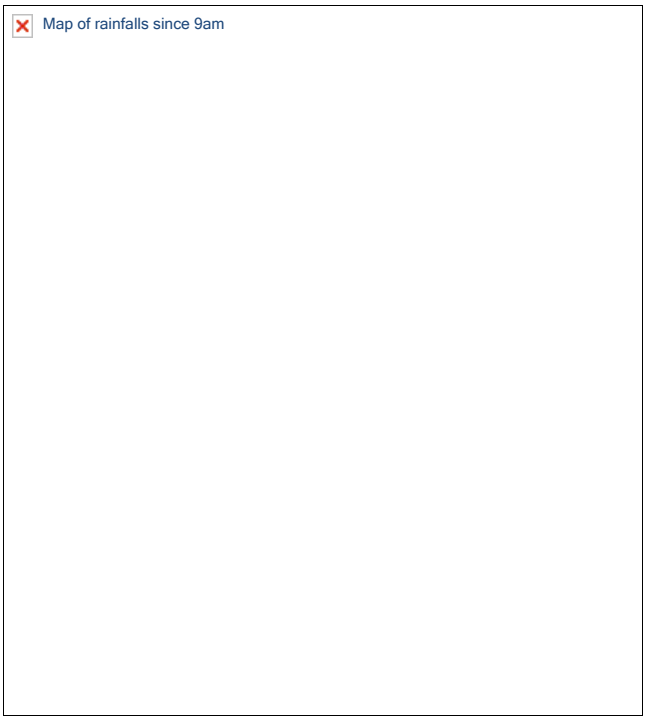
Plot of River Height Observations

Data as Table | Previous Station | Next Station | Back to Bulletin

About this plot

1. The river height data is the latest available operational data provided for flood warning purposes and has not been quality controlled.
2. Stations marked with * or # indicate that the data is provided from automatic equipment.
3. Stations marked with * are Telephone Telemetry Devices and are nominally polled once a day and more often during floods.
4. Stations marked with # are ALERT Radio Telemetry and report every 3 hours and more often when the water level changes.
5. All river height reports are in metres and are shown in local time.
6. Heights or depths above/below roads, bridges, dam spillways and weirs are given as a guide only. For road open/closed information, see the RACQ website.
7. This product includes data made available to the Bureau by other agencies. Separate approval may be required to use the data for other purposes. Refer to Listing of Operating Agencies for Station Ownership.
8. Where data is supplied from a Department of Environment and Resource Management (DERM) Monitoring Site, please follow this link to get advice on data use and copyright.
9. For other Station details: Flood Classifications, Road Crossings, Survey/AHD Details, Maps

Map of rainfalls since 9am



From: [redacted] idebaywater.qld.gov.au]
Sent: Sunday, 26 December 2010 6:25 PM
To: [redacted] 'peter.allen[redacted]; [redacted]
Cc: [redacted] 'Sue.Brooks[redacted] Peter Care
Subject: Re: lenthalls river heights EAP

Hello Esther,

I have just sent a text to [redacted] to ring you which he was eminently about to . The levels on the bom site are higher than our telemetry shows hence the slight mismatch in timing. He has been watching this closely all day as you would expect.

Regards.

From: [redacted]
Sent: Sunday, December 26, 2010 05:59 PM
To: 'Allen Peter' [redacted]
Cc: [redacted] < [redacted]>; Peter Scott; 'Sue Brooks' [redacted]>
Subject: lenthalls river heights EAP

Peter,

We received a call this morning telling us the river height was rising, we were told we would get a call when the dam level was 350mm above RL 26 – We have not received any contact since this morning, do you know what is going on?

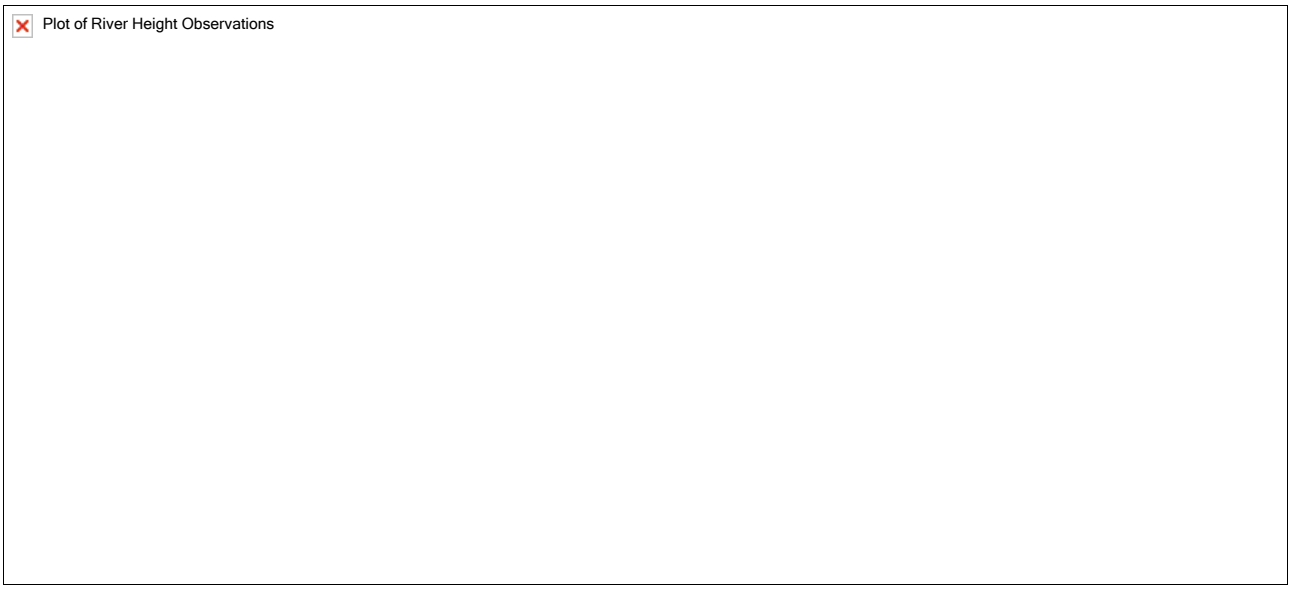
Regards

Esther

Latest River Heights for Burrum R at Lenthalls Dam

Issued at 5:41 pm EST Sunday 26 December 2010
About river heights plots | About this Plot
Station details: **Station Number:** 040906 **Name:** Burrum R at Lenthalls Dam # **Owner:** CBM/FCRC:137903

Data from the previous 4 days.



Data as Table | Previous Station | Next Station | Back to Bulletin

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This email has been scanned for Wide Bay Water by the MessageLabs Email Security System.

Email 2.

From: [redacted]
Sent: Monday, 27 December 2010 8:20 AM
To: [redacted]
Cc: 'Allen Peter'
Subject: RE: lenthalls river heights EAP

HI [redacted]

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Data as Table | Previous Station | Next Station | Back to Bulletin

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Cc: @iprimus.com.au'; 'Sue.Brooks; Peter Care
Subject: Re: lenthalls river heights EAP

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Regards.

From: @bigpond.com]
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Subject: lenthalls river heights EAP

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Station details:Station Number: 040906 **Name:** Burrum R at Lenthalls Dam # **Owner:** CBM/FCRC:137903

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Data as Table | Previous Station | Next Station | Back to Bulletin

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LENTHALLS DAM GATES FAILURE 2008 – A CASE STUDY IN GATE RELIABILITY AND HUMAN FACTORS, FAILURE TO IMPLEMENT RISK MANAGEMENT PROCEDURE.

[redacted]

Abstract

The city of Hervey Bay is a growing tourist community that is located a comfortable 3.5 hour drive north from Brisbane. To meet growing water demands in the community, Wide Bay Water Corporation (WBW) required the raising of its water supply – Lenthals Dam.
Queensland Dam owners are aware of their obligation to manage their dams to minimise adverse environmental impacts and public risk.

In 2002 [redacted] CEO Wide Bay Water Corporation, KD Murray and Allan Crichton Principal Dam Engineer GHD published a study of options for the increase of Lenthals Dam, the paper is titled Raising Lenthals Dam – A Case Study in New Technology and the Environment. This publication referenced the final choice chosen for the dam increase; 2m crest gates to raise the full supply level to AHD26. A gated system was seen as beneficial in meeting post winter flood objectives[1].

The dam is assessed as Failure Impact Assessment Category 2, population at risk 270 not including upstream population and upstream state forest recreational users. The relevant standard is QLD Dam Safety Management Guidelines February 2002.
The Lenthals Dam Crest gates were installed in 2007 and failed to operate as designed from January 2008. In February 2008 high rainfall led to a moderate flood event, all gates inoperable. The gates failed to lower to release flood water.
In this incident, manual operation of the gates did not occur it is believed the mechanism was not operable. The operating authority failed to implement the Emergency Action Plan and failed to evacuate flood impacted upstream sites. Three persons were put at risk due to upstream flooding. Had the flooding been more prolonged or severe the persons trapped faced injury or death.

Australia has a strong reputation with respect Dam Safety and Incident management, this near fatal incident offers an opportunity to review and amend existing Dam Safety Requirements, Risk Management and Gate Reliability Criteria...
This incident provides ANCOLD with an opportunity to review all current guidelines and enhance Dam Safety standards with emphasis on the importance of mitigating human failure and ensuring public safety.

Introduction

Emergency Management Plans and arrangements are designed to treat residual risk and this is their place in the process.[2] It is clearly evident that the Dam Owner/ Operator, Regulators, Community and Emergency Management Planners need to establish clear communication.

---

[1] Tim Waldron, K D Murray and Allan Crichton. *Raising Lenthalls Dam - A Case Study in New Technology and the Environment.* Dam Infrastructure Technology Review, Wide Bay Water , Hervey Bay: IPWEA, 2002.

[2] Dam Safety Risk Treatments Steve Warren Australian Journal of Emergency Management2001

Reducing consequences can be achieved by workable functioning evacuation plans and warning systems[3] that seem to be absent in the Lenthals Dam Feb 2008 Incident.
Human behaviour is an important consideration in the management of Dam Failure risk; "…simple mistakes, operational, mismanagement, unnecessary oversights, or destructive intent can interact with other hazards to compound the possibility of failure[4]"

This case study considers the Human Failures that contributed to the upstream flood risk in the Lenthals Dam Failure February 2008. To what extent did a failure to follow Lenthals Dam Emergency Action Plan (EAP) requirements enhance the risks posed to the public?
It is in the public interest to ask a series of questions regarding the implementation of the Emergency Action Plan during the February 2008 event and the draft format of the EAP when the Lenthals Dam Incident occurred.

- Is it acceptable that the EAP was in draft when the Lenthals Dam Gate Failure occurred?
- Is it acceptable that the section of the EAP titled affected landholders was blank?
- Is it acceptable that the regulator approved the dam increase and gates whilst still waiting on key compliance requirements to be met?
- How could it be that the crest gate system chosen got the seal plate and gate seal clearance so wrong?
- Is it acceptable that prior to the Lenthals Dam Failure Incident upstream landholders were not contacted, consulted or briefed as to the circumstances in which evacuation would occur?
- Should members of the public exposed to such a risk, be relocated prior to construction, there-by eliminating many of the risks faced and alleviating the constructing authority from the more onerous aspects of risk management, liability and negligence exposure?
- Despite assurances by Wide Bay Water Corporation that the gates were to operate automatically and lower at lower water levels after the Feb08 event, the gates did not operate automatically. In fact one was lowered manually and the rest did not lower manually despite water levels lowering. How is it that the dam operator was so uninformed during the incident regarding the operational and risks of failure in flood that they could not provide the regulator with accurate information?

To what extent would a strict adherence to the requirements in the Emergency Action Plan have minimised the risks posed to members of the public isolated by flood waters?

In the light of the Lenthals Dam Gate Failure Incident, Water Infrastructure Operators and Risk Managers should now address the changes required to be made to Dam Safety Risk Management and Dam Safety Requirements to ensure that future Dam Failure Incidents in Australia do not occur.
In the event of an incident steps must now be taken to ensure that EAP requirements are consistently adhered to.

[3] Dam Safety Risk Treatments Australian Journal of Emergency Management Steve Warren Victoria State Emergency Service

[4] Indiana Department of Natural Resources Dam Safety Inspection Manual 280803

Background

Lenthals Dam was constructed in 1983- 1984 to supply water to the Hervey Bay City Council area. The capacity of the storage is 17,256 ML for a Full Supply Level (FSL) at 24.0m AHD.

The existing dam consists of a zoned earthfill embankment, which is approximately 350 metres long. The elevation of the embankment crest is 34.0 metres AHD. The mass concrete ogee spillway is located on the right bank and is 75 metres wide energy dissipation channel, tapering over a distance of approximately 95 metres.

Two weirs downstream of Lenthals, Burrum Number 1 (AMTD 23.3 K=km) and Burrum Number 2 AMTD 28.2 km) complete the in river distribution system which diverts water from Lenthals Dam to water treatment plants.

The storage capacity for Lenthals Dam is based on photogrammetric mapping. The catchment covers 500km2 with the majority of the flow generated by the two tributaries Doongul and Logbridge Creek.

To ensure that there is adequate water supply for the future needs of Hervey Bay region, it was proposed that the FSL of Lenthals Dam be raised by two metres from its existing FSL of 24.0m AHD to 26.0m AHD. This provided an additional 11,150 ML of storage[5]. (Tim Waldron 2002)

In December 2007 the full supply level was raised 2m using Crest Gates. The Crest Gate is a patented system produced by Flowgate Projects (Pty) Ltd, South Africa[6].

The Lenthals Dam Raising Design Report[7] describes the construction as 2m Crest Gates comprising "…4 no. 14.8m wide gates and 1 no. 9.8m wide gate (total Length of spillway crest reduced from 75.3m to 69m). The crest gates open by moving downwards.

The gates failed to operate as designed from January 2008; the Principal Dam Gate Failure Incident occurred in 2008. Rectification works on the Crest Gates are still underway at the time of writing.

Individuals at Risk

- 270 Individuals down stream
- 12 Individuals Upstream (approx not included in EAP) and unknown numbers of campers at Wongi Campsite

At the time of the incident 3 individuals were isolated by rising flood waters at a farm house upstream. Those cut off by rising upstream floodwaters were not initially aware of the Gate Failure Incident and were not notified by the Dam Operator WBWC.

[5] Raising Lenthals Dam – A Case Study in New Technology and the Environment Tim Waldron Wide Bay Water Corporation, K D Murray Sun Water and Allan Crichton GHD

[6] Raising Lenthals Dam – A Case Study in New Technology and the Environment Tim Waldron K D Murray and Allan Crichton 2002

[7] 411/16039/00/60817 February 2006

Lenthals Dam Gate Failure February 2008 - the Incident

The incident is best described by the Dam Operator Wide Bay Water (WBWC) the following is quoted from correspondence, 10 March WBWC to Principal Engineer (Dam Safety) Water Industry Regulation, Department of Natural Resources QLD (Author Peter Care Director Engineering Consultancy Services (WBWC).

- On the 29th January Wide Bay Water (WBWC) staff were successful in opening (lowering) the centre and smallest gate installed on the dam structure water level at the time was 25.44m. The dam designers were notified at the time.
  Author Note: It is unclear if this Incident was reported to Dam Safety at the time, when Dam Safety were contacted on the 14th of February the regulator was not aware that the gates were not operable (manually or otherwise) This would constitute an incident.
- On the 5th of February 2008 heavy rainfall in the Lenthals Dam catchment resulted in the dam water level exceeding RL26 and overtopping the crest gates.
- By 6th of February the dam water level had reached RL26.55m and none of the five gates had opened as designed. The first gate should have opened at 26.15 with each gate opening at 50mm reservoir levels.
- On the 11th February the dam water level had dropped to 26.20m with still no gates opening. The Crest Gate Designers, GHD attended the site to view the gate in operation.
  Author Note – the affected land holders and individuals were not notified of the gate malfunction in the continuing rain event.

- Continued heavy rainfall in the catchment resulted in the dam level reaching 27.41 on the 12th of February with **no gates opening. GHD** and their sub-consultant Flowgate Projects from South Africa were notified of the events. WBWC were notified by GHD that there was potential for all gates to drop of their own accord if the dam levels exceeded27.55 and that the smallest gate may drop as water levels receded.
  Author note: The EAP called for evacuation after water levels reached RL26.91 and no evacuation of the affected public occurred, there was no public announcement of risk or the need to evacuate.
- On the 16th of January 2008 around midday the smallest gate opened and remained down for about 15 hours to release flows down the Burrum River. The gate closed automatically at the correct now reduced reservoir level.
- On the 18th of February, GHD and WBW were able to open Gate 1, adjacent to the walkway, with the assistance of a hydraulic jack. Once open the gate responded normally to manual control and closed without incident within 15 minutes on operating the manual control valve.
- GHD and Flowgate Projects staff attended the site on 25th February to determine the cause of the gates failure to open as designed. Gate 1 was lowered again with the assistance of a hydraulic jack which established that the primary cause of the inoperability was due to the seal friction as a result of the high pressure exerted on the gate seals. An external load of approximately 600kg was sufficient to operate the gate and allow the gate to lower. Subsequent operation was achieved with 200kg of external load. The gate outlet was adjusted to reduce the flow out of the gate and increase the volume of water within the gate during filling to increase the opening weight of the gate and allow it to lower. This was trialled and Gate 1 operated without any external assistance.

- The outlets for each of the five gates have subsequently been adjusted to allow automatic operation along with the lowering of the emergency inlet weirs- to ensure complete buoyancy tank filling at a lower water level.
  Author note: this does not seem an accurate reflection of the situation as the gates did not lower and it was not possible to lower them automatically, the gates did not automatically open subsequent event in June 2008 and there is evidence to suggest the gates could not be manually lowered in June 2008.
- Measurements of the gap between the spillway lintel seal plates and the seal clamping plate on each gates confirmed that the compression of the seal is greater than calculated during the design stage. **Author Note**: Why wasn't this discovered at final certification.
- During the repeated operation of Gate 1 the movement of the gate was carefully observed and the gate once clear of the seal plate moves easily and freely. Gate closure after closing of the manual control valve is consistent and without incident.
- GHD and Flowgate Projects are presently evaluating options for adjusting the current gate arrangement, in the short term to ensure reliable operation of the gates, and in the long term to provide a permanent solution to prevent high load on the lintel seal. The long term solution may require the dam level to be below RL24.0m or the installation of stop logs on the dam crest to allow modification to be made.
  Author note: gates still under repair manual lowering is believed impeded.

Immediately prior to the February 2008 Lenthals Dam water level was at FSL RL26. The January rain had filled the catchment.
It is believed that the Crest Gates installed, were inoperable from the date of installation.
The recorded peak water level at Lenthals Dam was RL27.4 on 12 February 2008.

Properties and the Wongi Water Hole Campground are directly upstream from the impoundment where the Burrum River is joined by tributaries Doongul Creek and Lenthals Dam. Raised water levels in this location caused by flooding and gate failure are a significant risk as egress from these sites is impeded by cut roads in flood events.

The affect of the Lenthals Dam Gate failure was upstream flooding (to higher levels than recorded at the impoundment wall), roads were cut off and water rose around the residence where 3 individuals were stranded. The flood level 1.4m over the seized gates was higher than modelling for previous incidents recorded in the EAP but not much lower than publicly documented historical flood incidents.

Risk Management and Incident Reporting Requirements.

At the time of the Incident in February 2008 the Lenthals Dam Emergency Action Plan was still in Draft, and the affected land holders contact section was blank. The requirements in that Lenthals Dam EAP were:

- *Reservoir Level is approaching RL26.5 and further rain is forecast or reservoir is rising, check all gates are open when reservoir level reaches 26.5. If all gates are not opened operate manually the gates in order to open those*[8]
- *Reservoir Level is approaching RL26.91and further rain is forecast or reservoir is rising (Historical Peak 26.91…The major flooding will prompt the evacuation of many houses … Declare a Major*

[8] Lenthals Dam Emergency Action Plan Table 5.6 41/16885/02/358620

Flood Incident, advise the CEO, WBW of status and evacuation process… Continue to advise the CEO, WBW that the evacuation is in process[9]
The Dam Safety Condition Schedule Lenthals Dam (#309) stated:
".2 where the reservoir headwaters are such that inundation of any upstream dwellings is likely, such dwellings must be considered in the preparation of any action Emergency Action Plan. "
The current EAP at the time of the incident did not consider upstream dwellings.

"*The EAP must cover the potential failure of any part of the structure that can put a population at risk either upstream or downstream. The emergency events described in the EAP shall cover those events as outlined in the Queensland Dam Safety Management Guidelines – February 2002, and include such failure modes as: …..c. Failure of control structures such as intake works, outlet works and gated spillways i. loss of one and all gates in a sunny day event, ii) Loss of one and all gates in a flood event.*
4. Inundation mapping shall be developed as outlined in Queensland Dam Safety Management Guidelines – Feb 2002 and shall be of sufficiently large a scale so as to easily identify those areas subject to possible danger."[10]
"
It was noted than in the event of an emergency*, "the dam operator must notify the Chief Executive, Natural Resources and Water within forty- eight (48) hours. The notification shall include a brief description of the event and the time of activation of the Emergency Action Plan. It was noted in*"[11].

It was noted in the Lenthals Dam Safety Conditions Audit Report that "The *biggest issue for Wide Bay Water (WBW) is the lack of systems / staff for operating the dam with the commencement of wet season so WBW should give priority to finalise this O&M manual and train staff to operate and maintain the equipment." "There is no record of any past inspections carried out on the Dam, with the completion of the Dam upgrade works Annual inspections should be carried out for 2008"*[12]

It is in the public interest to ask, why Lenthals Dam was given approval and commissioned if these issues were unaddressed.
How is it, the Dam Safety Regulator was told on initial enquiry with Wide Bay Water that the gates were not commissioned i.e. were in the lowered flow release position rather than commissioned and unable to release flow?

Human Factors: Failure to implement risk management procedures as required by Lenthals Dam Emergency Action Plan

The Lenthals Dam operator <u>did</u> <u>not</u> <u>follow</u> <u>Emergency</u> <u>Action</u> <u>Plan</u> <u>procedures</u> when the gates failed. After the water reached RL26.5 it was not possible to manually lower gates[13]**.** Water levels reached 27.4 no evacuation was carried out as required in the Lenthals Dam Emergency

[9] Lenthals Dam Emergency Action Plan Table 5.7 41/16885/02/358620
[10] Dam Safety Condition Schedule Lenthals Dam Condition Schedule.doc NRW
[11] Page 6 section 11 Dam Safety Condition Schedule Lenthals Dam Condition Schedule.doc NRW
[12] Page 10 Lenthals Dam Wide Bay Water Dam Safety Audit 2007 Natural Resources and Water QLD Govt.
[13] Lenthals Dam Emergency Action Plan Table 5.6 41/16885/02/358620

Action Plan Table 5.7 41/16885/02/358620. Affected members of the public were not notified of the gate failure or of the risk, not surprising when this section (Affected Landholders) was blank in the only draft of the document available.

- Both Tables 5.6 and 5.7 require the notification of SES and Police. Members of the public contacted Police at Maryborough and State Emergency Services (SES) at the time of emergency they did not know there was a problem with the Lenthals gate operation or that individuals were isolated in rising floodwater upstream.
- The version of the EAP in February 2008 did not have a section covering "the *potential failure of any part of the structure that can put a population at risk either* **upstream** *or downstream."* The EAP in existence in Feb 08 did not seem to address in detail steps to deal with a gate failure in a flood event even though tables in the document address possible levels should this occur. The EAP did not have any mention of **upstream** flood risk or methods of evacuation should this occur.

It is apparent that the affected upstream public and stakeholders were not consulted when the consultants GHD compiled the Lenthals Dam Emergency Action Plan and it is recommended that greater consultation and openness be a requirement in the compilation of Emergency Action Plans. The provision of Inundation mapping for flood and dam failure and consultation preconstruction may well have eliminated the risks to upstream individuals entirely.

Local knowledge can contribute to a greater understanding of flows into a catchment when historical recorded data is not available. It must be a requirement of future Dam planning and Dam safety planning that this knowledge is included in modelling and tested against the hypothesis and conclusions in the modelling of probable dam failure and flood incidents.

It is recommended that when Dam Infrastructure is planned Emergency Action Plans are complete and Dam Safety requirements are met before the infrastructure is installed and operational. Suitably trained staff must be in employ prior to installation/ completion rather than at some later point.
Risk Assessments and Risk Assessment Trees are no substitute for commonsense on behalf of the constructing authority and Dam operator. Sometimes a simple cost benefit analysis will provide a solution. if Individuals face significant harm in the event of a failure and a cost benefit analysis reveals a low cost solution (compared with the overall project and liability risk over the life time of the infrastructure)– then this low cost solution must be taken up. Relocating upstream parties prior to construction would have eliminated the majority of the risks faced. Due to the low upstream population this could have been achieved at minimal cost – why was this option rejected by a well funded constructing authority, why does the dam operator reject this option now, the risks are unchanged.

The risks faced by the public were greatly enhanced in the February 2008 incident as documents (EAP) were incomplete and processes were not followed (no evacuation undertaken).
In the interests of public safety it must be asked if between July 2007 and February 2008 given identified issues of *lack of systems / staff for operating the dam*[14] *,* any steps had been taken to address the inadequacies identified by Dam Safety Natural Resources and Water.

[14] Page 10 Lenthals Dam Wide Bay Water Dam Safety Audit 2007 Natural Resources and Water QLD Govt

It must be asked would public safety be enhanced if the regulator was better resourced to penalise and take action against Dam Operators who don't comply with the requirements set out.
It might be asked if Building Industry Regulators have a legislated capacity to apply punitive action why doesn't the regulator of Dam Safety in this specific instance 270 persons are at risk and the infrastructure is significant. What is the QLD government doing about this?

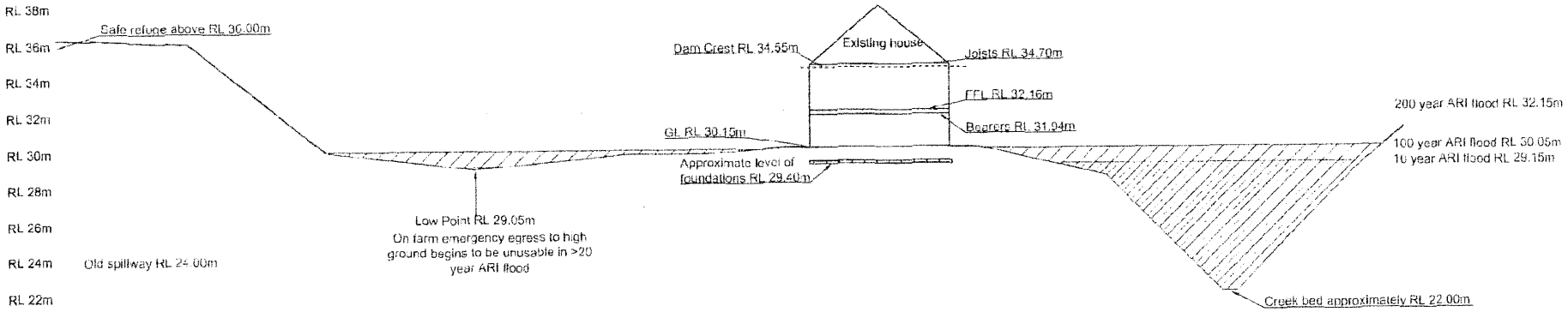
The Lenthals Dam Gate Failure February 2008 Incident provides an opportunity for further investigation and greater understanding of how it is that a well resourced Dam operator (Wide Bay Water) could fail to follow the recommendations made by Natural Resources and Water QLD within the time frames.
This situation may well have added to the Human Failures that magnified the risk posed by individuals when the gate infrastructure failed.

It is vital to consider that the results of the gate failure and associated human factors were minimised by the cessation of rain not by any action taken by the operator or the regulator or emergency services. Luck was the critical factor in the lack of injury or fatality this is unacceptable.

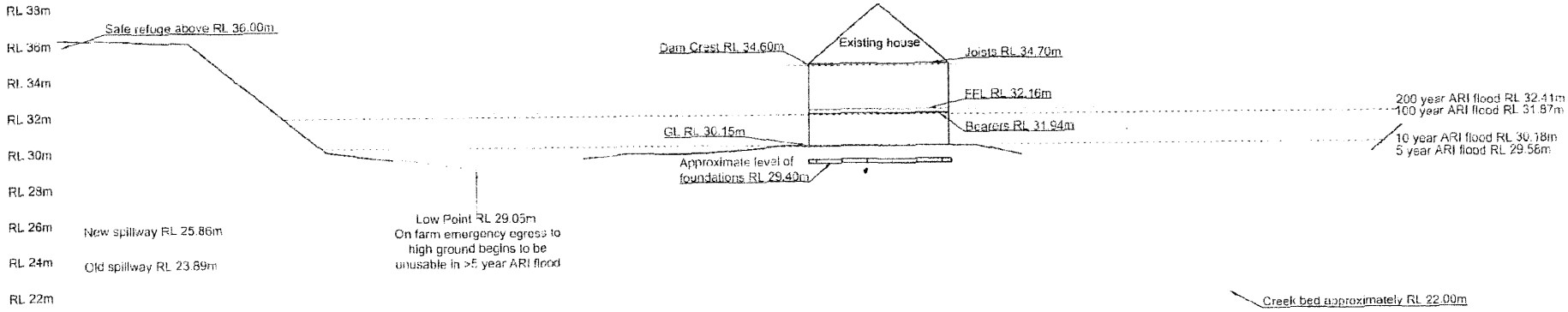
The public have a high expectation of infrastructure managers and in this case the public expectation was not met, worse could have happened.

Dam Safety NRW QLD are continuing to monitor the situation and can provide more details:
Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephone [redacted] **Mobile** [redacted] **Facsimil** [redacted]
Email peter.allen[redacted]
www.nrw.qld.gov.au

Case 2 - Post dam, spillway at RL 24.00m*



Case 3 - Post dam, spillway at RL 26.00m*, gates normal



Notes
Vertical axis scale as shown
Horizontal axis not to scale

Unless noted otherwise, all levels are AHD

Existing house height set timber on stumps founded at approximately RL29.4m

*Nominal spillway levels RL24m and RL26m to Burrum Datum

GILBERT+SUTHERLAND
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Eastside
5/232 Robina Town Centre Drive, Robina, Qld. 4230
Phone 55789944 Mobile 0418 760919 Fax 55789945

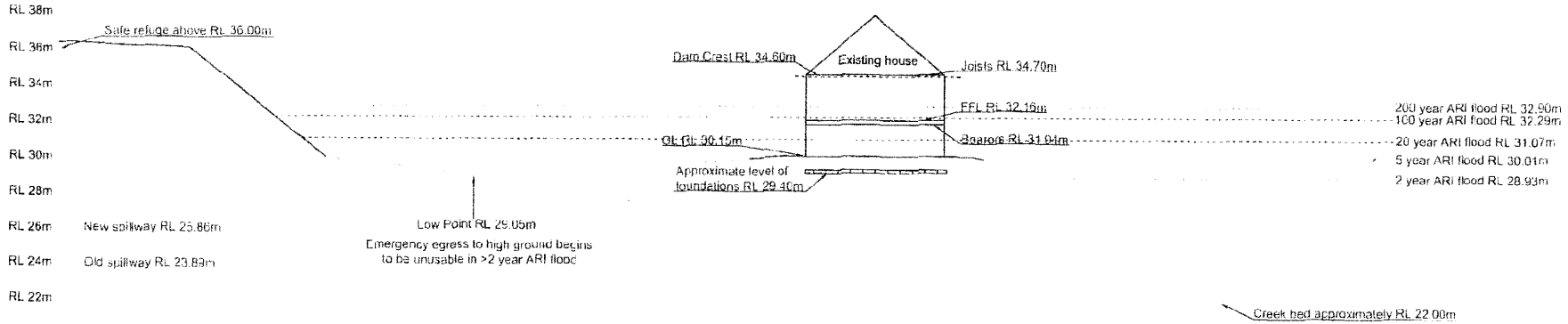
FIGURED DIMENSIONS TO BE READ IN PREFERENCE TO SCALING.

APPROVED

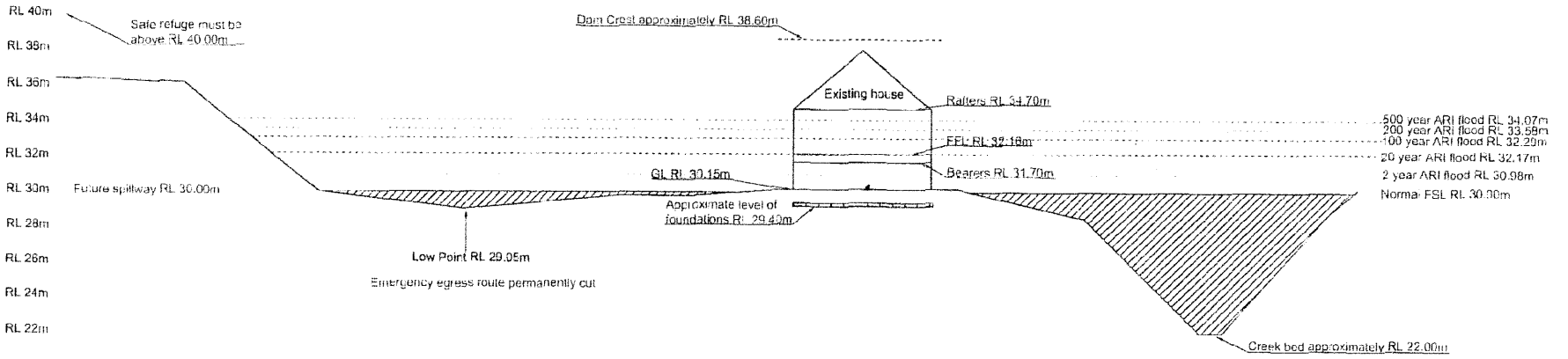
PROJECT
ALLAN FARM HOUSE
ASSESSMENT OF INCREASED FLOOD HAZARDS AND RISKS
LENTHALLS DAM, DOONGUL CREEK
CROSS SECTION OF FLOOD HEIGHTS

SCALE AS SHOWN	DRAWN K.S.S.	DRAWING No.
DATE 02/11/09	CHECKED	HJ0063.1.2

Case 4 - Post dam, spillway at RL 26.00m*, all spillway gates fail



Case 5 - Post dam, ultimate raising - spillway at RL 30.00m



Notes
Vertical axis scale as shown
Horizontal axis not to scale

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Existing house height set timber on stumps founded at approximately RL29.4m

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FIGURED DIMENSIONS TO BE READ IN PREFERENCE TO SCALING.	APPROVED	SCALE AS SHOWN	DRAWN K.S.S.
		DATE 02/11/09	CHECKED

DRAWING No. HJ0063.1.3

27th March 2010

The Honourable Stephen Robertson

Minister for Natural Resources, Mines and Energy and Minister for Trade

Labour State Member for Stretton

Electorate Office

Unit [redacted] Pinelands Road

SUNNYBANK HILLS Q 4109

Esther and [redacted]

C: /- [redacted] Ashgrove Avenue

Ashgrove QLD 4060

Re: Lenthalls Dam Gate Failure – Public Safety Risk Community Cabinet 2008

In 2008 we raised the risks related to Lenthalls Dam, being an ongoing risk of dam gate failure with Honourable Premier Anna Bligh and the Honourable Paul Lucas at the Hervey Bay Community Cabinet. At the Hervey Bay Community Cabinet we met with the Honourable Craig Wallace and his staff to discuss the gate failure, public risk and methods of resolving and removing the risks. (The dam gates failed to operate twice in 2008 we are concerned regarding operation of the gates in March 2010).

Since 2008, we have received advice from experts Gilbert and Sutherland that the risks are much greater than we feared. Please see the attached material provided to us by Gilbert and Sutherland. We are very concerned that the public safety risks remain unresolved. We have been verbally advised by DERM (Dam Safety) that the Dam Operator Wide bay Water Corporation (WBWC) is refusing to meet with us to address the issues and we are concerned that the State will not take sufficient steps to address the risk. The State has overarching statutory responsibility and the public perception is that the state will keep the public safe from the risks posed by large infrastructure.

Please see the attached drawings provided by experts at Gilbert and Sutherland showing the current risks to our upstream farm house caused by the development of Lenthalls Dam and the Lenthalls Dam gates. These findings are based upon data undertaken by GHD for WBWC, who developed and manage Lenthalls Dam.

By way of overview of the issues please refer to the following key dates

- February 2008 Lenthalls Gates fail to operate as designed & members of the public were cut-off of upstream. Emergency Action Plans are not implemented and an evacuation as called for under the EAP is not undertaken.
- 27 March 2008 the Office of the Minister for Natural Resources and Water writes to Allan's confirming that the Lenthalls Dam Gates have failed to operate as designed and provided to Allan's WBWC correspondence confirming failure to operate as designed.
- 29 June 2008 Allan's attended Hervey Bay Community Cabinet and raised the issues directly with Honourable Premier Anna Bligh, the Honourable Minister Craig Wallace, and the Honourable Minister Paul Lucas.
  At this meeting we asked that the dam operator (WBWC) be required to address and resolve the risks up and down stream and that WBWC be required to meet with affected stakeholders to address and resolve the issues, including relocation of the farm house away from the inundation zone. To date, Allan's have not been consulted with respect to the Emergency Action Plan nor has WBWC met with us.
- 03 December 2008 the Honourable Minister Mr Craig Wallace wrote to Miss Fiona Simpson MP. Minister Wallace confirmed the dam gate failure had occurred and confirmed that WBWC acknowledged that "*there is a potential risk to upstream residents to be impacted as a result of Dam Level rising."*

Gilbert and Sutherland findings confirmed this risk and show that the risks are much worse than we feared (see attached).

To date the only progress is that of WBWC writing to us and making a limited admission of flood risk saying they would buy land. We do not want to sell land and do not see that this resolves the inundation and dam gate failure risks as relocation of the farm house would.

DERM Dam Safety Director Peter Allen who administers the Water Supply (Safety and Reliability Act) 2008 and John McKenna have been attempting to coordinate a meeting between DERM Dam Safety / Emergency Management QLD, WBWC and ourselves with a view to updating the Emergency Action Plan and resolving the risks. This meeting has now been cancelled twice. DERM has advised us verbally that WBWC are refusing to meet with ourselves/ Dam Safety and EMQ. The DERM Dam Safety officers are sincere in their attempts but DERM appears reluctant to ensure that the Dam Operator attends a meeting and participates in a process that could resolve all the risks.

DERM Dam Safety Director Peter Allen and John McKenna are sincere and we appreciate their efforts.

While the Dam Operator (WBWC) is taking a fool hardy and exposed position with the risks, current and ongoing, it seems that for some reason your government is reluctant is unwilling or unable to enforce its own legislation Water Supply (Safety and Reliability Act) 2008 to ensure public safety. The Act provides for a provision to issue *"Instruction/ Direction"* and penalise by way of points. This process concerns us far less than a removal of the risk but provides an avenue for the state to mitigate the risk to public safety.

In March of this year WBWC contacted us at 4.30am for evacuation and 1 person was cut off on our northern lot in what we are advised by experts was, in Lenthalls Catchment a less than 1 in 1 event. We have placed enquiry with Dam Safety regarding the operation of the Lenthalls Dam Gates at this time.

We are concerned that someone will be hurt the longer the risks remain, the dam operator WBWC has their heads in the sand and the state is resiles from using its own legislation, to bring the Dam Operator into consultation and **relocation that would remove <u>all</u> the risks**.

Yet again we are asking for your help.

Regards

Per Esther and [redacted].

(We are just so worried that someone will be killed or hurt while this goes on).

From: [redacted]@bigpond.com]
Sent: Wednesday, 22 December 2010 6:31 AM
To: [redacted]
Subject: FW: Emergency Action Plan escalation protocols for [redacted] and Esther Allen and family

From: [redacted] [[redacted]@widebaywater.qld.gov.au]
Sent: Tuesday, 21 December 2010 7:54 AM
To: [redacted]; [redacted]@deacons.com.au
Cc: [redacted]@aar.com.au; 'Peter.Allen[redacted]
Subject: RE: Emergency Action Plan escalation protocols for Donna and Esther Allen and family

Thanks Esther,

we shall update our contacts listing from today.

I will also have James advise you the expectations about inflows, dam levels and if we are having any issues with the gates as we have had since the storms of Sunday the 12.12.10 .

Maintenance on the gates will commence late today or this evening as we expect the levels to be around the top of the gates RL 26 during this afternoon as we now have two gates down.

Regards.

[redacted]
Chief Executive Officer
Wide Bay Water Corporation
Phone[redacted]
Mobil[redacted]
Email:[redacted]widebaywater.qld.gov.au

From: [redacted]@bigpond.com]
Sent: Tuesday, 21 December 2010 7:37 AM
To: [redacted]; [redacted]@deacons.com.au
Cc: [redacted]@aar.com.au
Subject: RE: Emergency Action Plan escalation protocols for Donna and Esther Allen and family

[redacted],

I spoke to [redacted] and he said he would relay message while on leave with respect to current contact numbers for the next 12 months and keep on file.

In the event of river height rise or gate failure and or both please contact;

[redacted] **and text** [redacted]

Given how mobile the extended family, business partners are etc it would be best if the same details were communicated to both, it would speed up the follow up.

A suitable process we think would be workable would be to communicate, river height condition of gates, repair option, expected rainfall to [redacted] and text to the second mobile for further distribution this way no one will be missed.
(ie a few weekends ago we had overlooked we had discussed with a brother in law in his family gathering up there, while we were away for the week.)

Condition of the gates is critical as it tells us wether we should expect extremely irregular river height rise and timing. [redacted] has been neglecting this critical information regarding the valves etc and neglecting the follow up calls the EAP requires.

Regards

Esther

From: [redacted] [redacted]@widebaywater.qld.gov.au]
Sent: Monday, 20 December 2010 11:28 AM
To: [redacted]@deacons.com.au'
Cc: [redacted]'; [redacted]@aar.com.au'
Subject: Emergency Action Plan escalation protocols for Donna and Esther Allen and family
Importance: High

Dear [redacted],

I have spoken with Esther this morning about the current advice practices of this Corporation (during a flood event) for folk whom may be resident at the Allen family property which is are you are aware in the catchment of the Lenthals Dam.

We have in place Esther's and [redacted] telephone numbers but no process to escalate to others who may be aware of whom is at the property when we are trying to advise of any potential or actual flood events that might require evacuation or at least a state of readiness for inundation on parts of the said property.

This matter is somewhat urgent given the current weather patterns and I would be keen to have in place at least a interim solution until I can meet with Esther in the New Year to discuss this protocol so that it can be updated annually and the EAP generally.

Regards.

[redacted]
Chief Executive Officer
Wide Bay Water Corporation

Phone [redacted]
Mobile [redacted]
Email [redacted]widebaywater.qld.gov.au

From: [redacted]@bigpond.com]
Sent: Monday, 20 December 2010 7:48 AM
To: [redacted]'
Cc: 'Sue Brooks'
Subject: RE: Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!

[redacted],

[redacted] has our home number. WBW has refused to meet with us in the past to discuss the Emergency Action Plan and I can inform you that neither my home nor my work number are useful for that purpose. These contacts are of no use – if I happen not to be in – we are rarely at home and they are certainly not acceptable contacts over the Christmas period.

It was suggested to WBW that while it would not resolve the safety issues in any way, a useful process would be for a yearly update of the coordinated response with respect to stakeholders and update of contacts that was a formalised approach would be better for all concerned. Calling the wrong number does not mitigate WBW duty of care in our situation. We suggested WBW write to [redacted] - and we respond with contacts in writing at the beginning of each year.

You are welcome to call me this morning. A suitable course of action would be to peruse the most recent Letter WBW to Allans and [redacted] response on behalf of Allans.

Obviously this matter will move forward one way or another at great cost to both parties, we hope not with loss of life but the longer this drags on the higher the risks to us are.

The fact that the valves are clogged mean that a resolution should be found asap (a problem endemic to the gate design and one that has occurred numerous times overseas, and a problem WBW planners were well aware of. Normally this design is used for smaller irrigation dams in unpopulated areas as I understand it)

You are welcome to call and I appreciate your interest.

Regards

Esther Allan

From: [redacted] [redacted]@widebaywater.qld.gov.au]
Sent: Monday, 20 December 2010 7:21 AM
To: [redacted]@bigpond.com'
Subject: FW: Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!

Dear Esther,

I have tried to call the number below but understand it may be your work number thus will try again after 9 am to update you on the latest with the dam gates .

The weather is now blue sky as of about an hour ago thus we should see the levels start to abate in the Dam in the next few hours.

My contact details are provide below.

Regards.

[redacted]
Chief Executive Officer
Wide Bay Water Corporation
Phone
Mobile
Email: widebaywater.qld.gov.au

From: [redacted] @frasercoast.qld.gov.au]
Sent: Sunday, 19 December 2010 3:58 PM
To: [redacted]
Subject: FW: Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!

FYI as per our discussion on Friday. See email from Esther below….

Cr Sue Brooks
Environmental Sustainability Portfolio
Fraser Coast Regional Council
ph [redacted]

The contents of this email are my personal comments and may not necessarily reflect Council policy. This email is for you personally so please ask my permission prior to forwarding it on to other persons. Thanks, Sue

---

From: [redacted] [redacted] bigpond.com]
Sent: Friday, 17 December 2010 12:15 PM
To: Sue Brooks
Cc: [redacted] qnp.newsltd.com.au; [redacted]; [redacted]
Subject: Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!

Hi Sue,

Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!
Lenthalls Dam gates were not functioning last week.
The update from Peter Allen Director Dam Safety DERM is that last week when we evacuated on Sunday 3 gates weren't functioning.

This may have affected the really rapid water rise that occurred. We got three calls from WBW on the Sunday – [redacted] was with baby in Brisbane - [redacted] and I had done a stock run and left after [redacted] relayed the second message. This was lucky as we are not sure by the time the third message came in we would have been able to get out if we had not left earlier. After we left he lost contact with us – and did not know if we were in or out – or had managed to cross Powell or Logbridge safely.

Water levels have been very high – the access is now very damaged and should be urgently repaired – another big storm and the causeway may be critically undermined if not fixed. The causeway has been scoured at the sides by the current and lost its protective sheeting/ outer material.

Peter Allen DERM – tells us that the gates at Lenthalls Dam are not functioning as designed in that there are problems with the outlets for the buoyancy tank – there is a team on standby when water is low enough to clear the clogged inlets. (This has been common problem overseas with this design over seas) .

We have asked for Peter Allen to give us an update before DERM closes for business as we were planning an extended family get together between xmas and new year and intended to be up there to undertake works.

Would you please follow up getting the causeway repaired as soon as possible and let us know of your progress.
Would you also update the new CEO and ask for some feed back regarding the condition of the gates.

We have had a series of scares in the last week and we are very concerned regarding our position.

Regards

Esther Allan
PH[redacted]

From: Sue Brooks [redacted]
Sent: Thursday, 16 December 2010 3:00 PM
Subject: Wishing you peace and joy this Christmas

Hello and best wishes at this busy time of year. I wish you and your family and friends a very happy healthy and safe holiday season. I look forward to everyone working together to make 2011 a very successful year.

Many, many cheers, Sue

WISHING YOU
PEACE & JOY
THIS CHRISTMAS

The Mayor, Councillors
and staff of Fraser Coast Regional
Council appreciate your support and wish
you a very Merry Christmas and a Happy New Year.

Festive
Fraser Coast

Fraser Coast
REGIONAL COUNCIL

Fraser Coast Councillors
Mick Kruger – Mayor
Julie Arthur – Deputy Mayor
Sue Brooks | David Dalgleish | Linda Harris
Debbie Hawes | Barbara Hovard | Belinda McNeven
Les MucKan | Anne Nioa | Gerard O'Connell

Executive Officers
Andrew Brien – Chief Executive Officer
Lisa Desmond – Director Organisational Services
Peter Smith – Director Community & Development
Wayne Sweeney – Director Infrastructure & Environment

From: [redacted][redacted]widebaywater.qld.gov.au]
Sent: Monday, 20 December 2010 7:21 AM
To: [redacted] bigpond.com'
Subject: FW: Lenthalls Dam Gate assistance required - Causeway at Logbridge Creek Gouged out !!

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Mobil [redacted]
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Fraser Coast Regional Council
ph [redacted]
[redacted]

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Regards

Esther Allan
PH [redacted]

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Many, many cheers, Sue

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Executive Officers
Andrew Brien – Chief Executive Officer
Lisa Desmond – Director Organisational Services
Peter Smith – Director Community & Development
Wayne Sweeney – Director Infrastructure & Environment

From: Allen Peter [redacted]
Sent: Friday, 18 March 2011 3:18 PM
To: [redacted]
Cc: [redacted]; [redacted]; [redacted]@gmail.com; [redacted] Guppy Ron
Subject: RE: Lenthalls Dam k- Most Recent Reports

I have exchanged emails with [redacted] and he has advised me to the effect that …

- WBW asked GHD to review the EAP with particular emphasis on the various dam levels which trigger contacts with the Allen family et al. This report has now been received by WBW. WBW have also asked GHD to review the Dam Flooding report in respect of the recent rainfall events and data supplied from BOM to ascertain if there are any changes that might be made to it. It is expected that this report should be received by WBW next week.

- [redacted] has also indicated that they have agreed to supply both reports to you and your consultant engineer Neil Collins. Once they have that data and have considered any implications it provides over the risks to your house and the people on site, WBW will enter into discussions with you on how to move forward.

Peter

Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephon [redacted], **Mobile** [redacted] **Facsimile** [redacted]
Email [redacted]
www.derm.qld.gov.au

From: [redacted][mailto [redacted]bigpond.com]
Sent: Thursday, 17 March 2011 5:33 PM
To: Allen Peter
Cc: [redacted]'; 'Neil Collins'; [redacted]@gmail.com
Subject: Lenthalls Dam k- Most Recent Reports

Peter,

With reference to our telephone conversation. Has Wide Bay Water provided you with the revised/new EAP Report I believe undertaken by GHD? and do you have a copy of the new upstream flooding report also generated by GHD. As previously discussed with you the copy right rests with GHD and they as responsible parties have been happy to release this information for peer review in the past.

Regards

Esther Allan

3 sheets of A4 paper = 1 litre of water

+--+

From: [redacted] [redacted]@bigpond.com]
Sent: Thursday, 14 April 2011 6:30 PM
To: [redacted]
Cc: [redacted]'; 'Neil Collins'; '[redacted]@aar.com.au'; 'Peter Care'; 'Allen Peter'; [redacted]; '[redacted]@gmail.com'
Subject: RE: Rainfall and Dam Levels for April

Peter,

I think I would need to refer much of this question to Neil Collins, the risks are to high for simple opinion.
Instinct tells me that it is better to know than not as on the one day you are not updated could be the one day the situation progressively gets worse, isn't that why we would need the early warning? As I understand it.? I would not want that on my conscience and I cant imagine your people would either.

It is a very distressing position for us to be in.

Regards

Esther

From: [redacted]widebaywater.qld.gov.au]
Sent: Thursday, 14 April 2011 5:46 PM
To: [redacted]
Cc: [redacted]; 'Neil Collins';[redacted]aar.com.au; Peter Care
Subject: RE: Rainfall and Dam Levels for April

Dear Esther,

Based on the way the current EAP s 4.5 is worded that is possibly the case.

As you are aware it states "**Reservoir Level is approaching RL 26.10m and further rain is forecast OR the**
Reservoir is rising (at RL 26.10m water begins to flow into the Inlet Weir of crest gate No.3, onset of Minor Flooding based on BOM Classification is estimated to be RL 26.20m)".

It really is a judgement call at EAP 4.5 given the current dam levels and the likelihood of rain.

This is one of the reasons for the review of the EAP as we have precisely discussed to enable clear advice to yourself and others but not to the point where it would be perhaps become counter productive.

In other words we might have contacted you every day based on the data below.

I would appreciate your feedback on that point as it will assist with the EAP review.

Regards.

[redacted]
Chief Executive Officer
Wide Bay Water Corporation
Phone [redacted]
Mobil [redacted]
Email: [redacted] idebaywater.qld.gov.au

From: [redacted] [[redacted]bigpond.com]
Sent: Thursday, 14 April 2011 5:35 PM
To: [redacted]
Cc: 'Doongul Creek'; 'Neil Collins'; [redacted]aar.com.au
Subject: RE: Rainfall and Dam Levels for April

[redacted]

Re: Rainfall and Dam Levels for April

In confirmation then, as per data below, we should have been notified on more than the one occasion in April of levels rising and weren't?

Regards

Esther Allan

From: Peter Scott
Sent: Thursday, 14 April 2011 8:57 AM
To: [redacted]'
Cc: Peter Care; [redacted]; 'Doongul Creek'; 'Neil Collins'
Subject: FW: Rainfall and Dam Levels for April

Dear Esther,

On the 19 March 2011 a text message was sent to[redacted]([redacted]) but unfortunately it appears due to a human error here the primary message to you wasn't sent which I apologise for before the dam level reach RL 26.100m.

The dam level peaked at RL 26.270m at approximately 2:00pm 21 March 2011. Gates 3, 2 and 4 automatically opened and closed in accordance with design expectations.

April data as requested

Lenthall Dam Level and Rainfall Data - April 2011

Date	Level (m)	Musket (mm)	Lenthall (mm)
1-Apr-11	25.968	1	3
2-Apr-11	25.991	5	3
3-Apr-11	25.990	3	4
4-Apr-11	25.991	1	0
5-Apr-11	26.006	4	3
6-Apr-11	25.991	0	0

7-Apr-11	25.998	0	3
8-Apr-11	26.029	9	16
9-Apr-11	26.025	0	0
10-Apr-11	26.037	0	1
11-Apr-11	26.037	1	0
12-Apr-11	26.029	0	0
13-Apr-11	26.029	0	0

Please advise if any additional information is required.

Regards

[redacted]
Chief Executive Officer
Wide Bay Water Corporation
Phone
Mobile [redacted]
Email: [redacted]@widebaywater.qld.gov.au

From: [redacted] [redacted]bigpond.com]
Sent: Thursday, 14 April 2011 6:29 AM
To: [redacted]
Cc: 'Doongul Creek'; 'Neil Collins'
Subject: Rainfall and Dam Levels for April

[redacted],

Would you please provide rainfall data and dam levels (daily) for April, also copies of reports made to us, I don't recall receiving any updates
We have noted some significant rainfalls and flow still coming in late last week. The water table is very very high, worryingly so (house area a swamp).

I notice the pump has been working at Wongi again and we have debri across certain crossings.

I imagine then that water levels have breached RL26 for this to occur, as I understood it we would be contacted from the time water levels reached RL26.15?

Regards

Esther Allan

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This email has been scanned for Wide Bay Water by the MessageLabs Email Security System.

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From: [redacted][mailto[redacted]widebaywater.qld.gov.au]
Sent: Friday, 24 December 2010 1:46 PM
To: 'Allen Peter'; [redacted]; [redacted]
Cc: [redacted]; ALLAN Esther; Peter Care
Subject: RE: Report on Operation of Lenthalls Dam Gates
Importance: High

Dear Peter and Esther,

[redacted] can provide Esther with an update by telephone if you require on the situation right now.

The gates post some maintenance on Tuesday evening/Wednesday morning with GHD in attendance are now operating automatically.

Two have operated as designed in the past day both down and up and one down again from recall ([redacted] can confirm).

We expect four gates to operate now automatically but there is still a question with gate 5 until we have water at the height to trigger it opening automatically if it does.

The issues to date isn't with silt or debris rather with the air being vented out when the gates fill with water.

The levels on the BOM site are a little higher than the actual levels which I understand are at o about RL 26.1 an hour or two ago.

[redacted] myself and Peter are all on call/standby over the break.

Kind regards.

[redacted]

[redacted]

From: Allen Peter [[redacted]]
Sent: Friday, 24 December 2010 1:25 PM
To: [redacted]
Cc: [redacted]; ALLAN Esther; [redacted]
Subject: RE: Report on Operation of Lenthalls Dam Gates

Esther,

I don't have anything further on the operation of the gates than you would have from your emails with Peter Scott from WBW. It is good to see that you and Peter Scott have opened communications.

The BoM currently expect the heavy rain to be in far north Queensland in the next day or so but they do expect heavier rain in the south east of the State on Sunday and Monday.

I note from the BoM website that the level in Lenthalls was relatively stable at 26.35m (ie. 0.35 above FSL) at 10:10 this morning. I do not have a report on what gates are operating at the moment. [redacted]

[redacted] or [redacted] will be the best people to provide you with that information. The situation will remain volatile in the next few days and will need to be watched.

Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephone [redacted], **Mobile** [redacted]
Email [redacted]
www.derm.qld.gov.au

From: [redacted] bigpond.com]
Sent: Thursday, 23 December 2010 6:47 AM
To: Allen Peter
Cc: [redacted]; 'ALLAN Esther'
Subject: Report on Operation of Lenthalls Dam Gates

Hi Peter,

RE: Report on Operation of Lenthalls Dam Gates.

When you rang last Friday to confirm the that the gates weren't operating properly due to silt/debri in the inlet valves, you committed to a full update before close of business for the Christmas break.

Being informed is the first link in attempting to ensure our safety in spite of the enhanced risks and a critical part of the states duty of care, I would appreciate a full update.

Regards

Esther Allan

From: Allen Peter [redacted]
Sent: Friday, 24 December 2010 1:49 PM
To: Peter Scott; [redacted]
Cc: [redacted]; ALLAN Esther; Peter Care
Subject: RE: Report on Operation of Lenthalls Dam Gates

Thank you very much [redacted]. I hope all goes well over the Christmas period.

Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephone [redacted]
Email [redacted]
www.derm.qld.gov.au

From: [redacted] [mailto:[redacted]widebaywater.qld.gov.au]
Sent: Friday, 24 December 2010 1:46 PM
To: Allen Peter; [redacted]; [redacted]
Cc: [redacted] ALLAN Esther; Peter Care
Subject: RE: Report on Operation of Lenthalls Dam Gates
Importance: High

Dear [redacted] and Esther,

[redacted] can provide Esther with an update by telephone if you require on the situation right now.

The gates post some maintenance on Tuesday evening/Wednesday morning with GHD in attendance are now operating automatically.

Two have operated as designed in the past day both down and up and one down again from recall (James can confirm).

We expect four gates to operate now automatically but there is still a question with gate 5 until we have water at the height to trigger it opening automatically if it does.

The issues to date isn't with silt or debris rather with the air being vented out when the gates fill with water.

The levels on the BOM site are a little higher than the actual levels which I understand are at o about RL 26.1 an hour or two ago.

James, myself and Peter are all on call/standby over the break.

Kind regards.

[redacted]

[redacted]

From: Allen Peter [redacted]
Sent: Friday, 24 December 2010 1:25 PM
To: [redacted]
Cc: [redacted]; ALLAN Esther; [redacted]
Subject: RE: Report on Operation of Lenthalls Dam Gates

Esther,

I don't have anything further on the operation of the gates than you would have from your emails with Peter Scott from WBW. It is good to see that you and Peter Scott have opened communications.

The BoM currently expect the heavy rain to be in far north Queensland in the next day or so but they do expect heavier rain in the south east of the State on Sunday and Monday.

I note from the BoM website that the level in Lenthalls was relatively stable at 26.35m (ie. 0.35 above FSL) at 10:10 this morning. I do not have a report on what gates are operating at the moment. Peter Scott or James Castle will be the best people to provide you with that information. The situation will remain volatile in the next few days and will need to be watched.

Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephone [redacted] **Mobile** [redacted] **Facsimile** [redacted]
Email [redacted]
www.derm.qld.gov.au

From: Damian Carstens [redacted]
Sent: Thursday, 23 December 2010 6:47 AM
To: Allen Peter
Cc: '[redacted]'; 'ALLAN Esther'
Subject: Report on Operation of Lenthalls Dam Gates

Hi Peter,

RE: Report on Operation of Lenthalls Dam Gates.

When you rang last Friday to confirm the that the gates weren't operating properly due to silt/debri in the inlet valves, you committed to a full update before close of business for the Christmas break.

Being informed is the first link in attempting to ensure our safety in spite of the enhanced risks and a critical part of the states duty of care, I would appreciate a full update.

Regards

Esther Allan

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+------------------------------------------------------------------+

Think B4U Print

1 ream of paper = 6% of a tree and 5.4kg CO2 in the atmosphere

3 sheets of A4 paper = 1 litre of water

+------------------------------------------------------------------+
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From: [redacted][mailto[redacted]widebaywater.qld.gov.au]
Sent: Friday, 24 December 2010 1:46 PM
To: [redacted]; Damian Carstens; James Castle
Cc:[redacted]; ALLAN Esther; Peter Care
Subject: RE: Report on Operation of Lenthalls Dam Gates
Importance: High

Dear Peter and Esther,

James can provide Esther with an update by telephone if you require on the situation right now.

The gates post some maintenance on Tuesday evening/Wednesday morning with GHD in attendance are now operating automatically.

Two have operated as designed in the past day both down and up and one down again from recall (James can confirm).

We expect four gates to operate now automatically but there is still a question with gate 5 until we have water at the height to trigger it opening automatically if it does.

The issues to date isn't with silt or debris rather with the air being vented out when the gates fill with water.

The levels on the BOM site are a little higher than the actual levels which I understand are at o about RL 26.1 an hour or two ago.

James, myself and Peter are all on call/standby over the break.

Kind regards.

[redacted]

[redacted]

From: Allen Peter [[redacted]
Sent: Friday, 24 December 2010 1:25 PM
To: [redacted]
Cc:[redacted]; ALLAN Esther; [redacted]
Subject: RE: Report on Operation of Lenthalls Dam Gates

Esther,

I don't have anything further on the operation of the gates than you would have from your emails with Peter Scott from WBW. It is good to see that you and Peter Scott have opened communications.

The BoM currently expect the heavy rain to be in far north Queensland in the next day or so but they do expect heavier rain in the south east of the State on Sunday and Monday.

I note from the BoM website that the level in Lenthalls was relatively stable at 26.35m (ie. 0.35 above FSL) at 10:10 this morning. I do not have a report on what gates are operating at the moment.[redacted]

[redacted] or [redacted] will be the best people to provide you with that information. The situation will remain volatile in the next few days and will need to be watched.

Peter Allen
Director Dam Safety (Water Supply)
Office of the Water Supply Regulator
Telephone [redacted]
Email [redacted]
www.derm.qld.gov.au

From: [redacted]@bigpond.com]
Sent: Thursday, 23 December 2010 6:47 AM
To: Allen Peter
Cc: '[redacted]'; 'ALLAN Esther'
Subject: Report on Operation of Lenthalls Dam Gates

Hi Peter,

RE: Report on Operation of Lenthalls Dam Gates.

When you rang last Friday to confirm the that the gates weren't operating properly due to silt/debri in the inlet valves, you committed to a full update before close of business for the Christmas break.

Being informed is the first link in attempting to ensure our safety in spite of the enhanced risks and a critical part of the states duty of care, I would appreciate a full update.

Regards

Esther Allan

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Thank you.

CLIENTS | PEOPLE | PERFORMANCE

Wide Bay Water

Lenthalls Dam Flooding

December 2010 Event

June 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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2. *may only be used and relied on by Wide Bay Water;*
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The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in GHD's proposal; and*
- *did not include those not listed in GHD's proposal.*
- *The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report.*

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on until [insert a "sunset" timeframe, eg 3 or 6 months], after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

Contents

1. Introduction

1.1 Background

This flood investigation was commissioned by Wide Bay Water in response to a storm event that occurred in December 2010. It builds on the work of an earlier 2009 study, which investigated the flood levels at Lenthalls dam during the February 2008 floods (Lenthalls Dam Flooding, GHD, February 2009).

In February 2008, during a moderate rainfall event, a flood incident occurred at Lenthalls Dam. This was attributed to the failure of the crest gates, which malfunctioned and did not open to release the floodwaters during the peak of the storm. The rising water levels at the dam backed up along an upstream tributary, and resulted in some residents near the watercourse being stranded at their farmhouse.

In December 2010, after several days of continuous rainfall, another flood event occurred. Water levels at the dam rose and reached trigger levels, and the residents in the area were subsequently notified and evacuated in accordance with the Lenthalls Dam Emergency Action Plan. The water levels at the dam eventually exceeded February 2008 dam levels.

1.2 Objectives

The primary objective of this study is to review and update the February 2009 work, where applicable, on the basis of the December 2010 storm event. The scope of work includes the following:

- Obtain and review available rainfall and dam water level information for the December 2010 storm event;
- Review and update hydrology and hydraulics models developed for February 2009 Lenthalls Dam Flood Report, where applicable;
- Recalibrate hydrology and hydraulic models if necessary; and
- Update findings of February 2009 study report, where applicable.

2. Available Data

A description of the Lenthalls Dam catchment has previously been provided in the February 2009 report (Lenthalls Dam Flooding, GHD, February 2009)). The reader is referred to that report for additional details on the catchment, watercourses, and other drainage characteristics relating to the site.

Data obtained and reviewed for this study included the following:

- Lenthalls Dam Flooding Report, GHD, February 2009;
- Digital Terrain Model of site (from aerial photogrammetry) at 2m contour intervals supplemented by field survey of creek at selected locations;
- RORB hydrology model (February GHD 2009);
- HEC-RAS hydraulics model (GHD, February 2009);
- Spillway rating curves with all gates operational and all gates not-operational (GHD, December 2008);
- Lenthalls Dam water level records, from 21 December 2010 to 30 December 2010, (provided by Wide Bay Water);
- Rainfall records at Lenthalls Dam Alert (Station No. 040906), Howard Post Office. 040098), Musket Flat (Station No. 040902), 1 December 2010 to 20 January 2011 (irregular rainfall time series data, provided by Wide Bay Water and Bureau of Meteorology);
- Water level records at Howard Alert (Station No. 040907), 1 December 2010 to 18 January 2011 (provided by Wide Bay Water); and
- Event log for the December 2010 flood event, 22 December 2010 to 29 December 2010 (provided by Wide Bay Water).

It is noted that the December 2010 event log was recorded manually by a field operator manning the dam operations during the flood event. While this was not included in the data originally provided for the study, it was later requested to assist in validating the hydrology model adopted for the dam.

3. Study Methodology

3.1 Hydrology (RORB Model)

RORB is a networked rainfall and runoff model that is widely used in Australia for flood estimation (Australian Rainfall and Runoff, ARR 1998).

The RORB rainfall-runoff model developed for the February 2009 Flood Study was adopted and used to simulate the hydrological behaviour of the catchment for the December 2010 event.

It is noted that the 2009 RORB model was configured using data from an earlier version of RORB (DNRW 1999). The 2009 model updated the 1999 model and was calibrated using the February 2008 flood event. Additional details of the RORB model and calibration work undertaken are documented in the February 2009 report.

Based on the results of the February 2009 study, the Lenthalls Dam catchment was found to have RORB model parameters of 30 and 0.8, for kc and m, respectively. An initial loss of 8 mm and a continuing loss of 2 mm/hr were also derived for the February 2008 event.

In this present study, the above RORB model parameters established from the 2009 Flood Study were reviewed and used as the basis for calibration and validation of the December 2010 storm event.

3.2 Historical Rainfall Data

Historical rainfall information provided by the Bureau of Meterology included the following:

- Lenthalls Dam Alert (Station No. 040906);
- Howard Post Office (Station No. 040098); and
- Musket Flat (Station No. 040902);

It is noted that Lenthalls Dam Alert (Station 040906) is located within the dam itself, while Musket Flat (Station 040902) is located mid-catchment approximately 17 km upstream of the dam. Howard Post Office (Station 040098) is located 10 km to the north and downstream of Lenthalls Dam.

The rainfall data was provided as raw irregular time series data. This was processed and converted to regular time series, at time steps of 30 mins, for the purposes of this study. The processed rainfall data are plotted in Figure 3-1 for Lenthalls Dam and Figure 3-2 for Musket Flat.

In calibrating the December 2010 event, both the rainfall at Lenthalls Dam Alert and Musket Flat were initially weighted and used. However, it was later found that the rainfall data at Lenthalls Dam Alert had better correlation with the water levels in the dam and was adopted for the study.

The rainfall data at Howard Post Office was used for consistency checks but was not used for this study, as the rainfall data at Lenthalls Dam Alert was considered to be appropriate.

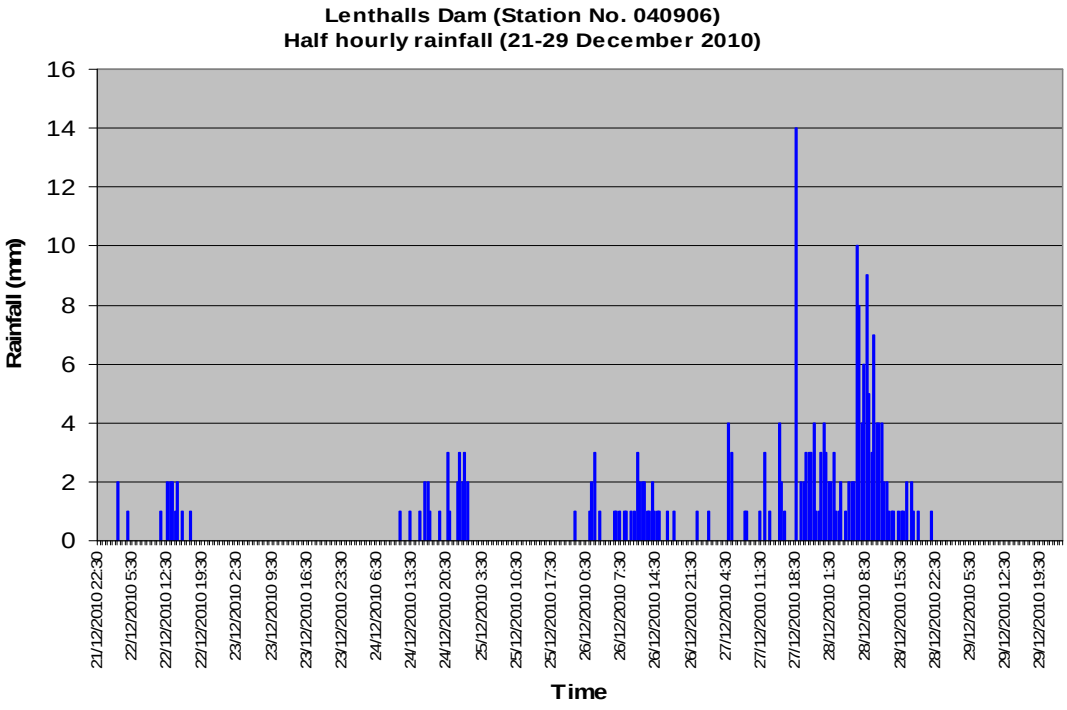

Figure 3-1 : Half-hourly Rainfall Data at Lenthalls Dam Alert (21-29 December 2010)

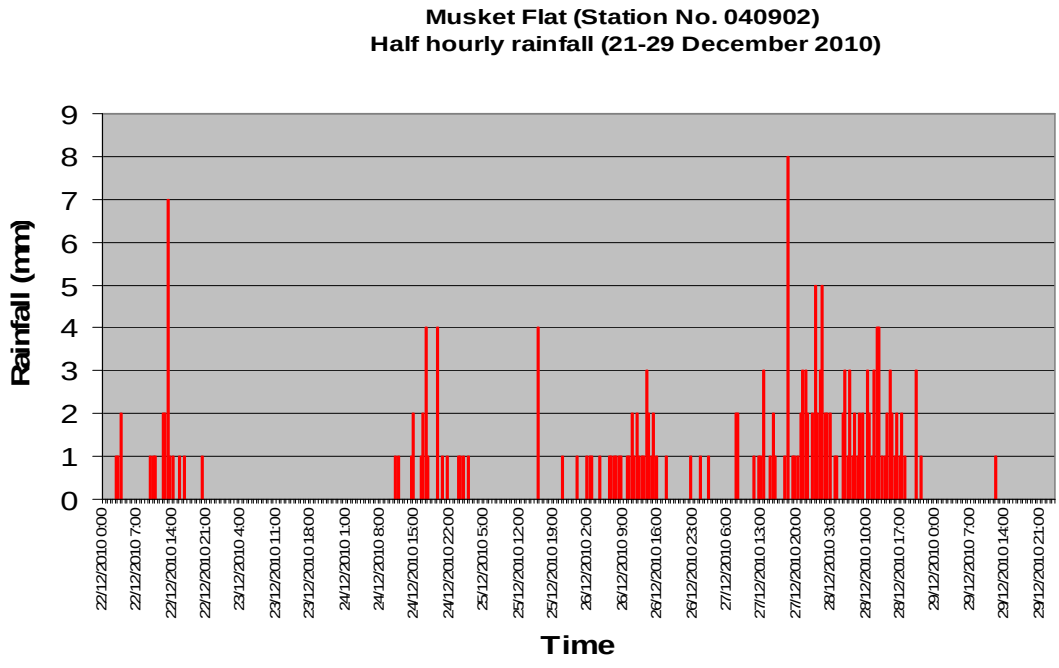

Figure 3-2: Half-hourly Rainfall Data at Musket Flat (21-29 December 2010)

3.3 Lenthalls Lanthalls Dam Discharge Characteristics

Dam storage characteristics and rating curves for the spillway Crest Gates were obtained from the 2009 report. The discharge curves, for scenarios with all the crest gates opened, and all the crest gates closed, are shown in Figure 3-3.

The scenario with all the crest gates opened represents the design dam operational rule as per the Lenthalls Dam Operation Manual, whereby Gate 3, Gate 2, Gate 4, Gate 5, and Gate 1 are progressively opened to release the floodwaters as the water level in Lenthalls Dam rises.

The scenario with all crest gates closed shows the behaviour of the dam in the event that the floodwaters are not released through the gates but discharged only over the spillway. In this case, the dam water levels are seen to rise steeply. This scenario occurred during the February 2008 storm event, when all the gates were jammed and could not be opened.

For the December 2010 storm event, the data log provided by Wide Bay Water indicated that some of the gates were opened, closed, and reopened at various times leading to the peak of the storm. There were problems with some of the equipment, including the SCADA and Lenthalls Dam radar level sensor. Gate 5 was also reported to have failed to open throughout the storm event. However the log indicated that Gates 1, 2, 3 and 4 were opened at 4.23 am (dam water level at 26.379) on the 27 December 2010. After that, no additional information on the status of the gates was recorded up to the time the dam water level peaked at 28.12 m (7.30 pm on 28 December 2010) and thereafter. It is noted that the recorded peak water level derived from the time series (Figure 3-5) is slightly higher at 28.183 m. This may be because the water level had not yet reached its peak at the time the entry was made in the event log. It is assumed that the actual peak water level was 28.183 m AHD.

The event log indicated that the crest gates did not function as designed or intended, and that only four of the five gates were operable. This meant that neither of the design discharge curves presented in Figure 3-3 was applicable during the December 2010 event.

In other to simulate the operation of the dam during the December 2010 event, a new discharge curve was derived to reflect the event log and sequence of gate opening, closure and re-opening adopted during that event. In doing so, the same discharge relationships used to model the original discharge curves in Figure 3-3 were adopted. The results are shown in Figure 3-4.

Figure 3-4 effectively shows a new discharge curve with only four of the five gates working (Gate 5 reportedly did not function). As expected, the new discharge curve lies between that for all five of the gates closed and all five of the gates opened.

The corresponding stage-storage and stage-discharge relationships established for the above 3 operational scenarios (all five gates closed, all five gates opened, four of five gates opened) are presented in Table 3-1 and Table 3-2.

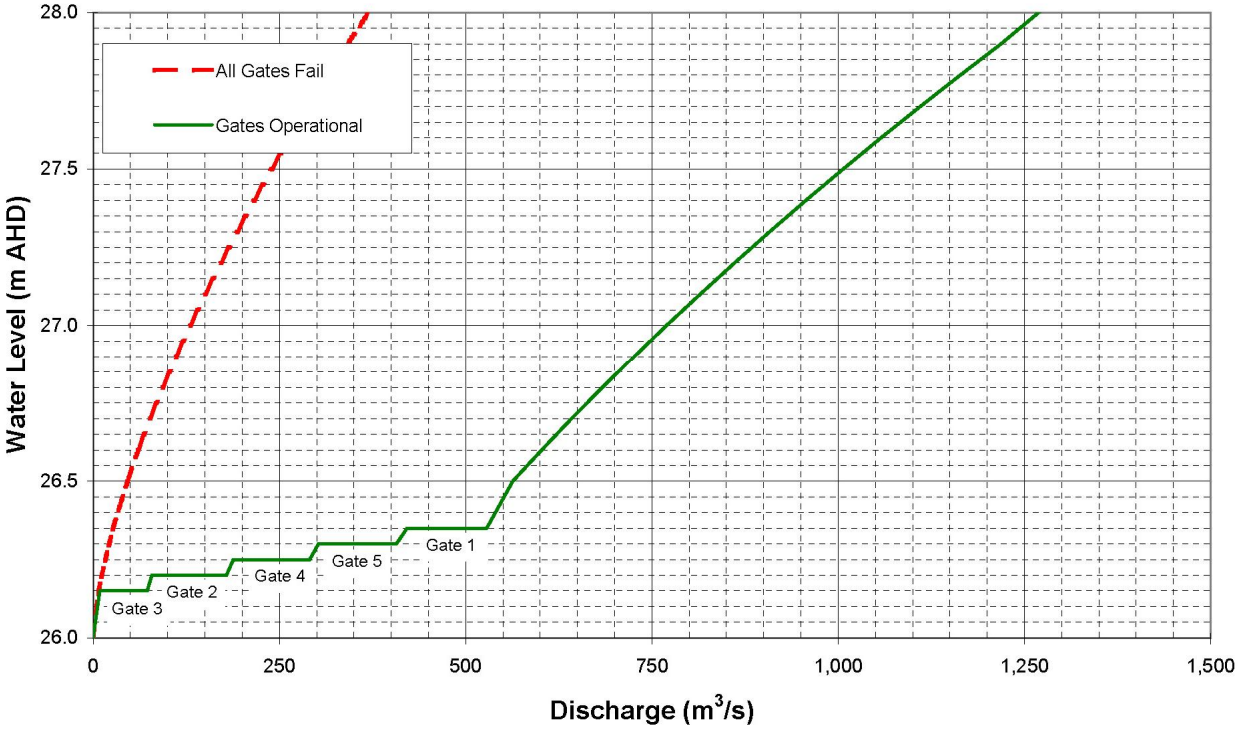

Figure 3-3: Discharge Data for Lenthalls Dam with Crest Gates Fully Operational and Fully Non-Operational

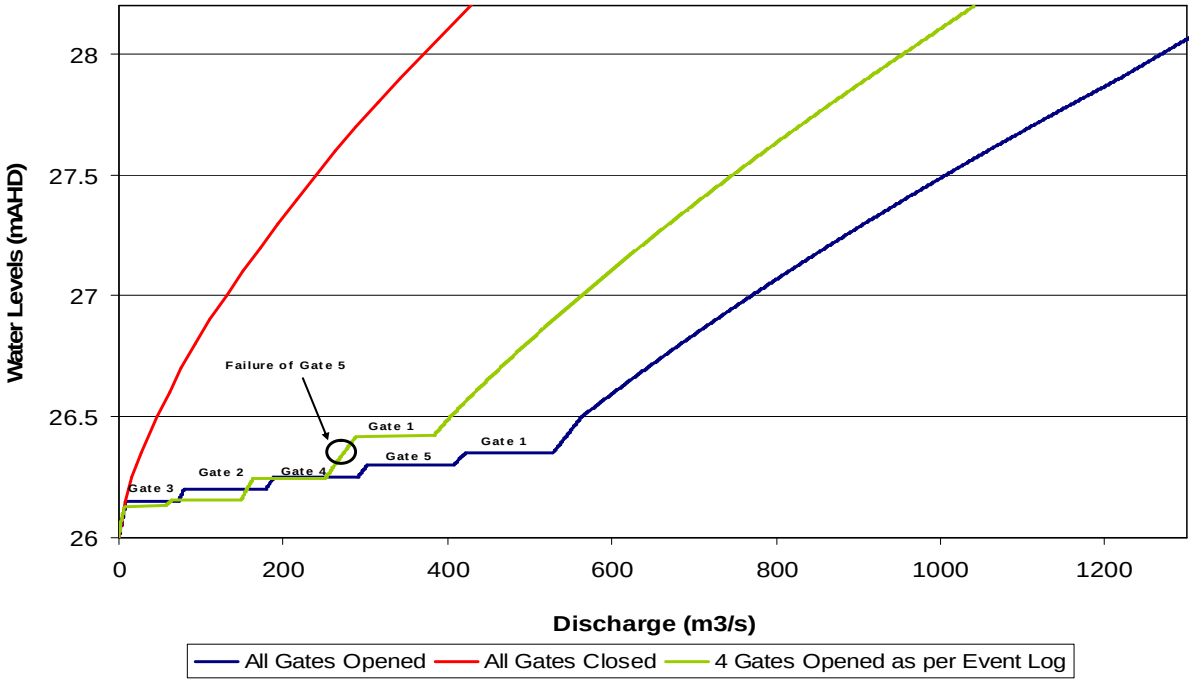

Figure 3-4: Discharge Curves for Lenthalls Dam with 5 Crest Gates Fully Opened, 5 Gates Fully Closed, and 4 of 5 Gates Opened

Table 3-1: Lenthalls Dam Stage Storage Discharge Data (All Gates Closed and All opened)

Elevation Storage	
Elevation (m)	Storage (ML)
12.00	0
12.20	0.67
14.00	512.7
16.00	1650
18.00	3801
20.00	6951
21.00	8938
21.40	9823
21.80	11,260
23.00	13,990
24.00	17,260
24.20	18,030
24.80	20,770
25.00	21,840
26.00 FSL	28,630
26.30	30,910
26.31	31,000
26.35	31,370
26.36	31,460
26.40	31,820
26.41	31,920
26.45	32,280
26.46	32,370
26.50	32,740
26.51	32,830
27.00	37,330
27.50	43,210
28.00	49,090
29.00	63,720
30.00	81,380
31.00	102,400
32.00	127,100
33.00	155,700
34.00	188,300
35.00	225,300

Storage Discharge		
Storage (ML)	Discharge m3/s	
	5 Gates Fully Opened	5 Gates Fully Closed
28,631	0	0
29,768	8.82	8
29,768	72.55	8
30,148	78.84	12
30,148	179.02	12
30,527	188.18	16
30,527	290.66	16
30,906	302.46	21
30,906	407.15	21
31,365	421.4	27
31,365	528.23	27
32,741	563.28	46
33,659	602.13	61
34,576	642.19	76
35,493	683.47	93
36,411	725.96	111
37,328	769.68	131
38,504	814.62	151
39,681	860.8	172
40,857	908.2	193
42,034	956.85	216
43,210	1006.7	240
44,386	1057.9	264
45,563	1110.3	289
46,739	1163.9	315
47,916	1218.8	342
54,943	1470.9	485
62,257	1740.9	644
70,782	2028.2	818
79,610	2332.4	1005
89,783	2653.3	1204
100,292	2990.6	1415
112,267	3321.5	1638
124,608	3663.7	1870
138,508	4017	2113
152,799	4381	2365
168,712	4755.3	2627
185,030	5139.7	2898
203,115	5533.9	3177

Table 3-2: Lenthalls Dam Stage Storage Discharge (Gates 1, 2, 3, 4 Opened, Gate 5 Closed)

Elevation Storage	
Elevation (m)	Storage (ML)
12.00	0
12.20	0.67
14.00	512.7
16.00	1650
18.00	3801
20.00	6951
21.00	8938
21.40	9823
21.80	11,260
23.00	13,990
24.00	17,260
24.20	18,030
24.80	20,770
25.00	21,840
26.00 FSL	28,630
26.30	30,910
26.31	31,000
26.35	31,370
26.36	31,460
26.40	31,820
26.41	31,920
26.45	32,280
26.46	32,370
26.50	32,740
26.51	32,830
27.00	37,330
27.50	43,210
28.00	49,090
29.00	63,720
30.00	81,380
31.00	102,400
32.00	127,100
33.00	155,700
34.00	188,300
35.00	225,300

Storage Discharge	
Storage (ML)	Discharge (m3/s)
	Gates 1, 2, 3, 4 Opened (Gate 5 closed)
28,631	0
29,010	1.7
29,389	4.8
29,617	7.1
29,617	55
29,768	64
29,806	64
29,806	149
30,148	156
30,474	163
30,474	251
30,527	252
30,906	263
31,365	274
31,824	285
32,007	289
32,007	383
32,282	391
32,741	404
33,200	418
33,659	433
34,117	448
34,576	464
35,035	479
35,493	496
35,952	512
36,411	528
36,869	545
37,328	562
37,916	579
38,504	598
39,093	615
39,681	634
40,269	652
40,857	670
41,445	689
42,034	708
42,622	728
43,210	747
43,798	767
44,386	787
44,975	807
45,563	828
46,151	848
46,739	869
47,327	890
47,916	912

3.4 Water Level Data

Water level records were obtained at Lenthalls Dam Alert (Station No. 040906) and Howard Alert (Station No. 040907). Howard Alert is located approximately 8 km downstream of Lenthalls Dam Alert.

The water levels recorded at Lenthalls Dam are presented in Figure 3-5, while those at Howard Alert are presented in Figure 3-6. It is noted that the discharge from Lenthalls Dam (catchment area 511 km^2) provides most of the discharge into Howard Alert (catchment area 610 km^2). There is, however, approximately 100 km^2 of catchment area downstream of Lenthalls Dam which also discharges into Howard Alert.

Based on Figures 3-5 and 3-6, the recorded peak water level at Lenthalls Dam was 28.183 m AHD (6 pm, 28 December), while that at Howard Alert was 7.42 m AHD (2 pm, 28 December).

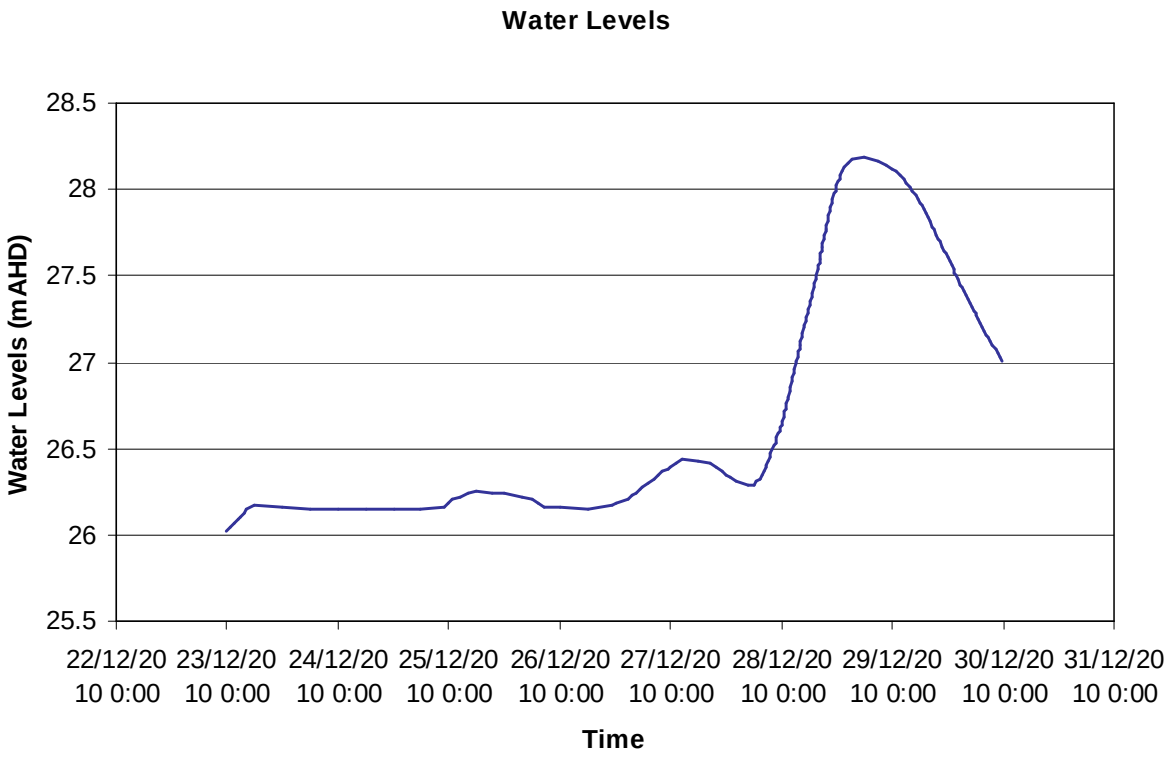

Figure 3-5: Water Level Data Recorded at Lenthalls Dam for December 2010 Storm Event

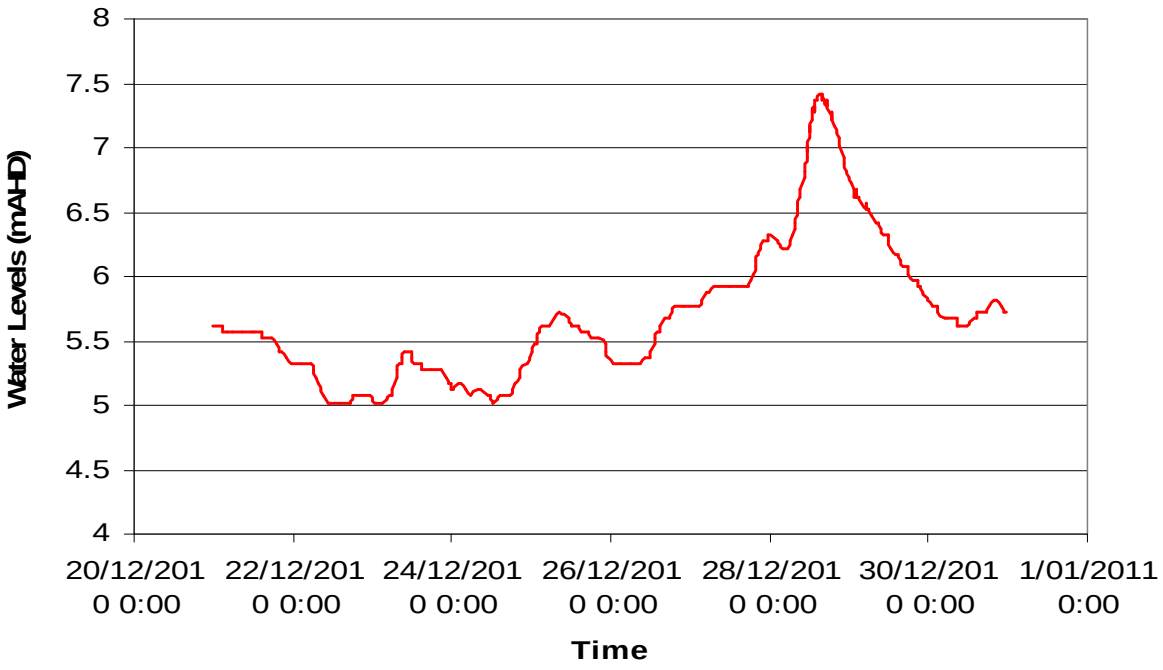

Figure 3-6: Water Level Data Recorded at Howard Alert for December 2010 Event

3.4.1 Calibration of RORB Model

The same model used to simulate the February 2008 event was used to assess the December 2010 event. As noted earlier, the original calibration parameters were initially adopted (Table 3-3). These parameters were later varied to test the robustness of the previous calibration in assessing the December 2010 storm event.

Table 3-3: RORB Parameters (February 2009 model)

Parameter	Adopted Value
Catchment kc	30
Catchment m	0.8
Initial Loss (mm)	8
Continuing Loss (mm/hr)	2

4. Findings

4.1 RORB Model Results

A range of calibration parameters were trialled in the RORB model in assessing the robustness of the model and in examining the December 2010 storm event. The results are presented in Table 4-1 for 3 gate operation scenarios as follows:

- Scenario 1 – All 5 gates opened and operational;
- Scenario 2 – All 5 gates closed and non-operational; and
- Scenario 3 – 4 gates opened (Gates 1, 2, 3, and 4), and 1 gate closed (Gate 5) as per Event Log for December 2010 Event.

For Scenario 1, the results for 15 runs are presented, while for Scenarios 2 and 3, the results for 4 runs and 7 runs are presented, respectively. The RORB model hydrographs for some of these model runs are also plotted in Figures 4-1 to 4-6. It is noted that in Figures 4-1 to 4.6, the recorded hydrographs were derived using the Lenthalls Dam water levels recorded by Wide Bay Water and the Bureau of Meteorology.

Scenario 1 (All Gates Opened)

In Table 4-1 , the results for Scenario 1 indicate that the peak water level at the dam could not possibly have reached the recorded peak of 28.18 m AHD, with all the 5 gates opened and operational. This was the case for the full range of model parameters tested. Example plots, for RUN 1A, RUN 1I and RUN 1J, are shown in Figure 4-1, Figure 4-2 and Figure 4-3,

It is noted that the model parameters k_c and m represent the intrinsic characteristics of the catchment, which were previously determined, and it was not expected that these parameters would have to be altered in validating the model. Nevertheless, the results confirmed that Scenario 1 does not apply and that in fact the gates were not all operational during the December 2010 storm event.

The results for Scenario 1 also indicate that the model, when applied to the December 2010 event, was not particularly sensitive to initial loss but more sensitive to continuing loss. This was due to the long duration storm for the December 2010 event, as expected.

Scenario 2 (All Gates Closed)

In Table 4-1, the results for Scenario 2 indicate that the peak water level in the dam would reach the recorded peak of 28.18 m AHD if the 5 gates had been closed and non-functional. In addition to the peak discharge, the timing and shape of the modelled hydrograph also matched the recorded data (Figure 4-4).

These results were not expected if the gates had been functioning. However, it is interesting to note in Figure 4-4 that there was a rapid drop in the recorded dam water level at the falling limb after passage of the dam peak water level. While this cannot be confirmed, one possibility is that the gates somehow closed and opened again after the peak of the storm had passed.

Table 4-1: Results of Calibration Tests

Scenario	Kc	m	Initial Loss (mm)	Continuing Loss (mm/hr)	Peak Q in (m^3/s)	Peak Q out (m^3/s)	Modelled Dam Water Levels (m AHD)		Recorded Peak (m AHD)
							Starting	Peak	
Original Model (2008 storm)	30	0.8	8	2					
Scenario 1 Gates All Operational									
1A	30	0.8	8	2	734.73	609.66	25.98	26.62	28.183
1B	30	0.8	7	2	734.73	609.66	25.98	26.62	28.183
1C	30	0.8	5	2	734.73	609.66	25.98	26.62	28.183
1D	30	0.8	3	2	734.73	609.66	25.98	26.62	28.183
1E	30	0.8	0	2	734.73	609.66	25.98	26.62	28.183
1F	30	0.8	8	1.5	805.96	659.42	25.98	26.74	28.183
1G	30	0.8	8	1	876.89	713.91	25.98	26.87	28.183
1H	30	0.8	8	0.5	947.59	770.46	25.98	27.00	28.183
1I	30	0.8	8	0	1018.17	819	25.98	27.11	28.183
1J*	30	0.8	8	2	448.12	413.07	25.98	26.32	28.183
1K*	30	0.8	8	1	577.81	535.51	25.98	26.38	28.183
1L*	30	0.8	8	0	721.42	629.49	25.98	26.67	28.183
1M	20	0.8	8	2	891.103	694.01	25.98	26.82	28.183
1N	10	0.8	8	2	1227.36	824.95	25.98	27.12	28.183
1O	0	0.8	8	2	3699.36	942.72	25.98	27.37	28.183
Scenario 2 All Gates Closed									
2A	30	0.8	8	2	734.73	433.2	25.98	28.215	28.183
2B	30	0.8	8	2.1	722.76	425.38	25.98	28.188	28.183
2C	30	0.8	8	2.11	721.57	424.59	25.98	28.185	28.183
2D	30	0.8	8	2.12	720.38	423.81	25.98	28.182	28.183
Scenario 3 4 Gates Opened as per Event Log									
3A	30	0.8	8	2	734.73	557.87	25.98	26.99	28.183
3B	30	0.8	8	1.5	805.96	603.46	25.98	27.12	28.183
3C	30	0.8	8	1	876.89	655.08	25.98	27.26	28.183
3D	30	0.8	8	0.5	947.59	711.54	25.98	27.41	28.183
3E	30	0.8	8	0	1018.17	770.04	25.98	27.56	28.183
3F	12	0.8	0	0	1440.51	945.18	25.98	27.98	28.183
3G	<12	0.8	0	0	critical model error				

*Using weighted rainfall at Lenthalls Dam and Musket Flat. Other runs use rainfall at Lenthalls Dam only.

Scenario 3 (4 Gates Opened, 1 Gate Failed as per Event Log)

In this Scenario, the exact sequence of gate opening, closure and re-opening was followed as per the Event Log, and 4 gates were assumed to have opened, with the 5th gate failing to open, as noted earlier.

The results, presented in Table 4-1, are rather surprising. Essentially, they showed that the recorded peak water level in the dam of 28.18 m AHD could not possibly be reached using the Event Log. This was the case for the full range of model parameters tested, including the use of impractical parameters. Example plots for RUN 3A and RUN 3E are shown in Figure 4-5 and Figure 4-6. In these two runs, the peak RORB model levels are between 0.6 to 1.2m lower than the recorded peak dam level.

This raises the possibility that all the gates had somehow failed to open during the peak of the storm, which would be consistent with the results for Scenario 2.

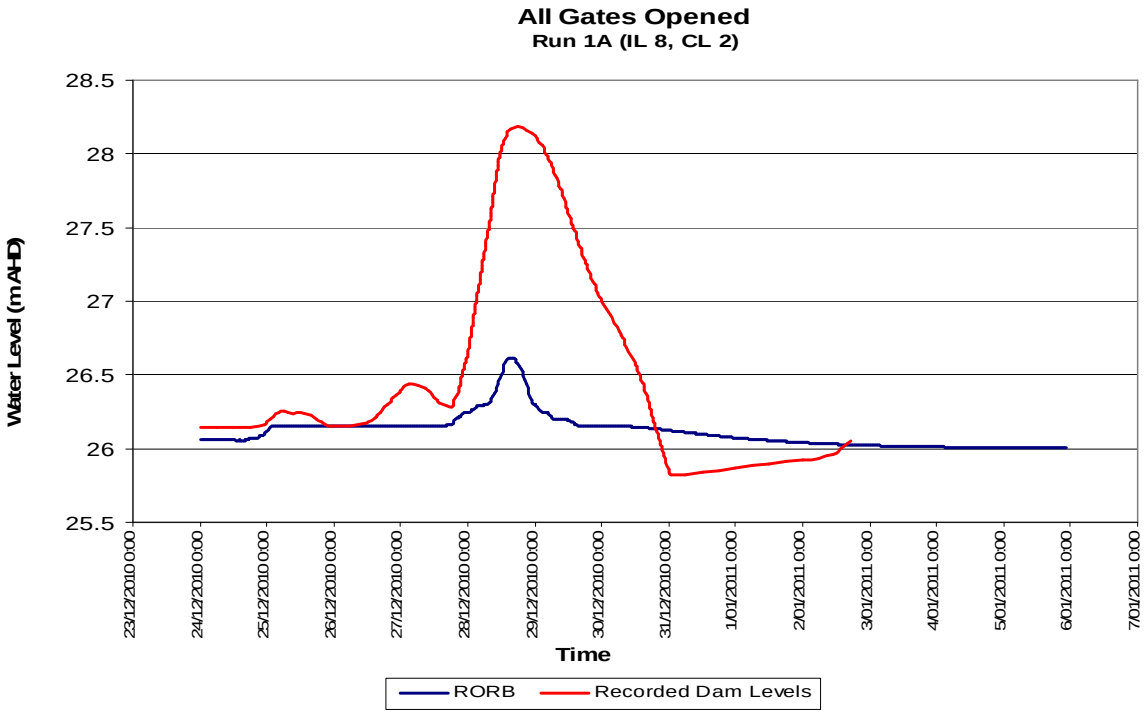

Figure 4-1: Scenario 1A (All Gates Opened) Dam Outflow Hydrographs

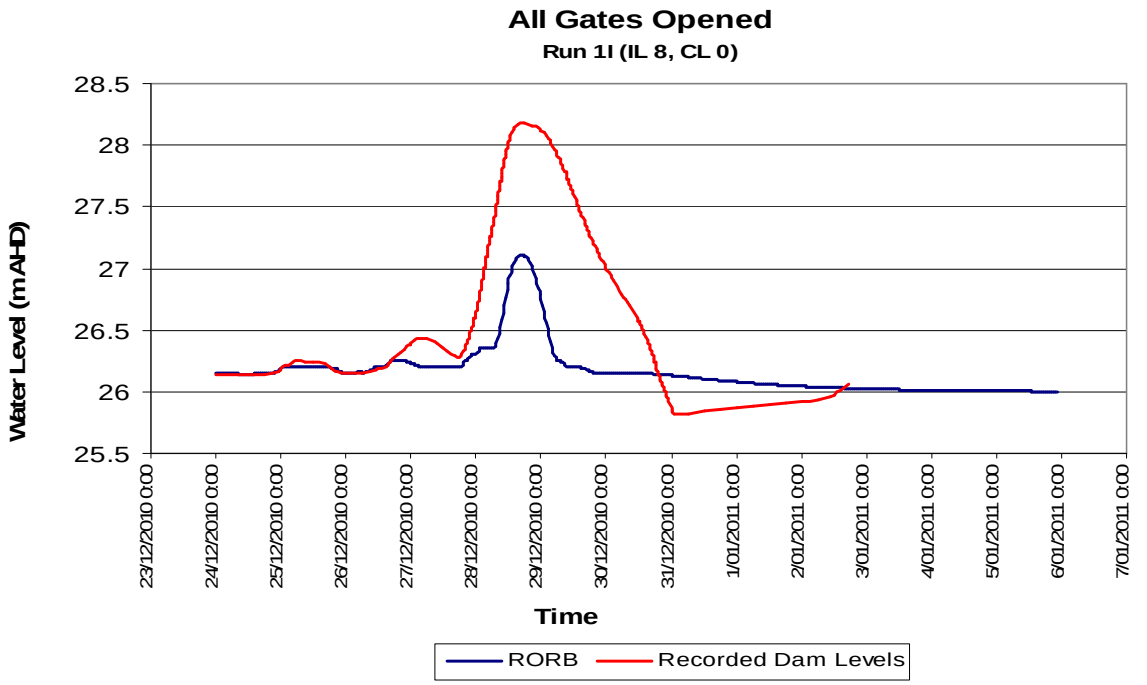

Figure 4-2: Scenario 1I (All Gates Opened) Dam Outflow Hydrographs

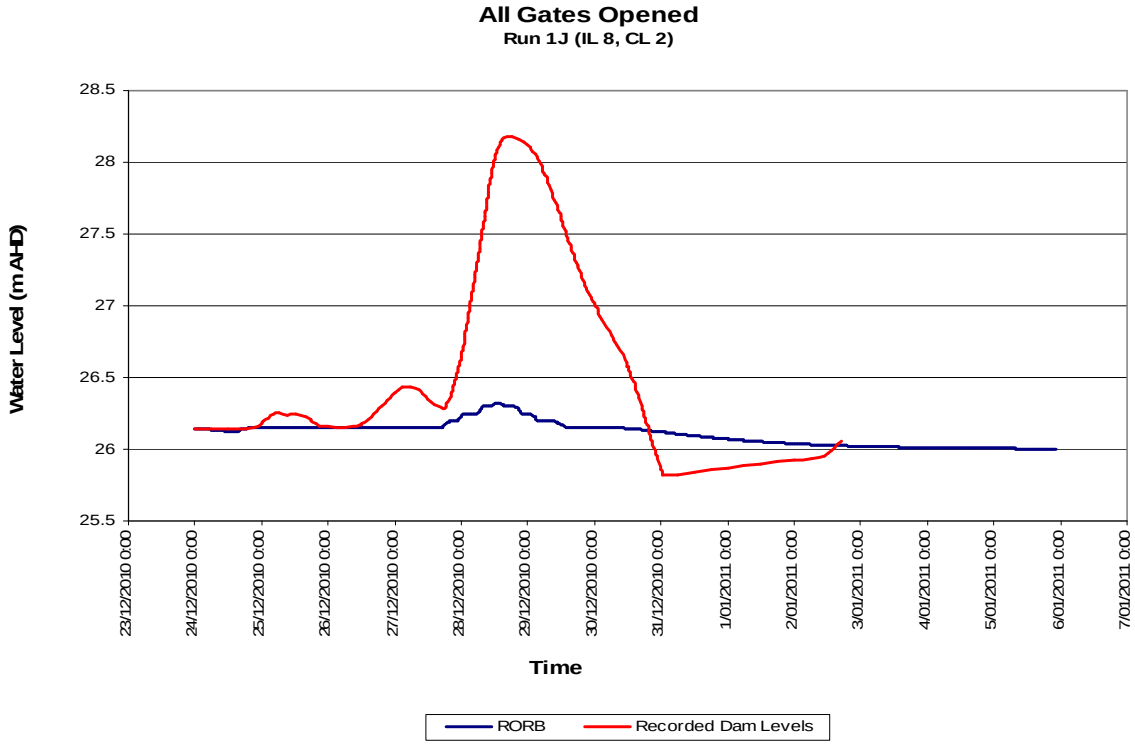

Figure 4-3: Scenario 1J (All Gates Opened) Dam Outflow Hydrographs

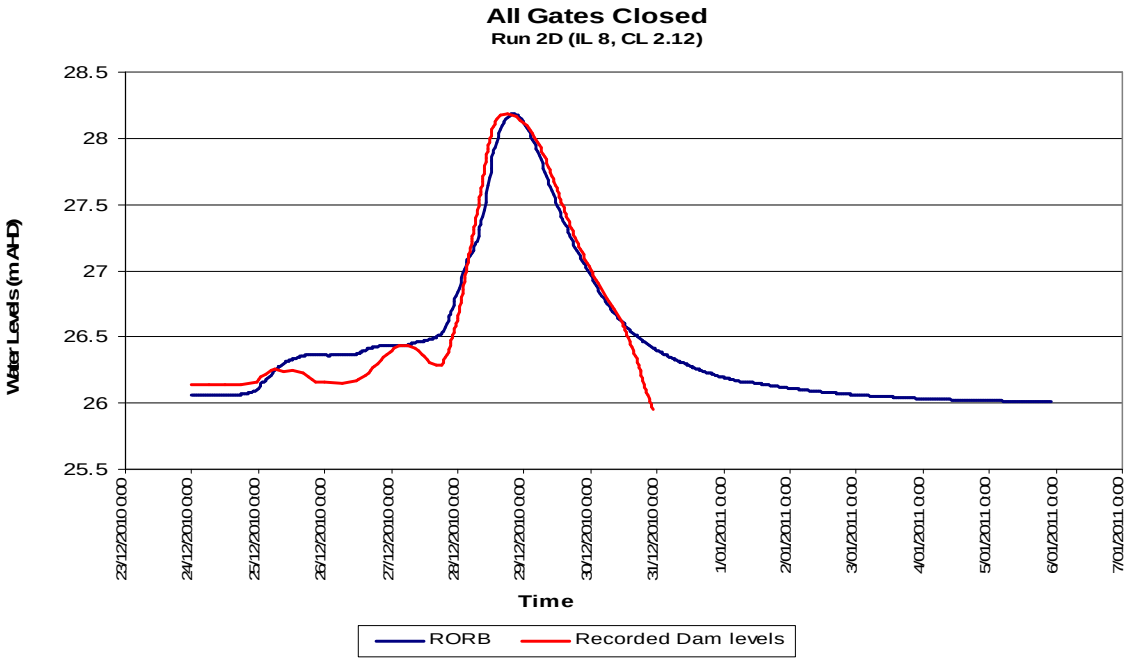

Figure 4-4: Scenario 2D (All Gates Closed) Dam Outflow Hydrographs

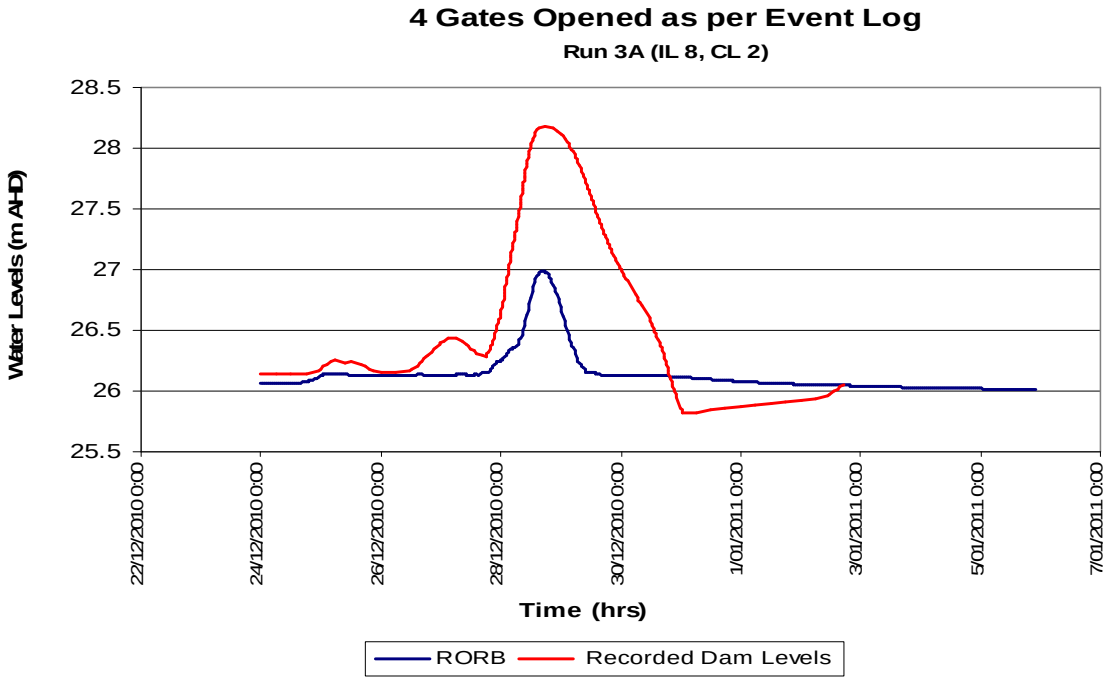

Figure 4-5: Scenario 3A (Event Log) Dam Outflow Hydrographs

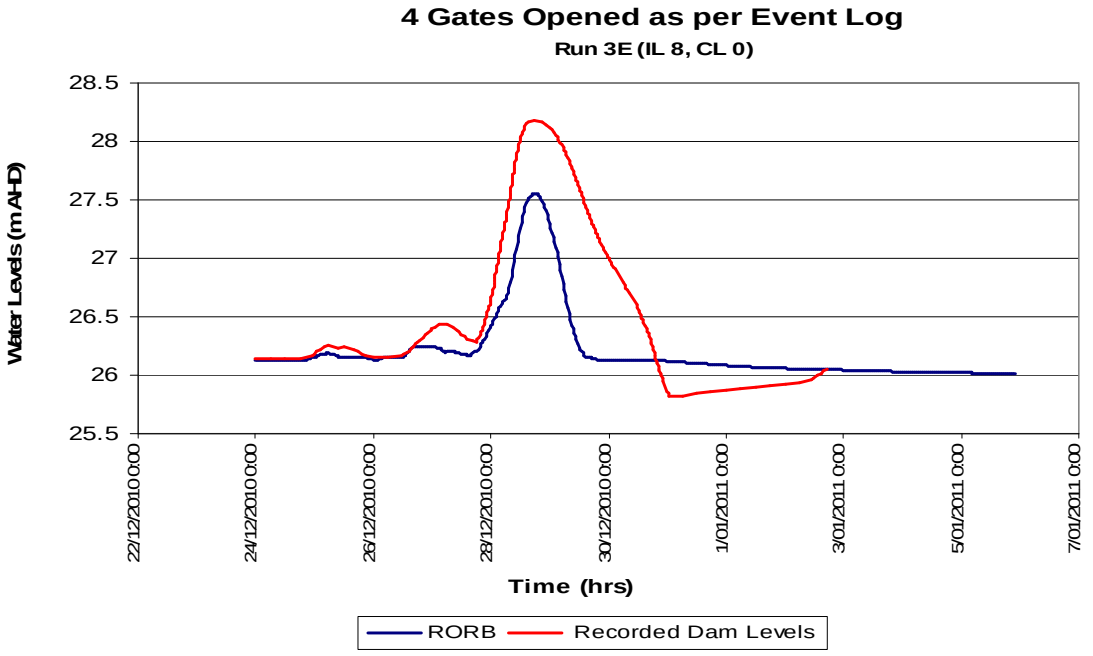

Figure 4-6: Scenario 3E (Event Log) Dam Outflow Hydrographs

4.2 Magnitude of December 2010 Event

In order to assess the magnitude of the December 2010 storm event, the recorded rainfall depths were compared with design rainfall depths for the full range of durations from 1 hour to 120 hours (5 days). In Table 4-2, the comparison suggests that the December 2010 event was a relatively small event, with a magnitude significantly less than that for a 1 in 5 year ARI event. This was the case for all the durations checked. It is noted that in Table 4-2, the 1 in 2 year ARI design rainfall depths were not available and therefore not shown.

In Table 4-3, design water levels for the dam are extracted from the Lenthalls Dam Flooding Report (2009) and examined. These design levels are based on the stage-storage-discharge relationships for the dam and form the basis for the design and operation of the dam. Accordingly, with all the gates opened, the peak water level in the dam is not expected to exceed 28 m AHD, up to the 1 in 50 year ARI event. However, a dam water level of 28 m AHD would be exceeded at the 1 in 5 year ARI event if the gates are closed.

Considering that the rainfall intensities for the December 2010 event were rather small and less than that for the 1 in 5 year ARI event, it does not appear consistent or plausible that the peak water level in the dam could have risen to that of the 1 in 50 year design dam level with all the gates opened. This is notwithstanding a scenario with 4 instead of 5 gates opened.

By contrast, the results are consistent with the design case with all the gates closed. It can be seen from Table 4-2 and Table 4-3, that the magnitude of the December 2010 storm (rainfall intensities and dam water level less than 1 in 5 year ARI) matches that of the design condition for a 1 in 5 year ARI event with all the gates closed.

Overall, the above results are consistent with the likelihood that the gates had somehow shut closed during the peak of the December 2010 event.

Table 4-2: Comparison of Recorded Rainfall Depths for December 2010 Event with Design Depths

Duration	Peak Recorded Rainfall Depth for December 2010 Event	Design Rainfall Depth (CRC Forge)[1]		
		1 in 5 year ARI	1 in 10 year ARI	1 in 20 year ARI
1 hr	15	61	69	79
3 hrs	39	87	99	114
6 hrs	66	109	123	142
12 hrs	82	135	154	178
18 hrs	123	161	185	217
24 hrs	143	182	211	248
120 hrs	238	269	311	366

1: Lenthalls Dam Flooding Report, GHD 2009

.

Table 4-3: Design Dam Water Levels

Design Condition	Recorded Level (m AHD)	Design Peak Water Level at Lenthalls Dam (m AHD)[1]					
		1 in 2 year ARI	1 in 5 year ARI	1 in 10 year ARI	1 in 20 year ARI	1 in 50 year ARI	1 in 100 year ARI
All Gates Closed		27.81	28.52	28.88	29.3	29.86	30.26
All Gates Opened		26.39	26.94	27.23	27.63	28.15	28.52
February 2008	27.45						
December 2010	28.18						

1: Lenthalls Dam Flooding Report, GHD 2009

4.3 Howard Alert Water Level Records (Burrum No. 1 Dam)

The water level data available at Howard Alert (Station No 040907) were obtained and analysed to assist in understanding the flow behaviour and what may have happened at Lenthalls Dam. As noted earlier, Howard Alert is located downstream of Lenthalls Dam, with approximately 100 km^2 of catchment area in-between.

It is noted that Lenthalls Dam reached a peak water level of 28.18 m AHD at 6 pm on the 28 December 2010 (Figure 3-5). By comparison, Howard Alert reached a peak water level of 7.42 m AHD at 2 pm on the 28 December 2010 (Figure 3-6). At Howard Alert, the water level was at about 7.1 m AHD between 6 to 7 pm on the same day. Based on the rating curve for Howard Alert, a water level of about 7.1 m AHD corresponds to a discharge of approximately 650 m^3/s (Figure 4-7).

In Table 4-4, the discharge at Howard Alert is estimated using the stage-storage-discharge data for Lenthalls Dam, coupled with the intervening catchment area flow between Lenthalls Dam and Howard Alert, and then compared with the recorded discharge at Howard Alert. The purpose of this comparison is to establish the order of magnitude of flow that would be expected at Howard Alert if the gates at Lenthalls Dam had either been fully opened, fully closed, or partially opened.

Based on a catchment area of 511 km^2 at Lenthalls Dam and a peak inflow of 735 m^3/s, the 100 km^2 intervening catchment area downstream of Lenthalls Dam was estimated to have a peak contributing flow of approximately 142 m^3/s into Howard Alert.

With the Lenthalls Dam gates all opened, a peak water level of 28.18m is estimated to yield a peak discharge of 1362 m^3/s. With 4 of the 5 gates opened (Gate 5 closed), the peak discharge would reduce to 1034 m^3/s. This would further reduce to 424 m^3/s if all the gates are closed.

In Table 4-4, taking into account the discharge from Lenthalls dam and that from the contributing catchment downstream of Lenthalls Dam, it is clear that the recorded discharge at Howard Alert could not possibly have been only of the order 650 m^3/s if 4 of the 5 Lenthalls Dam gates were opened. This is

because the corresponding discharge from Lenthalls Dam alone would have exceeded that flow. However, the results are entirely consistent if the gates were all closed. In this case, the estimated total discharge of 566 m^3/s at Howard Alert compare favourably with the recorded discharge of 650 m^3/s.

On the basis of the above results, it is concluded that the Lenthalls Dam gates were most probably closed during the peak of the December 2010 event.

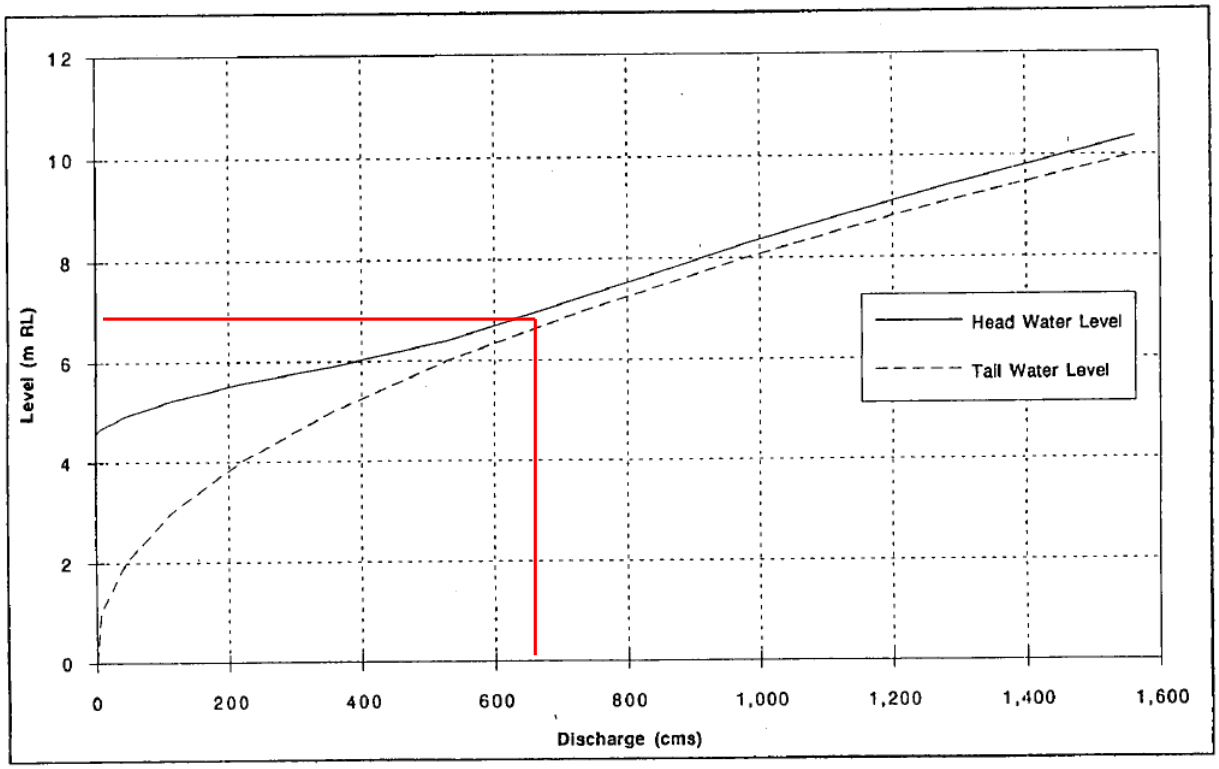

Figure 4-7: Rating Curve for Howard Alert (Burrum No 1 Dam)

Table 4-4: Estimated and Recorded Discharge at Howard Alert

Scenario	Lenthalls Dam		Downstream Catchment Flow (100 km^2)[1] (m^3/s)	Estimated Discharge at Howard Alert (m^3/s)	Recorded Discharge at Howard Alert (m^3/s)
	Peak Level (m AHD)	Peak Discharge (m^3/s)			
All Gates Opened	28.18	1362	142	1504	650
All Gates Closed	28.18	423.9	142	566	650
4 Gates Opened (Gate 5 Closed)	28.18	1034.3	142	1176	650

1: This catchment area exists between Lenthalls Dam and Howard Alert

4.4 Analysis of Gate Malfunction

In order to identify the period during which the gates may have malfunctioned, the recorded flows at Howard Alert and Lenthalls Dam were plotted and compared. As the flow at Howard Alert is made up of the flow from Lenthalls Dam and the 100 km^2 intervening catchment between these gauges, any period of time where the recorded flow at Lenthalls Dam is greater than that at Howard Alert would therefore be erroneous.

The results are plotted in Figure 4-8. It is noted that the recorded flows at Lenthalls Dam and Howard Alert were derived from the recorded water levels and their respective rating curves. For comparison, the flows with all the Lenthalls Dam crest gates hypothetically closed, with 4 of the gates hypothetically opened, as well as the modelled inflow at Lenthalls Dam, are also included.

In Figure 4-8, it is evident, based on the recorded flow at Howard Alert, that flow regulation at the Lenthalls crest gates did occur. This is characterised by the distinct regulated flow pattern at Howard Alert for extended periods of time on the 22 December, 23 December, 25 December and 27 December. In other words, the opening and closure of the crest gates at Lenthalls Dam did work up to that time.

However, it is evident that the Lenthalls crest gates malfunctioned at around 17:36 hours on the 27 December (WSL = 26.284 m) to 04:07 hours on the 28 December (WSL = 27.1 m). At around this time, it is seen that the Lenthalls Dam discharge, with 4 gates hypothetically opened, begins to exceed that at Howard Alert, which is erroneous and not possible.

Another indicator of the malfunction is the shape of the Howard Alert hydrograph at around the above times (17:36 hours 27 December to 04:07 hours 28 December). During this time period, it can be seen that the Howard Alert hydrograph shape is markedly similar to the Lenthalls Dam inflow shape. While not definitive, this suggests that there was no discharge from the Lenthalls Gates, and the inflow into Lenthalls Dam was essentially spilling over the spillway.

Interestingly, the recorded flow pattern at Howard Alert suggests that flow regulation kicked in again after around 17:50 hours on the 29 December (WSL = 27.28 m). This means that the gates functioned during the early hours of the storm event, malfunctioned as the dam water levels rose, but somehow functioned again after the water levels dropped.

Overall, the above findings support the notion that the Lenthalls Dam crest gates malfunctioned and somehow shut closed during the peak of the December 2010 storm event. This resulted in the dam water levels rising to a peak of 28.183 m AHD, which would not have occurred if the gates had operated as intended.

4.5 Design Flood Levels Upstream of Lenthalls Dam

The design flood levels upstream of Lenthalls Dam have previously been determined in the Lenthalls Dam Flood Study Report (GHD 2009). This covers the full range of flood events from the 1 in 2 year ARI event to the 1 in 100 year ARI event, and includes Doongul Creek, Logbridge Creek, and several un-named tributaries. The reader is referred to the 2009 report for full details of the design flood levels along those watercourses.

Taking into account the December 2010 storm event, it is considered that the design flood levels established in the 2009 Report for the watercourses upstream of Lenthalls Dam are still relevant, appropriate and would remain unchanged. In essence, the December 2010 event was a relatively small event, and the unexpected high water levels in the dam was attributed to the failure of the crest gates.

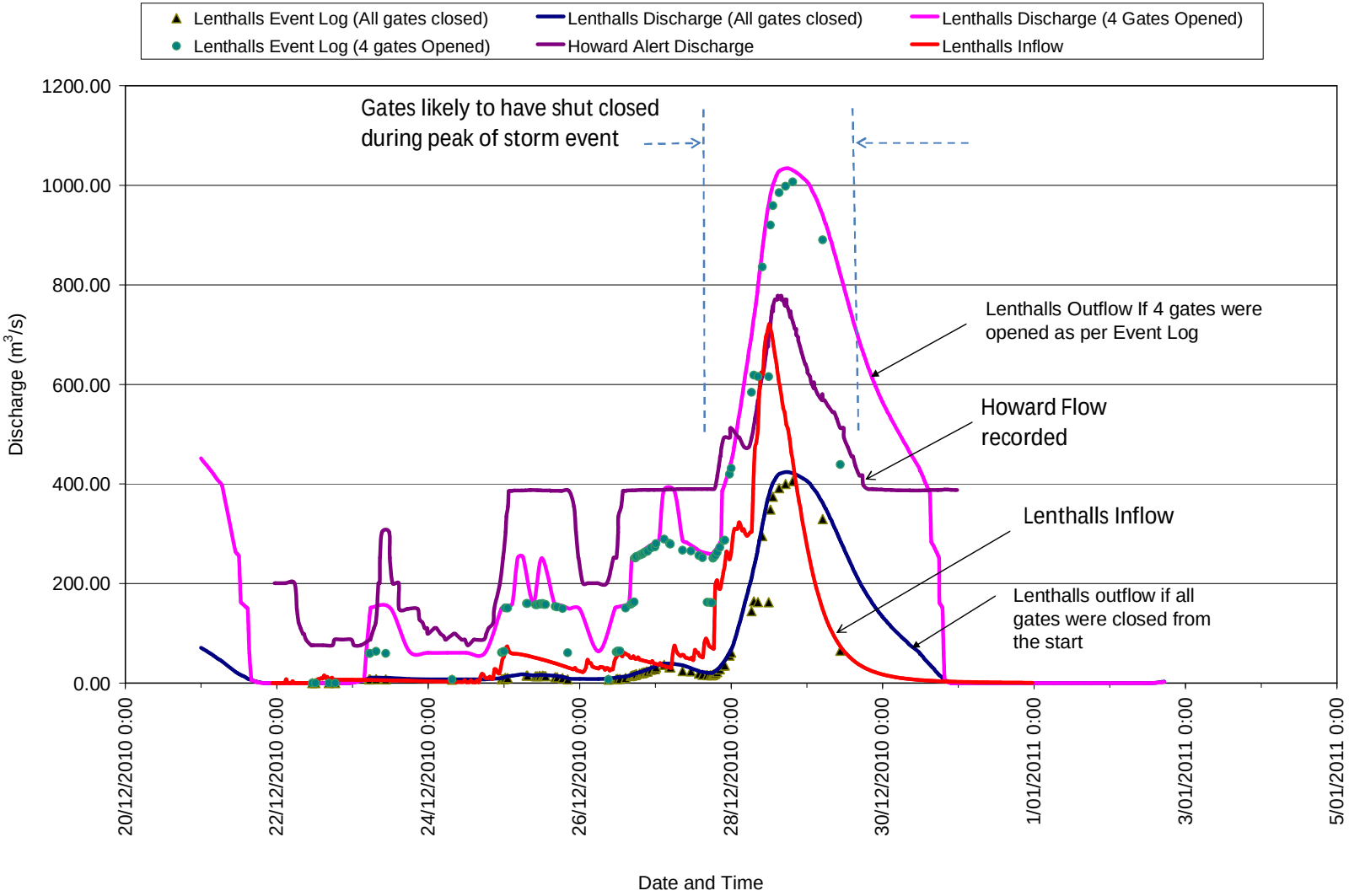

Figure 4-8: Analysis of Lenthalls Dam Gate Malfunction

5. Conclusions

The December 2010 storm event was assessed using the hydrological model RORB previously developed and calibrated for the Lenthalls Dam catchment. The results indicated that calibration of the December 2010 event was only possible if the Lenthalls Dam gates had been fully closed rather than opened during the peak of the storm.

The magnitude of the rainfall intensities for the December 2010 event was found to be relatively small and less than that for the 1 in 5 year ARI event. On this basis it was found that the peak water level of 28.18 m AHD recorded at the dam would occur only if all the crest gates were closed during the storm event.

It was found that the relatively small December 2010 event would have had to behave as a 1 in 50 year ARI event for it to reach a peak water level of 28.18 m AHD. This was not considered to be plausible.

Comparison of the peak flow recorded at Howard Alert (Burrum No. 1 Dam) with that estimated using the Lenthalls Dam data and RORB model, indicated that the recorded flows are consistent with the Lenthalls Dam gates being all closed.

Further analysis of the recorded flows at Howard Alert and Lenthalls Dam indicated that the Lenthalls Dam gates did operate, and opened and closed, during the early stages of the December 2010 event. However, as the water levels in the dam rose, the gates malfunctioned and shut closed. The gates then appeared to work again after passage of the storm peak.

It is concluded that the Lenthalls Dam gates were faulty and did not function as intended during the peak of the December 2010 storm event. This led to the dam water levels rising to higher than expected levels for a storm the size of the December 2010 event. In terms of design flood levels in the watercourses upstream of Lenthalls Dam, it is considered that the flood levels established in the 2009 report, for the full range of events up to the 1 in 100 year ARI flood, are still appropriate and remain unchanged.

Considering that malfunction of the gates for a relatively small event could lead to a significant rise in water level at the dam, a major storm event could potentially result in major consequences. It is recommended that the dam design as well as the operation of the crest gates be reviewed, with the view of rectifying any faults to mitigate against any potentially adverse impacts.

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