IN THE MATTER OF
THE QUEENSLAND FLOODS COMMISSION OF INQUIRY

A COMMISSION OF INQUIRY UNDER THE COMMISSIONS OF INQUIRY ACT 1950

AND PURSUANT TO COMMISSIONS OF INQUIRY ORDER (No. 1) 2011

SECOND STATEMENT OF JOHN TIBALDI

On the 1st day of April 2011 I, **John Tibaldi**, of C/- 240 Margaret Street, Brisbane, state on oath:

1. I am currently employed by Queensland Bulk Water Supply Authority ("**Seqwater**") as Principal Engineer, Dam Safety.

2. I make this statement in response to a requirement dated 25 March 2011 issued by Justice Catherine E Holmes, Commissioner of Inquiry, pursuant to section 5(1)(d) of the *Commissions of Inquiry Act* 1950 (Qld).

The Manual of Operational Procedures for Flood Mitigation at Wivenhoe and Somerset Dams (the "Manual")

3. I was not involved in the original creation of the Manual. However, the need for the Manual and the way it was developed are touched upon in:

   (a) Revision 6 of the Manual dated 20 December 2004 ("**Revision 6**"), Section 1.1.

   (b) Revision 7 of the Manual dated November 2009 ("**Revision 7**"), Section 1.1.

4. The current process for amendment of the Manual is set out in Section 1.8 of Revision 7, which provides:

> If Seqwater is of the opinion that this Manual should be amended, altered or varied, it must submit for approval as soon as practical, an appropriate request to the Chief Executive, setting out the

Filed on behalf of: Queensland Bulk Water Supply Authority trading as Seqwater

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Ref MGI:120128021

mgib A0117089978v1 120128021

> circumstances and the exact nature of the amendment, alternation or variation sought. The Chief Executive may accept, reject or modify the request prior to approval.

5. Revision 7 was approved by the Chief Executive under the *Water Supply (Safety and Reliability) Act* 2008 (Qld). I understand that any amendment to Revision 7 must also be approved by the Chief Executive under that Act.

6. Section 7.5 of Revision 7 provides:

> Prior to the expiry of the approval period, Seqwater must review the Manual pursuant to the provisions of the Act. The review is to take into account the continued suitability of the communication network and the flood monitoring and forecasting system, as well as hydrological and hydraulic engineering assessments of the operational procedures.

7. I have only been involved in one revision of the Manual. That was the most recent revision (Revision 7). Revision 7 was a Five Yearly Review under Section 7.5 above. I was not involved in previous revisions. I have not read the first five revisions of the Manual. I cannot comment on the amendments made during those revisions.

8. In relation to the most recent revision (Revision 7):

   (a) My involvement commenced in about August 2009.

   (b) I was responsible for organising meetings with the Dam Safety Regulator, the other Flood Operations Engineers and others to discuss possible changes, and for drafting suggested changes which were agreed by the participants in those meetings.

   (c) During the process, a number of drafts were produced and a number of meetings were held with, amongst others, the Dam Safety Regulator, to discuss those drafts.

   (d) Also during the process, Engineer 2 and I undertook a study to optimise the Wivenhoe /Somerset Operating Target Line. We produced a document entitled "Somerset-Wivenhoe Interaction Study" dated October 2009. Annexed to this statement and marked "JT-1" is a true copy of that document. At page 24 of that document, we recommended that a new operating target line be adopted. That recommendation was accepted and approved by the Dam Safety Regulator and adopted in Revision 7 at page 40.

   (e) The process continued until the participants were satisfied that the document was suitable to be submitted for final approval.

[redacted] [redacted]

(f) I wrote a short paper to explain the proposed amendments in Revision 7, and drafted the letter to be sent by the Chief Executive Officer of Seqwater seeking approval of the proposed amendments. Annexed to this statement and marked "JT-2" is a true copy of each of those documents.

(g) In recent months I have become aware of minor corrections that may be required to the Manual. I consider that there is an ambiguity in the flow chart which appears on page 23 of Revision 7. The boxes in the centre of the page deal with the circumstances in which you would adopt Strategy W2 or Strategy W3. In my view, a note should be inserted to read "In situations where the intent of Strategy W2 cannot be met, Strategy W3 should be used". There are also arithmetical errors in the tables which appear in Appendix J of Revision 7 in relation to discharge which I have discussed with the Dam Safety Regulator.

(h) The Brisbane City Council was briefed on this review of the Manual. In this regard I refer to paragraph 66 of my first statement dated 25 March 2011 ("**my first statement**").

9. In practice, the Manual is used by appointed Flood Operations Engineers during flood events to make operational decisions associated with making flood releases from the dams.

10. I have addressed the way in which weather forecasts provided by the Bureau of Meteorology are used by Flood Operations Engineers in my first statement. In this regard I refer to paragraphs 46 and 47 of my first statement. In my opinion, this is the way such weather forecasts should be used.

11. The "priorities" in the Manual are the objectives set out in the Manual. They are set out in paragraph 28 of my first statement. In practice, the "weight" given to those priorities reflects their descending order of importance.

12. I cannot comment on how the implementation of the objectives set out in the Manual has changed over all seven revisions of the Manual as I was not involved in the implementation of the first five revisions. However, changes were made to the objectives of the Manual in Revision 7. Those changes were explained in the short paper I prepared (which is part of Annexure "JT-2" referred to above) as follows:

> The Flood Mitigation Objectives contained in the previous version of the Manual in order of importance were:
>
> - Ensure the structural safety of the dams;

[redacted] [redacted]

- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Minimise disruption and impact upon Wivenhoe Power Station;
- Minimise disruption to navigation in the Brisbane River.

Following investigations, it was determined that decisions made during flood events have never given consideration to either minimising disruption and impact upon Wivenhoe Power Station or minimising disruption to navigation in the Brisbane River.

The Wivenhoe Power Station is not adversely impacted to any degree until the Dam Levels exceed EL 74.0 AHD. At these levels, the primary consideration is only the structural safety of the dam and minimising disruption to the power station is not a consideration.

Similarly, at the stage in a flood event where Wivenhoe Dam outflows potentially disrupt navigation in the Brisbane River, the higher level flood objectives dominate decision making processes. Additionally, it is not currently possible to derive a sensible relationship between releases from Wivenhoe Dam and disruption to navigation in the Brisbane River. Recent experience showed that one of the primary disruption mechanisms associated with the Brisbane River navigation is the cancellation of the public transport "CityCat" services. Such cancellations occurred in May 2009, when releases were not being made from Wivenhoe Dam. It is understood that the cancellations at this time were a function of factors associated with debris entering the river system downstream of the dam. Presently, it is not considered possible to incorporate such factors in flood release decision making processes.

Regardless of the difficulties, to provide recognition that in some circumstances considerations of disruption to navigation may be required, the updated Manual allows disruption to navigation in the Brisbane River to be taken into account when considering disruption to rural areas downstream of the dam. The updated manual states however that consideration of navigation is generally secondary to considerations associated with reducing bridge inundation downstream of Wivenhoe Dam.

With consideration to these changes, the Flood Mitigation Objectives contained in the updated version of the Manual in order of importance are:

- Ensure the structural safety of the dams;
- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.

The first three objectives are unchanged from the previous version, while the last two objectives were added to reflect current operating practice. Naturally, at the end of an event, a primary objective is to

> ensure that the dams are at full supply levels. Additionally in the drain down phase of the event, there has always been an objective to minimise impacts to riparian flora and fauna, particularly critical species such as lung fish.

13. On my reading of the Manual, the dams cannot be drawn down below Full Supply Level. As to this:

    (a) The Manual applies in a Flood Event.

    (b) The Manual provides that the Wivenhoe spillway gates are not to be opened for flood control purposes prior to the reservoir level exceeding EL 67.25.

    (c) The Manual also provides that storage should be retained at Full Supply Level at the conclusion of the Flood Event.

    (d) Section 8.5 provides, amongst other things, that:

> The final gate closure should occur when the lake level has returned to Full Supply Level ...
>
> ... The aim should always be to empty stored flood waters stored above EL 67.0m within seven days after the flood peak has passed through the dams ...
>
> There may be a need to take into account base flow when determining final gate closure. This may mean that the lake level temporarily falls below Full Supply Level to provide for a full dam at the end of the Flood Event.

    (e) The temporary fall referred to in this passage can only occur at the conclusion of a Flood Event, and only to the extent necessary to provide for a full dam at the end of the event. I would not characterise this as drawing the dam down below Full Supply Level in any meaningful sense.

    (f) In my view, the discretion given to the Senior Flood Operations Engineer under section 2.8 of the Manual would not, on any realistic view, permit the dams to be drawn down to below Full Supply Level. That discretion only arises where the Senior Flood Operations Engineer forms the opinion that "it is necessary to depart from the procedures set out in this Manual to meet the flood mitigation objectives set out in Section 3." It is difficult to think of any realistic scenario during flood operations where it would be possible in a practical sense to drain the dams down to below Full Supply Level to meet those objectives.

14. The Manual reflects a particular balance between regional water supply security and the provision of flood mitigation benefits. Whether that balance should be changed is a


significant policy question for the Government. Any change would have a significant impact on people living in south east Queensland. Flood Operations Engineers can provide technical information on options being considered by the Government. However, the Government would also need to consider a broad range of other matters before making an informed policy decision. Those other matters include dealing with the possibility of another drought, the possibility of water restrictions, the possibility of south east Queensland running out of water, and the price of water.

Current dimensions and features of Wivenhoe and Somerset dams

15. To the best of my knowledge, the current dimensions and features of Wivenhoe dam may be summarised as follows:

(a) It is an earth and rock fill dam. It is not designed to be overtopped. Overtopping the dam will likely cause it to fail resulting in significant loss of life, extreme damage to rural and urban communities downstream of the dam and the loss of South East Queensland's primary source of water.

(b) It has radial gates and an auxiliary spillway which are used to release water during flood events.

(c) There are 5 radial gates, each 12.0m wide by 16.0m high.

(d) The fixed crest level of the spillway (or the bottom of the closed radial gates) is at EL 57.0m.

(e) The top of the closed radial gates is at EL 73.00m.

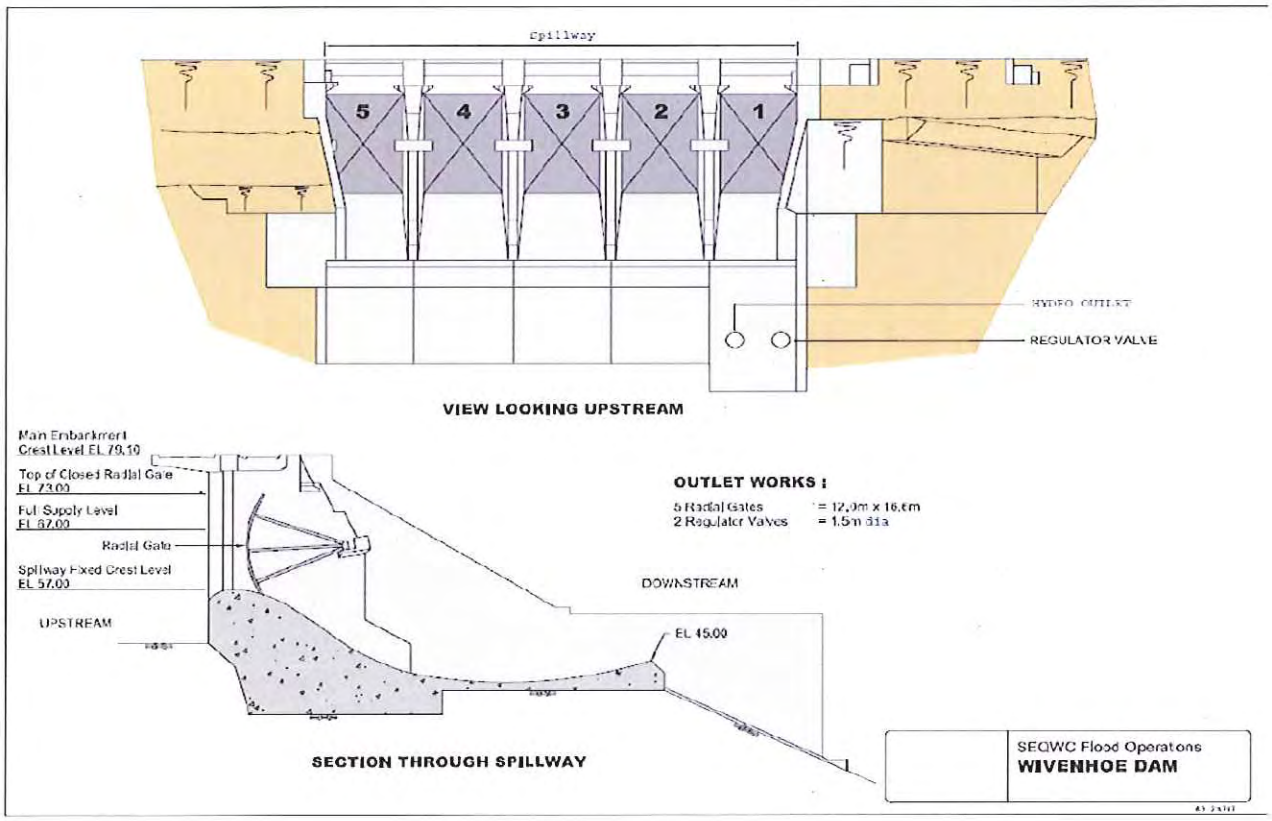
(f) The Full Supply Level of the dam is EL 67.0m.

(g) The failure level of the dam in the original design was EL 79.1m. Temporary works were installed during construction of the dam to raise this level to EL 79.7m. In 2005, permanent works including the construction of a new wave wall on the crest of the dam were completed to raise the failure level of the dam to from EL 79.7 to EL 80.0m.

(h) The radial gates are shown in the following figure and photograph:

[redacted]

[redacted]


Spillway
5
4
3
2
1
REGULATOR VALVE
VIEW LOOKING UPSTREAM
Main Embankment
Crest Level EL 79.10
Top of Closed Radial Gate
EL 73.00
Full Supply Level
EL 67.00
Radial Gate
Spillway Fixed Crest Level
EL 57.00
UPSTREAM
DOWNSTREAM
EL 45.00
OUTLET WORKS :
5 Radial Gates = 12.0m x 16.6m
2 Regulator Valves = 1.5m dia
SECTION THROUGH SPILLWAY
SEQWC Flood Operations
WIVENHOE DAM

(i) The auxiliary spillway consists of 3 fuse plugs.

(j) A fuse plug is effectively a zoned earth and rock fill embankment that is constructed on a non-erosive sill or weir. The embankment is designed to erode in a controlled manner when the lake water level reaches a pre-determined level. Below this level, the embankment impounds water in the same manner as a typical zoned earth and rock fill embankment. The upstream face of the embankment consists of a riprap layer to protect against wave action.

(k) The first of the three fuse plugs is initiated at EL 75.7m, the second at EL 76.3m and the third at EL 76.7m.

(l) After a fuse plug is triggered, the fuse plug bay erodes to a level of EL 67.0 m. Following an initiation event, the auxiliary spillway will operate every time the water in the dam exceeds Full Supply Level until the fuse plug is re-constructed.

(m) Full Supply Level equates to a volume of 1,165,000 ML.

(n) The dam was designed with a flood storage compartment of 1,420,000 ML.

16. To the best of my knowledge, the current dimensions and features of Somerset dam may be summarised as follows:

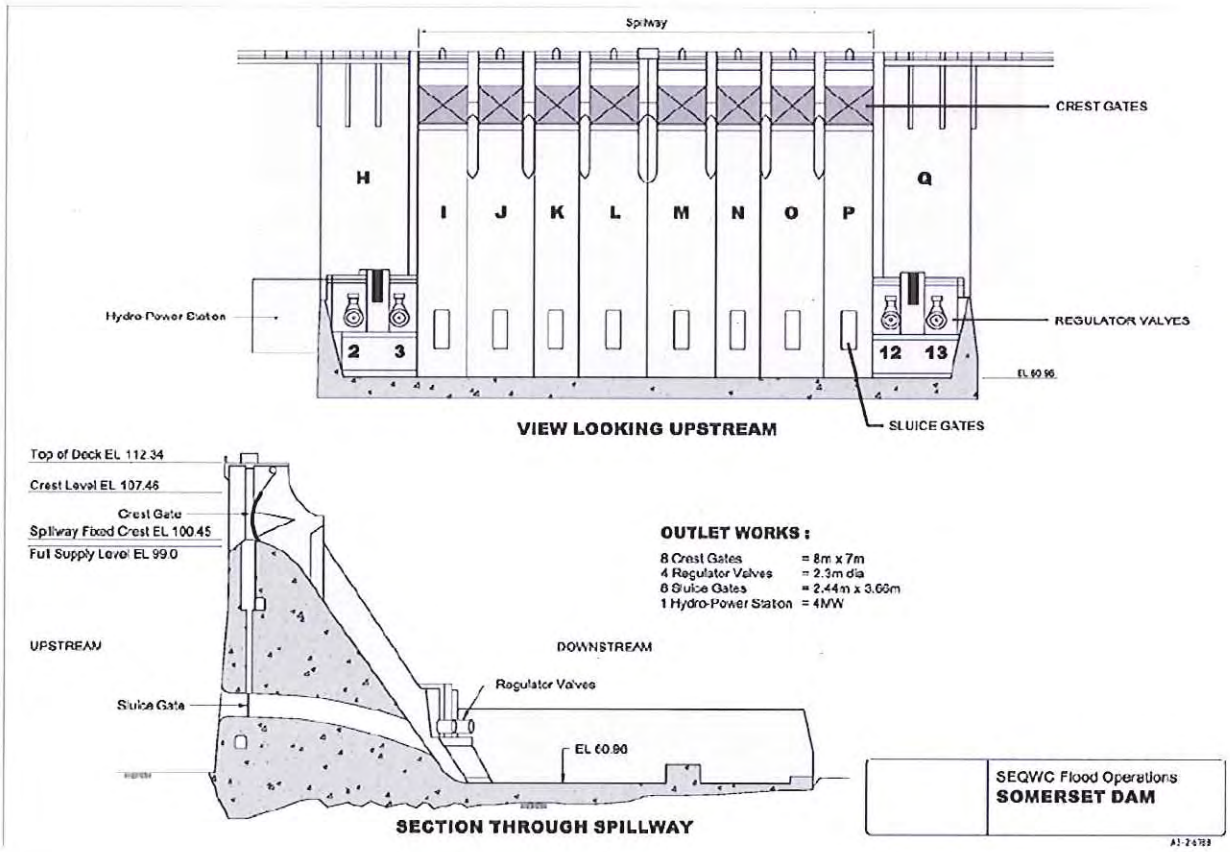
(a) It is a mass concrete dam. It is designed to withstand only limited overtopping, with dam failure expected at a level of 109.70 when the mass concrete sections become over-stressed. Depending on dam water levels, the flood wave produced by the failure of Somerset Dam could cause Wivenhoe Dam to fail. Certainly if Somerset Dam failed as a result of overtopping when the level in Wivenhoe Dam was greater than EL 75.0, then Wivenhoe Dam would be expected to fail.

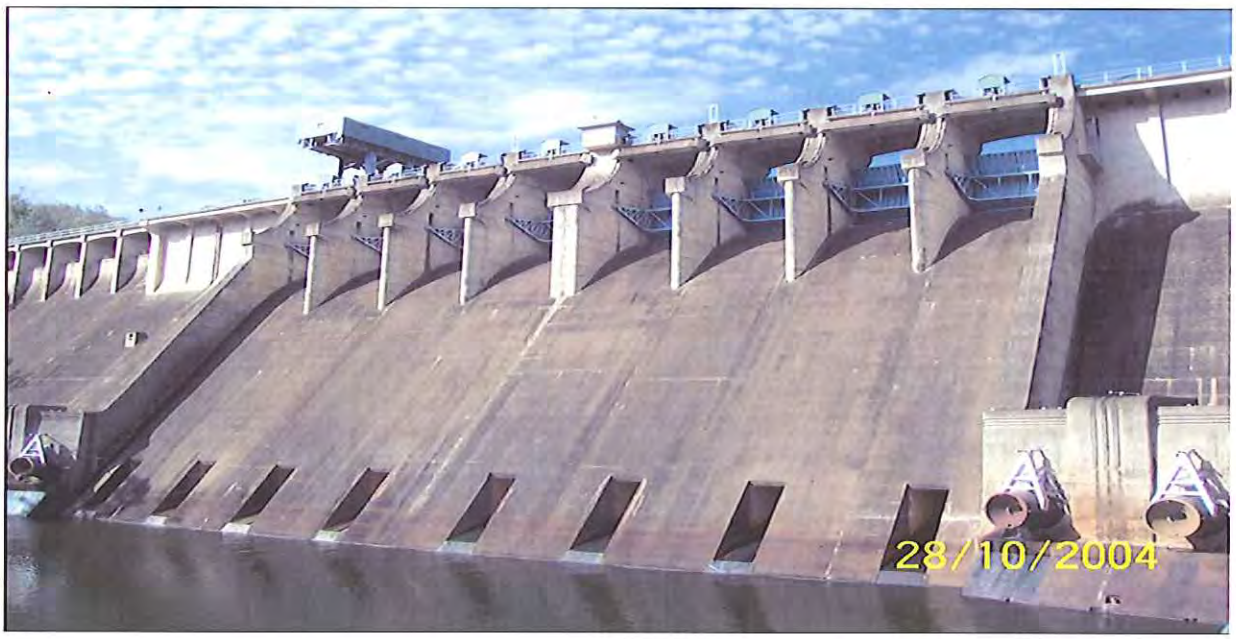
(b) It has radial dates, sluice gates and regulator valves which are used to release water during flood events.

(c) This arrangement is depicted in the following figure and photograph:

[redacted]

[redacted]





(d) The Full Supply Level of the Dam is EL 99.0m. This equates to a volume of 379,800 ML.

[redacted]

[redacted]

(e) At its dam crest level of EL 107.46m, the dam has a flood mitigation capacity of approximately 524,000 ML.

SWORN by **JOHN TIBALDI** on 1 April 2011 at Brisbane in the presence of:

Deponent

Solicitor

IN THE MATTER OF
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A COMMISSION OF INQUIRY UNDER THE
COMMISSIONS OF INQUIRY ACT 1950

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SECOND STATEMENT OF JOHN TIBALDI

INDEX OF ANNEXURES

Annexure No.	Document	Date	Page No.
JT-1	Somerset-Wivenhoe Interaction Study	October 2009	1
JT-2	Paper on Manual Revision and Letter from Seqwater CEO	December 2009	53

[redacted]

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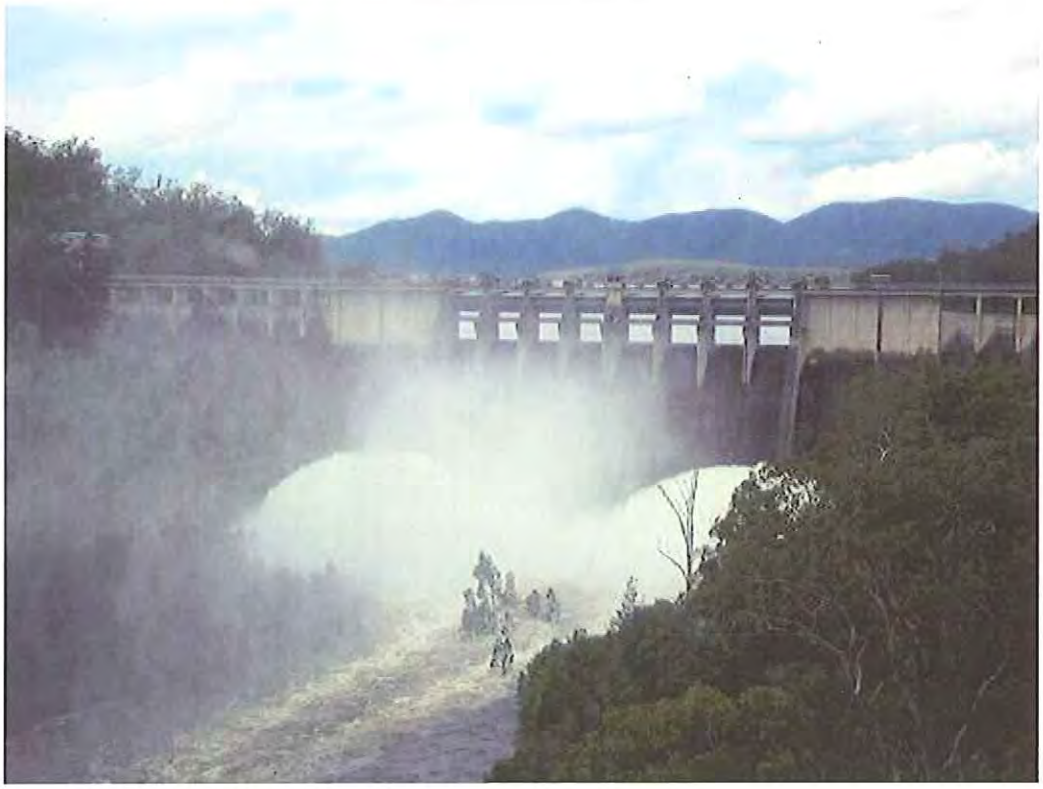
JT-1



Somerset-Wivenhoe Interaction Study

Terry Malone & John Tibaldi

October 2009

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ABREVIATIONS

AFC	Acceptable Flood Capacity
AEP	Annual Exceedance Probability
DCF	Dam Crest Flood
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMPDF	Probable Maximum Precipitation Design Flood

1.0 INTRODUCTION

To maximise the combined flood mitigation benefits of Wivenhoe and Somerset dams, the operation of the dams during floods is interdependent. This report examines this interdependency and recommends an operational procedure to maximise the overall flood mitigation benefits of the dams, while preserving as much as possible the safety of the dams. To determine the optimal flood mitigation strategy, a Somerset-Wivenhoe Operating Target Line is used to examine the relationship between the levels in the two dams during a flood event.

The existing Operating Target Line requires review because it does not properly account for the raising of Wivenhoe Dam (Wivenhoe Wave Wall now AHD 80.0 metres AHD) and construction of an Auxiliary Spillway that occurred in 2005. It also does not properly account for the revised failure level of Somerset Dam (Somerset Failure Level now 109.7 AHD) or for scenarios associated with floods centred on the Somerset Catchment.

This Operating Target Line is optimised for the following two competing objectives:

- Dam flood level peaks in both dams are to be equally minimised in relation to their associated dam failure levels.
- Flows in the Brisbane River downstream of Wivenhoe Dam are to be minimised.

When selecting the optimum Target Line, consideration must also be given to the time needed at the onset of a Flood Event to properly assess the magnitude of the event and the likely impacts. Such assessment is critical in ensuring that the required strategies are followed in the management of the event. Commencing a release strategy without such assessment may not result in maximising the Flood Mitigation benefits of the storages.

2.0 METHODOLOGY

The following methodology was used in the investigation of the Somerset-Wivenhoe Operating Target Line:

- The latest available design flows for the Brisbane River to Wivenhoe Dam and for Stanley River to Somerset Dam were checked, verified and collated.
- The existing operations spreadsheet was modified to reflect both the revised critical levels (see Section 2.1) and the updated operations strategies for both dams. The spreadsheet was then checked and verified against a range of flood events.
- A range of flood events were examined against a range of trial Target Lines. Dam flood level peaks and flows in the Brisbane River downstream of Wivenhoe Dam were calculated and graphed for each trial.
- Flood Events relating to both Wivenhoe centred floods and for Somerset centred floods were investigated.
- All results were analysed and an optimum Target Line was selected based on the following factors:
    - Equal minimisation of flood level peaks in both dams in relation to their associated dam failure levels.
    - Minimisation of flows in the Brisbane River downstream of Wivenhoe Dam.
    - Consideration of the time needed at the onset of a Flood Event to properly assess the magnitude of the event and the likely impacts, so that the likely optimal strategy to maximise the Flood Mitigation benefits of the storages can be selected.

2.1 CRITICAL LEVELS

The Somerset-Wivenhoe Operating Target Line is influenced by the critical levels in each dam. These critical levels are shown in the following tables, with all levels shown in relation to Australian Height Datum.

Table 2-1: Critical Levels for Somerset Dam

Item	Elevation m AHD
Full Supply Level	99.00
Spillway Fixed Crest	100.45
Current Sluice Trigger Level	102.25
Main Dam Crest	107.46
Maximum Allowable Flood Level	109.70
Top of Deck	112.34

In the current Flood Manual, the maximum allowable flood level was taken to be the elevation of the main dam crest of EL 107.46 m AHD. A study undertaken by NSW Commerce (NSW Commerce 2005) determined that the failure level at the *"Change of Slope"* in the upper abutment monoliths is EL 109.7 m AHD.

The change in maximum allowable flood level has significant implications for the slope of the operating target line and associated target levels.

Table 2-2: Critical Levels for Wivenhoe Dam

Item	Elevation m AHD
Spillway Fixed Crest	57.00
Full Supply Level	67.00
Gate Trigger Level	67.50
Upper Limit of W1 Operating Strategy	68.50
Top of Closed Gate	73.00
Upper Limit of W2 & W3 Operating Strategy	74.00
Main Embankment Crest	79.10
Top of Wave Wall	79.90
Saddle Dam Embankment Level	80.00

2.2 HISTORICAL OPERATING LEVELS

Somerset Dam was completed in 1953 while Wivenhoe dam was not completed until 1986. There are only a limited number of historical events which may be used for testing and comparison of gate operating levels. These are events that have occurred since 1986.

The table below, shows the levels at which sluices were commenced to be operated in historical events. The levels are shown for general information and no firm conclusions can be drawn from them.

Table 2-3: Historical Sluice Opening Levels

Event	First Sluice Opening m AHD
Jan-74*	101.60
Jan-76*	100.29
Jun-83*	100.90
Early Apr 89	99.30
Late Apr 89	99.56
Feb-92	100.74
Feb-99	102.57
Apr-09	99.39

*Wivenhoe dam not constructed.

2.3 CURRENT SOMERSET-WIVENHOE OPERATING TARGET LINE

The Somerset-Wivenhoe Operating Target Line is shown in Figure 2-1.

The maximum allowable water level in Somerset Dam was taken to be EL 107.46 m AHD. This level was previously understood to be the failure level for Somerset Dam. Following detailed engineering assessments, this level was revised in 2005 and the failure level for Somerset Dam is now understood to be EL 109.7 m AHD.

The operation of the sluices in Somerset Dam was dependent on the position at the time i.e. below the operating target line sluices were opened; above the operating target line sluices were closed.

The level of EL 102.25 m AHD, the level at which the sluice gates operations for Somerset Dam commence under the current Operating Target Line, was based on the commencement of flooding of the Mary Smokes Bridge in the upstream reaches of the Somerset Reservoir.

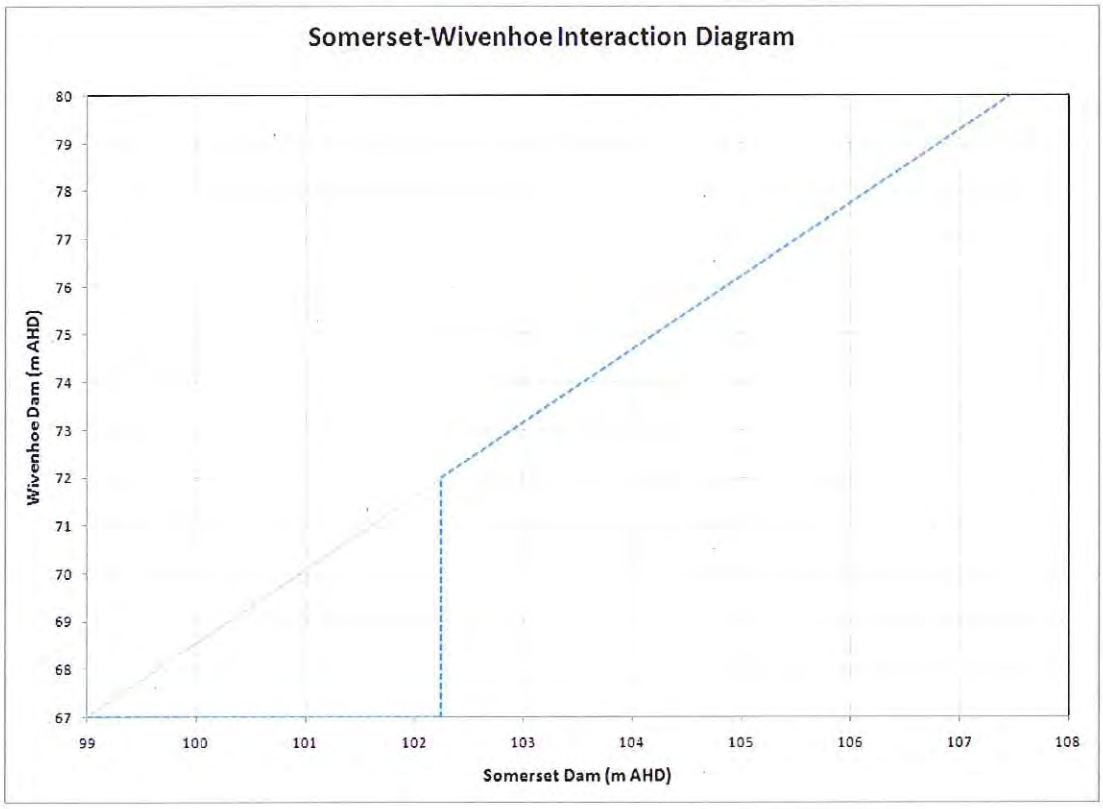


Figure 2-1: Current Somerset-Wivenhoe Operating Target Line

3.0 DESIGN HYDROLOGY

This study utilises the latest available flood hydrology for Somerset and Wivenhoe Dams. As part of the Wivenhoe upgrade, the Wivenhoe Alliance updated the design flood hydrology for the Wivenhoe catchment in September 2005 (Wivenhoe Alliance 2005). The Alliance also reviewed the Somerset Dam flood hydrology in 2004 (Wivenhoe Alliance 2004).

In September 2009, Seqwater commenced a review of the flood capacity of Somerset Dam. At the time of this investigation, the study had not been completed and only preliminary design flood estimates were available.

For Somerset Dam, there are differences between the design inflow hydrographs generated by the Wivenhoe Alliance in 2004 and those generated by Seqwater in 2009. Similar differences might also be expected in the current set of Wivenhoe design inflows.

Given the age of the models, the occurrence of significant floods events since this time and the differences in the Somerset design estimates, the flood models should be revised and the calibration revisited. This will occur in 2010 and the Somerset-Wivenhoe Operating Target Line will be investigated again at that time.

3.1 WIVENHOE DAM FLOOD HYDROLOGY

The design floods adopted by the Wivenhoe Alliance in 2005 utilised the calibrated WT42 models derived by the Department of Natural Resources in 1993 (DNR 1993). Since the 1993 study, the design rainfall methodology was significantly updated and the Alliance study included the latest estimates. As a result, the design floods were significantly higher than the 1993 estimates.

The study concluded that the 48 hour storm produced the highest outflows and results of the study are summarised in Figure 3-1.

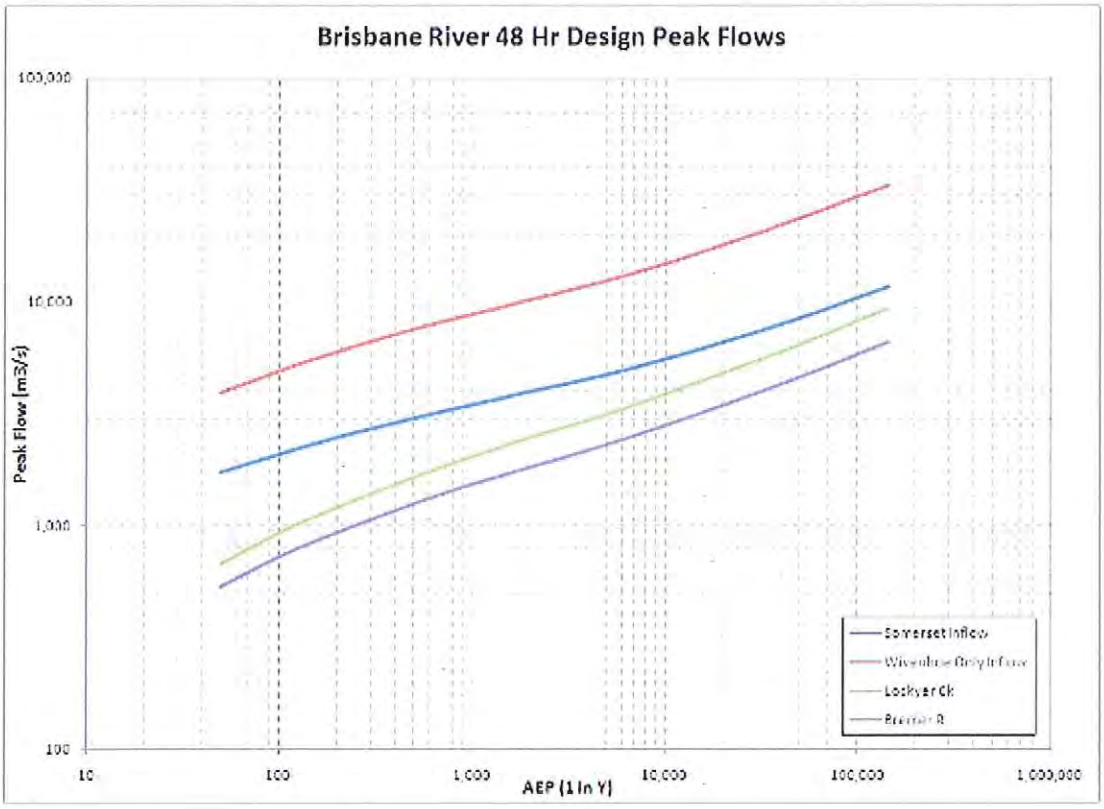


Figure 3-1: Brisbane River Peak Flow Estimates

Specifically for Wivenhoe Dam, the study concluded that:

- The AEP of the PMP is 1 in 143,000.
- The 36 hour storm produces the highest inflow peak for all AEPs.
- The 48 hour storm produces the highest peak outflow for the 1 in 200, 1 in 500, 1 in 5,000 and 1 in 10,000 AEP event for the existing dam. The 72 hour event produces the highest outflow peak for the 1 in1,000 and 1 in 2,000 AEP events for under the Stage 1 (now existing) spillway arrangements.
- The spillway augmentation does not impact upon design flows up to the 1 in 2,000 AEP event. This is substantially larger than the 1974 flood.
- Under the existing spillway arrangement, the DCF is approximately 1 in 100,000 AEP.

Individual design flood hydrographs derived by the Alliance for the Stanley River to Somerset Dam, the upper Brisbane River to Wivenhoe Dam (excluding the Stanley River), Lockyer Creek and the Bremer River are given in Appendix A. These flows have been adopted for assessment the operating target line for Wivenhoe centred floods.

3.2 SOMERSET DAM FLOOD HYDROLOGY

As the Somerset catchment is substantially smaller than the Wivenhoe catchment, design rainfalls and resultant flows are substantially higher than the Wivenhoe centred flood estimates. Additionally, the AEP of the PMP for the catchment is significantly higher i.e. 1 in 750,000.

The Wivenhoe Alliance also determined design flood estimates for the Stanley River to Somerset Dam (Wivenhoe Alliance 2004). The adopted design rainfalls and the resultant peak inflows are shown in Table 4-3. The studies utilised the WT42 models calibrated in the earlier DNR study. The FloodRoute program, developed by the NSW Department of Commerce, was used to route the flows through the storage to determine maximum discharges and water levels.

Table 3-1: Wivenhoe Alliance Design Rainfalls and Peak Inflows for Somerset Dam

AEP	24 Hour		36 Hour		48 Hour		72 Hour	
(1 in Y)	Rainfall (mm)	Peak Inflow (m3/s)	Rainfall (mm)	Peak Inflow (m3/s)	Rainfall (mm)	Peak Inflow (m3/s)	Rainfall (mm)	Peak Inflow (m3/s)
100	360	5,250	425	4,666	475	3,921	545	3,855
10,000	760	13,071	895	11,558	1,015	9,726	1,195	10,369
1,000,000	1,180	21,676	1,400	18,520	1,590	16,008	1,930	18,064

The current investigation of design flows for the Stanley River to Somerset Dam (Seqwater 2009d) adopted an URBS model of the catchment and calibrated to a series of floods including several events post 1993 floods not used in the original WT42 model calibration. As shown in Figure 3-2, the design inflows in both the Alliance and Seqwater studies are, not surprisingly, significantly higher the 1993 DNR study.

The relatively minor differences between the Alliance and Seqwater studies could be attributed to model and loss differences.

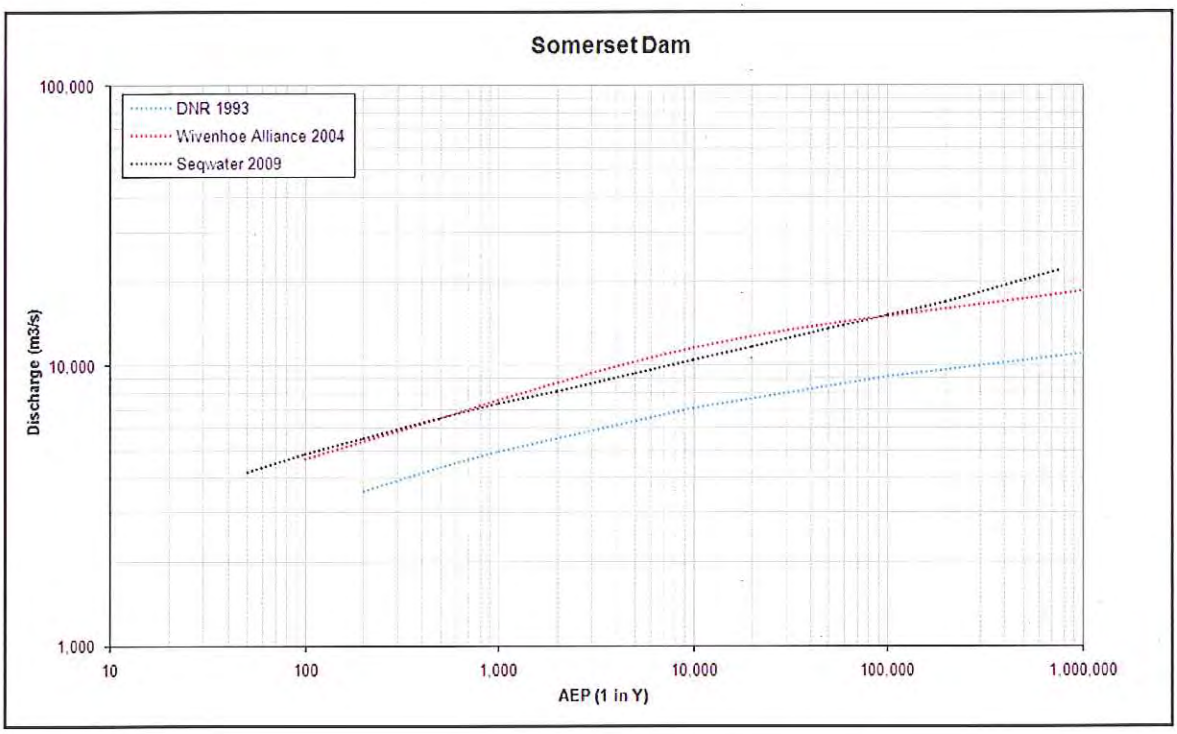


Figure 3-2: Stanley River to Somerset Dam Design Flows

4.0 INTERACTION INVESTIGATIONS

The investigation of a Somerset-Wivenhoe Operating Target Line involved routing the design floods through the dams using the operations spreadsheet. This spreadsheet has been developed and modified by various users in recent years. The latest version, Version 4A, was modified by Peter Allen, DERM, as part of this study to ensure it matched with current operating strategies for both dams. The modifications were verified as part of the investigation process.

The inputs into the operations spreadsheet are the design flows generated either during the Alliance study or during the latest Somerset Dam study. The spreadsheet allows the user to modify the starting level of the dam (usually assumed to be FSL) and the critical levels which define the Operating Target Line.

Output from the spreadsheet includes:

- Interaction diagram showing the relative levels between Somerset and Wivenhoe along with the Operating Target Line;
- Inflow and outflow from, and peak water level in, Somerset Dam, and;
- Inflow and outflow from, and peak water level in, Wivenhoe Dam, and;
- Flows in the lower Brisbane River downstream of Wivenhoe Dam.
- Summary tables of peak flows and levels.

Several Operating Target Line scenarios were considered. These are listed as follows:

- Somerset Dam sluice operating levels of EL 102.25, EL 100.45 and EL 99.0
- Wivenhoe Dam target operating levels of EL 67.0 and EL 68.5.

The corresponding operating target lines considered in the investigation are shown in Figure 4-1.

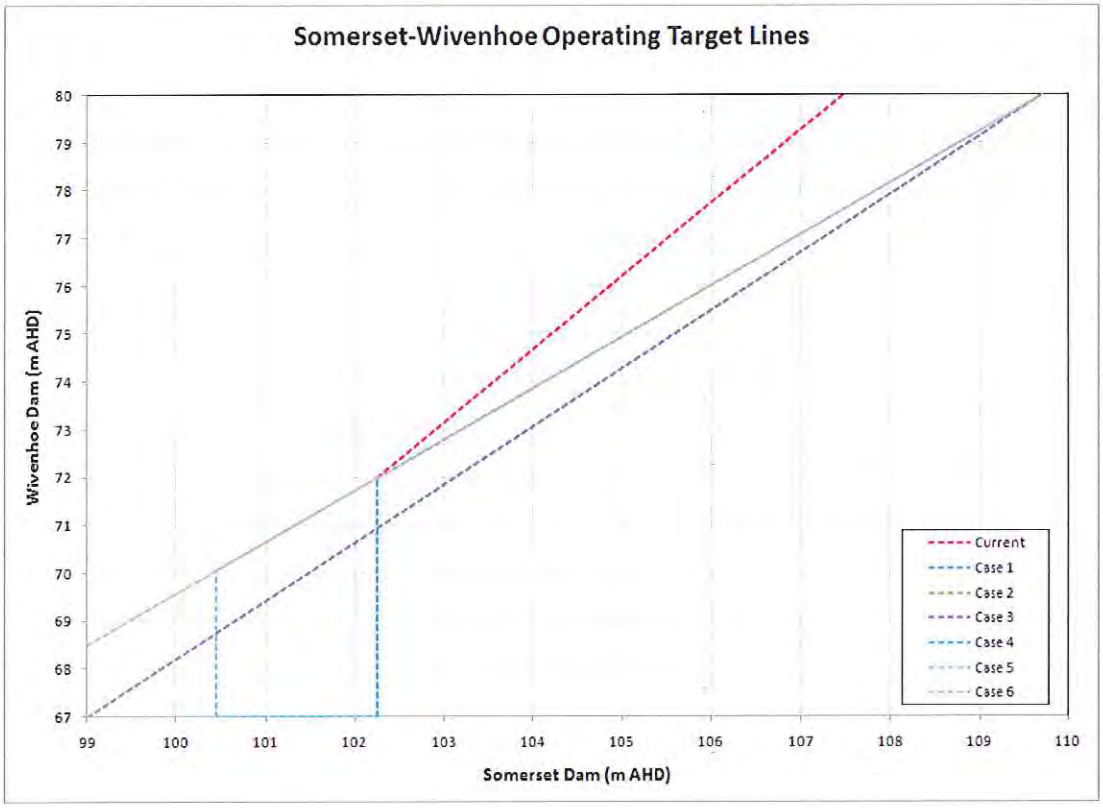


Figure 4-1: Trial Operating Target Lines

TRIAL OPERATING TARGET LINE CASE SUMMARY			
	LINE ORIGIN	**LINE CHANGE POINT**	**LINE END POINT**
Case 1	67.0, 102.25	71.0, 102.25	80.0, 109.7
Case 2	67.0, 100.45	68.75, 100.45	80.0, 109.7
Case 3	67.0, 99.0	-	80.0, 109.7
Case 4	68.5, 102.25	72.0, 102.25	80.0, 109.7
Case 5	68.5, 100.45	70.0, 100.45	80.0, 109.7
Case 6	68.5, 99.0	-	80.0, 109.7

Cases 3 and 6 which commence sluice operation at the Somerset Dam FSL (EL 99.0 m AHD), are not considered feasible options because they provide no time at the onset of a Flood Event to properly assess the magnitude of the event and the likely impacts. Such an approach is unlikely to maximise the Flood Mitigation benefits of the storages in all by the very rare events i.e. events in the order of 1 in 100 000. Accordingly Cases 3 and 6 have not been considered any further.

4.1 WIVENHOE CENTRED FLOODS

A range of AEPs from 1 in 100 up to the PMPDF (1 in 143,000) was investigated in assessing the four selected trial Operating Target Lines for Wivenhoe centred floods.

Peak water levels and flows for selected locations are shown below while more detail results are contained in Appendix B. Note the instability in the recession of the hydrographs at Lowood and Moggill in the 1 in 1,000 flood.

4.1.1 Somerset Peak Water Level

For events up to the 1 in 10,000, Case 5 which has the Somerset sluices opened at EL 100.45 results in lower peak water levels than the other Cases. This is not surprising as under this scenario flood water is released earlier from Somerset Dam.

In the extreme events, there is little difference in the peak water levels achieved under each operating scenario as shown in the table below.

Table 4-1: Somerset Dam Peak Water Levels

AEP	Case 1	Case 2	Case 4	Case 5
100	102.69	102.11	102.69	101.15
1,000	103.64	103.75	103.51	103.28
10,000	105.91	105.94	105.75	105.72
100,000	109.33	109.23	109.33	109.23
143,000	110.17	110.12	110.17	110.05

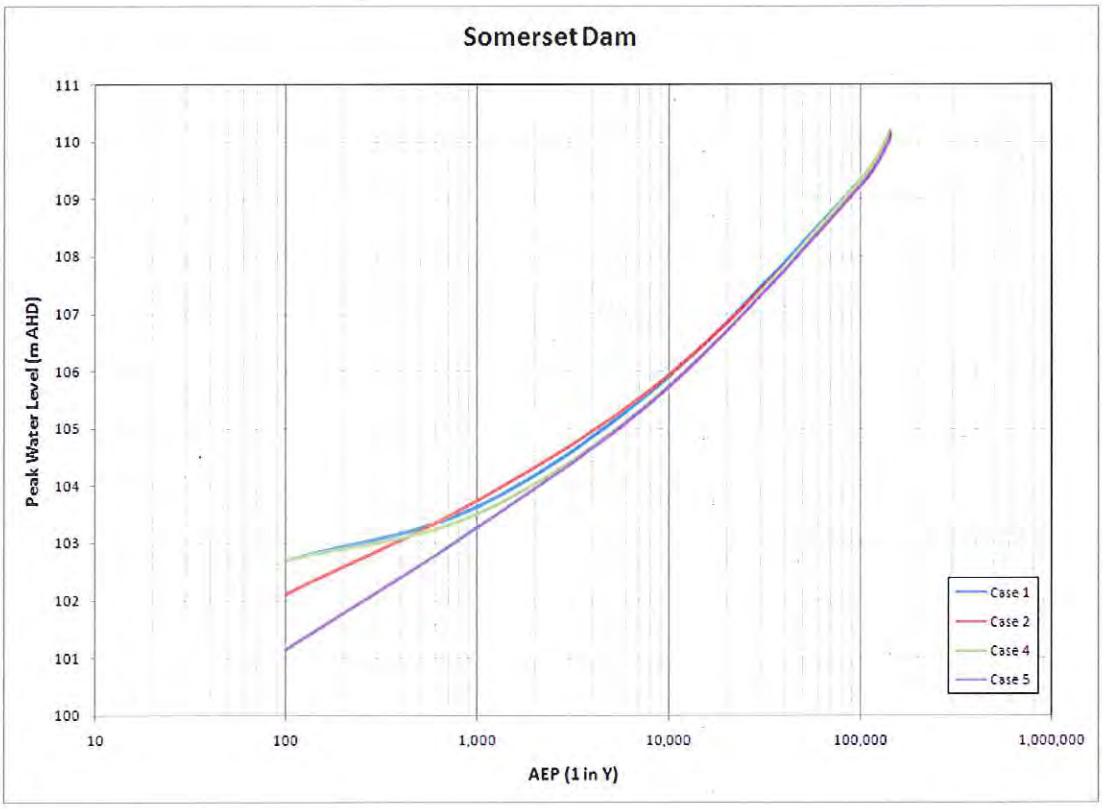


Figure 4-2: Somerset Dam Peak Water Levels

4.1.2 Wivenhoe Peak Water Level

Case 2, which has the Somerset sluices opened at EL 100.45, results in the lowest peak water level in Wivenhoe Dam up to the 1 in 1,000 flood. Beyond this AEP, differences in peak water levels are very small.

Table 4-2: Wivenhoe Dam Peak Water Levels

AEP	Case 1	Case 2	Case 4	Case 5
100	72.35	72.15	72.48	72.44
1,000	74.70	74.59	74.77	74.66
10,000	76.21	76.20	76.20	76.21
100,000	79.15	79.12	79.15	79.12
143,000	80.17	80.14	80.17	80.15

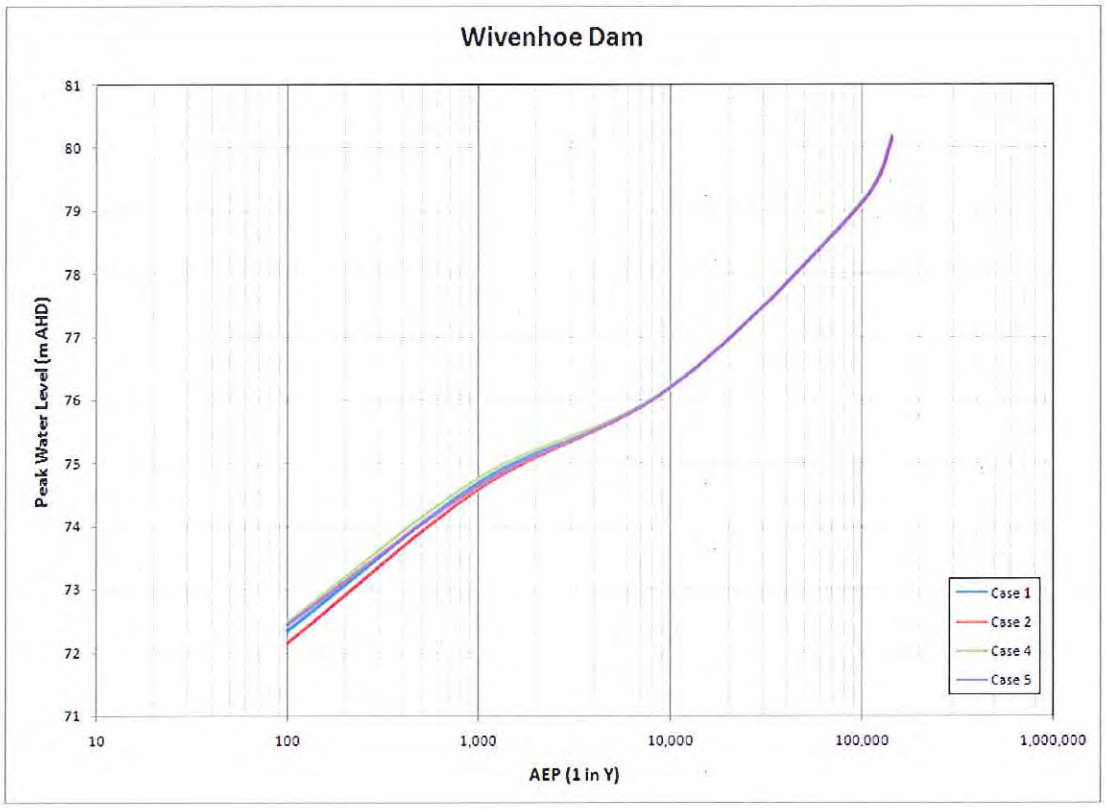


Figure 4-3: Wivenhoe Dam Peak Water Levels

4.1.3 Lowood Peak Flows

At Lowood, there is generally an insignificant difference in the peak flows between the different operating cases. Case 2, which has the Somerset sluices opened at EL 100.45, results in marginally lower peak flows up to the 1 in 1,000.

Table 4-3: Lowood Peak Flows

AEP	Case 1	Case 2	Case 4	Case 5
100	2,877	2,784	2,937	2,999
1,000	7,535	7,207	7,844	7,534
10,000	20,216	20,159	20,238	20,200
100,000	35,301	35,243	35,301	35,243
143,000	39,066	38,996	39,066	39,018

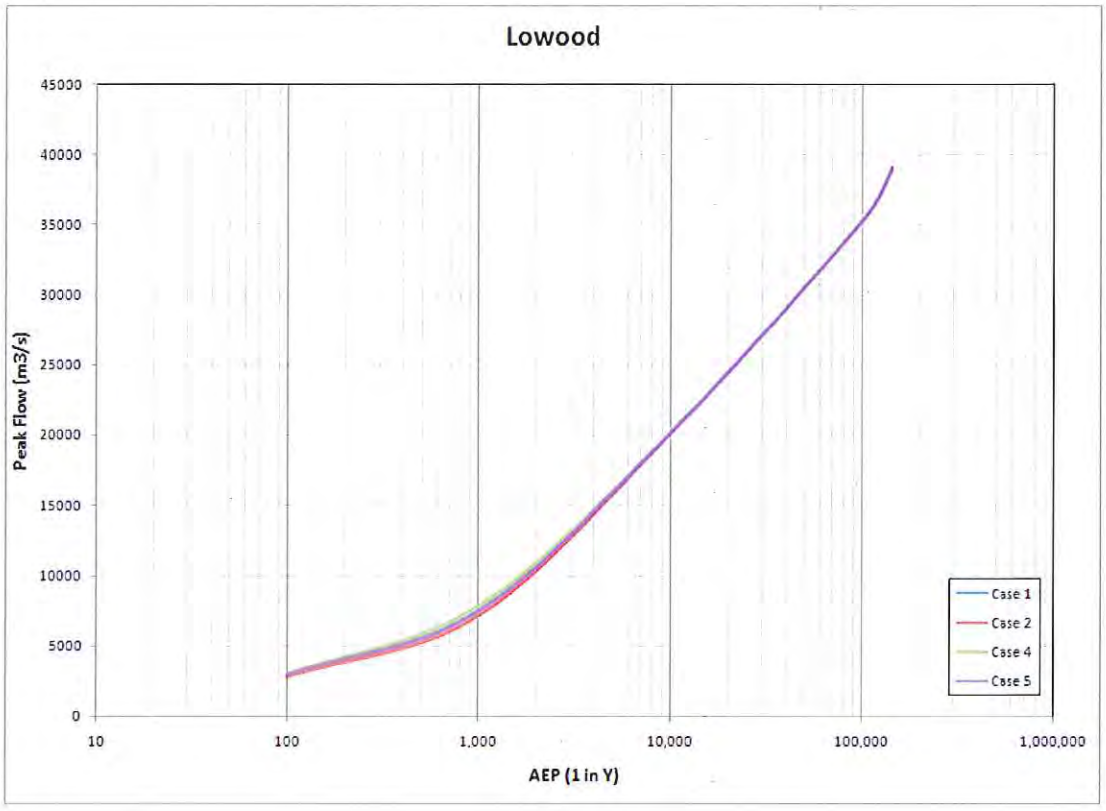


Figure 4-4: Lowood Peak Flows

4.1.4 Moggill Peak Flows

Similarly to Lowood, there is generally an insignificant difference in the peak flows at Moggill between the different operating cases. Case 2, which has the Somerset sluices opened at EL 100.45, results in marginally lower peak flows up to the 1 in 1,000.

Table 4-4: Moggill Peak Flows

AEP	Case 1	Case 2	Case 4	Case 5
100	3,075	3,002	3,123	3,220
1,000	7,963	7,630	8,258	7,961
10,000	21,209	21,085	21,274	21,186
100,000	36,963	36,906	36,963	36,906
143,000	40,868	40,796	40,868	40,823

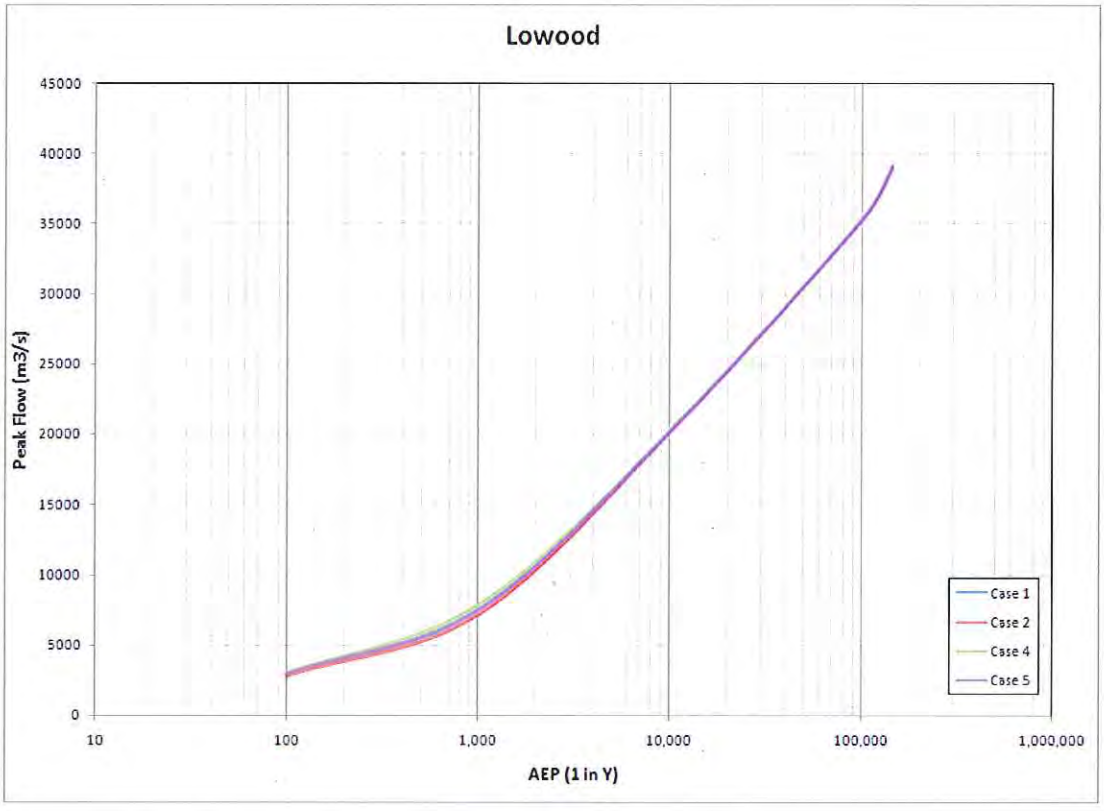


Figure 4-5: Moggill Peak Flows

4.2 SOMERSET CENTRED FLOODS

As noted earlier, the Somerset centred floods generate high peak inflows and flood volumes than the corresponding Wivenhoe centred floods. The behaviour of Somerset Dam has been checked using recent design flood estimates (Seqwater 2009).

It has been assumed that co-incident flooding of 1 in 100 in upper Brisbane, Lockyer and Bremer. However, this is not critical in the assessment of the peak water levels in Somerset as the opening of the sluices and the peak water levels in Somerset is dominated by the early rising limb of the Somerset inflows and not by the peak of the Wivenhoe inflows.

The results of this section of the study in Table 4-5 and Figure 4-6 show that opening the Somerset sluice gates has a demonstrable reduction on the peak water levels over the entire range of floods.

Table 4-5: Somerset Dam Peak Water Levels

AEP	Sluices Open @ EL 100.45 m AHD	Sluices Open @ EL 102.25 m AHD
100	103.59	102.93
1,000	105.75	105.51
10,000	108.34	108.20
20,000	109.15	109.02
50,000	110.21	110.05
100,000	111.03	110.91

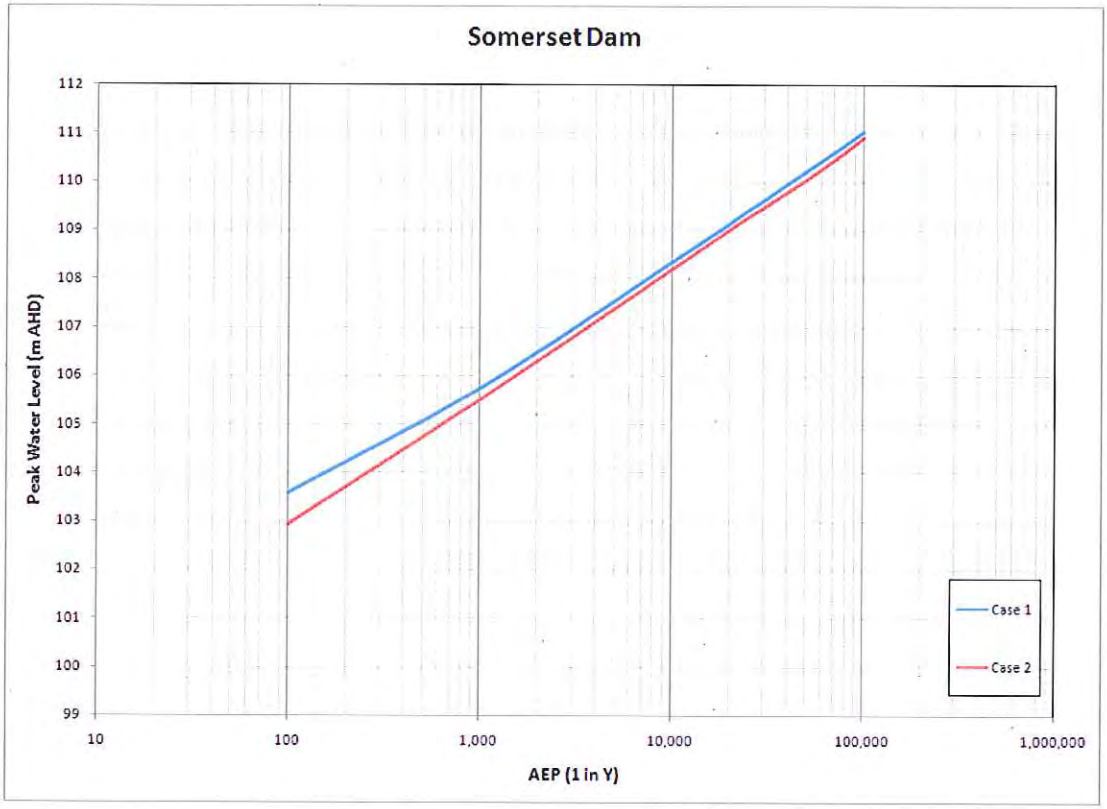


Figure 4-6: Somerset Dam Peak Water Levels

5.0 CONCLUSIONS

- At Lowood and Moggill, there is generally an insignificant difference in the peak flows between the different operating cases. Accordingly this is not a major consideration in case comparison or selection between the considered cases.

- The reduction of the sluice operating level in Somerset Dam for EL 102.25 to EL 100.45 provides the following benefits:

    - A lower peak water level in the dam itself.
    - Lower flood levels in upstream areas around Kilcoy.
    - Improvement in the flood immunity of Somerset Dam in extreme events.
    - Lower peak water levels in Wivenhoe Dam up to the 1 in 1,000 flood (beyond this AEP, the reduction in peak water levels is very small).

  All of these factors support the selection of either Case 2 or Case 5 as the preferred operating option.

- When comparing Cases 2 and 5, Case 5 provides the best results overall when considering resultant peak water levels in Somerset and Wivenhoe Dams. For events up to the 1 in 10000 in particular, Case 5 improves the flood immunity of Somerset Dam, while having little impact on the safety of Wivenhoe Dam.

6.0 RECOMMENDATIONS

It is recommended that the Case 5 Operating Target Line, shown in Figure 6-1, be adopted for the operation of Somerset and Wivenhoe Dams.

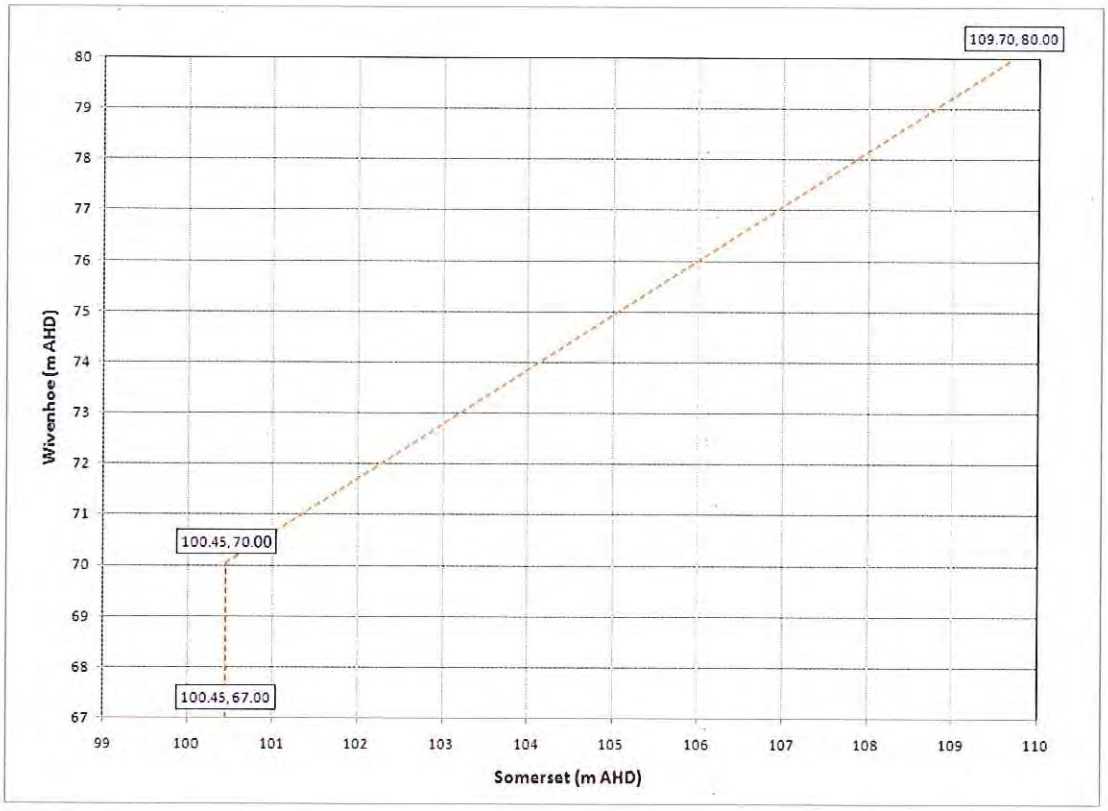


Figure 6-1: Recommended Operating Target Line

References

(DNR 1993) Department of Natural Resources, *Brisbane River Flood Hydrology Report, Design Flood Estimation for Somerset and Wivenhoe Dam,* Main Report, Volume I, Mar 1993.

(NRW 2007) Department of Natural Resources and Water, *Guidelines for the Acceptable Flood Capacity of Dams,* February 2007

(Seqwater 2009a) Seqwater, *Emergency Action Plan for Somerset Dam,* Oct 2009.

(Seqwater 2009b) Seqwater, *Emergency Action Plan for Wivenhoe Dam,* Oct 2009.

(Seqwater 2009c) Seqwater, *Manual of Operational Procedures for Flood Mitigation for Wivenhoe Dam and Somerset Dam*, (Draft), Oct 2009.

(Seqwater 2009d) Seqwater, *Somerset Dam – Design Flood Hydrology*, (Draft), Oct 2009.

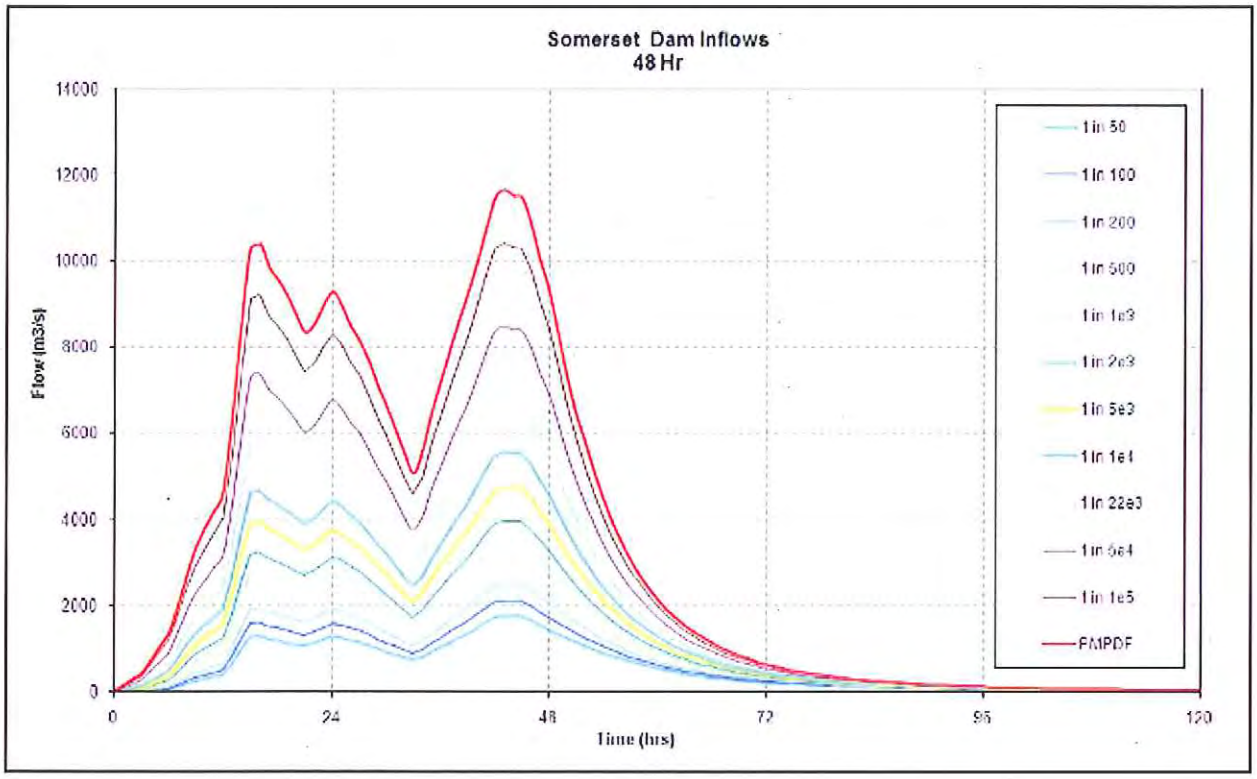
(NSW Commerce 2005) NSW Department of Commerce, *Somerset Dam – Stability of Abutment Monoliths,* Report No DC 05099, May 2005.

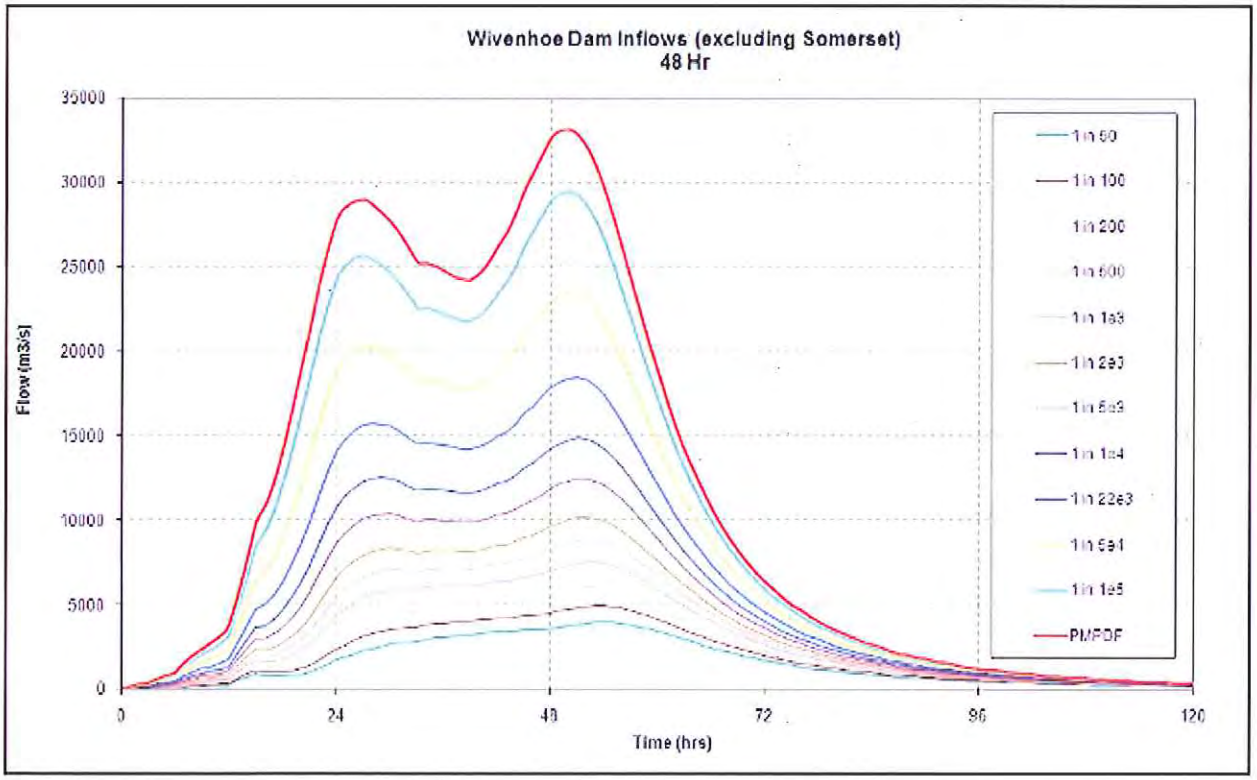
(Wivenhoe Alliance 2004) Wivenhoe Alliance, *Somerset Dam – Maximum Flood Level Estimates for Various Gate Operation Scenarios,* Q1091, Feb 2004.

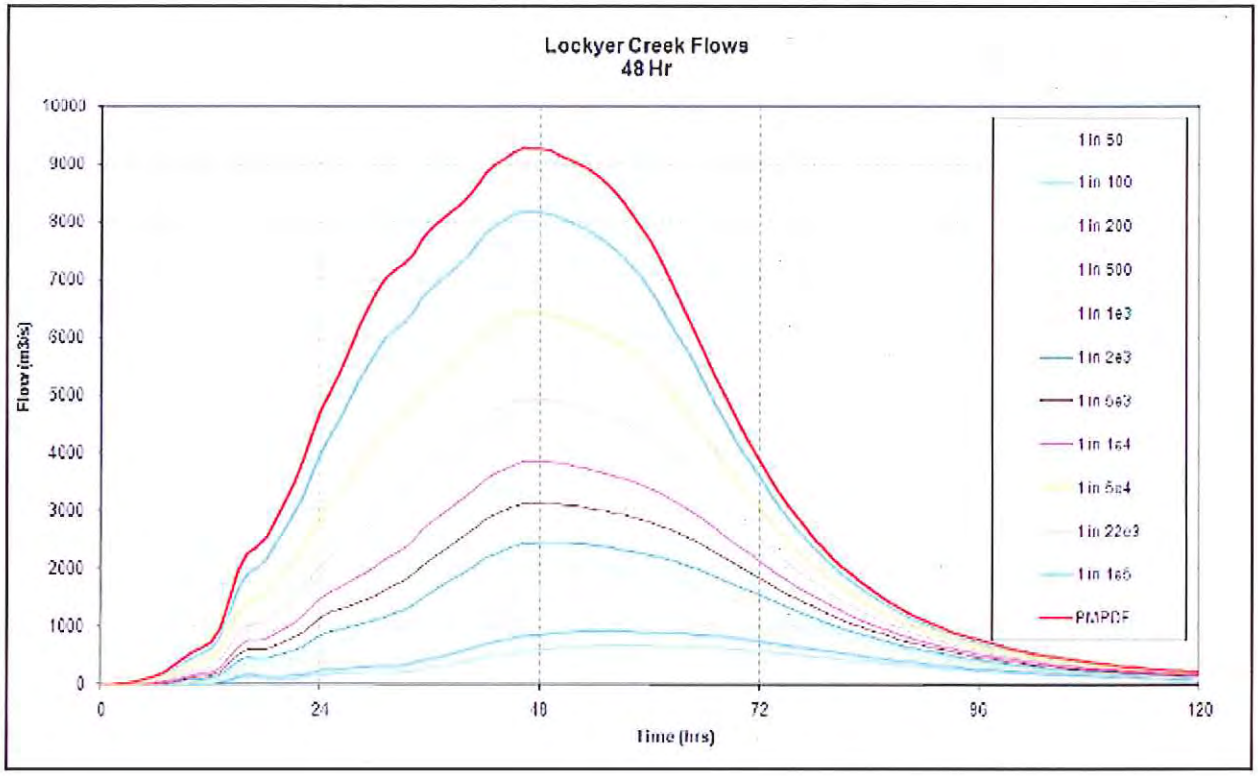
(Wivenhoe Alliance 2005) Wivenhoe Alliance, *Design Discharges and Downstream Impacts of the Wivenhoe Dam Upgrade,* Q1091, Sep 2005.

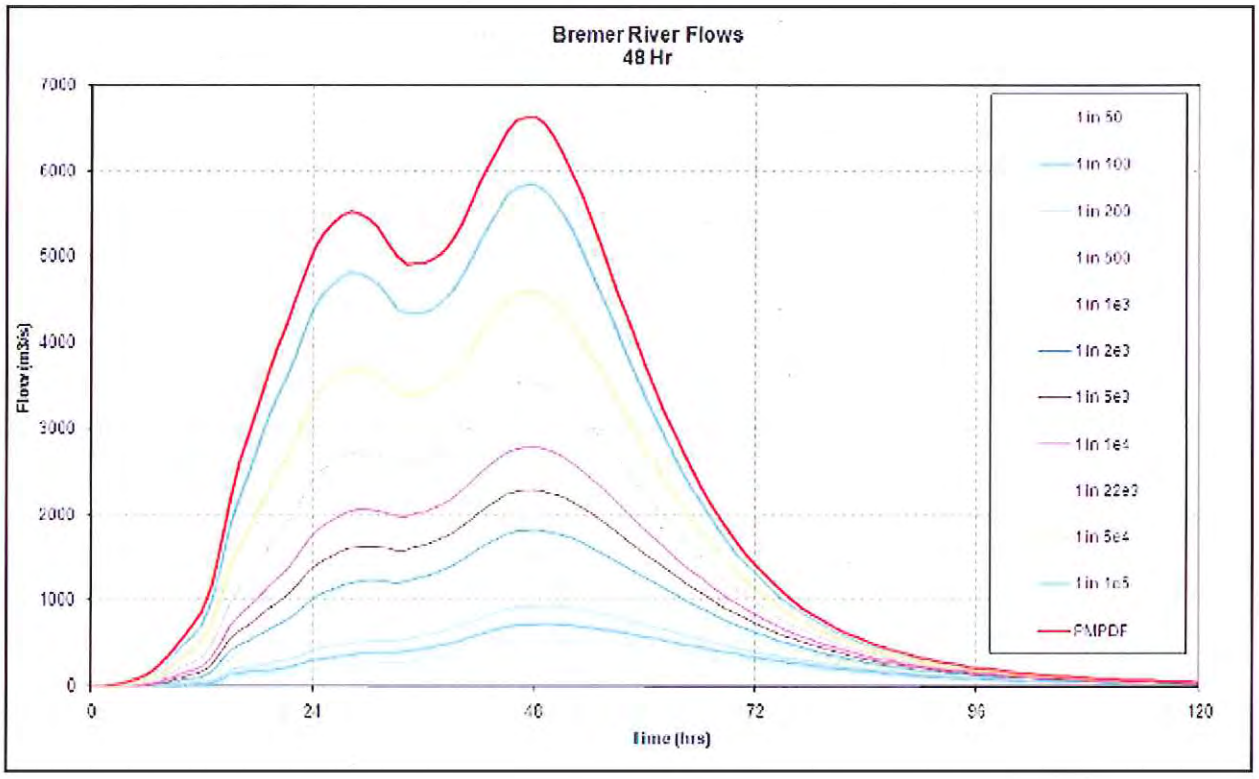
Appendix A

Wivenhoe Centred Design Flows

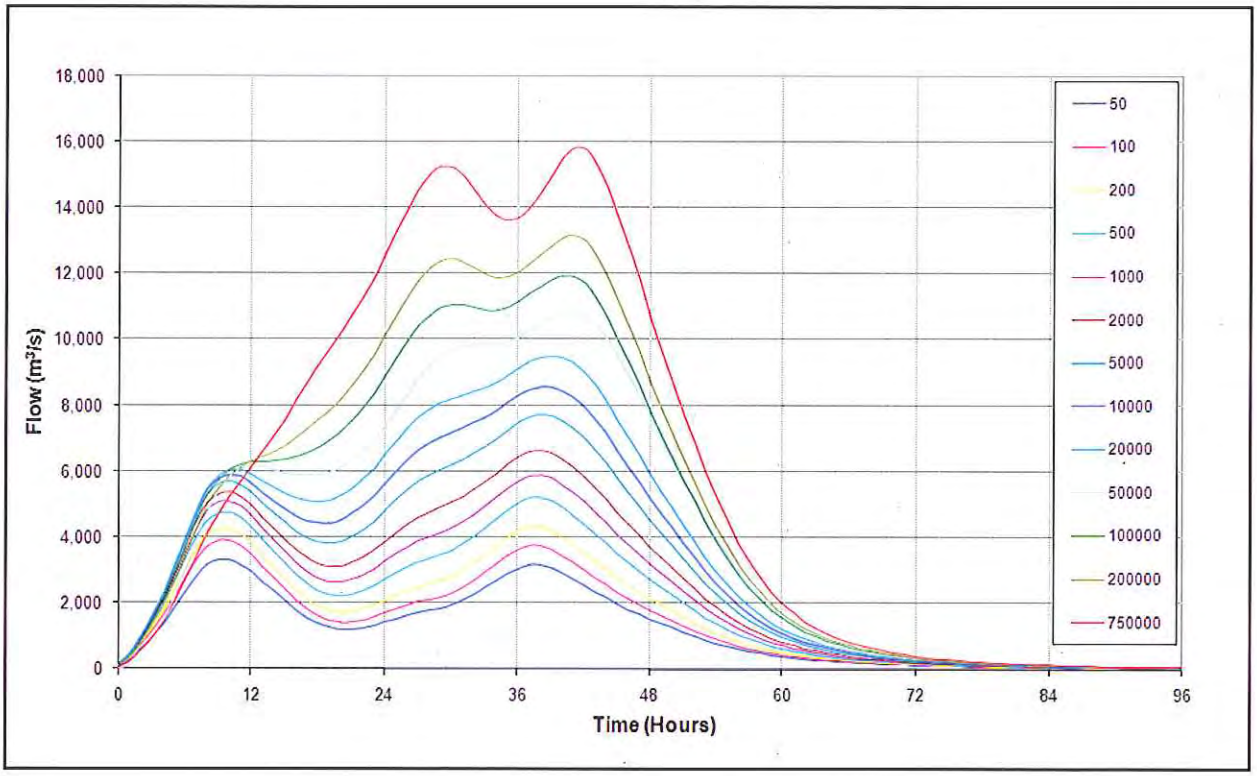





Lockyer Creek Flows
48 Hr
Flow (m3/s)
Time (hrs)
1 in 50
1 in 100
1 in 200
1 in 500
1 in 1e3
1 in 2e3
1 in 5e3
1 in 1e4
1 in 5e4
1 in 22e3
1 in 1e5
PMPDF


Bremer River Flows
48 Hr
Flow (m3/s)
Time (hrs)
1 in 50
1 in 100
1 in 200
1 in 500
1 in 1e3
1 in 2e3
1 in 5e3
1 in 1e4
1 in 22e3
1 in 5e4
1 in 1e5
PMPDF

Somerset Centred Design Flows

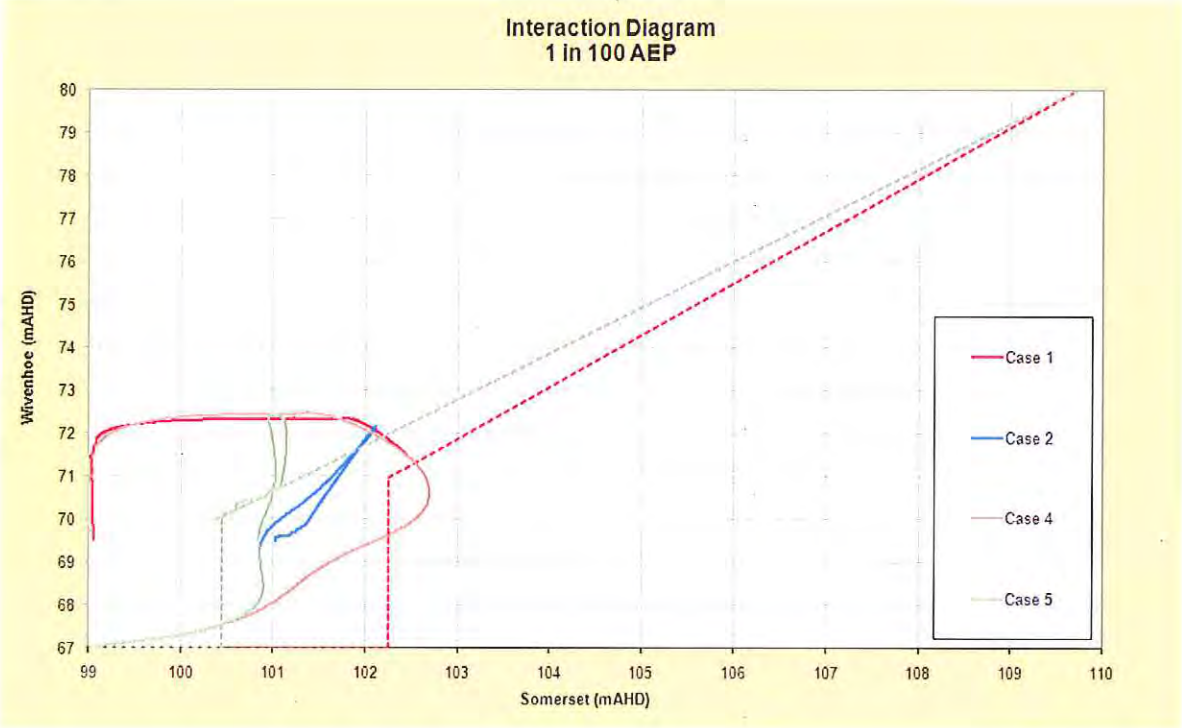


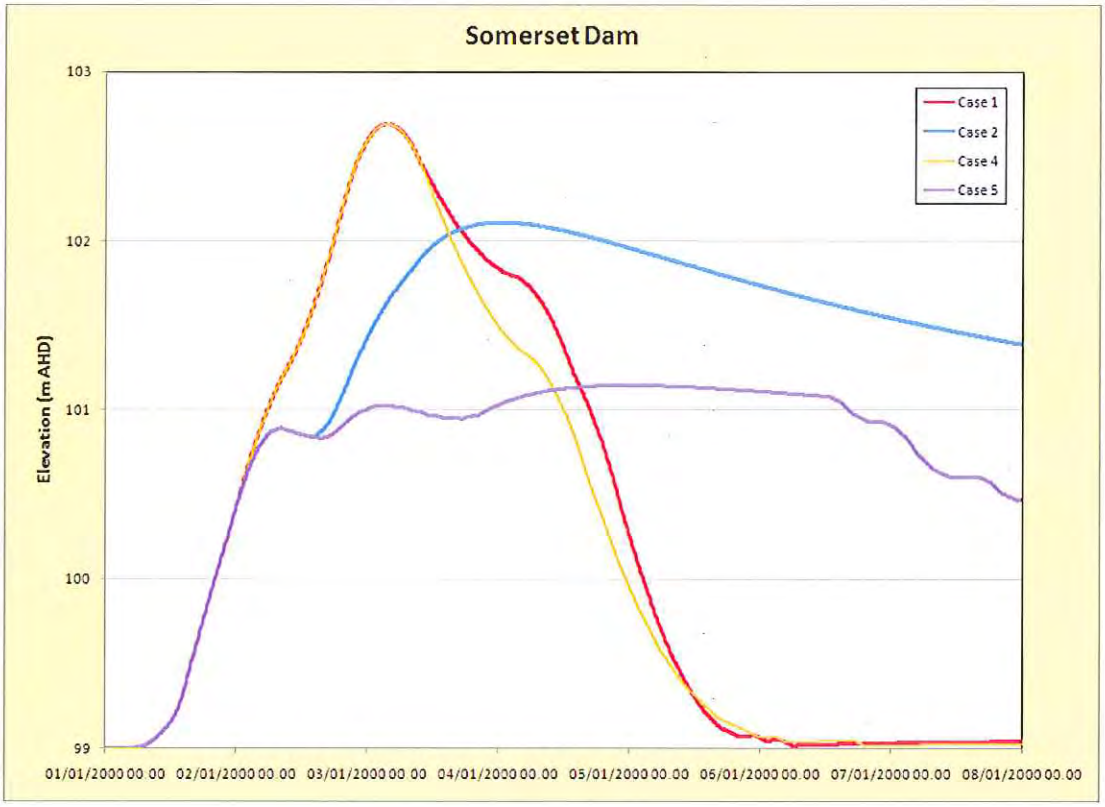
Appendix B

Wivenhoe Centred Results

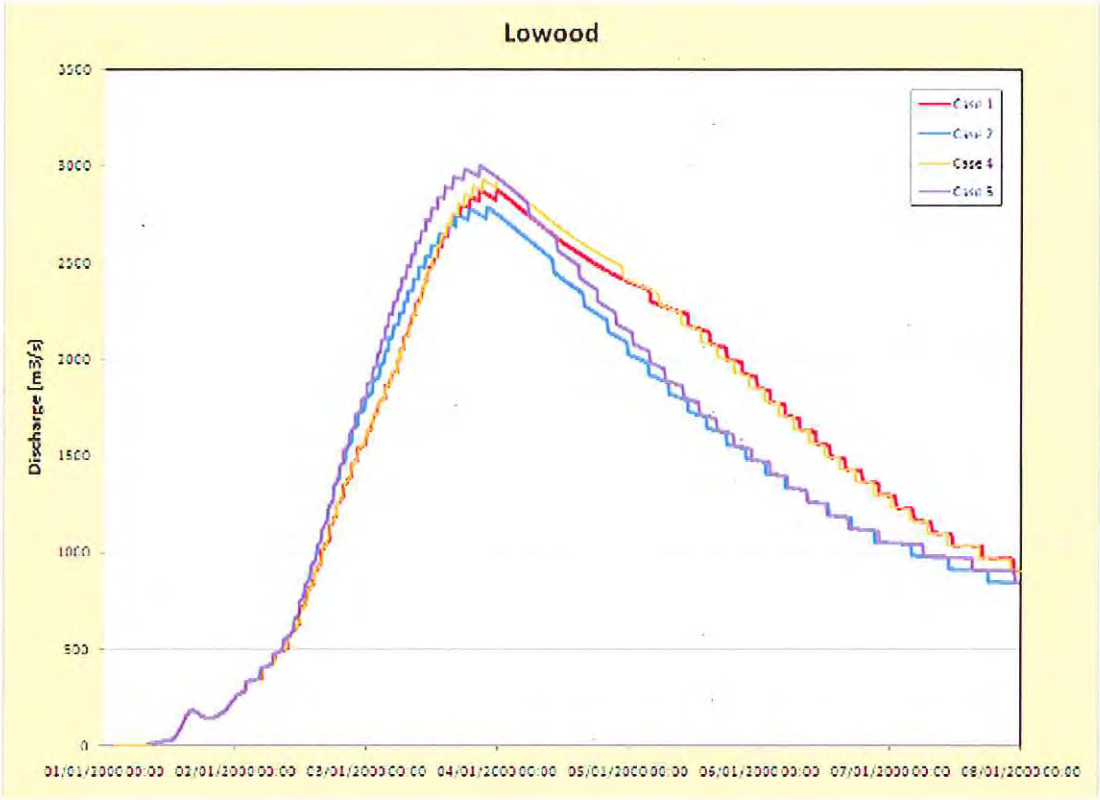
1 in 100 AEP

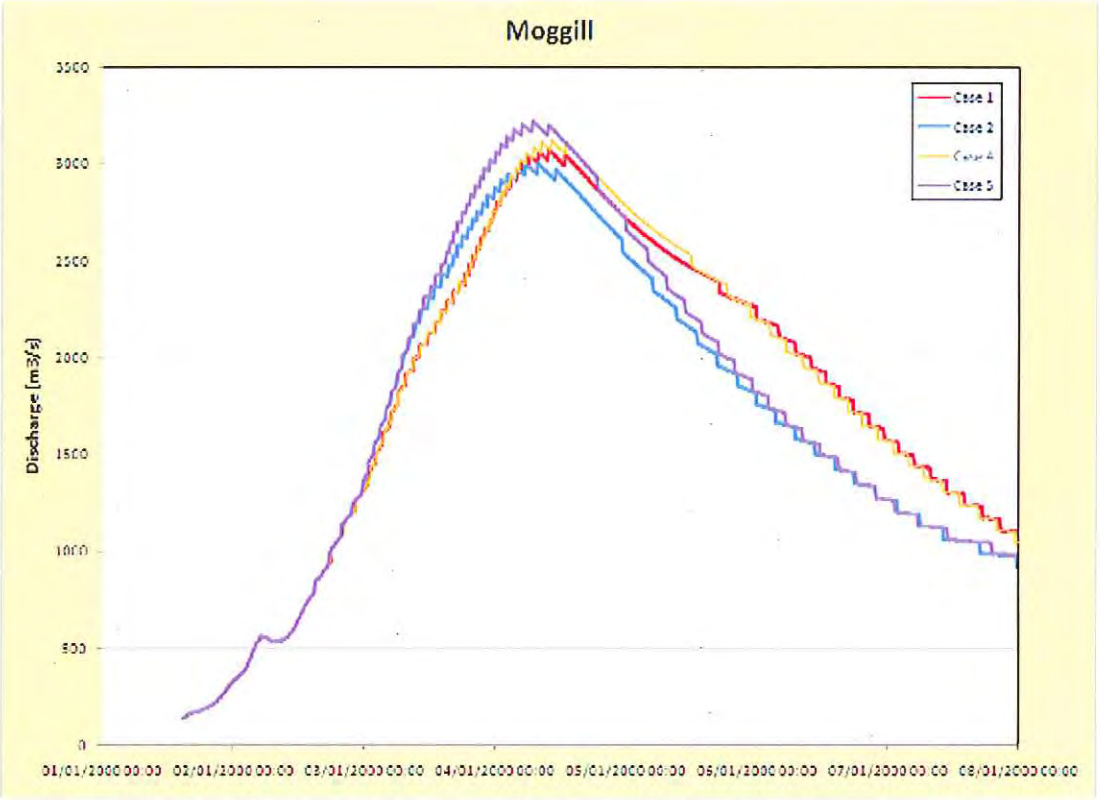
Item	Unit	Wivenhoe Operating Level			
		67.0 m AHD		68.5 m AHD	
		Somerset Operating Level		Somerset Operating Level	
		102.25	100.45	102.25	100.45
		Case 1	Case 2	Case 4	Case 5
Somerset Peak Elevation	m AHD	102.69	102.11	102.69	101.15
Wivenhoe Peak Elevation	m AHD	72.35	72.15	72.48	72.44
Lowood Peak Flow	m3/s	2,877	2,784	2,937	2,999
Moggill Peak Flow	m3/s	3,075	3,002	3,123	3,220




Somerset Dam
Elevation (m AHD)
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

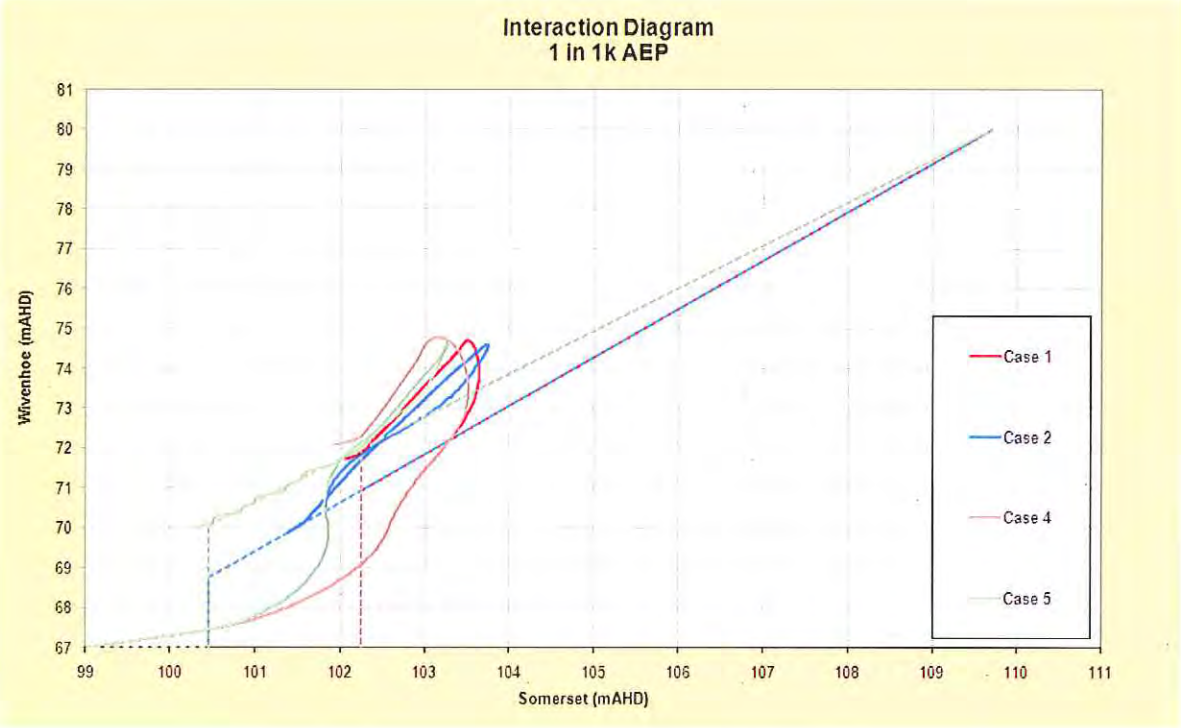

Wivenhoe Dam
Elevation (m AHD)
73
72
71
70
69
68
67
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

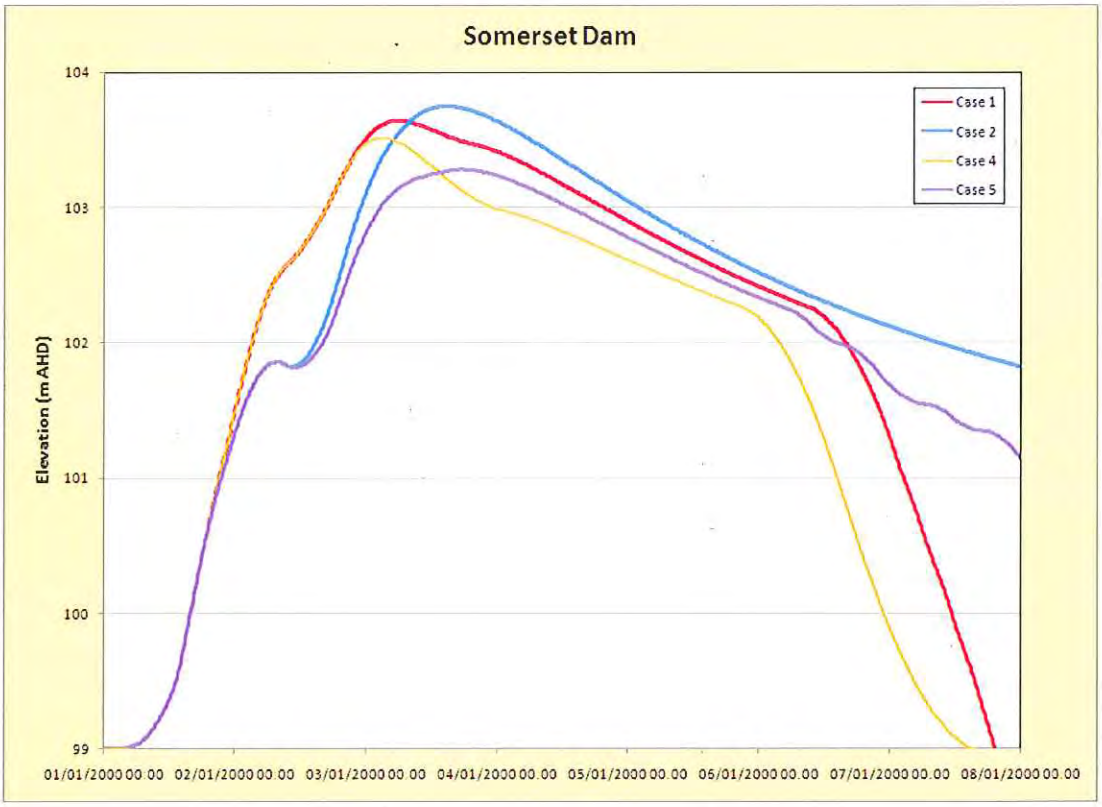

Lowood
Discharge [m3/s]
3500
3000
2500
2000
1500
1000
500
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00


Moggill
Discharge [m3/s]
3500
3000
2500
2000
1500
1000
500
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00

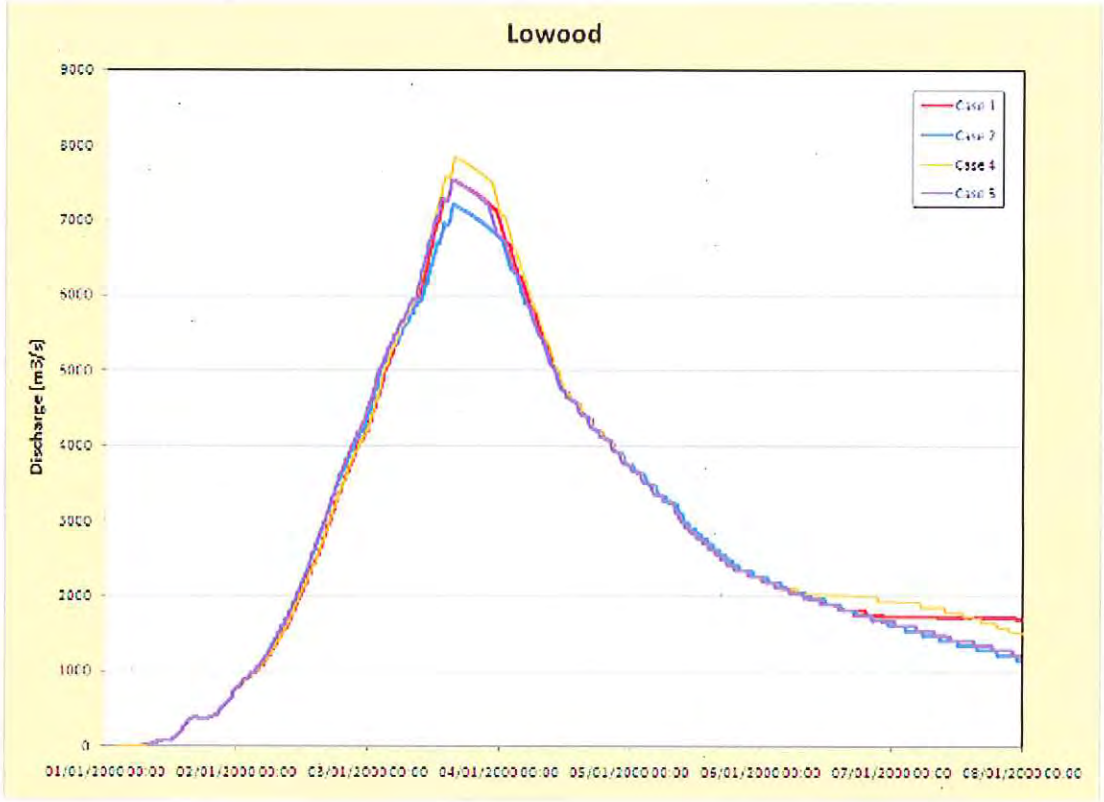
1 in 1,000 AEP

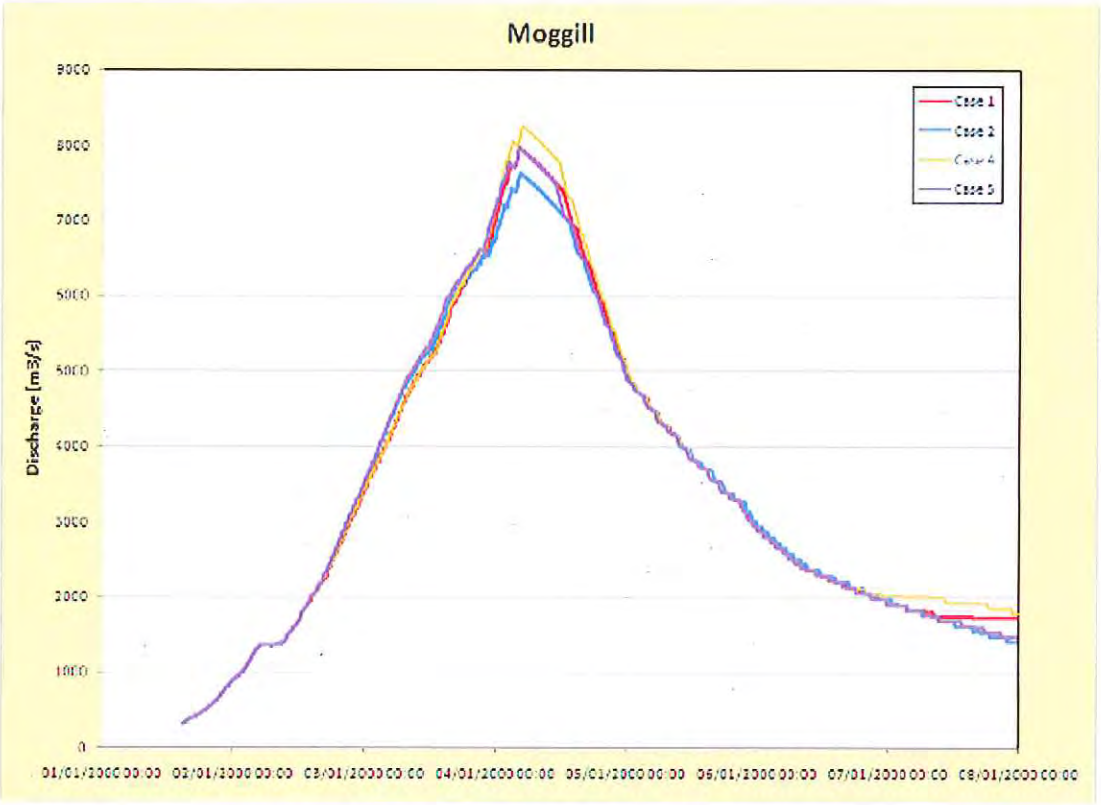
Item	Unit	Wivenhoe Operating Level			
		67.0 m AHD		68.5 m AHD	
		Somerset Operating Level		Somerset Operating Level	
		102.25	100.45	102.25	100.45
		Case 1	Case 2	Case 4	Case 5
Somerset Peak Elevation	m AHD	103.64	103.75	103.51	103.28
Wivenhoe Peak Elevation	m AHD	74.70	74.59	74.77	74.66
Lowood Peak Flow	m3/s	7,535	7,207	7,844	7,534
Moggill Peak Flow	m3/s	7,963	7,630	8,258	7,961




Somerset Dam
Elevation (m AHD)
104
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

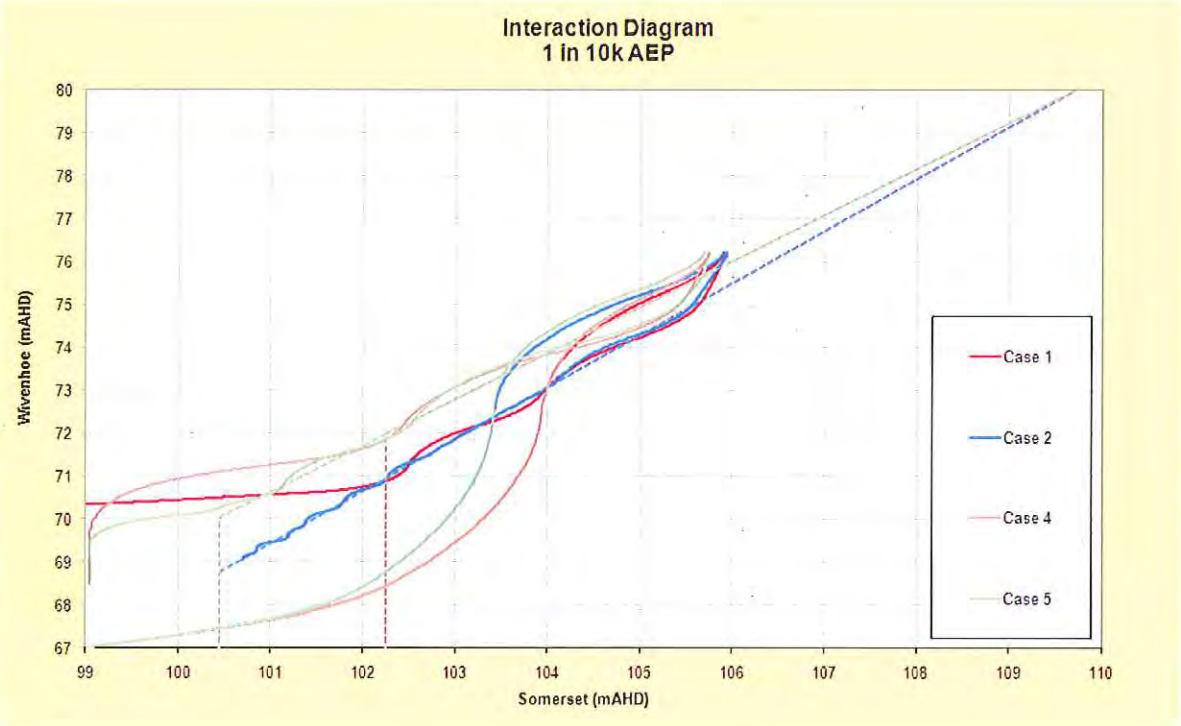

Wivenhoe Dam
Elevation (m AHD)
76
75
74
73
72
71
70
69
68
67
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

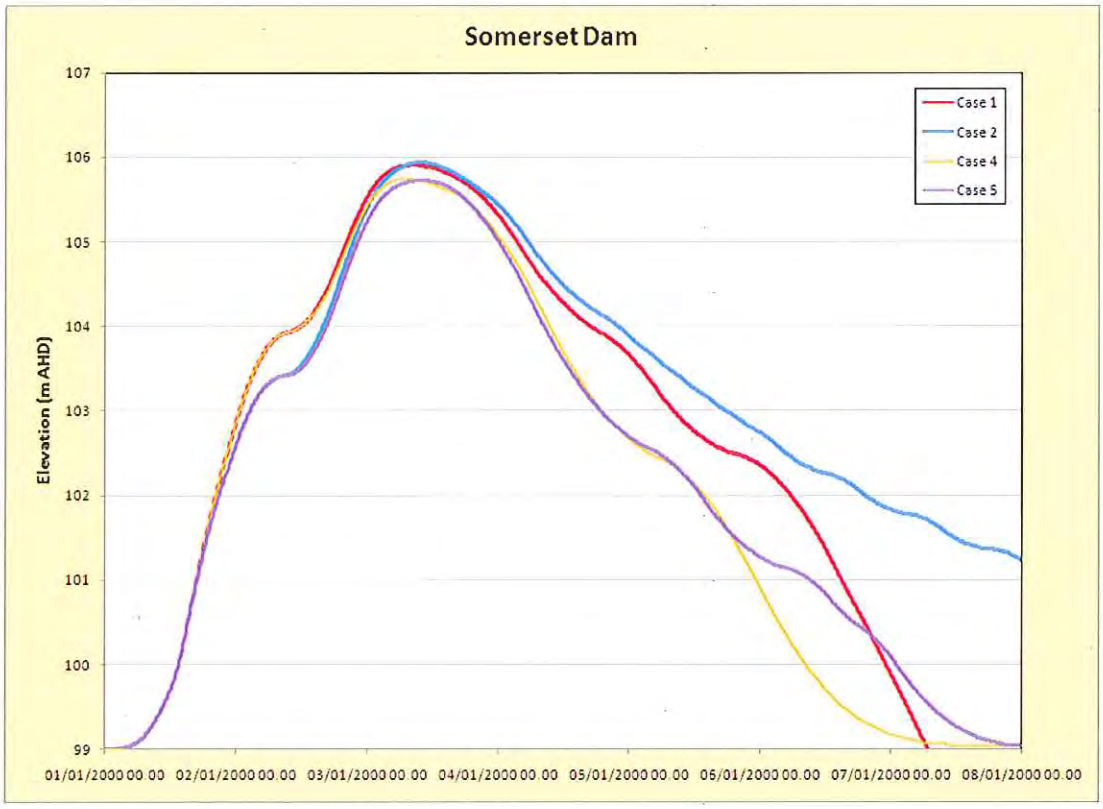

Lowood
Discharge [m3/s]
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00

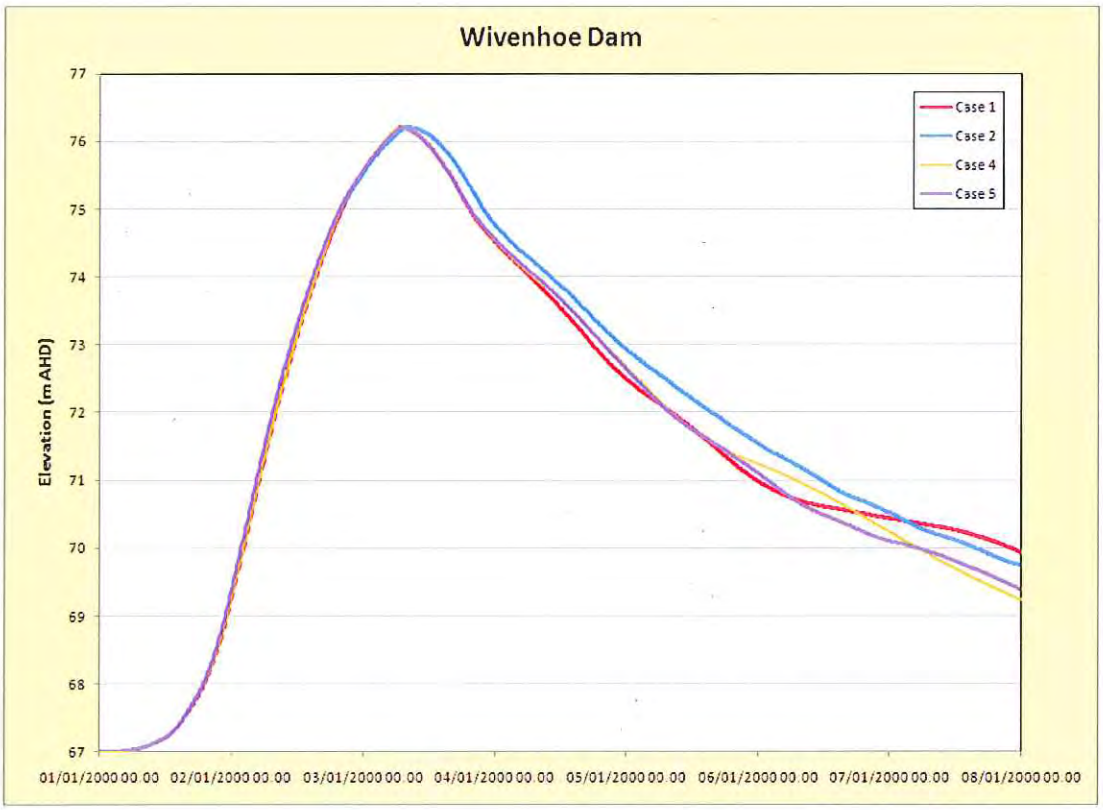

Moggill
Discharge [m3/s]
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00

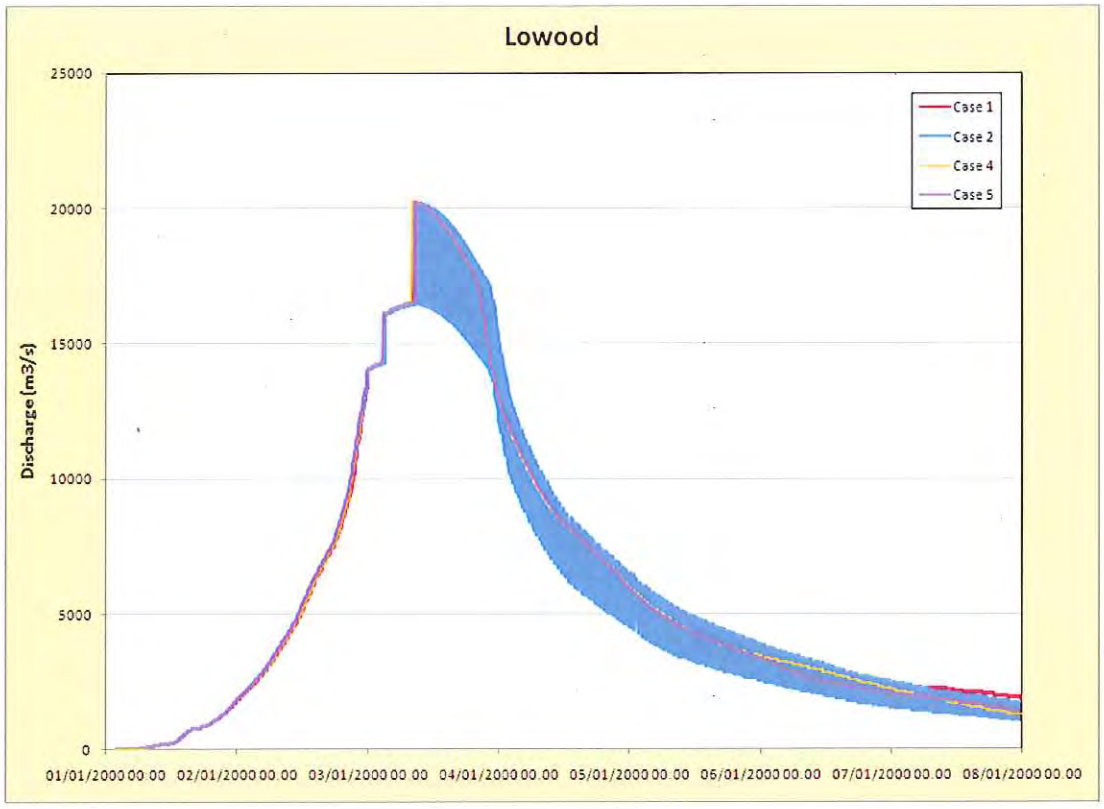
1 in 10,000 AEP

Item	Unit	Wivenhoe Operating Level			
		67.0 m AHD		68.5 m AHD	
		Somerset Operating Level		Somerset Operating Level	
		102.25	100.45	102.25	100.45
		Case 1	Case 2	Case 4	Case 5
Somerset Peak Elevation	m AHD	105.91	105.94	105.75	105.72
Wivenhoe Peak Elevation	m AHD	76.21	76.20	76.20	76.21
Lowood Peak Flow	m3/s	20,216	20,159	20,238	20,200
Moggill Peak Flow	m3/s	21,209	21,085	21,274	21,186




Somerset Dam
Elevation (m AHD)
107
106
105
104
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00


Wivenhoe Dam
Elevation (m AHD)
77
76
75
74
73
72
71
70
69
68
67
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00


Lowood
Discharge [m3/s]
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
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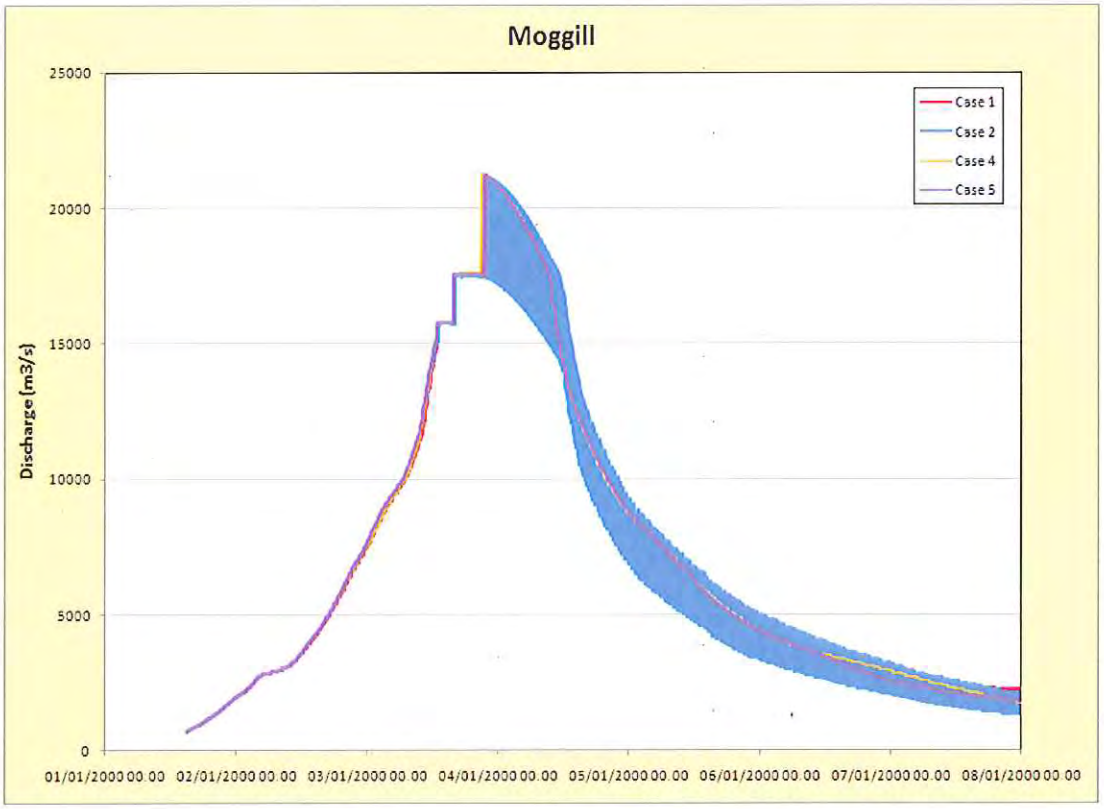
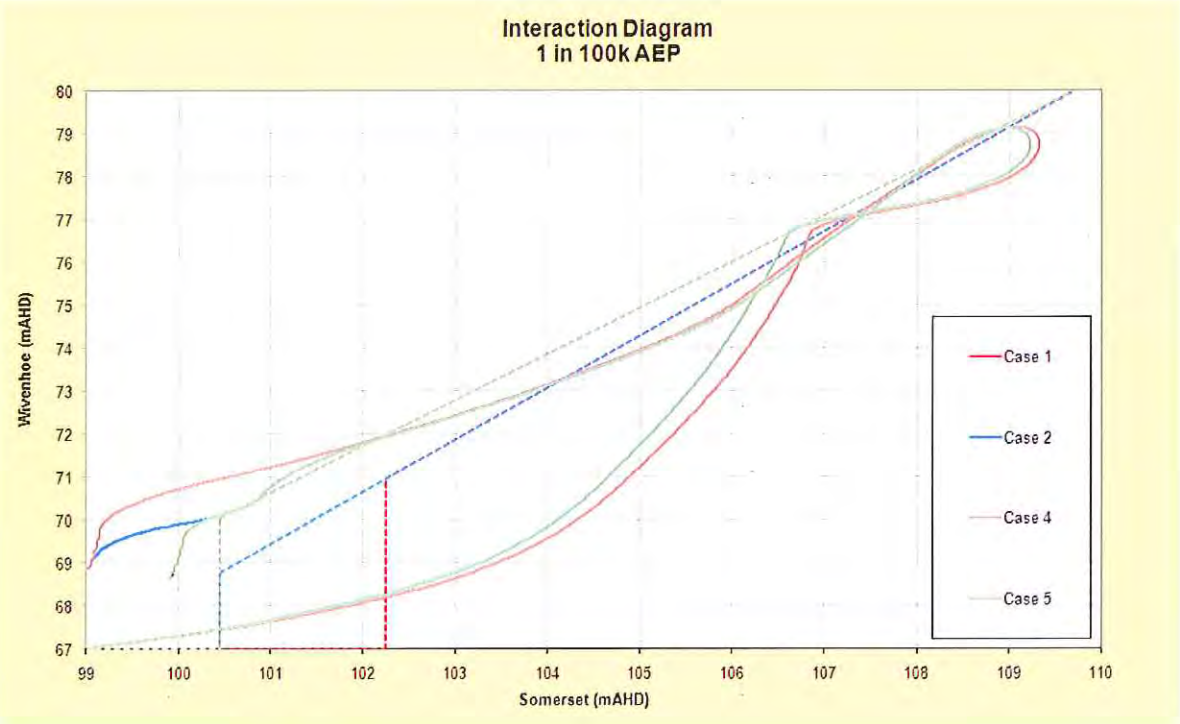
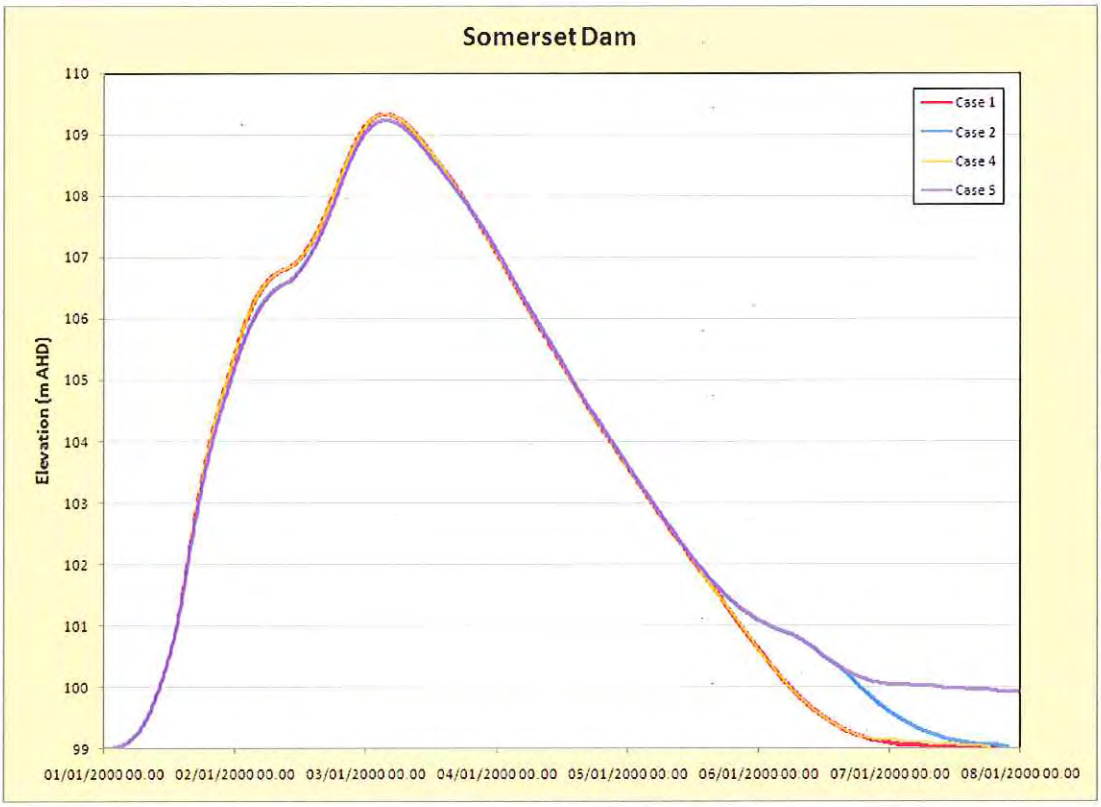
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00


Moggill
Discharge [m3/s]
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

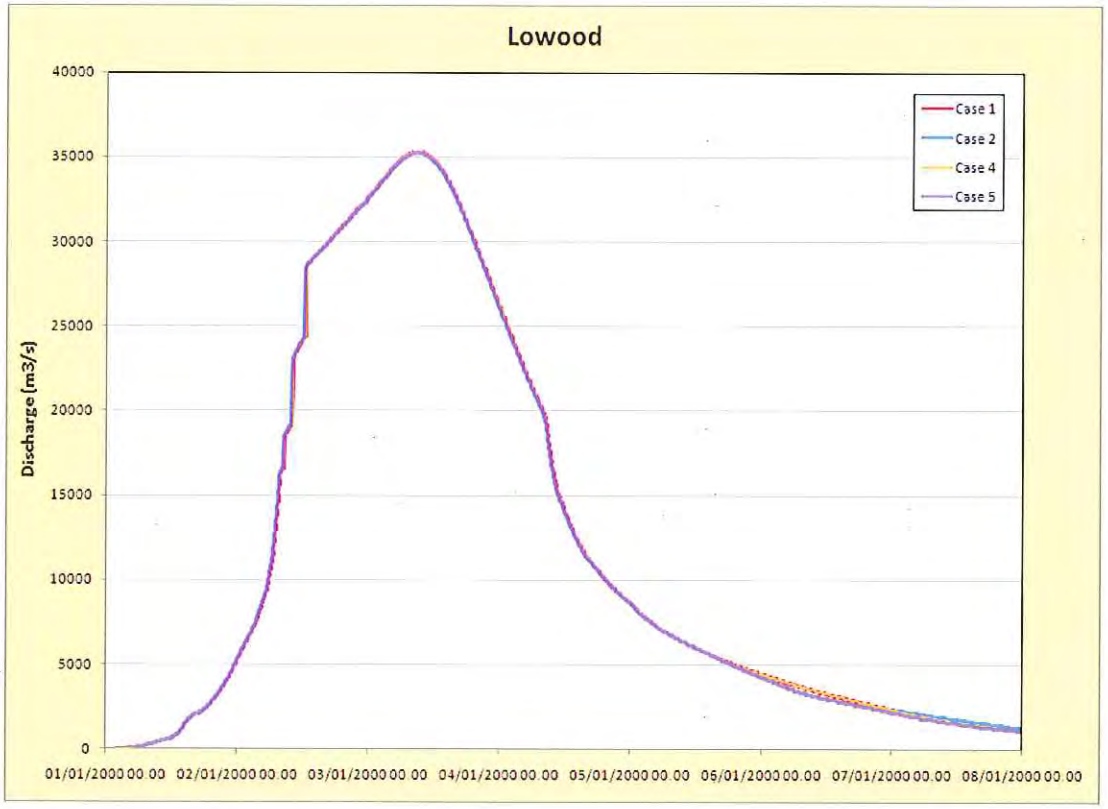
1 in 100,000 AEP

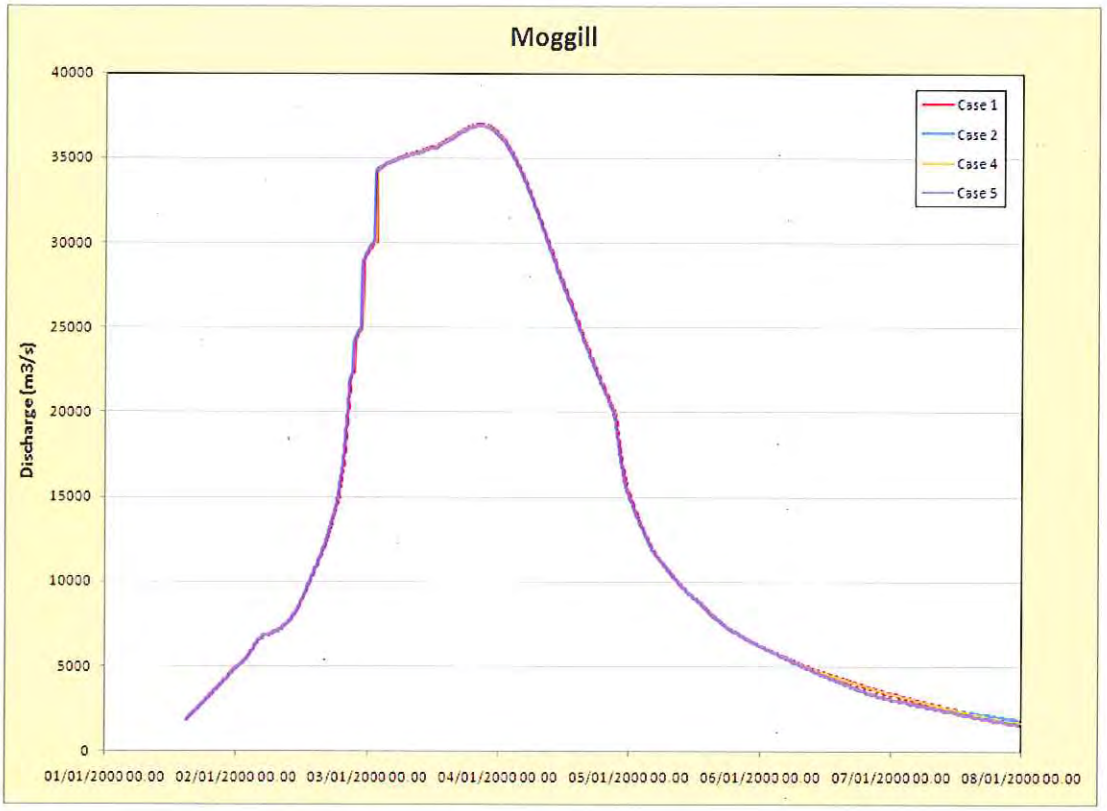
Item	Unit	Wivenhoe Operating Level			
		67.0 m AHD		68.5 m AHD	
		Somerset Operating Level		Somerset Operating Level	
		102.25	100.45	102.25	100.45
		Case 1	Case 2	Case 4	Case 5
Somerset Peak Elevation	m AHD	109.33	109.23	109.33	109.23
Wivenhoe Peak Elevation	m AHD	79.15	79.12	79.15	79.12
Lowood Peak Flow	m3/s	35,301	35,243	35,301	35,243
Moggill Peak Flow	m3/s	36,963	36,906	36,963	36,906




Somerset Dam
Elevation (m AHD)
110
109
108
107
106
105
104
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

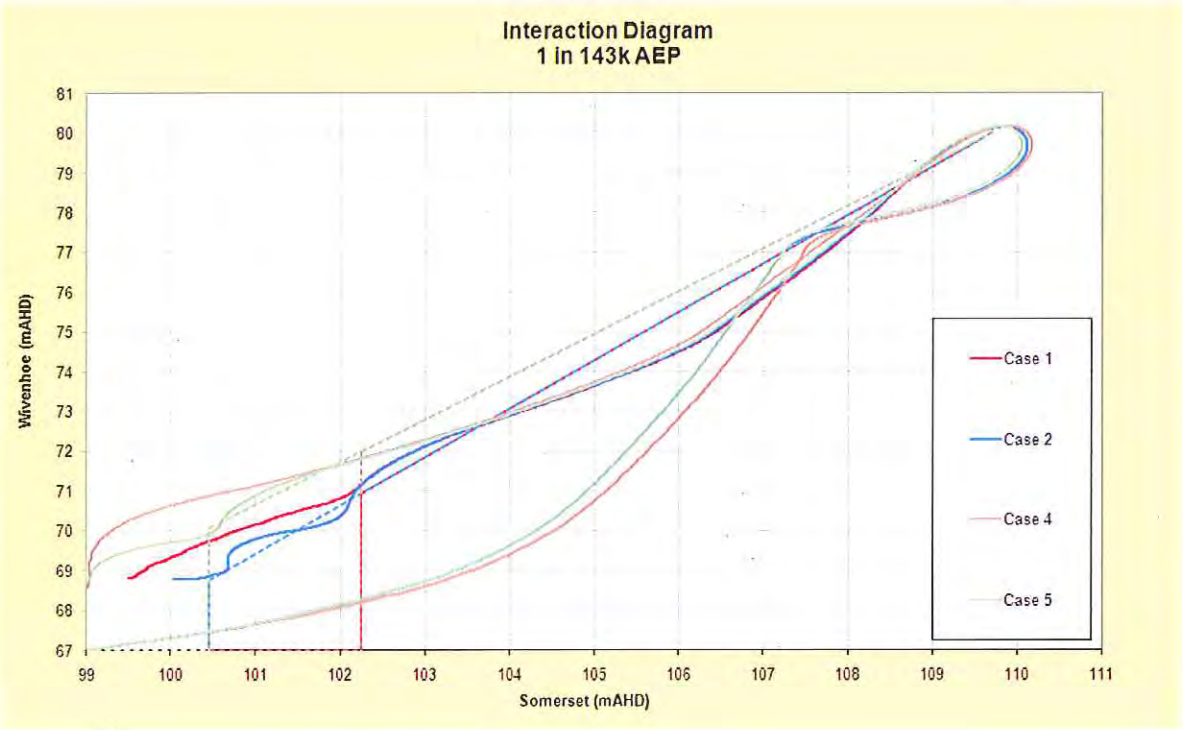

Wivenhoe Dam
Elevation (m AHD)
80
79
78
77
76
75
74
73
72
71
70
69
68
67
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

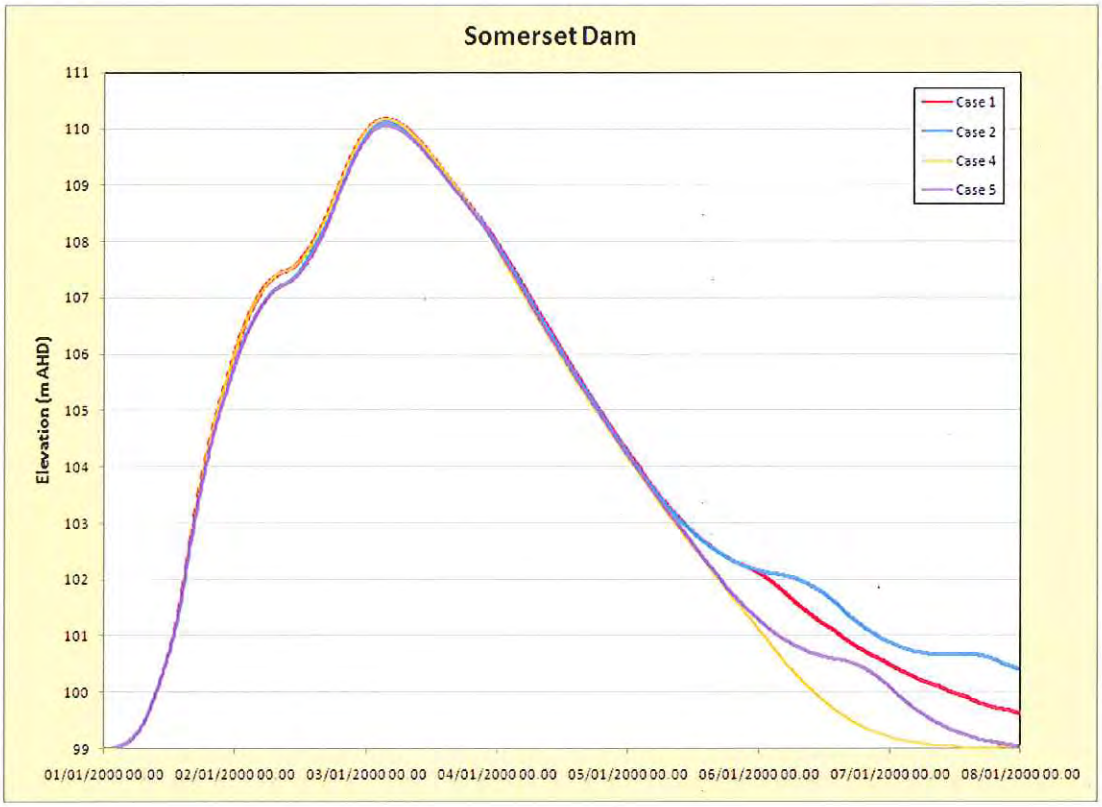

Lowood
Discharge (m3/s)
40000
35000
30000
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00


Moggill
Discharge (m3/s)
40000
35000
30000
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

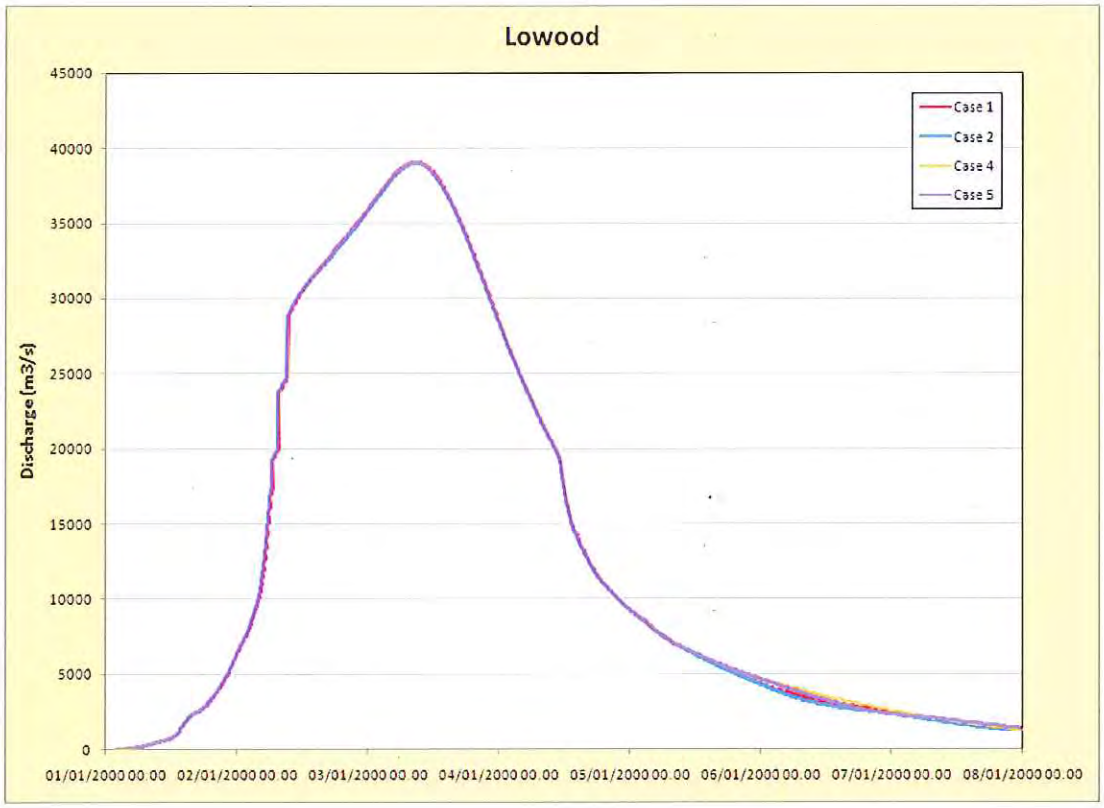
1 in 143,000 AEP

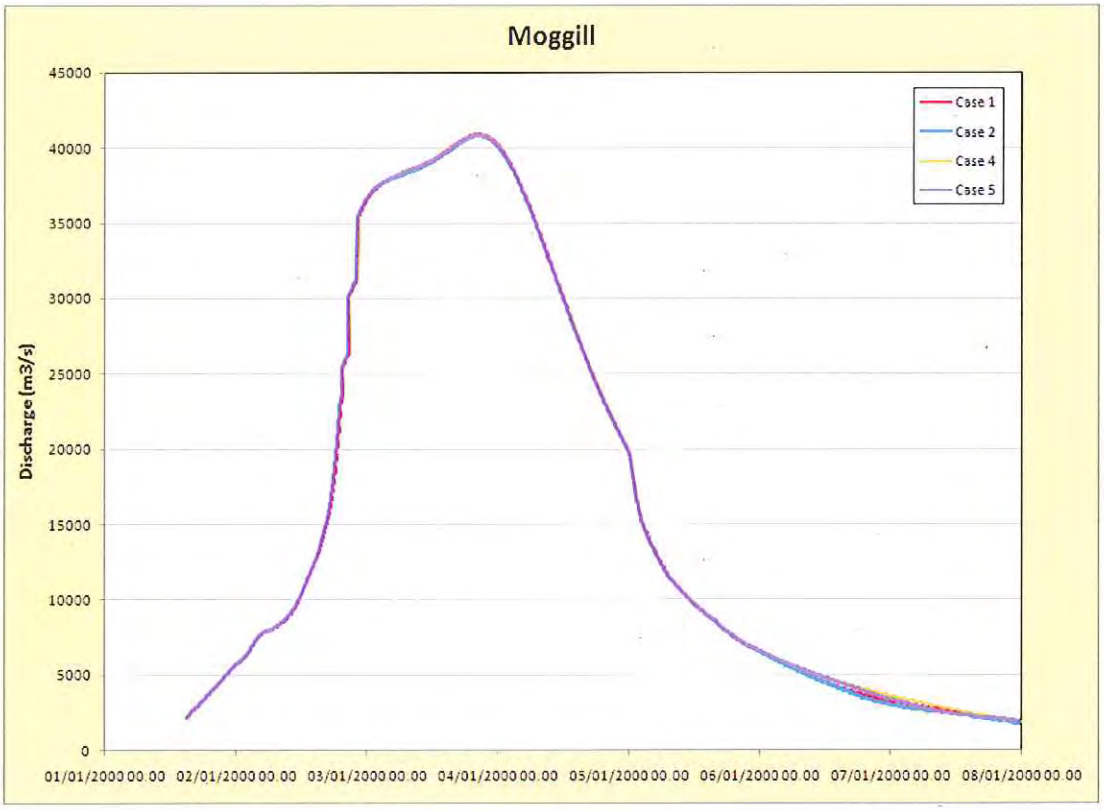
Item	Unit	Wivenhoe Operating Level			
		67.0 m AHD		68.5 m AHD	
		Somerset Operating Level		Somerset Operating Level	
		102.25	100.45	102.25	100.45
		Case 1	Case 2	Case 4	Case 5
Somerset Peak Elevation	m AHD	110.17	110.12	110.17	110.05
Wivenhoe Peak Elevation	m AHD	80.17	80.14	80.17	80.15
Lowood Peak Flow	m3/s	39,066	38,996	39,066	39,018
Moggill Peak Flow	m3/s	40,868	40,796	40,868	40,823




Somerset Dam
Elevation (m AHD)
111
110
109
108
107
106
105
104
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00


Wivenhoe Dam
Elevation (m AHD)
81
80
79
78
77
76
75
74
73
72
71
70
69
68
67
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00


Lowood
Discharge (m3/s)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

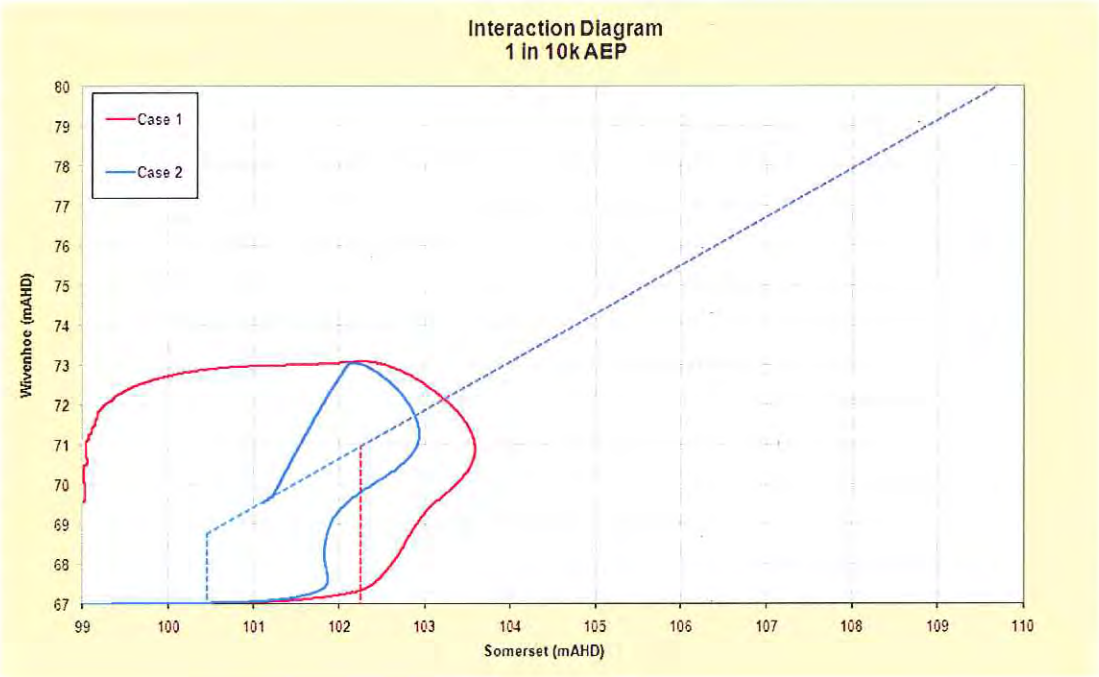

Moggill
Discharge (m3/s)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Case 1
Case 2
Case 4
Case 5
01/01/2000 00.00
02/01/2000 00.00
03/01/2000 00.00
04/01/2000 00.00
05/01/2000 00.00
06/01/2000 00.00
07/01/2000 00.00
08/01/2000 00.00

Appendix C

Somerset Centred Results

1 in 100 AEP

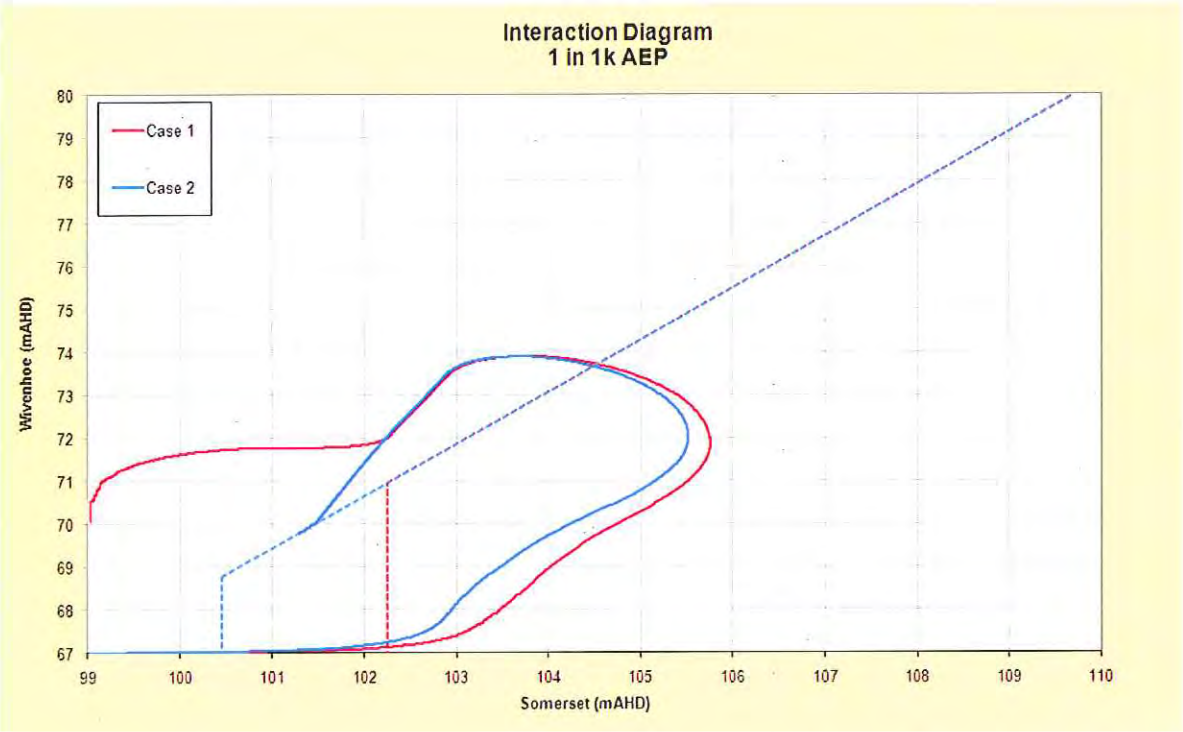
Item	Unit	Wivenhoe Operating Level	
		67.0 m AHD	
		Somerset Operating Level	
		102.25	100.45
		Case 1	Case 2
Somerset Peak Elevation	m AHD	103.59	102.93

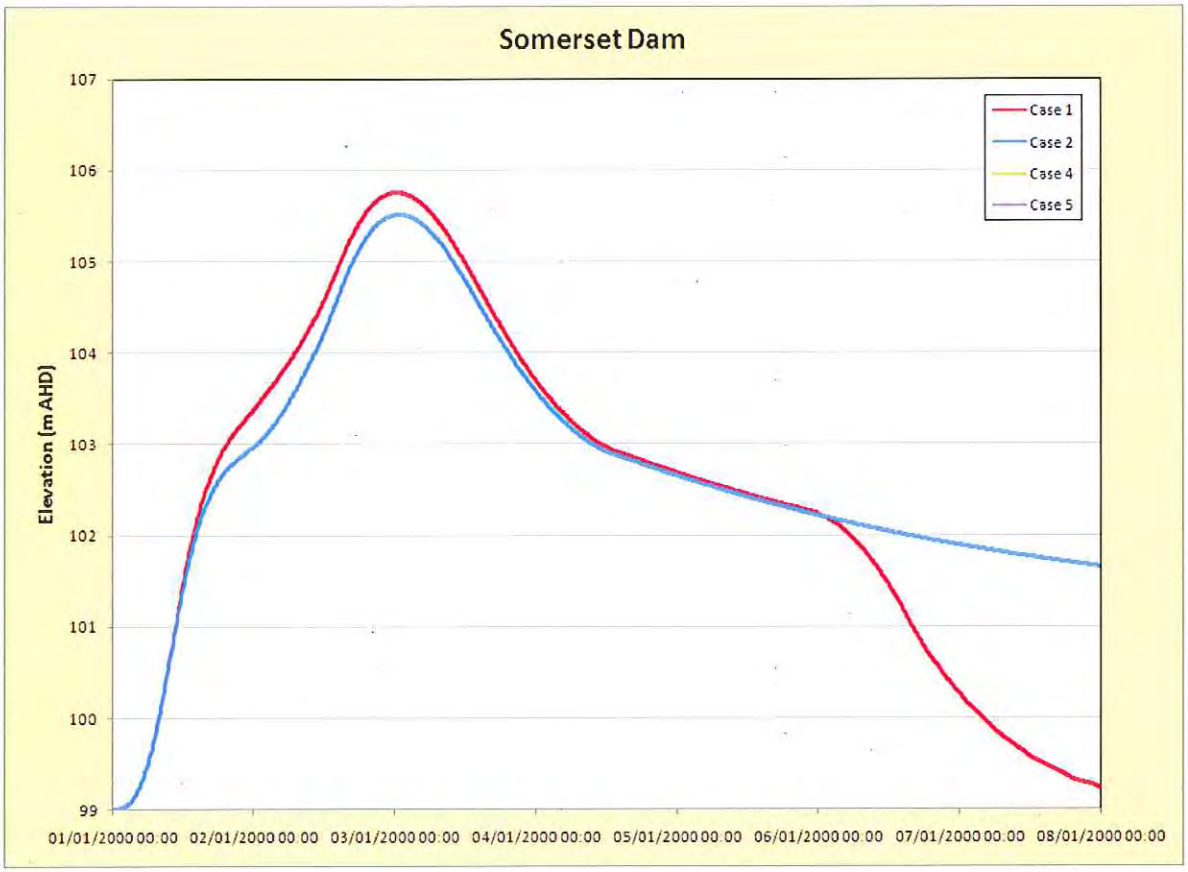



Somerset Dam
Elevation (m AHD)
107
106
105
104
103
102
101
100
99
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00
Case 1
Case 2
Case 4
Case 5

1 in 1,000 AEP

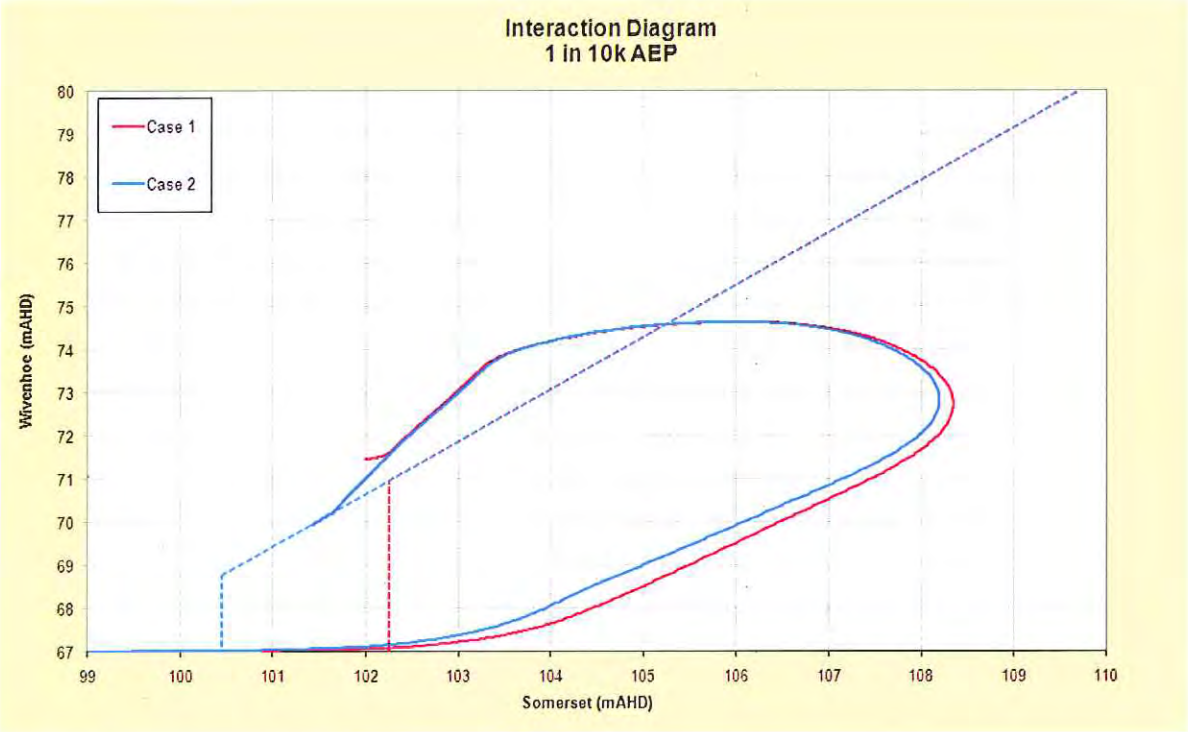
Item	Unit	Wivenhoe Operating Level	
		67.0 m AHD	
		Somerset Operating Level	
		102.25	100.45
		Case 1	Case 2
Somerset Peak Elevation	m AHD	105.75	105.51

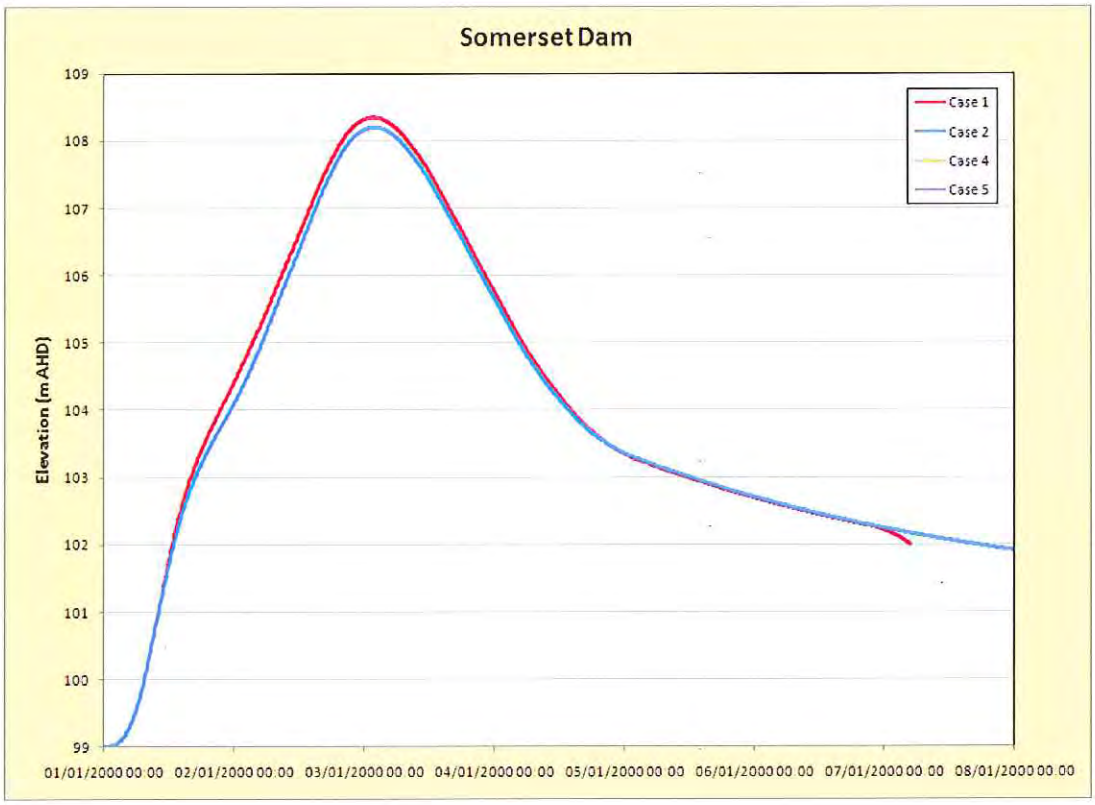



Somerset Dam
Elevation (m AHD)
107
106
105
104
103
102
101
100
99
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00
Case 1
Case 2
Case 4
Case 5

1 in 10,000 AEP

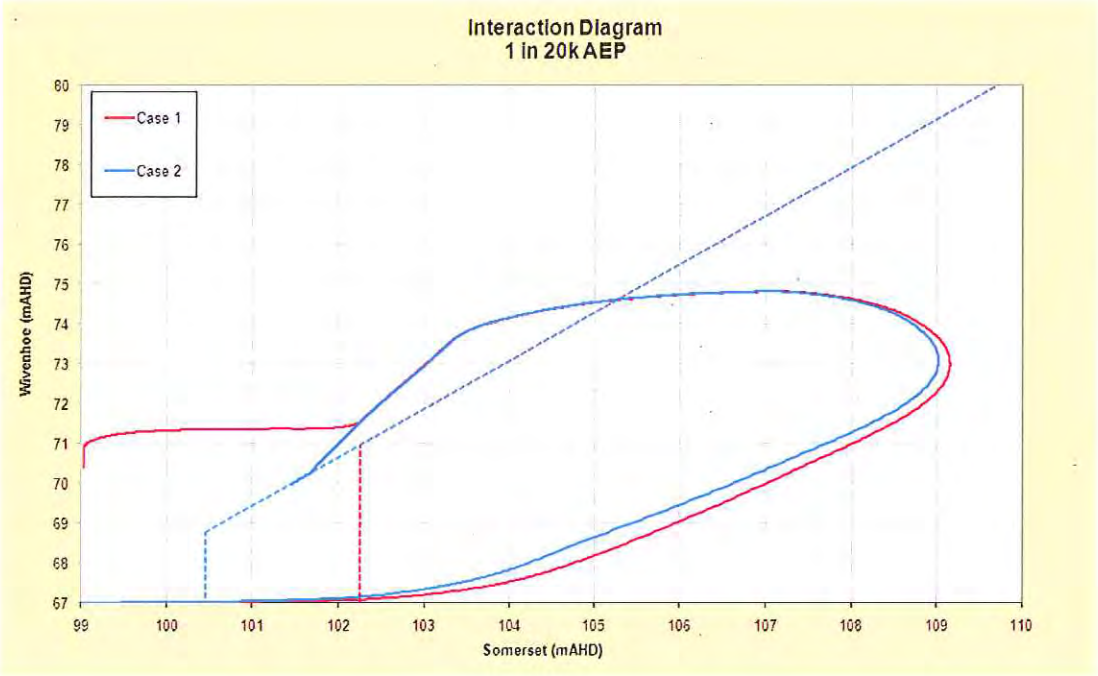
Item	Unit	Wivenhoe Operating Level	
		67.0 m AHD	
		Somerset Operating Level	
		102.25	100.45
		Case 1	Case 2
Somerset Peak Elevation	m AHD	108.34	108.20

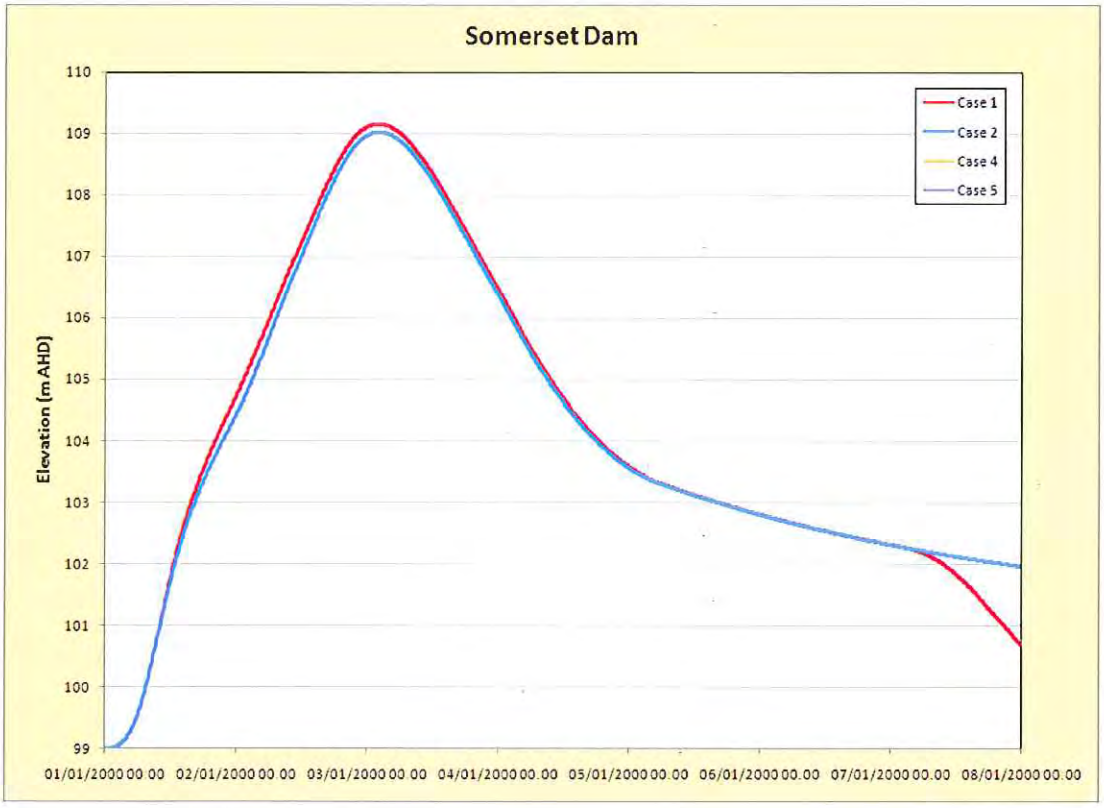



Somerset Dam
Elevation (m AHD)
109
108
107
106
105
104
103
102
101
100
99
Case 1
Case 2
Case 4
Case 5
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00

1 in 20,000 AEP

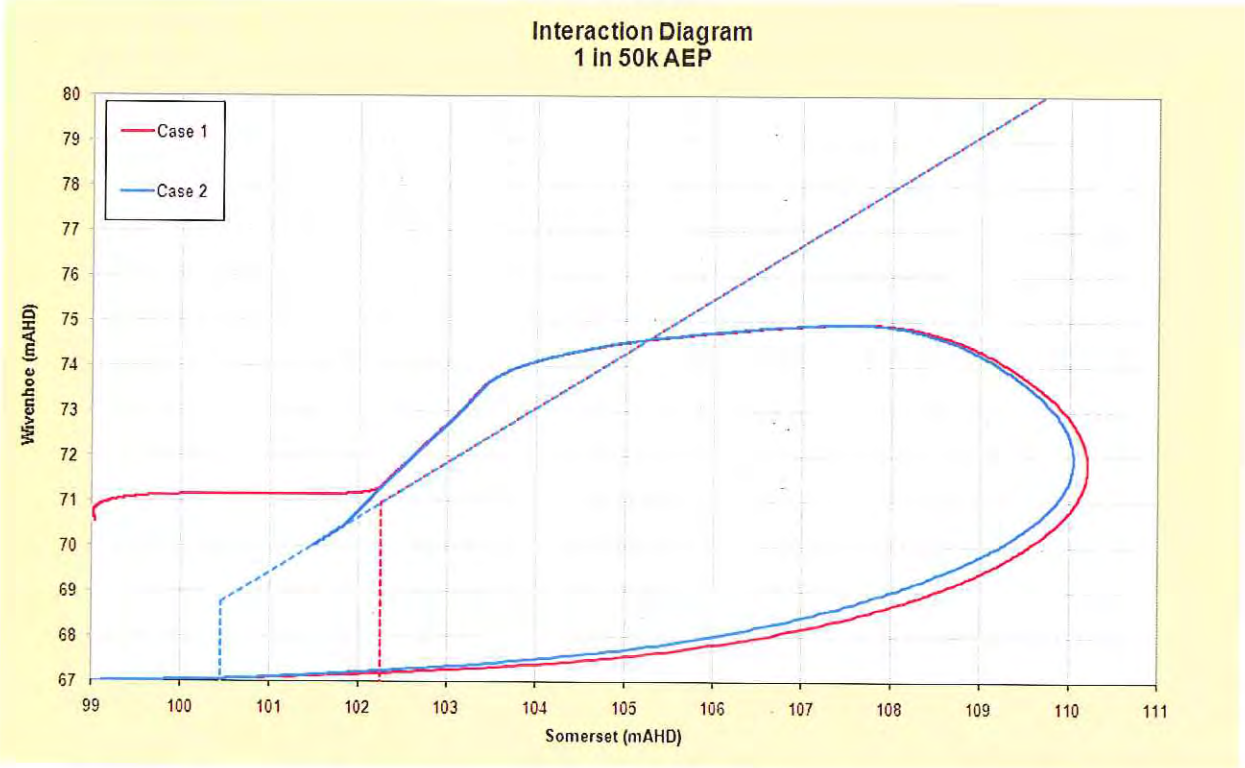
Item	Unit	Wivenhoe Operating Level	
		67.0 m AHD	
		Somerset Operating Level	
		102.25	100.45
		Case 1	Case 2
Somerset Peak Elevation	m AHD	109.15	109.02




Somerset Dam
Elevation (m AHD)
110
109
108
107
106
105
104
103
102
101
100
99
01/01/2000 00:00
02/01/2000 00:00
03/01/2000 00:00
04/01/2000 00:00
05/01/2000 00:00
06/01/2000 00:00
07/01/2000 00:00
08/01/2000 00:00
Case 1
Case 2
Case 4
Case 5

1 in 50,000 AEP

Item	Unit	Wivenhoe Operating Level	
		67.0 m AHD	
		Somerset Operating Level	
		102.25	100.45
		Case 1	Case 2
Somerset Peak Elevation	m AHD	110.21	110.05



MANUAL OF OPERATIONAL PROCEDURES FOR FLOOD MITIGATION AT WIVENHOE DAM AND SOMERSET DAM

NOTES ON NOVEMBER 2009 REVISION

INTRODUCTION

Seqwater has recently completed a comprehensive review and revision of the Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam. This work was very extensive and has resulted in a major rewrite of the Manual. Changes to the Manual can be grouped into four broad categories, which are:

- Administrative Issues.
- Improved Operational Descriptions.
- Review of Manual Objectives.
- Technical Amendments.

Changes within these categories are explained in detail below.

ADMINISTRATIVE ISSUES

Numerous reference changes to the manual were needed to account for the new water management institutional arrangements that were introduced by the Government in 2008. These reference changes resulted from the following:

- Change in relevant legislation to the Water Supply (Safety and Reliability) Act 2008.
- Change in relevant regulatory agency to the Department of Environment and Resource Management.
- Change in dam owner to the Queensland Bulk Water Supply Authority trading as Seqwater.
- Change in Agencies requiring information and holding controlled copies of the Manual in accordance with the Local Government Amalgamations of 2008.

None of these reference changes resulted in any change in operational procedure from the previous version of the Manual.

IMPROVED OPERATIONAL DESCRIPTIONS

Flood Events impacting on Wivenhoe and Somerset dams are caused by actual rainfall events that can vary in intensity, duration and distribution over a catchment area in excess of 10000 square kilometres. Accordingly, there is an infinite number of Flood Event scenarios that the Manual needs

[redacted] [redacted]

to account for. Previously, the operational approach taken in the Manual was procedural in nature. However, given the infinite scenarios to be catered for, it was obviously not possible for the Manual to contain a specific procedure relating to every possible flood event scenario. Therefore, following extensive discussion with both the Regulator and the Flood Operations Engineers and also taking into account the experience of previous flood events, a more practical approach was introduced.

The new approach does not change the original operational intent contained in the previous Manual, but does allow the optimisation of flood mitigation benefits, depending on the understanding of the magnitude of the flood event at any point in time. The approach provides strategies and objectives to guide flood operational decision making. The strategy chosen at any point in time will depend on the actual levels in the dams and the following predictions, which are to be made using the best forecast rainfall and stream flow information available at the time:

- Maximum storage levels in Wivenhoe and Somerset Dams.
- Peak flow rate at the Lowood Gauge (excluding Wivenhoe Dam releases).
- Peak flow rate at the Moggill Gauge (excluding Wivenhoe Dam releases).

Strategies are likely to change during a flood event as forecasts change and rain is received in the catchments. It is not possible to predict the range of strategies that will be used during the course of a flood event at the commencement of the event. Strategies are changed in response to changing rainfall forecasts and stream flow conditions to maximise the flood mitigation benefits of the dams.

Flowcharts have been provided in the updated Manual to assist in Strategy selection. Additionally improved detail was provided within each strategy to clarify the intent of the Manual. This improved detail was wholly consistent with the intent and objectives of the previous version. Finally, additional detail was provided to cater for the following scenarios that were not covered in the previous version:

- **Potential to avoid a fuse plug initiation at Wivenhoe Dam by either initiating an early release of water from Wivenhoe Dam or by holding water back in Somerset Dam.** Neither action is allowed to adversely impact on the safety of the dams. In practice, the possibility of such a situation arising is considered extremely unlikely and will only occur if the event is well understood (i.e. no significant further rain is forecast for the event) and the peak flood level in Wivenhoe roughly corresponds to a fuse plug initiation level. However, it was thought that the situation should be covered off in the Manual for completeness.

- **Somerset Dam exceeds full supply level, while Wivenhoe Dam does not.** This scenario is of minor to insignificant risk, because it does not result in releases of water from Wivenhoe Dam. However, the situation was encountered in May 2009 and it was again thought that the situation should be covered off in the Manual for completeness.

REVIEW OF MANUAL OBJECTIVES

The Flood Mitigation Objectives contained in the previous version of the Manual in order of importance were:

- Ensure the structural safety of the dams;
- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Minimise disruption and impact upon Wivenhoe Power Station;
- Minimise disruption to navigation in the Brisbane River.

Following investigations, it was determined that decisions made during flood events have never given consideration to either minimising disruption and impact upon Wivenhoe Power Station or minimising disruption to navigation in the Brisbane River.

The Wivenhoe Power Station is not adversely impacted to any degree until the Dam Levels exceed EL 74.0 AHD. At these levels, the primary consideration is only the structural safety of the dam and minimising disruption to the power station is not a consideration.

Similarly, at the stage in a flood event where Wivenhoe Dam outflows potentially disrupt navigation in the Brisbane River, the higher level flood objectives dominate decision making processes. Additionally, it is not currently possible to derive a sensible relationship between releases from Wivenhoe Dam and disruption to navigation in the Brisbane River. Recent experience showed that one of the primary disruption mechanisms associated with the Brisbane River navigation is the cancellation of the public transport "CityCat" services. Such cancellations occurred in May 2009, when releases were not being made from Wivenhoe Dam. It is understood that the cancellations at this time were a function of factors associated with debris entering the river system downstream of the dam. Presently, it is not considered possible to incorporate such factors in flood release decision making processes.

Regardless of the difficulties, to provide recognition that in some circumstances considerations of disruption to navigation may be required, the updated Manual allows disruption to navigation in the Brisbane River to be taken into account when considering disruption to rural areas downstream of the dam. The updated manual states however that consideration of navigation is generally secondary to considerations associated with reducing bridge inundation downstream of Wivenhoe Dam.

With consideration to these changes, the Flood Mitigation Objectives contained in the updated version of the Manual in order of importance are:

- Ensure the structural safety of the dams;

- Provide optimum protection of urbanised areas from inundation;
- Minimise disruption to rural life in the valleys of the Brisbane and Stanley Rivers;
- Retain the storage at Full Supply Level at the conclusion of the Flood Event.
- Minimise impacts to riparian flora and fauna during the drain down phase of the Flood Event.

The first three objectives are unchanged from the previous version, while the last two objectives were added to reflect current operating practice. Naturally, at the end of an event, a primary objective is to ensure that the dams are at full supply levels. Additionally in the drain down phase of the event, there has always been an objective to minimise impacts to riparian flora and fauna, particularly critical species such as lung fish.

TECHNICAL AMMENDMENTS

To maximise the combined flood mitigation benefits of Wivenhoe and Somerset dams, the operation of the dams during floods is interdependent. To determine the optimal flood mitigation strategy, a Somerset-Wivenhoe Operating Target Line is used as a guide to optimise flood mitigation benefits, while protecting the structural safety of the dams.

The existing Somerset-Wivenhoe Operating Target Line required review because it did not properly account for the raising of Wivenhoe Dam and construction of an Auxiliary Spillway that occurred in 2005. It also did not properly account for the revised failure level of Somerset Dam or for scenarios associated with floods centred on the Somerset Catchment.

A report was prepared to examine these issues in detail and the results of this report are the basis for the bulk of the technical amendments contained in the updated manual, particularly in relation to changes to the Somerset-Wivenhoe Operating Target Line. The report is entitled "Somerset-Wivenhoe Interaction Study (October 2009)". This report should be read to understand the nature and reasons for these amendments.

The other significant technical amendment related to the simplification of the loss of communications procedures. The Wivenhoe Dam minimum gate opening sequence was simplified by providing opening increments in steps of either 50 or 100 millimetres. This made the sequence easier to follow for dam operators and had very little change on dam outflows. The other change to the table was made to correct an inconsistency that allowed dam outflows of greater than 4000 m^3/s at dam levels less that EL 74.0 m AHD. This was considered to be an error in the previous manual as it is inconsistent with the flood manual objectives. Wivenhoe gate opening sequences were also made consistent between "normal communications" and "loss of communications" procedures.

The Somerset Dam Loss of Communication procedure was also simplified to provide straightforward sluice opening and closing procedures in accordance with the Somerset-Wivenhoe Operating Target Line. The simplified procedure was extensively modelled and was found to consistently provide

better results in terms of optimising the flood mitigation benefits of the two dams. This modelling is contained in the Somerset-Wivenhoe Interaction Study (October 2009).

seqwater
WATER FOR LIFE

When contacting Seqwater please ask for John Tibaldi
Telephone: [redacted]
Reference: 09-000047

3 December 2009

Mr Peter Allen
Director Dam Safety (Water Supply)
Department of Natural Resources and Water
PO Box 2454
BRISBANE QLD 4001

Dear Mr Allen

MANUAL OF OPERATIONAL PROCEDURES FOR FLOOD MITIGATION AT WIVENHOE DAM AND SOMERSET DAM

As you are aware, Seqwater has recently completed a comprehensive review and revision of the Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam. This work has been very extensive and has resulted in a major rewrite of the existing Manual. Your assistance with this work is acknowledged and I would like to thank you for your input.

Now that the revision is complete, I request that you approve the updated Manual by gazette notice, in accordance with the provisions of Chapter 4 (Part 2) of the Water Supply (Safety and Reliability) Act 2008. Two copies of the updated Manual are attached and John Tibaldi will liaise with you directly in relation to the provision of a suitable electronic document to facilitate gazettal. Also attached is a copy of the Somerset – Wivenhoe Interaction Study, that was the basis of the technical changes in the updated Manual; and a short paper that summarizes the changes made to the Manual.

I trust the information provided is in accordance with your requirements and I ask that you contact me on [redacted] should any issues arise that impact on the requested approval.

Yours faithfully

[redacted]

Peter Borrows
CEO

Attachments:

- Summary of Manual changes.
- Revised Manual of Operational Procedures for Flood Mitigation at Wivenhoe Dam and Somerset Dam, November 2009 x 2.
- Somerset – Wivenhoe Interaction Study (October 2009).