QFCI

Date: 10/2/12 JM

Exhibit Number: 1124

Queensland Floods Commission of Inquiry
Level 30 400 George Street
BRISBANE QLD 4000

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18 November 2011

Attention: Mr [redacted]

Dear Sir,

Re: Modelling of Additional Dam Release Scenarios – Addendum to"Review of Hydraulic Modelling" Report

1 We refer to the Commission's request that WMAwater undertake modelling of additional dam release scenarios, on account of submissions received relating to WMAwater's Review of Hydraulic Modelling Final Report (the WMAwater report, Reference 1).

Scope

2 The Commission requested that WMAwater model the following alternative dam release scenarios:

a. As per the Option B scenario, assume that the water level in Wivenhoe Dam was at 75% of Full Supply Level (FSL) prior to the onset of the flood. Option B did not include a change to the trigger levels for various release strategies in the Manual (Reference 8) to allow releases to occur between 75% and 100% FSL. The Commission requested that the impact of lower trigger levels on this scenario be assessed; and

b. Reference 1 approached the Option A scenario on the basis that the transition to Strategy W4 occurred at 4.00pm on 10 January 2011. In its Interim Report (Reference 2) the Commission found that the first time at which a "with forecast" prediction suggested that the level of the lake would exceed 74.0 metres was at 8.00pm on 9 January 2011. Accordingly, the Commission requested that the Option A scenario be modelled on the basis that the transition to Strategy W4 occurred at 8.00pm on 9 January 2011.

3 The submission by Mr Michael O'Brien dated 31 August 2011 endorses an additional alternative gate operation scenario (described in Section 8.4 of that submission), which WMAwater have modelled as part of the response to that submission. Mr O'Brien described the scenario as follows:

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- *"At 09:00 am on Thursday 6th January commence opening the gates in a logical, rational sequence."*
- *"By early evening all five gates are set at 6.00 metres vertical opening."*
- *"A Maximum Discharge Rate of 3350 cubic metres per sec"*
- *"A Maximum Dam Water Level of EL. 72.90"*

General Comments

4 Within the bounds of the scenarios requested by the Commission, there is some scope for interpretation of the operating procedures specified by the Manual, particularly with regards to the rate of gate openings under Strategy W4, as discussed in Paragraphs 69 and 70 of Reference 1:

69 There is some ambiguity in the Manual as to the rate at which gates should be opened once Strategy W4 is triggered. On one hand the Manual states under Strategy W4A that gate openings are occur at the intervals of 0.5 m every 10 minutes. On the other hand there is a requirement to consider the "impact if rapidly escalating discharge…on downstream reaches." In practice during the January 2011 event, the Flood Engineers opened the gates at a rate of about 1.0 m per hour under Strategy W4, which produced an increase in outflow rate that mimicked the rate of increase of dam inflow. This appears to be a reasonable rate of opening to balance the requirements under Strategy W4.

70 However this flexibility of gate opening rates means that if Strategy W4 had been engaged earlier, two different courses of action would have been open to the Flood Engineers, either:

a. To quickly escalate outflows to match inflows and stabilise the level in the dam, resulting in a lower eventual peak lake level but a higher peak discharge than what actually occurred; or

b. To increase outflows at a slower but steady rate, to make more use of the remaining mitigation storage in the dam, resulting in a similar peak lake level as what occurred.

5 It should be noted that the scenario where trigger levels are adjusted to correspond to a 75% FSL initial storage in Wivenhoe Dam is quite different from a policy perspective to Option B from Reference 1. Option B considers the scenario where the antecedent rainfall in the dam catchment is such that the water storage component is not at full supply, or the dam has been drawn down in anticipation of flooding (as has been proposed for to the 2012 wet season). However the proportion of dam storage allocated to water supply remains unchanged (i.e. 100% FSL). If flood mitigation trigger levels are amended to allow releases between 75% and 100% FSL, there is an implicit acceptance that the proportion of the dam storage allocated to water supply has been reduced, in a trade off for more flood mitigation storage. Decisions to change the trigger levels of flood release strategies should only be made after a thorough assessment of the implications for water supply security.

6 To reflect this difference, the scenarios with an initial storage level of 75% FSL and an attendant reduction in trigger levels are referred to as Option E.

7 For the Option E scenarios, the trigger levels were amended as follows. The trigger levels specified for Strategy W1 are reduced by an equivalent 25% of FSL. The entry trigger level for Strategies W2 and W3 are reduced by about 25% of FSL from 68.50 mAHD to 66.0 mAHD. The entry trigger level for Strategy W4 is maintained at 74.0 mAHD, as this level is primarily determined by the capacity of the dam to increase releases as the lake level approaches the overtopping level of the dam. As these factors are unchanged by the 75% FSL starting condition, it is reasonable to leave the Strategy W4 trigger level unchanged.

8 For Option E therefore, the bulk of the additional flood mitigation storage provided (by adopting a lower water supply component of 75% FSL) is available during Strategy W2 or W3 operations.

9 These two courses of action after an earlier transition to Strategy W4 were assessed in Reference 1 as two alternative scenarios, Option A4 and A5. For this addendum report, a similar methodology has been adopted, with Option A6 investigating a high release strategy to stabilise dam levels, and Option A7 aiming to make more use of the available dam storage once Strategy W4 is triggered.

Summary of Scenarios Considered

10 The modelling scenarios assessed in this addendum report are summarised below. Charts displaying the Wivenhoe Dam releases and storage levels are provided in the discussion for each scenario that follows in later sections.

11 Option A6 – Transition to Strategy W4 at 8.00pm on 9 January 2011. The gates are opened quickly in accordance with the Manual “until the storage level of Wivenhoe Dam begins to fall.”

12 Option A7 – Transition to Strategy W4 at 8.00pm on 9 January 2011. The gates are opened to release more flow than that allowed under Strategy W3, but the dam level is allows to rise until it reaches 74.0 mAHD, at which point releases are increased until the storage level of Wivenhoe Dam begins to fall.

13 Option E1 – Wivenhoe Dam is assumed to be at 75% FSL (a level of 64.27 mAHD) at the onset of the flood (9:00 am on 6 January 2011). The trigger levels are adjusted as per Paragraph 7. When the Wivenhoe Dam level exceeds 74.0 mAHD, dam releases are increased until the level begins to fall.

14 Option E2 – Similar to Option E1, however when the Wivenhoe Dam level exceeds 74.0 mAHD, dam releases are only slightly increased to utilise more of the available storage, and reduce dam outflows. This is a plausible scenario as at the point when the level exceeds 74.0 mAHD the dam inflows are decreasing rapidly (refer to Figure 4).

15 Option F – The Wivenhoe Dam gates are opened steadily from 9:00 am on 6 January, reaching 6.0 m full opening width by 9:00 pm on 7 January. This strategy is slightly different to that described by Mr O'Brien (refer to Paragraph 3 above). The slightly slower rate of opening was required to achieve a peak discharge of 3,450 m3/s and peak dam level of 72.9 mAHD, similar to those stated, which could not be obtained by using a literal application of Mr O'Brien's description of the scenario.

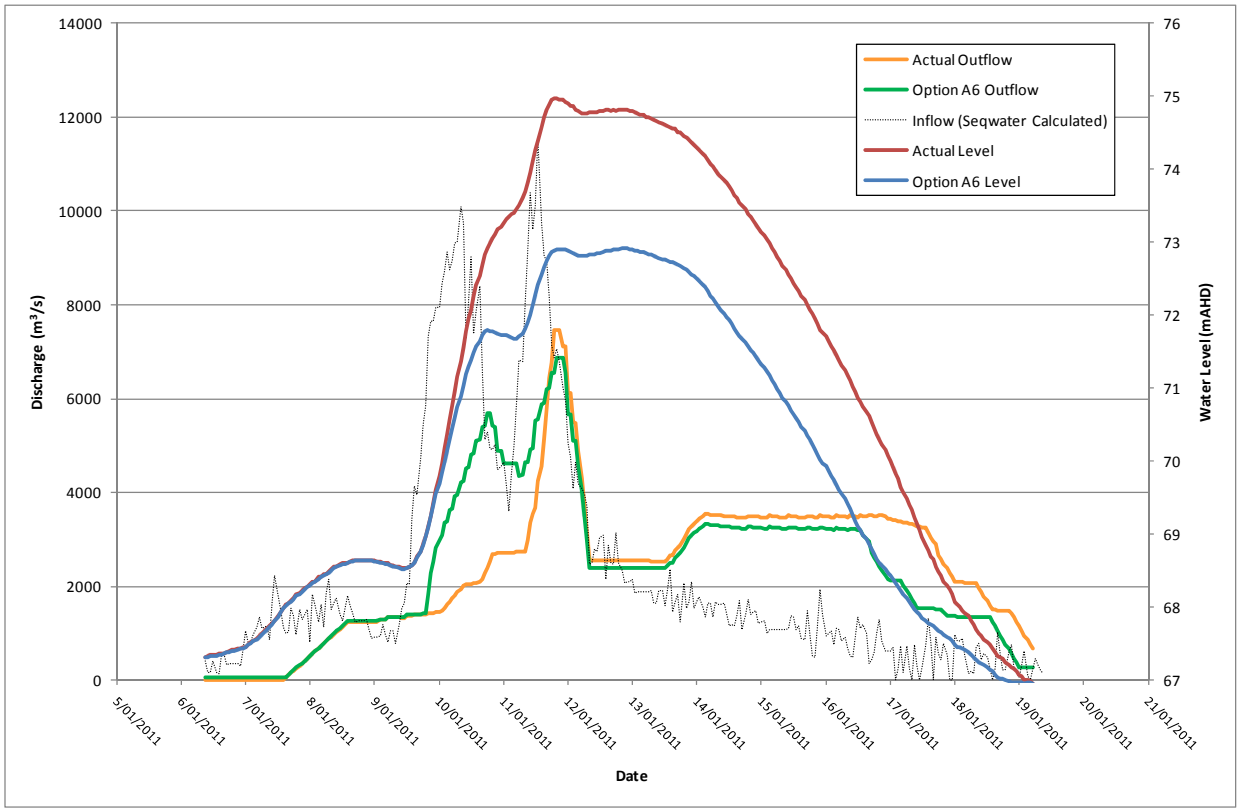
16 Peak flood levels at key locations from the modelling of the above scenarios are presented in Table 1 below. A negative value of "Peak Flood Level Difference" for a given scenario indicates a benefit (i.e. a reduction in flood levels compared to what actually occurred).

Table 1: Alternative Dam Operation Results

Location	Case 1	Option A6	Option A7	Option E1	Option E2	Option F
	Peak Flood Level (mAHD)	Peak Flood Level difference relative to Case 1 (m)				
Moggill	17.6	+0.3	-0.9	-1.3	-1.8	-1.4
Jindalee	13.1	+0.3	-0.8	-1.2	-1.6	-1.3
Oxley	8.3	+0.3	-0.5	-0.9	-1.3	-1.0
Brisbane	4.6	+0.2	-0.3	-0.6	-0.8	-0.6

Discussion – Early Transition to Strategy W4 (Option A)

Figure 1: Option A6 Wivenhoe Dam Releases and Water Levels



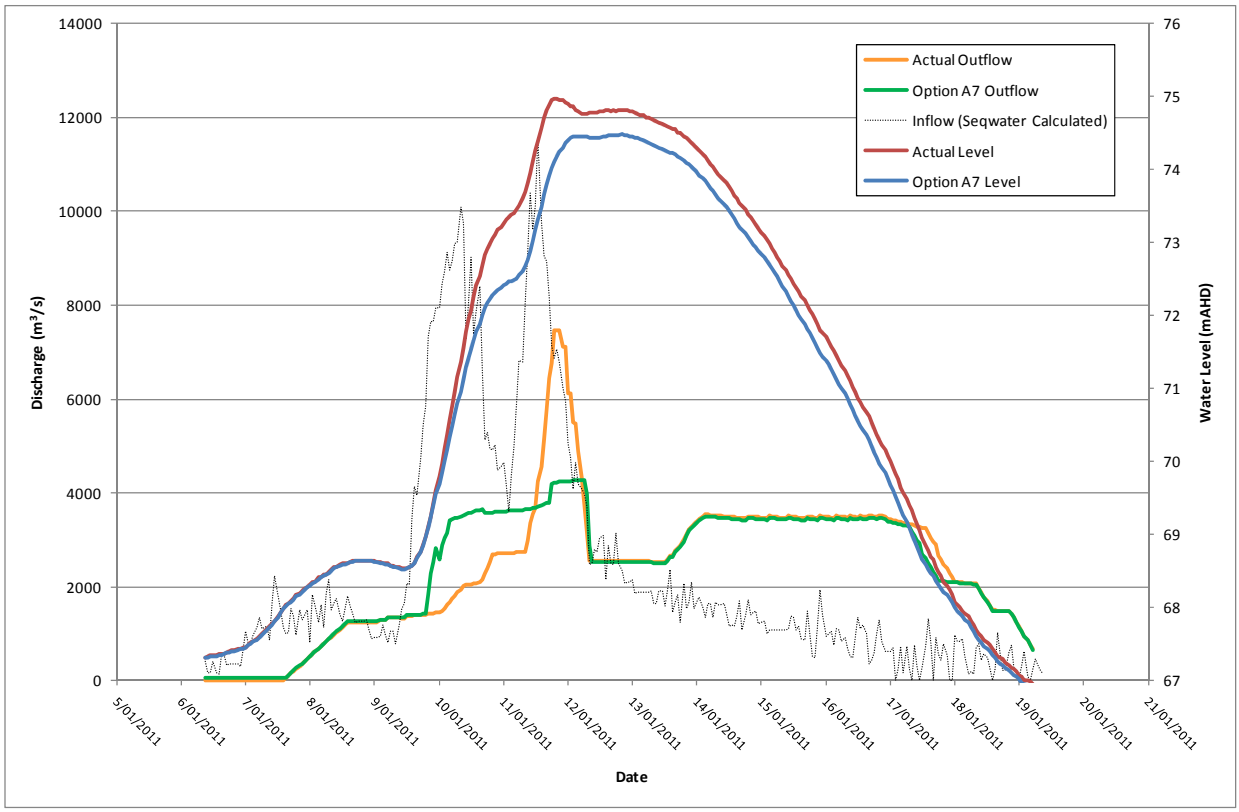
17 As with Options A4 and A5 considered in Reference 1, an earlier transition to Strategy W4 during the January 2011 flood would have had mixed results, depending on the rate of gate openings adopted while under Strategy W4. Modelling indicates that Option A6 would have resulted in increased flood levels from Moggill to Brisbane, by around 0.2 m to 0.3 m compared to what actually occurred, while Option A7 would have lowered flood levels by 0.3 m at Brisbane and 0.9 m at Moggill.

18 Option A6 (Figure 1) is considered an extreme case, as the rapid opening of gates followed under this scenario would result in a significant proportion of the flood mitigation capacity not being used. Under this scenario, the Wivenhoe Dam would not even have reached 74.0 mAHD (maximum 72.9 mAHD), which would raise the question as to whether such an early instigation of Strategy W4 was really necessary. However, this scenario is still of interest as it constitutes a literal interpretation of the Manual, which states “Gate openings are generally to occur at the minimum intervals and sequences as specified in Section 8.6 until the storage level of Wivenhoe Dam begins to fall.”

19 Option A7 (Figure 2) is a more reasonable reflection of the likely results of an earlier transition to Strategy W4, at the time identified by the Commission. The dam releases are quickly increased to between 3,500 m^3/s and 4,000 m^3/s, but are not increased further until the dam level actually surpasses 74.0 mAHD, at which point it is necessary to further increase releases

to stabilise the dam water level. The maximum dam level reached would have been 74.5 mAHD, 0.5 m lower than what actually occurred.

Figure 2: Option A7 Wivenhoe Dam Releases and Water Levels



20 These findings are similar to those made by assessing Options A4 and A5 in Reference 1, except that the even earlier transition to Strategy W4 in Option A5 compared to Option A7 would have increased the potential benefit in terms of lower flood levels. It is therefore considered likely that a transition to Strategy W4 at 8:00pm on 9 January 2011 would have resulted in slightly lower flood levels than those actually experienced, with a maximum potential benefit as indicated by the Option A7 results in Table 1.

Discussion – Reduce Water Supply Component to 75% FSL (Option E)

21 It can be seen from Figure 3 and Figure 4 that the Option E scenarios would have resulted in significantly reduced peak outflows from Wivenhoe Dam (green line) compared the actual releases (orange line). The bulk of the additional 25% of FSL devoted to flood mitigation would have been available to help absorb the second inflow peak to the dam, thereby avoiding the "spiky" release peaking at 7,500 m^3/s. Modelling indicates that the lower peak release from Wivenhoe Dam would have lowered peak flood levels by between 1.3 m and 1.8 m at Moggill, and by between 0.6 m and 0.8 m at Brisbane.

22 As mentioned previously, while the potential benefits of this scenario are significant when considering the January 2011 flood, these benefits alone are not sufficient reason to justify a reduction in the proportion of the dam devoted to water supply. Such a decision should

incorporate thorough consideration of the consequences for water supply security, or the cost of developing alternative water supply infrastructure.

Figure 3: Option E1 Wivenhoe Dam Releases and Water Levels

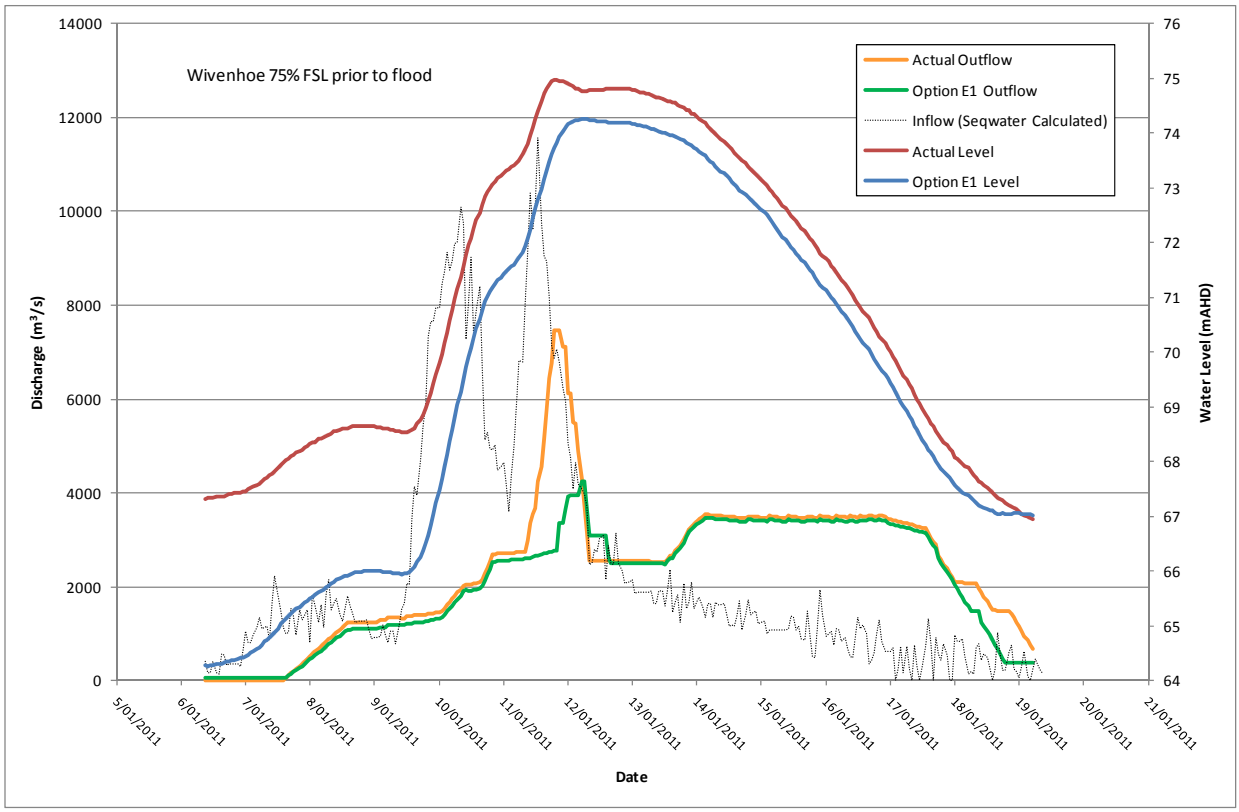
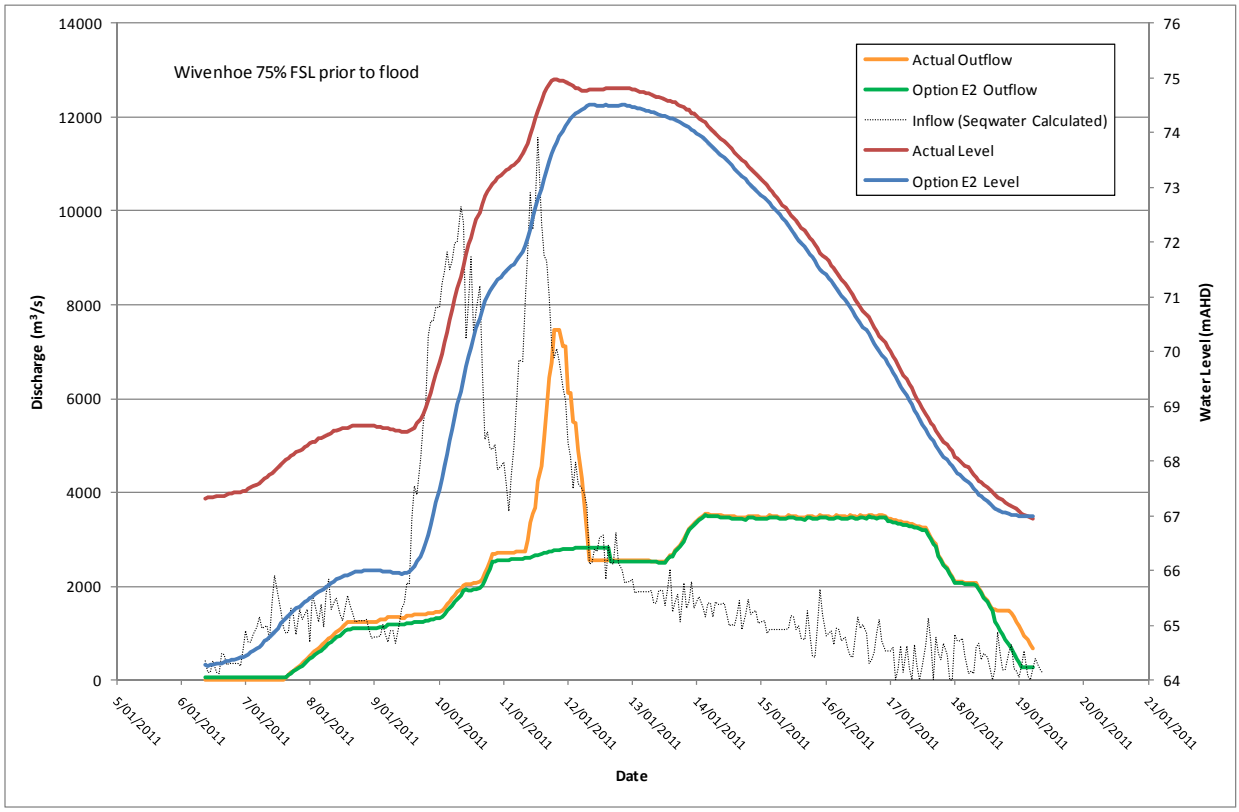


Figure 4: Option E2 Wivenhoe Dam Releases and Water Levels

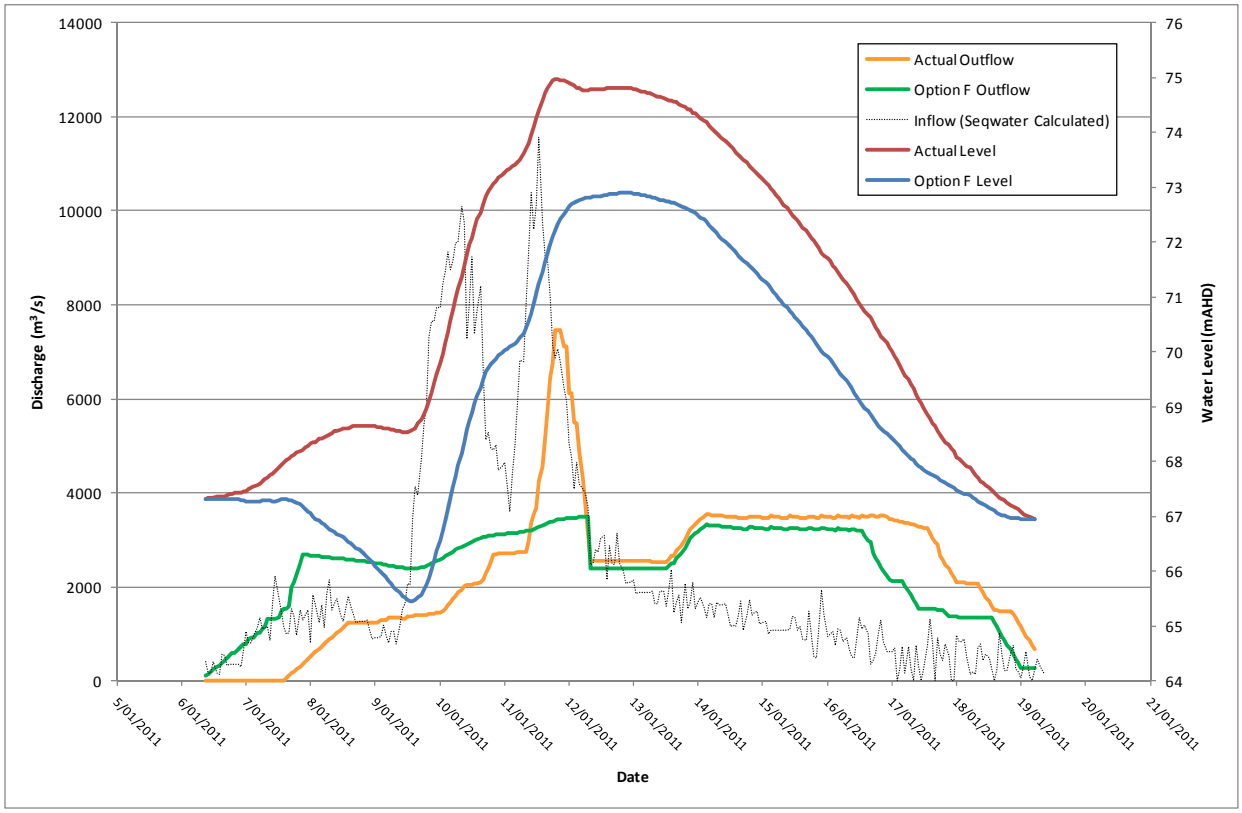


23 It should be noted that the estimated flood mitigation benefit from the Option E scenarios will not be the same for floods of different magnitudes to the January 2011 flood. For the majority of floods, which are not large enough to trigger Strategy W4, such changes are likely to be of little benefit for flood mitigation. It is likely that only for large floods (where Strategy W4 is triggered) that the full benefits of a reduction to 75% FSL and attendant change to trigger levels are likely to be realised.

Discussion – Option F

24 Option F (Figure 5) involves a rapid early increase of Wivenhoe Dam releases, such that releases exceed dam inflows, and the storage level in the dam is drawn down below FSL (Reaching a minimum of 65.4 mAHD or about 87% of FSL). As a result of the early increase in dam releases, a stable release rate of between about 2,500 m3/s and 3,500 m3/s can be achieved throughout the duration of the flood. The reduced peak discharge would result significantly lower flood levels downstream of the dam.

Figure 5: Option F Wivenhoe Dam Releases and Water Levels



25 Option F is an example of a “full hindsight” strategy, in that it relies on complete foreknowledge of the dam inflows in its formulation. The rapid early escalation of dam releases is desirable so that additional storage is available to mitigate the peak of the flood, although information to justify such releases was not reasonably available at the time, even taking forecast rainfall into account. Option F is not considered a plausible alternative scenario in light of the information available to dam operators at the time, or the constraints of the dam operation.

26 According to the Option F scenario, at 9:00 pm on 7 January all the gates would be opened to 6.0 m, with a release rate of about 2,700 m^3/s. At that point in time, model predictions taking into account forecast rainfall estimated a maximum Wivenhoe Dam level of 68.9 mAHD, and a maximum flow at Moggill of 1,037 m^3/s excluding Wivenhoe Dam releases (Run 8, Reference 9). There was therefore no justification for such a high dam release rate at that time.

27 In addition to requiring an unrealistic level of foreknowledge about future rainfall, the Option F scenario violates several aspects of the Manual, including:

a. Disregard of Strategy W1, which contains provisions for delayed releases so as "not to submerge the bridges downstream of the dam prematurely;"

b. Disregard of the upper limits for total target flow at Moggill under Strategies W2 and W3; and

c. Disregard of the objective to "retain the storage at Full Supply Level at the conclusion of the Flood Event" when relying on information about forecast rainfall available at the time.

28 Consequently, WMAwater consider that Option F is not a credible alternative dam operation scenario, and the Commission should not ascribe significant weight to this scenario in making its findings. Adopting this approach generally would result in inferior flood mitigation outcomes for most minor and moderate floods (i.e. not large enough to trigger Strategy W4).

Yours sincerely,
WMAwater

Mark Babister
Director

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Associate

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