REVIEW OF DAM OPERATIONS

BRISBANE RIVER FLOODS – JANUARY 2011

SCOPE

Put succinctly, this review addresses any commissions or omissions that are at variance with the Flood Mitigation Manual for Wivenhoe and Somerset Dams during the January 2011 floods. The review is based on the contemporaneous report of the subject by the dam owner, Seqwater

THE CONTEXT

The rainfalls and flood events are classed as "rare" to "extreme" as classified by Australian Rainfall and Runoff.

The quantitative precipitation forecasts provided by the Bureau of Meteorology underestimated the rainfall intensities by more than 200% for the critical periods. In general,the flood volumes were more extreme than the peak flows.

The high rainfall intensities occurred in two separate bursts (before noon Sun 10Jan; around dawn Tues 11Jan) which may be considered unusual. However, the critical-period rainfall determined in the design of the dam is 36hours.

Because of an unusually wet spring/summer, not only were dams full but the catchments were well primed.
The remote recording of rainfall and streamflow records, telemetered in real time, performed creditably in the circumstances despite some failures.

The greatest rainfall intensities appear to have fallen immediately east of Lake Wivenhoe(Dagular Range) where recording stations are few but the run-off is quick to respond.

Despite diverse monitoring tools, water levels at the dams proved the most reliable and were used predominantly. A "glitch" in the automatic water-level reading at Wivenhoe,during peak discharges, was detected and avoided.

In all the circumstances, communication to the dams was critical but was maintained.

No operating mechanism at the dams was rendered inoperable although stand-by generators were needed.

The operation of Somerset Dam in flood is relatively simple with lake levels kept in-step with Wivenhoe's.

THE MANUAL

The operating strategies for the dams, while mandatory, have in-built flexibility in order to satisfy lower-order priorities if considered possible.

Significant variations from the manual are permitted subject to formal authorizations of "reasonable discretion" by the Chief Executive, DERM (delegated to Director, Dam Safety) in consultation with the Chairperson, Seqwater.

The manual sets out a clear hierarchy of priorities in implementing operating strategies during floods. It clearly implies safety to the public in relevant, higher-order priorities.

Flood height in Wivenhoe Dam was not predicted to exceed the level at which the fusable plug in the right-abutment spillway would operate. However,it was a near event and should focus attention for the future.

THE OPERATIONS – Wivenhoe Dam

The Early Phases

Although the flood operations were initiated at 8am 6Jan until 3pm 7Jan, the flood at Wivenhoe Dam hardly exceeded the minor flood category, and only the lower downstream river crossings had been cut. All Brisbane River flows were held in storage (in accordance with the Manual, Strategies 1A – 1C) because of excessive downstream tributary flows.

Initial Wivenhoe Releases

After 3pm 7Jan, when the lake level exceeded EL68.0, Wivenhoe gates were progressively opened as required (Strategies 1D/E). This eventually resulted in stabilizing the lake level around EL68.0 and the total flows at Mt Crosby Weir bridge below deck level.

Conclusion

The initial/early phases of gate operation were in accordance with the Manual.

The Transition

Just before 8am 8Jan, the lake level exceeded EL68.5 and the Manual required a change to Strategy W2 – a transition in emphasis towards preventing urban flooding. In the event, StrategyW2 was not feasible because intermediate-level river crossings had already been broached. Hence Strategy W3 was immediately invoked, as suggested by the Manual; gates were opened progressively.

Close reading of the Manual is somewhat confusing and the resulting impracticality of Strategy W2 is predictable.

Conclusion

The short-circuiting of Strategy W2 was unavoidable; it would be feasible only when flooding is minor and predominantly below Wivenhoe Dam

Steady State

In the 24 hours from 8am 8Jan, the outflow from the dam was held steady and the lake water levels had peaked temporarily; flow contributions from downstream tributaries were diminishing

The notable event, in hindsight, was that rainfall forecasts predicted that nothing more severe was anticipated. In fact, consideration was given to the possibility of reverting to lower order strategies for the dam outflows.

The First Peak

The first burst of heavy rainfall occurred before noon on Sun 9Jan. By 2pm the estimated total dam inflow exceeded historical records and by 7pm was again revised upwards by over 50%.

According to early indications, Strategy W3 would be sufficient to deliver the flood mitigation benefits of the dam without compromising its safety. By 7pm, predictions were indicating that lower priority objectives under Strategy W3 (rural areas) were no longer viable and Strategy W4 (dam safety) was foreseeable though not strictly predicted (0.1m lower lake level).

Increased water releases from the dam were made about midnight of 9Jan and continued for about 24 hours by which time the inflows had well and truly fallen (< 4000 m3/s cf peak > 10000 m3/s).

Around 9pm 10Jan, the Director, Dam Safety was contacted and approved a temporary delay in invoking strategy W4 even though the forecast lake level would exceed EL74.0. This was done in light of the reducing inflow and limited forecast rain. Outflows were held constant in the face of falling inflows.

Technically, the delay in invoking Strategy W4 was an exercise in "reasonable discretion" as defined by the Manual. Contact with DERM is recorded but not with the Chairman, Seqwater as stipulated. The hiatis in gate opening strategy had little or no practical effect as events unfolded.

While the dam releases were within the limits of the Manual, the only improvement that could have been made was in the earlier timing of gate openings. Even so, the effect would have been to marginally increase flows (perhaps 10% to around 3000m3/s maximum) but reduce lake levels (<EL73.0).

Conclusion

During the first flood peak, the dam was operated in accordance with the Manual.

The exercise of "reasonable discretion" towards the end of the flood wave was for a limited time and had little impact.

An improvement in gate operation, by earlier and higher releases, would only be of benefit if and when a second flood wave occurred.

The Second Peak

In the early hours of Tuesday 11Jan, the second intense period of rainfall in the catchment commenced. At this time, it appeared that outflows from the dam had been stabilized below 3000m3/s . On the contrary, a decision was required at 8am to adopt Strategy W4 which prioritizes dam safety. The lake level was then EL73.7 and was estimated to peak between EL74.5 – 75.1.

As required by Strategy W4, the gates were continuously opened soon after 8am until the lake water level was stabilized at 7-8pm at EL74.97. (Flow 7460m3/s).

There was limited opportunity to react earlier to the second flood wave : 4am -8am. An earlier beginning of gate opening could have reduced the outflow only marginally (<10%)

Conclusion

The second flood wave eventuated just as the first was abating. Strategy W4 for gate operation was required from the outset and was followed as required.

Despite operations targeting the safety of the dam, the flood mitigation effects were still substantial (36%).

Operation of the gates,where practicable, any earlier would have had only minor benefits.

Although operation of the fuse plug did not need to be considered formally, the relevant lake level (EL 75.5) got closer than its design likelihood (AEP 1/5000) might suggest.

The Receding Flood

Because the outflows from the dam had exceeded the damaging flows for urban areas, there was a clear imperative to reduce flows as quickly as reasonable once the second flood peak had passed. The limitation on the rate of closure of the gates was subordinate to the need "to reduce downstream flooding". At the same time, there was a requirement to follow the "natural recession of the flood". Both these stipulations were followed closely until the outflow was around 2500m3/s, as dictated by downstream flows. During this phase, the lake level had fallen only about 0.4m from its peak. .

Finally the dam release was stepped up to about 3500m3/s for 3+ days to effect draw down of the lake to normal storage level as required.

Conclusion

The requirements of the Manual were met during the receding flood.

OPERATIONS – Somerset Dam

Somerset dam's crest gates are held totally raised during a flood and controlled releases are made predominantly through the sluices. The flood mitigation benefits of both dams are maximized by controlling the lake level at Somerset in step with that at Wivenhoe.

Early in the first flood wave, the lake levels in Somerset tended to be in advance of the target with respect to Wivenhoe's by about 2m. However, this was corrected by the end of that flood wave. The result was that Somerset provided better mitigation (68.5%) during the first,higher flow peak.

During the second flood wave , the reverse applied with Somerset lake levels lagging behind the target by around 1.5m. Nevertheless, the outflow from Somerset did not exceed that of the first flood peak; lake level,however peaked at EL105.11 (Flow 1460m3/s; cf inflow 4170m3/s) during the second flood wave.

Conclusion

Somerset Dam performed a beneficial function in the flood mitigation system. Although the lake levels deviated from the nominated target in the Manual, there were negligible adverse effects.

Findings

- Overall the Manual was followed closely during the whole flood event.
- The irrelevance of Strategy W2 was predictable.
- The only improvement possible for the operations was in the earlier opening of Wivenhoe gates at the beginning of both peak flows. The overall effect would have been minor.
- In the exercise of "reasonable discretion",whilst not enacted, the Chairman,Seqwater does not appear to have been consulted as stipulated.

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