Initial Assessment of Potential Flood Mitigation for Communities Downstream of Googong Dam

ICON WATER AND QUEANBEYAN CITY COUNCIL

Summary Report

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December 2010 Flood Event

On 9 December 2010 the Queanbeyan River peaked at 8.4 metres at the Queens Bridge gauge and broke its banks, flooding the Queanbeyan Riverside tourist park. The December 2010 event resulted in $1.3M in damages. The peak flow at the Wickerslack flow gauge, just upstream of Queanbeyan, for this event was 620 m^3/s and the estimated annual exceedance probability of this event was 6%, or an average recurrence interval of 16 years.

There are a number of options that could be considered to provide flood mitigation for Queanbeyan and for areas along the Queanbeyan and Molonglo Rivers between Googong Dam and Lake Burley Griffin. This is a summary of a study undertaken to consider how the damage to Queanbeyan could be mitigated from three options only: targeting of airspace in Googong Dam to provide flood mitigation benefit, reduction in the operating level of Lake Burley Griffin, and clearing of vegetation along the channel and floodplain of the Molonglo and Queanbeyan Rivers between Lake Burley Griffin and Googong Dam. The analysis conducted in this study of potential flood mitigation impacts was limited to consideration of the December 2010 flood event only.

Googong Dam is owned and operated by Icon Water and its primary function is to supply drinking water to the population of Canberra and Queanbeyan. Googong Dam stores 121 Giga Litres (GL) of water at full supply level (FSL). This infrastructure has been designed as a drinking water storage for the Canberra and Queanbeyan communities and provides water at the second lowest cost per ML of water supplied of those sources in the system. Scrivener dam is operated by the National Capital Authority and is downstream of the Queanbeyan and Molonglo River confluence. Vegetation removal and poisoning activities have taken place since the flood.

Googong Dam was at 83.6% of active full storage capacity by midnight on 28 November 2010, leaving 19.63 GL of airspace below FSL. A trough of low pressure over eastern Australia caused extensive rainfall over the catchment between 28 November and 3 December 2010. The inflows to Googong Dam caused the reservoir to fill and the dam started spilling at around 11 am on 3 December 2010 and the dam continued to spill through to the main flood peak on 9 December 2010.

Googong Dam was constructed with the primary purpose of storing water and not mitigating floods. The existing infrastructure has limited capacity to release water quickly for flood control purposes, with the release capacity limited to a maximum rate of 790 ML/d or 9.1 m^3/s when the dam is at FSL. Mitigating a flood of the 2010 magnitude requires operation of the dam at below 100% storage in normal conditions and using the created airspace to store some of the water from the flood reducing the impacts downstream.

The inflows before the peak in the 2010 flood were significant. This means that Googong Dam would have had to be maintained at less than 77.8% storage to have any impact on the peak flow even while maintaining the maximum release rates that can be achieved from the existing infrastructure of the dam over the period between 28 November and 8 December 2010.

A cold front crossed southeastern Australia over the period between 7 and 9 December 2010 (Bureau of Meteorology, 2011), which caused significant rainfall in the Googong Dam catchment. There were substantial inflows to Googong Dam over this period due to the rain that occurred during this event and also because the event occurred on a relatively wet catchment, for which losses would have been low.

If releases via the outlet works were limited to 790 ML/d and the sequence of two flood events between 28 November and mid-December 2010 were repeated, it would not be possible to target an airspace of more than 77.8% of full supply volume as all of the available airspace would have been consumed by the first flood event (inflows between 28 November 2010 and 8 December 2010).

Figure 1 shows the modelled flow hydrographs for the scenarios run for the December 2010 flood event at Wickerslack. Even when the dam is spilling, water is stored within the reservoir of the dam (storage volume exceeds 121 GL) and hence the outflow flood from the dam is stretched out with a delayed and reduced peak flow, when compared with the flood peak had the dam not been built. If Googong Dam had not been constructed, the peak flow at the dam site would have been double the peak flow that was recorded from the

dam during the event and the peak flow at Wickerslack would have been 88% higher than the actual peak that was recorded during the event.

The 70% scenario in Figure 1 is a simulation where the dam level was maintained at 70% within the limitations of the maximum physical release rates from the dam with its existing infrastructure. Had airspace of 70% of full supply volume been targeted, the available airspace on 8 December 2010 would have been about 10.3 GL (the equivalent of starting at about 92.2% of full supply volume). As shown in the graph, this scenario lowers the peak of the flood upstream of Queanbeyan by about 1/3 from the peak flows that were actually recorded during the event, with the peak flow at Wickerslack reduced from 620 m³/s to 410 m³/s.

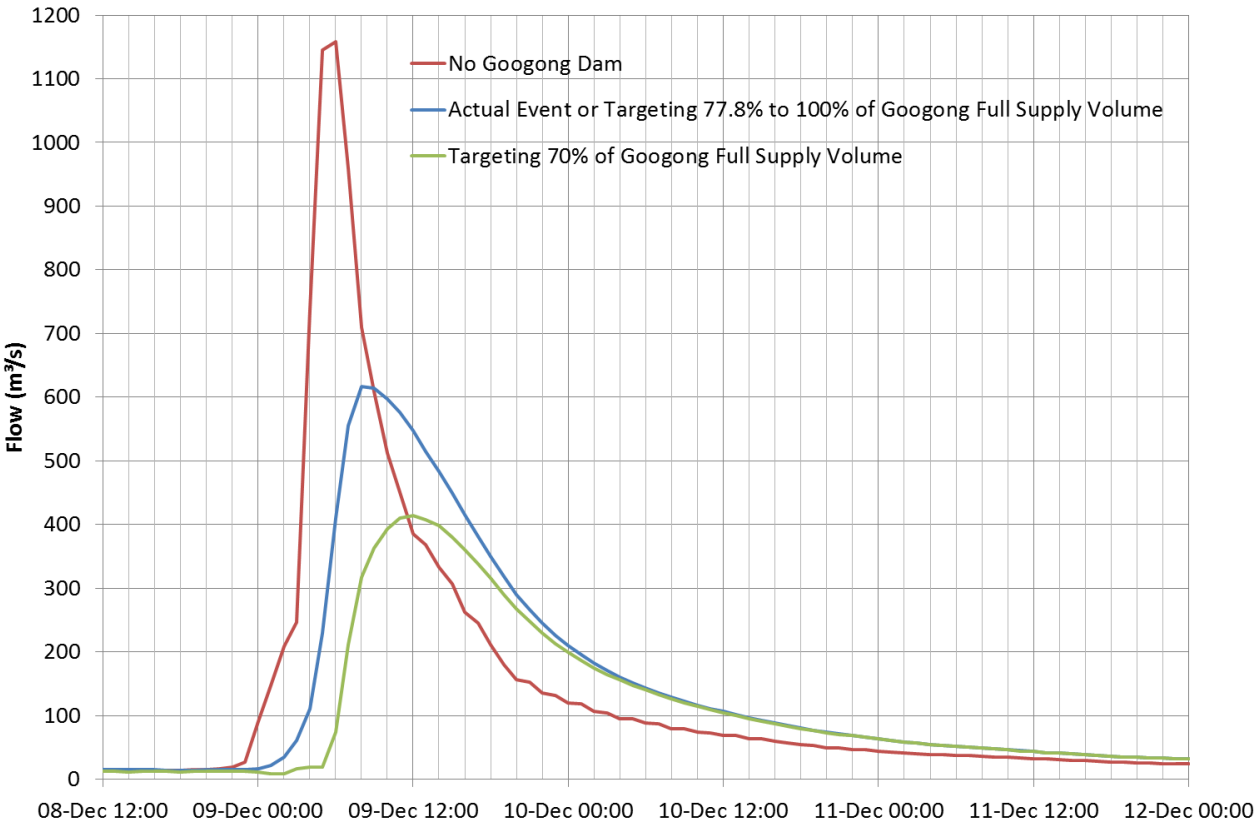

Figure 1 : Modelled flow hydrographs for 8-10 December 2010 flood event at Wickerslack, for the actual event and for hypothetical scenarios assuming targeting of airspace for flood mitigation in Googong Dam at 70% of full supply volume and without Googong Dam

Water Supply Costs Associated With Aiming for Flood Mitigation

The reduced peak created from targeting 70% of full supply volume for flood mitigation may have reduced the estimated cost of flood damage. The best case scenario is that all of the $1.3M in damage may have been avoided, although avoiding all of the damage costs is unlikely as some costs such as debris removal are likely to have been incurred even if the flood peak in Queanbeyan had been reduced.

Flood mitigation comes at a cost because operating Googong Dam at a lower level then forces Icon Water to use sources of water that have higher per costs per ML than Googong more frequently. Googong Dam is the cheapest source of supply after the much smaller Bendora and Corin dams. Operating Googong at 70% target reduces the mean annual volume of water supplied from Googong by 1.54 GL/year (from 8.82 to 7.29 GL/year) because during drought periods Googong Dam is most likely to start with a lower volume of water in it, due to the water discharged to create airspace for flood mitigation. Because less water can be supplied from Googong Dam during drought periods, water is then supplied from all of the other potential sources that have higher costs: Lower Cotter, the pipeline from the Murrumbidgee to Stromlo treatment plant, the pipeline from the Murrumbidgee to Googong and Tantangara.

The additional costs associated with operating and maintaining the water supply system and associated with additional restrictions would effectively represent the cost of an insurance premium borne by all consumers in Canberra and Queanbeyan to provide the airspace that may provide some level of flood mitigation for Queanbeyan. To provide a net benefit to the community, the benefits derived from flood mitigation, in terms of average annual damage cost would need to outweigh the increase in average annual costs associated with water supply and water restrictions.

This increases the average annual operating cost to Icon Water by $191k/year. Also, the system is less secure as it stores less water. The estimated increased in average annual cost due to more water restrictions (referred to as water security cost) is $10k/year for a total cost of $201k/year. If the annual exceedance probability of the December 2010 flood peak was 6% and the maximum reduction in flood damage was $1.3M, then an optimistically high assessment would be that the annual benefit of avoided flood damages is approximately $80k/year. So while the damage to Queanbeyan during the 2010 flood could have been prevented by operating Googong Dam to target 70% of current full supply volume for flood mitigation, on average, it would have cost more than twice as much to do so in other costs. There would be other significant costs associated with changing the function of Googong Dam to both a storage and mitigation dam as well that haven't been captured in this assessment, which has only considered water supply operating costs and the cost of restrictions.

Temporal Changes in Vegetation in Floodplain

Vegetation removed by the flood created debris and some of this debris collected on bridges and culvert structures, was deposited in the river channel and floodplain or was deposited in Lake Burley Griffin. Following the December 2010 flood, there was 1000 m³ of woody debris removed from Molonglo Reach and the East Basin of Lake Burley Griffin, at a cost to NCA of $ 0.5 M. Since the flood event, clearing programs have been undertaken using either poisoning or physical removal of live vegetation from the river channel and floodplain. The proportion of vegetation in the channel and floodplain between the NSW-ACT Border and Lake Burley Griffin declined by about 8% between early 2010 and early 2013. If the proportion of woody vegetation was maintained at 2013 levels then it is expected that there would have been a minor reduction in the hydraulic resistance along this reach, which may have marginally reduced flood levels from those actually observed in the December 2010 flood. Programs that poison the vegetation may create a store of dead vegetation in the floodplain and river channel that could be mobilised by future flood events.

Reduction in Level of Lake Burley Griffin

Lake Burley Griffin provides valuable social and visual amenity to the residents of Canberra, the ACT, the surrounding region and visitors to Canberra. When a flood event is not in progress, legislation (ACT Government, 1976) dictates that the Lake Burley Griffin must be managed for the water level to remain within a tolerance of ±0.10 m, or between 555.83 and 556.03 m AHD. It is possible that temporary reduction in the operating level of Lake Burley Griffin could be undertaken prior to a flood event but there is a risk that some or all of the forecast inflows would not eventuate and it would not be possible to refill Lake Burley Griffin to its normal operating level by the conclusion of the event, resulting in undesirable aesthetic impacts and numerous safety and amenity issues for users of the lake. Even if a temporary reduction of 0.5 m in the operating level of Lake Burley Griffin was undertaken prior to a flood, there would be minimal reduction in peak flood levels upstream of the Majura Parkway and it is very unlikely to provide any flood mitigation benefit for Queanbeyan.

References

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Canberra Times (2014) *Study Looks to Reduce Risk of Queanbeyan's Googong Dam Floods*, http://www.canberratimes.com.au/nsw/study-looks-to-reduce-risk-of-queanbeyans-googong-dam-floods-20140502-zr30n.html, Published 2 May 2014, Accessed 14 April 2015.

Jacobs (2015) *Initial Assessment of Potential Flood Mitigation for Communities Downstream of Googong Dam*, Report for Icon Water and Queanbeyan City Council, Revision 2, 25 June 2015.

Important note about this summary report

The sole purpose of this summary report and its companion full report (Jacobs 2015) and the associated services performed by Jacobs is to undertake this review of the potential benefits and costs that could be associated with some flood mitigation options for Queanbeyan. The options that were examined most closely in this study involved operating Googong Dam below its nominal Full Supply Level (FSL) on a routine basis. The analysis was confined to considering changes in the operation of Googong Dam that utilise the existing outlet works from the dam to manipulate storage level and options involving structural changes to Googong Dam were outside of the terms of reference. Jacobs were also engaged to undertake a qualitative analysis of the change in vegetation that has occurred along the channel and floodplain of the Queanbeyan and Molonglo rivers between Lake Burley Griffin and Googong Dam and temporary reduction in the level of Lake Burley Griffin in anticipation of a flood event. The work was conducted in accordance with the scope of services set out in the contract between Jacobs and the Clients. That scope of services, as described in this report, was developed with the Clients.

In preparing this summary report and its companion full report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by Icon Water, Queanbeyan City Council and National Capital Authority. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this summary report and its companion full report from information sourced from Icon Water, Queanbeyan City Council and National Capital Authority and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

No excerpts are to be taken as representative of the findings unless they are quoted correctly in the context of the full report. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report is an initial assessment that was undertaken over a period of six weeks and addresses a wide range of potential costs and benefits associated with the options that were considered. Accordingly, several of the results presented in this report were analysed in a qualitative manner. More detailed further analyses would be required to confirm several of the aspects that were addressed in this study. In some cases, Jacobs were provided with information that is commercial-in-confidence to Icon Water, National Capital Authority or Queanbeyan City Council. Where we were provided with that information, we have utilised it in our qualitative analysis but we were not authorised to publish some of this information in this report as it was commercial in-confidence to these organisations.

This report has been prepared on behalf of Jacobs' Clients for the project, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.