Submission No 5

INQUIRY INTO WATER NSW AMENDMENT (WARRAGAMBA DAM) BILL 2018

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The Hon Taylor Martin MLC
Committee Chair

Standing Committee of State Development,
Inquiry into Water NSW Amendment (Warragamba Dam) Bill 2018.

Dear Chair,

Concerns regarding Water NSW Amendment (Warragamba Dam) Bill 2018.

Thank you for the opportunity to raise a number of issues regarding Water NSW Amendment (Warragamba Dam) Bill 2018. I have a number of key concerns, which I believe warrant close scrutiny:

Risks associated with drinking water quality and public health

If the proposed new flood mitigation capacity were ever to be used, this would present significant water quality risks, including risks to public health, for Sydney Water drinking water customers. The likely impacts to water quality should be very carefully assessed before such a project is progressed.

Drinking water catchments contain various particulate and soluble substances, which may be mobilised to waterways by runoff from rainfall (Khan *et al.*, 2015). As a consequence, heavy rainfall and high river flows are commonly associated with elevated turbidity (Goransson *et al.*, 2013) and dissolved organic matter (Hongve *et al.*, 2004; Murshed *et al.*, 2014).

Transportation of particulate organic matter and dissolved organic matter from forested catchments involves a number of mechanisms and controls, which are only poorly understood for large, intense, storm events (Dhillon & Inamdar, 2014). Intensive events may involve mechanisms which may have low relative significance during less intensive events. For example, it has been proposed that intensive rainfall may lead to changes in water pathways in the catchments and thus increased leaching of organic components from the upper soil layer (Hongve *et al.*, 2004).

As a consequence of diminished runoff quality, water quality in lakes or storage reservoirs may also be impacted during heavy rainfall events. For example, the loading and distribution of suspended matter in storage reservoirs exhibit significant differences during wet and dry periods (Wang *et al.*, 2013).

Through increased concentration of organic matter in surface runoff and the subsequent necessary increase in chlorine disinfection doses, increased concentrations of disinfection by-products are a likely outcome in final treated drinking waters (Beaudeau *et al.*, 2011). In circumstances where satisfactory disinfection cannot be maintained, excessive rainfall has been a significant contributor to historical waterborne disease outbreaks in developed countries (Curriero *et al.*, 2001; Auld *et al.*, 2004; Hrudey & Hrudey, 2007; Nichols *et al.*, 2009).

A catchment, which is generally not inundated, but may become inundated during rare or occasional circumstances only, is akin to a catchment which has remained relatively dry during an extensive period of drought. During such circumstances, contaminants are known to accumulate (Mosley, 2015). Rainfall following prolonged periods of drought can mobilise heavily accumulated sediment and nutrients in a water catchment, leading to sudden influxes to streams and reservoirs (Wright *et al.*, 2014). In this way, drought-breaking rains can wash off accumulated organic carbon in a large 'flush' and organic carbon concentrations may remain elevated in reservoirs for a considerable period of time (Ritson *et al.*, 2014).

During August 1998, an intense low-pressure system off the east coast of Sydney caused heavy rainfall throughout the catchment of Lake Burragorang (Khan *et al.*, 2017). This resulted in high inflows into the lake, causing the storage level to increase from 58% of capacity to full within two weeks. The consequences at the Prospect Water Filtration Plant included an increase in turbidity, which peaked at >15 NTU (normally < 1 NTU).

One month earlier, following relatively light rainfall, *Cryptosporidium* and *Giardia* had been detected at the water filtration plant and at a supply reservoir within the distribution system. That incident was believed to have been resolved, but the heavy rainfall corresponded with further detections of these pathogens in both the raw and treated water from Lake Burragorang. *Cryptosporidium* and *Giardia* were detected at up to 12,080 and 7,620 (oo)cysts per 100 L in the bulk water pipelines to the water filtration plant (Cox *et al.*, 2003). Due to the high levels of *Cryptosporidium* and *Giardia* present it was necessary to issue three boil water alerts, the first of which prompted the Sydney Water Inquiry (McClellan, 1998).

Various causes for the contamination were proposed, and include a combination of the extreme rainfall and the immediate operational response (McClellan, 1998). The consequences of the rainfall were complicated due to approximately five years of preceding drought, which had allowed an accumulation of faecal matter and other debris in the catchment area's riparian zones. Its relatively simple to conceive how a large normally-dry flood mitigation area could present circumstances for a similar accumulation of contaminants and a sudden release during inundation.

As a result of the Sydney Water Inquiry, 91 recommendations were made to improve catchment management and water supply processes. The adoption of these recommendations saw major legislative changes, including the formation of the Sydney Catchment Authority (now part of Water NSW).

If the proposed flood mitigation area has been affected by bushfires in the lead-up to a flood event, this would further impact the integrity of the water catchment. Forest biomass is composed of many elemental substances, including carbon, nitrogen, phosphorous and a diverse range of inorganic species. A major product of bushfires is ash, the particulate material deposited on the ground and consisting of minerals and oxidised organic substances (Bodi *et al.*, 2014). Ash is highly mobile and may be very effectively redistributed from a burned site to surface depressions, foot-slopes, streams, lakes and reservoirs (Bodi *et al.*, 2014).

The major water quality impacts of bushfires are typically experienced after the fire, during subsequent heavy rainfall events (Stanford *et al.*, 2014). Runoff from burnt areas carries considerable quantities of sediment (Moody & Martin, 2009; Silins *et al.*, 2009; Emelko *et al.*, 2011; Smith *et al.*, 2011), as well as soluble nutrients contained in the ash, which can lead to problems for potable water supplies (Bodi *et al.*, 2014; Writer *et al.*, 2014).

Elevated concentrations of nutrients, most notably nitrogen and phosphorus, are the most commonly reported bushfire-derived water quality contaminants (Emelko *et al.*, 2011; Smith *et al.*, 2011). Bushfires in Australia have been shown to increase catchment nitrogen and phosphorus exports by around 5 to 6-fold, peaking at 15 kg ha^{-1} of total combined nitrogen and 2 kg ha^{-1} of phosphorous (Lane *et al.*, 2008).

Forest biomass may also act as a sink for regional urban pollutants, including metallic components of air pollutants. Consequently, forest fires may liberate large quantities of gradually-accumulated contaminants, leading to elevated concentrations of substances, including arsenic, aluminium, cadmium, chromium, iron, lead, mercury, sulphate, chloride, calcium, magnesium, manganese, barium, sodium, and potassium in sediment and local stream flows (Emelko *et al.*, 2011; Smith *et al.*, 2011; Bladon *et al.*, 2014; Costa *et al.*, 2014).

The potential water quality impacts of a large new flood mitigation area should be taken very seriously. They should be very carefully assessed and accounted for when undertaking any analysis of the costs, benefits and risks associated with the proposed development.

Lack of consideration of alternative flood mitigation strategies

I do not question the need to develop improved flood mitigation strategies for the Hawkesbury-Nepean floodplain in western Sydney. I have previously laid out my concerns in a submission to an earlier NSW Government Inquiry into the Adequacy of Water Storages in New South Wales (Khan, 2012).

In that same submission I put forward and argument for how the flood mitigation capacity of Warragamba Dam could be enhanced by a lowering of the full supply level, without need to increase the height of the dam wall. A reduction of the full supply capacity for Warragamba Dam would imply a reduced drinking water supply security for Sydney, unless alternative supply security could be obtained from other water supply sources. I provided some very simple calculations to illustrate how a 500 ML/day seawater desalination plant could provide an equivalent water supply security to around 620 GL of storage volume, which could then be surrendered to flood mitigation capacity. To put this figure in context, this is larger than the commonly quoted volume of Sydney Harbour (560 GL).

Since then, a research team from the University of Technology Sydney, Griffith University and Deakin University have provided a much more detailed analysis of this concept. They have published their findings in a peer-reviewed scientific research paper titled “The potential role of desalination in managing flood risks from dam overflows: the case of Sydney, Australia” (Turner *et al.*, 2016). If requested, I would be happy to obtain a copy for the Committee. An extract from the paper’s abstract is provided:

> “*This paper explores the growing need to understand the relationship between drought, flooding and infrastructure optimisation. The paper focuses on Sydney to illustrate the application of a system dynamics model. The new model explores options for raising the dam wall, offering airspace to assist flood protection, in contrast to options to lower the dam full supply level and utilise idle desalination capacity to fill the water security gap created. The illustrative results, using publicly available data, find that by lowering the dam water levels and operating desalination, significant flood protection can be achieved at a similar cost to raising the dam wall. The paper demonstrates the importance of optimising existing and new water resources for multiple purposes and how system dynamics modelling can assist water service providers in these complex investigations*”.

Of course, the findings from this study are not confined to the use of the current Sydney Desalination Plant. Indeed, the study canvasses the role of up to four seawater desalination plants, constructed over a number of decades in accordance with water supply security needs. In a more detailed analysis, the potential role of other alternative water supply security measures, such as potable reuse of advanced treated municipal wastewater (“water recycling”) could and should also be considered.

There are a number of important advantages that could potentially flow from such an approach. These include:

- The flood mitigation capacity could be achieved and maintained immediately (indeed, Warragamba Dam is currently at 67% of capacity, with an available ‘flood mitigation’ capacity of around 675 ML).
- Most of the necessary construction costs could be delayed until there is a clear need to expand seawater desalination and/or water recycling capacity. This may prove to be decades.
- Water supply diversification provides many additional benefits, which are well recognised by water supply planners and managers. These include increased flexibility of supply, which increases the resilience of the overall supply system.
- A reduced full supply level behind Warragamba Dam would translate to greater volumes of water being more regularly released to the Warragamba and Nepean Rivers. The increased flow regimes would have a positive environmental impact on the Nepean River. In addition to improved ecology, this would improve the value of the river as a recreational resource, for activities including swimming and fishing.
- Furthermore, increased flow and water availability in the Nepean River would improve water quality used as the raw drinking water supply for parts of North West Sydney served by the North Richmond Water Filtration Plant.

I would be very happy to provide further explanation of any of the issues that I have raised in this submission. Furthermore, I would have happy to provide copies of any of the references cited.

Yours sincerely,

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