Submission
No 74

INQUIRY INTO WATER AUGMENTATION

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The Hon Robert Brown MLC
Committee Chair

General Purpose Standing Committee No. 5,
Inquiry into the augmentation of water supply for rural and regional New South Wales.

Legislative Council
Parliament of NSW
Parliament House
Macquarie Street
Sydney, NSW, 2000

Dear Mr Brown,

SUBMISSION: INQUIRY INTO THE AUGMENTATION OF WATER SUPPLY FOR RURAL AND REGIONAL NEW SOUTH WALES

Thank you for your invitation to provide a submission to this very important and timely inquiry.

This submission addresses the Terms of Reference of the Inquiry, specifically:

> *b) examine the suitability of existing New South Wales water storages and any future schemes for the augmentation of water supply for New South Wales, including the potential for aquifer recharge.*
>
> *c) review the NSW Government's response to the recommendations of the June 2013 report by the Standing Committee on State Development on the adequacy of water storages in New South Wales.*
>
> *f) examine social, economic and environmental aspects of water management practices in NSW and international jurisdictions [including 3 specified case studies].*
>
> *i) any other related matters.*

The focus of this submission is the need to consider the potential significant contribution that water reuse or recycling can contribute to the effective water supply for many rural and regional communities in NSW. The effective use of municipal wastewaters (and other non-traditional sources of water) is a form of water supply augmentation, just as new water storages and water transfer pipelines provide water supply augmentation.

1. MY BACKGROUND AND EXPERIENCE

I am an Associate Professor in the School of Civil & Environmental Engineering, where I undertake research and teaching activities in the fields of water quality, drinking water and wastewater treatment, risk assessment and sustainability. I also lead the research stream on trace organic chemicals in water at the UNSW Water Research Centre. I am a current member of the Water Quality Advisory Committee to the National Health and Medical Research Council (NHMRC) and the Water Quality Technical Advisory Group to the World Health Organization (WHO). On both of those committees, I provide expert advice on many issues associated with water quality and health, including the development and revision of water quality guidelines. In particular, I have made significant contributions to the Australian Drinking Water Guidelines, Australian Guidelines for Water Recycling and (yet to be released) WHO Guidelines for water recycling for drinking ("potable reuse"). I am a member of the Australian Water Association (AWA) and current Chair of the AWA specialist Network for Water Recycling. I am also a member of Engineers Australia (MIEAust).

2. NSW GOVERNMENT'S RESPONSE TO THE RECOMMENDATIONS OF THE JUNE 2013 REPORT BY THE STANDING COMMITTEE ON STATE DEVELOPMENT ON THE ADEQUACY OF WATER STORAGES IN NEW SOUTH WALES

Recommendation #3 was "*that the NSW Government and local councils continue to support and promote demand management practices and urban water conservation measures such as* *stormwater harvesting and recycling wastewater*".

In response, the NSW Government indicated "*support*" for this recommendation. This was elaborated upon by noting that "*Local Council water utilities throughout NSW are currently required to develop Integrated Water Cycle Management Strategies, under the NSW Best Practice Management of Water Supply and Sewerage Framework. This includes adopting comprehensive demand management strategies and exploring water conservation options, such as stormwater harvesting*".

Indeed, it is true that the NSW Government requires local government water utilities to demonstrate "best practice management" as a pre-requisite for payment of a dividend from a surplus of the local government's water supply and sewerage businesses and for further financial assistance. One of the six criteria which must be complied with is "Integrated Water Cycle Management". This is described as "*the integrated management of the water supply, sewerage and stormwater services within a whole of catchment strategic framework having regard to catchment blueprints and other water management plans*" (NSW Government Department of Water and Energy, 2007).

The requirements for Integrated Water Cycle Management are most clearly outlined in Appendix F, which is a check list of the requirements (NSW Government Department of Water and Energy, 2007). Indeed, there are some required outcomes, which may be considered to be highly suggestive of water recycling, most notably "*effective integration of solutions across the urban water service to optimise benefits*". However, it is not reasonable for the NSW Government to argue that there is any real <u>promotion</u> of "stormwater harvesting and recycling wastewater". At best, the document directs local government utilities that undertake an assessment which may lead them to conclude –by their own research- that these strategies may be of value. In my opinion, this is a very low level of support from the NSW Government for stormwater harvesting and water recycling. This is in contrast to other water supply augmentation strategies, such as the construction of new dams and long pipelines, have been supported by the NSW Government in much more active ways.

If the NSW Government was to seriously support stormwater harvesting and water recycling, it could consider the following potential strategies:

- Make an announcement clearly and unambiguously stating that stormwater harvesting and water recycling projects will be strongly supported by the NSW Government in circumstances where they are found to offer appropriate opportunities as judged by a reliable triple-bottom line assessment of water management options.
- Facilitate the development or adoption of a framework to be used by local government water utilities to undertake appropriate triple-bottom-line water management options assessments. This framework should identify a number of general water management strategies –including stormwater harvesting and water recycling- which should be at least "screened" in the options assessments undertaken in this framework.
- Develop a clear policy statement outlining how any financial assistance for proposed water supply augmentation projects will be assessed in accordance with the outcomes of an appropriate triple-bottom-line water management options assessment.
- Develop and support a regulatory environment capable of assessing and effectively overseeing the operation of a wide range of water supply strategies including stormwater harvesting and water recycling including indirect and direct potable water recycling.

3. GENERAL APROACHES TO WATER REUSE/RECYCLING

Water 'reuse' or 'recycling' generally refers to the use of what would otherwise be considered 'wastewaters' for some beneficial application. In most cases, these terms refer to water, which has been collected at, and treated by, a municipal sewage treatment plant. Depending on the intended further purpose, that water may then be further treated prior to reuse for a variety of potential further applications.

Many NSW water utilities began to develop water recycling projects during the 1990s. This was largely in response to Environment Protection Authority (EPA)-imposed limits on the discharge of nutrients (primarily nitrogen) to the environment. Water recycling was adopted as a means of disposing of the nutrient-rich wastewater, thus avoiding the need for additional wastewater treatment for nutrient removal. In most cases, low-cost irrigation projects were developed such as irrigation of local golf courses, airports, or small plantations.

During the Millennium drought (approx. 2001-2007), many NSW water utilities made considerable further progress with the development of water recycling projects. At this time, the focus changed distinctly from water recycling as a waste disposal solution to water recycling as an opportunity to conserve fresh drinking water supplies. Consequently, many of these new projects sought to replace existing uses of drinking water with recycled water, rather than create new irrigation uses for the water. In some cases, this required increased levels of treatment to ensure satisfactory chemical and microbial water quality. New applications for recycled water included industrial uses and increasing attention on household use, such as by the adoption of ‘purple pipe’ dual reticulation systems.

A more recent interest has been in the use of recycled water as a means of minimising the energy requirements (and hence, carbon footprint) of an overall water supply and management strategy. Since pumping and distribution of water are often responsible for a significant component of overall energy costs, an emerging trend has been on the identification of applications close to the source of recycled water and those not requiring complex distribution to many individual sites.

A summary of the general approaches that may be adopted for water recycling is provided below.

Onsite municipal reuse

Onsite municipal water reuse is practised in Australia primarily by the selective capture of greywater sources from laundries and bathrooms. Typically, the greywater is treated by filtration and reused for toilet flushing and garden watering.

Very few houses and offices in Australia are capable of treating and reusing blackwater sources (such as from toilet flushings). Such systems require biological amelioration and disinfection.

The few systems in existence operate primarily as experimental or demonstration schemes since they are expensive to install and require careful on-going management.

Targeted municipal irrigation

Targeted municipal irrigation schemes are among the most common means of water reuse in Australia. In many cases, secondary or tertiary treated effluent is applied to public parks and gardens, golf courses and playing fields. Such reuse practices are attractive primarily for the generally low levels of treatment required and the need for a relatively small number of distribution pipes to transport the water to the points of use.

An alternative approach has been developed with the introduction of small portable sewer-mining operations. These involve the extraction of untreated sewage from municipal sewer mains. The water is then treated by a small, sometimes mobile, treatment plant (normally using membrane technology) and reused for irrigation. An advantage of portable sewer mining operations is that they may be relocated depending on temporary or seasonal demands. Sewer mines have been trialled in various public locations around Sydney, Melbourne and Canberra.

Industrial reuse

In many circumstances, it may be possible to identify industrial water users, which currently consume significant quantities of water from a potable water supply. If sufficiently treated, recycled water can be delivered to such users in a cost-effective way, it may be possible to free-up this potable water demand by replacing the consumption with recycled water. In addition to the potable water savings, such schemes have allowed for considerable infrastructure savings by eliminating the need to expand potable water mains capacity.

There are a number of successful case studies around Australia involving power stations adopting the use of recycled water for uses such as cooling water. Large-scale agreements for industrial reuse operations have been implemented at Kwinana (WA) involving mining, power generation, chemical fertiliser and petroleum companies. Bluescope Steel in Wollongong

(NSW) now receive around 20 megalitres of recycled water per day from Wollongong Sewage Treatment Plant for use in the steel manufacturing plant. This replaces water that was previously drawn from Sydney Water potable water supplies.

Agricultural reuse

Recycled water from Adelaide's largest water treatment plant is delivered via the Virginia Pipeline to agricultural areas on the Northern Adelaide Plains and the Barossa Valley. The scheme supports one of Australia's most valuable produce markets and provides an alternative source of water to the over-utilised local groundwaters. The Virginia Pipeline scheme was commissioned in 1999 and has a capacity of more than 100 ML per day delivered via a network of more than 100 kilometres of pipes.

Agricultural reuse has also been successfully practiced by a number of much smaller applications such as the Gerringong-Gerroa sewerage scheme and Shoalhaven Water's Reclaimed Water Management Scheme. Both these schemes supply water for dairy pasture irrigation on the NSW south coast.

Reticulation for household reuse

A growing number of new housing development areas in Australia have incorporated 'dual reticulation' systems for the redistribution of treated sewage back to households. These comprise a dedicated system of pipes, taps and fittings, which must be kept entirely segregated from the potable water supply and out-going sewage mains. The water delivered by dual reticulation schemes may only be used for a limited range of applications such as toilet flushing and garden watering.

The first and largest dual-reticulation scheme in Australia began operation at Rouse Hill (NSW) in 2001. The scheme has since expanded and now services more than 25,000 properties. The over-riding purpose of the Rouse Hill scheme was to protect the Hawkesbury Nepean river system from the environmental impact of increasing urban development. Since then, dual-reticulation schemes have been established at Newington (NSW), Ballina (NSW), Mawson

Lakes (SA), Springfield (QLD), Epping North (VIC).

As with targeted municipal irrigation, an alternative approach for household (or business) use has been developed with the introduction of small portable sewer-mining operations (Chanan *et al.*, 2015). These involve the extraction of untreated sewage from municipal sewer mains. The water is then treated by a small treatment plant and reused for a variety of non-potable applications. An excellent example now operates permanently Darling Harbour in the Darling Quarter development.

Planned potable reuse

With increasing demands on existing water supplies and limited access to new conventional water resources, some municipalities have begun to intentionally reuse highly treated municipal wastewater effluents to augment drinking water supplies.

Throughout the world, treated and untreated municipal effluents are discharged to waterways including streams and rivers. In many cases, towns and cities downstream draw upon such streams and rivers for municipal drinking water supplies. As such, water that was discharged as treated wastewater is unintentionally reused for drinking water supplies. This practice is commonly termed 'unplanned' or '*de facto*' potable reuse, indicating that although it is not usually seen as an intentional water supply strategy, it is nonetheless, a reality in many places (Rice & Westerhoff, 2015).

Planned potable water reuse involves the purposeful addition of highly treated wastewater (i.e., reclaimed or recycled water) to a drinking water supply. The distinction between 'unplanned' and 'planned' potable reuse is significant since the acknowledgement of intention and more holistic view of the overall urban water cycle has led to changes in implementation (Drewes & Khan, 2011). These changes have included increased attention to health risk assessment and management. In turn, these have led to the incorporation of enhanced or additional water quality treatment barriers in some cases (Drewes & Khan, 2015).

Practices of planned potable water reuse have been categorised as one of either 'indirect potable reuse' (IPR) or 'direct potable reuse' (DPR). The distinction is made on the inclusion or exclusion of what has been referred to as an 'environmental buffer' (Leverenz *et al.*, 2011). The incorporation of an environmental buffer involves transferring the water, at some appropriate point in the treatment train, to an environmental system such as a surface water reservoir or groundwater aquifer. The environmental buffer may serve a number of functions including storage, dilution and the opportunity for further water quality improvement by natural treatment processes such as sunlight-induced photolysis, biotransformation and natural pathogen inactivation. Furthermore, passing reclaimed water through an environmental buffer has been perceived to be beneficial regarding enhancing public perception of potable water reuse projects. This is achieved, in part, by providing a 'disconnection' between sewage as the source of the water and potable use as the final application. Projects that have incorporated the use of an environmental buffer are examples of IPR, while projects that omit any significant environmental buffer have been referred to as examples of DPR (Arnold *et al.*, 2012).

A range of planned potable reuse schemes, employing various natural and engineered treatment processes, have been developed internationally since the early 1960s (Drewes & Khan, 2011). The majority of these projects are examples of IPR schemes. However, there is now a rapidly growing trend toward interest in municipal DPR projects. There are now operational DPR plants in Namibia, South Africa and Texas, USA. Furthermore, there is considerable interest in developing DPR for a number of large cities in California including San Diego and Los Angeles.

I was recently the lead author of a report published by the Australian Academy of Technological Sciences and Engineering (ATSE), which investigated the potential future role for DPR in Australia (Khan, 2013). A key finding was that DPR is a potentially valuable opportunity for many Australian towns and cities, and thus should be considered among the range of all other water supply options for addressing current and future water shortages.

4. COMMENTARY ON PROPOSED NEEDLES GAP OR CRANKY ROCK DAM ON THE BELUBULA RIVER

Clearly there is an impending need to augment water supplies in a number of NSW Central West towns. A major *El Nino* event could rapidly exacerbate this need. However, the construction of the proposed dam is only one of many ways that water supplies could be better managed. As such, it is short-sighted to have a feasibility study that is essentially a Yes/No assessment for this one project. Instead, a study at this stage should be taking a much broader look at various available water management strategies and assessing them comparatively.

There are a number of reasons for why the proposed Needles Gap Dam, or the alternative Cranky Rock Dam, is unlikely to be the optimum strategy in this case. These include:

- The devastating impacts to the Cliefden Caves, which apply to both the Needles Gap site and the Cranky Rock site.
- The Belubula River is an inland river and does not flow to the sea. Hence any water captured from it is water that is taken from downstream uses including irrigators and the inland riverine environment.
- Under most circumstances, little water flows down the lower reaches of the Belubula River anyway, due to existing dams further upstream (Carcoar Lake and Lake Rowlands).
- Rainfall around Canowindra is around 700 mm/year, but evaporation is over 1000 mm/year. As such, storing water in shallow, high surface-area reservoirs will result in significant water losses, especially during the summer months.
- Water security problems are projected by CSIRO to intensify by 2030 in southern and eastern Australia as a result of reduced rainfall and higher evaporation.
- The proposed dam sites are just downstream from the Cadia Valley Operations open-pit gold mine and large mine tailings dam. These pose significant water quality risks for the proposed dams and would likely make them unsuitable storage locations for a drinking water supply.

There are a number of obvious alternative strategies that should be considered in parallel to the

Needles Gap or Cranky Rock Dams. These include:

- **Urban stormwater harvesting**: Nearby city of Orange is an excellent example of what can be achieved. The Blackmans Swamp Creek Stormwater Harvesting Scheme opened in 2009. This scheme involves capturing a portion of the town's urban runoff produced during storm events, and transferring these into the nearby Suma Park Dam to augment the city's bulk water supply. The high levels of treatment provided at the water treatment plant (using ozone and activated carbon) make this possible. Orange City Council has indicated that there are opportunities to at least double the capacity of this stormwater harvesting system.
- **Non-potable water recycling**: If carefully planned, treated municipal effluent (from sewage treatment plants) can be used for some important existing non-drinking water applications. If a suitable use can be found, this can be used to off-set (ie. replace) the demand on the drinking water supply. However, in most cases, there are limitations in how well this can be achieved without actually creating additional (unnecessary) water uses or without excessive distribution costs.
- **Indirect potable recycling**: There are many options to treat municipal effluents to a very high level suitable for recharging drinking water supplies. One only has to look at the proximity of the Orange sewage treatment plant to the city's main water supply of Suma Park Dam to see how simply this might be achieved. (Note that much of the water from the Orange sewage treatment plant (about 10 ML/day) is currently allocated to Cadia Valley Operations for mining operations (~30 km away). However, one could look at sending the mining operations the waste brine from a reverse osmosis treatment process and supplementing that with improved reuse of wastewater from the mine tailings dams).
- **Direct potable recycling**: There is a major emerging trend in the USA for inland cities to begin directly reusing advanced treated recycled water in their drinking water systems, without first storing it in an environmental buffer such as a reservoir. In some

circumstances, there are many advantages to be gained from this approach, as described in a recent report published by the Academy of Technological Sciences and Engineering (for which I was the lead author) (Khan, 2013).

- **Managed aquifer recharge (MAR)**: Instead of storing water in a surface water reservoir, water can be stored underground in an aquifer. There are a number of benefits in using an aquifer as a storage system including greatly reducing evaporation, delivering transportation and energy savings and lower construction costs compared to a large dam. Orange City Council is currently examining the possibility of using the Basalt Aquifer to the south of the city for MAR. This could be used for urban stormwater, highly treated recycled water (which is now happening in Perth), or even traditional surface water flows.

5. COMMENTARY ON PROPOSED WATER TRANSFER PIPELINE FROM THE MURRAY RIVER TO BROKEN HILL.

The proposed water transfer pipeline from the Murray River to Broken Hill will be discussed at length throughout the proceedings of this inquiry. As such, it is not necessary to provide a description of that proposal here.

However, long water transfer pipelines should never be considered in isolation from other potentially feasible water management options. It is apparent that the potential opportunities that may be realised from the (improved) use of recycled water have not been adequately considered in this case.

For example Essential Energy operates two large sewage treatment plants in Broken Hill, the Will Street STP and South STP, which together serve most of the population. Of the treated effluent produced by these plants, a small proportion is sold for reuse at a cost to purchasers of around 17c per 1000 Litres (IPART NSW, 2014). The major customers have traditionally been the Broken Hill Golf Course and Perilya (zinc, lead and silver mining company). Essential Energy do not fully recover the treatment costs associated with producing this reclaimed effluent. Furthermore, it is believed that these customers would not substitute treated drinking water if this supply was unavailable (IPART NSW, 2014). These observations suggest a very low level of value applied to this recycled resource and indicate that it is not being effectively used to offset demands on fresh drinking water.

In recent years, there has been an agreement to supply White Leeds Wet Lands with effluent form both sewage treatment plants. The White Leeds Wet Lands are not a natural wetland, but were constructed on what was previously predominantly dry pastoral land. It is my understanding that the White Leeds Wet Lands are now a privately owned tourism venture. Thus it is questionable whether the use of reclaimed water from Broken Hill is currently being used in a way that benefits the community by supplementing or offsetting current uses of freshly sourced drinking water.

Opportunities to rethink the overall strategy for the use of recycled water in Broken Hill should be taken. Such an opportunity should have been realised in during the determination of options available to address recurring water shortages for the city. An optimum use of recycled water would be one that either directly supplements available drinking water supply or else is used for non-drinking purposes that directly replace the current (or potential) use of fresh drinking water supplies. In order to ensure that reclaimed water is being used for a high value purpose, which would otherwise produce demand on fresh potable water sources, recycled water customers should be expected to pay at least 75% of the standard potable water cost for recycled water.

6. RECOMMENDATIONS FOR THE INQUIRY COMMITTEE

The following recommendations are provided for consideration by the Committee:

- **Recommendation 1**: Recommend that the NSW Government make an announcement clearly and unambiguously stating that stormwater harvesting and water recycling projects will be strongly supported by the NSW Government in circumstances where they are found to offer appropriate opportunities as judged by a reliable triple-bottom line assessment of water management options.
- **Recommendation 2**: Recommend that the NSW Government facilitate the development or adoption of a framework to be used by local government water utilities

to undertake appropriate triple-bottom-line water management options assessments. This framework should identify a number of general water management strategies – including stormwater harvesting and water recycling- which should be at least "screened" in the options assessments undertaken in this framework.

- **Recommendation 3**: Recommend that the NSW Government develop a clear policy statement outlining how any financial assistance for proposed water supply augmentation projects will be assessed in accordance with the outcomes of an appropriate triple-bottom-line water management options assessment.
- **Recommendation 4**: Recommend that the NSW Government further develop and support a regulatory environment capable of assessing and effectively overseeing the operation of a wide range of water supply strategies including stormwater harvesting and water recycling including indirect and direct potable water recycling.
- **Recommendation 5**: Recommend that the NSW Government undertake a full options assessment for enhancement of water security for the Central West region around the Belubula River. The 'yes/no' assessment of a proposed new dam on the river should be replaced with a triple-bottom line assessment of all available options including the expanded use of urban stormwater harvesting and water recycling. The outcomes of such an assessment should be publically released.
- **Recommendation 6**: Recommend that the NSW Government undertake a full options assessment for the enhancement of water security for Broken Hill. In addition to the current Murray River pipeline proposal, a triple-bottom line assessment of all available options including the expanded use of urban stormwater harvesting and water recycling should be undertaken. The outcomes of such an assessment should be publically released.

I hope that you will find my submission to this inquiry to be of value and interest to the Committee. Furthermore, I would be very happy to provide any required clarification or additional information that may be requested. I wish the committee well in the important task ahead of them and look forward to reading the outcomes of this inquiry.

Yours sincerely,

Dr Stuart Khan

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