The Commissioner,

Productivity Commission

Inquiry in to National Water Reform

18 April 2017

Dear Commissioner,

Thank you for the opportunity to make a submission to the Inquiry into National Water Reform. This submission generally responds to the terms of reference for this inquiry. In particular, the issues of whole of water cycle management, integration of water policy with other policy areas and economically efficient provision of water infrastructure are particularly relevant.

This submission provides a brief summary of key insights that are underpinned two decades of systems analysis to inform policies and experience of er reform processes. This submission provides considerable evidence that the urban water services model is becoming less efficient and greater competition across all of the scales of society is needed.

The supplementary solutions not accepted by the water industry, including water efficient appliances, rainwater harvesting and demand management behaviours at local scales, are providing greater public benefit than sole reliance on traditional centralised infrastructure supply. Realising these public benefits will require a different governance structure to dismantle monopoly power and encourage a much broader range of competitive solutions within a more diverse "new economy" market structure.

Cities are subject to a continuum of change that is influenced by demographic, economic, political, environmental, cultural, and social factors.[1] We live in a society and environment that is a linked system. It is not a collection of isolated events or entities that we can evaluate separately based on a single objective or item of infrastructure. It is important to recognise that government policy applies at multiple distributed scales within and throughout a system (society), and usually acts locally.

It often implied that a free market and competition will deliver more efficient economic outcomes. This proposition is dependent on some key concepts,[2] which are:

1. Many firms and entities are active in the market;
2. There is open and equal access to information;
3. The market consists of products that are highly similar; and

[1] Coombes P.J., Want, S., and Colegate, M., (2012). *Development of Policies for Water Cycle Reform in Greater Melbourne and Sydney.* Water and Climate – policy implementation challenges. Canberra.
[2] Pindyck R.S. and Rubinfeld D.L., *Microeconomics,* (Pearson Education, 8th Ed, 2015), 288-289

4. There is free entry and exit from the market.

Whilst the urban water industry delivers highly similar products as outlined in item 3, this submission argues that the other essential elements (items 1, 2 and 4) of responsive and competitive systems or markets are not available to Australians.

There are important sources of "Big Data" available that overcome the asymmetry of information in the water sector and this provides evidence of the potential for improved efficiency and competition.[3] The National Water Initiative has made a significant contribution to improving the transparency (Item 2 above) and competitiveness of the Australian water industry by initiating the sharing of information such as the National Performance Reports.[4]

The Australian Bureau of Statistics and the Bureau of Meteorology also provide excellent sources of information that can be used to assist with innovation in the water sector. However, additional open access to water resources information held by corporatized government entities is needed to drive competition, innovation and confidence in the sector. The recommendations of the Senate inquiry into Stormwater Management in Australia should be included in this Inquiry into National Water Reform.

In addition, the scope of reporting and subsequent open access to information needs to increase to include information about stormwater runoff including flooding, associated infrastructure and to quantify the urban stormwater resource.[5] These efforts need to be supported by enhanced monitoring, auditing and collation efforts facilitated by the Commonwealth government.

It is noteworthy that the Commonwealth government has supported the revision of Australian Rainfall and Runoff that was underpinned by the latest science and updated to include the last 30 years of climate and streamflow data. This open source information, data and guidance is assisting to protect Australians from flooding.[6] Nevertheless, additional effort is required to continue monitoring, observations and analysis that allow this type of quality national guidance. It is noteworthy that there is insufficient stormwater monitoring data in urban areas that are subject to substantial investment and the most concentrated risks from local flooding.

Government policies involve interventions to provide desired outcomes for society. The trade-offs in response to these interventions may be better understood using systems or holistic thinking that is supported by models of system dynamics. Solutions derived from deterministic partial analysis or assumptions about systems can produce unexpected outcomes across society. We need to find the best places to intervene in the system to produce outcomes that benefit the whole of society.

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[3] Coombes P.J., (2017), *Why the water supply needs a splash of competition*, Australian Financial Review January 18, 2017

[4] Australian Senate (2015), *Stormwater management in Australia,* The Senate Environment and Communications References Committee. Commonwealth of Australia.

[5] Ibid

[6] Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I (Editors), (2016), *Australian Rainfall and Runoff: A Guide to Flood Estimation,* Commonwealth of Australia (Geoscience Australia)

Urban water decisions are dominated by focus on single centralised solutions within a legacy protective government monopoly structure that often involves a triangular linked ownership between the state government bureaucracy, utility and regulator. This structure provides a dominant source of funds which creates a sameness of opinion – this perhaps creates the illusion of consensus about solutions and may be a barrier to competition.

A diversity of science and experience based evidence is required to foster innovation and efficiency. However, substantial politics of evidence exist within the Australia water sector.[7] This involves behind-the-scenes struggles and coalition-building that occurs between water utility providers, consultants, private companies, industry associations, experts, communities and all levels of government for preferred solutions.

This situation can result in an optimisation of the private costs and benefits relevant to service provided by a utility and exclusion from consideration of all other costs and benefits as external to the interests of the utility.[8]

A utility's choice of solution may also limit (crowd out) opportunity for solutions originating from within society (denoted in Figure 1 as external supply solutions) that may provide a wider range of benefits and provide competition. These negative externalities are incorporated in society's demand for a private good (water supply from the utility) and also increase the total costs incurred by society for consumption of the authority's private good as shown in Figure 1.

Figure 1 demonstrates an economic relationship for supply and demand for a private good (water services from a utility) and the associated impacts on society. The supply curve shows the total average cost of water services is a function of the quantity produced where the price of supply is regulated. These costs are a function of labour, energy, capital investment and other factors of production. The quantity of demand by consumers is a function of the regulated price of water and availability of alternatives.

[7] Daniell K.A, Coombes P.J., and White I. *Politics of innovation in multi-level water governance systems.* Journal of Hydrology. 519(C): 2415-2435. (2014).

[8] Coombes P.J., Smit, M., and MacDonald G., (2015). *Resolving boundary conditions in economic analysis of distributed solutions for water cycle management.* Australian Journal of Water Resources. Engineers Australia.

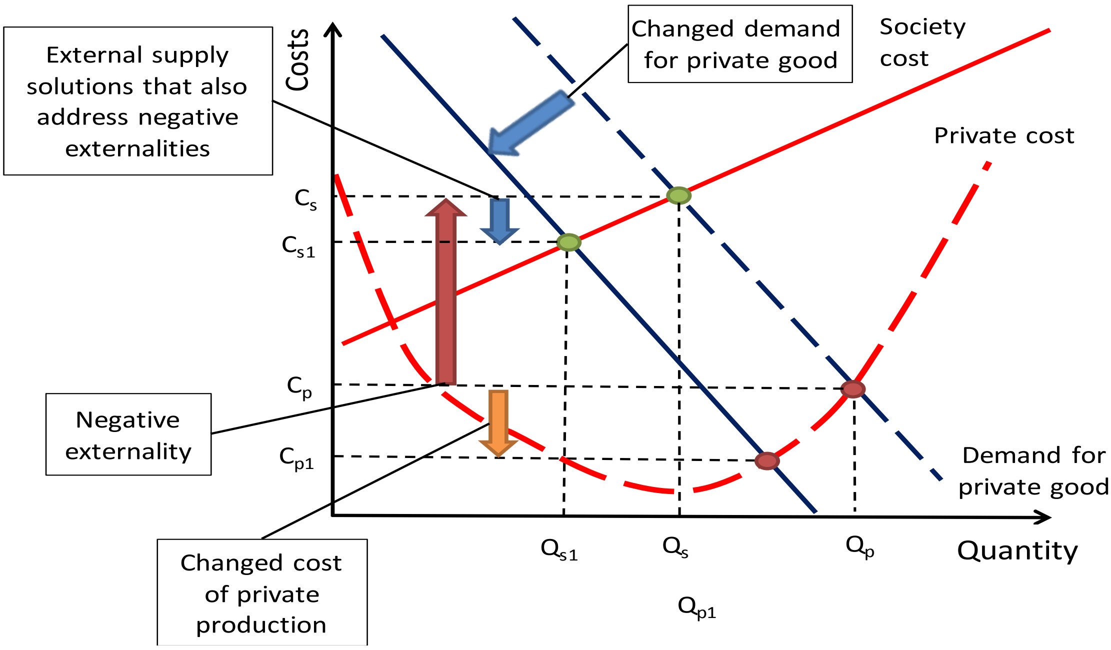

Figure 1: The uncounted negative externalities of private production increases society costs and the addition of external solutions that account for negative externalities reduce society and private costs

Figure 1 also illustrates the problem of not counting externalities in an economic analysis. A negative externality, for example increased greenhouse gas emissions from a desalination plant or increased stormwater runoff, will increase the costs to the whole of society C_s above the private costs experienced by the utility C_p. These costs are invisible in analysis from the perspective of the utility and are borne by society.

Introduction of additional supply solutions (such as buildings that include water efficient appliances and rainwater harvesting) shifts the demand curve to the left and reduces demand for the private good provided by the utility. For example a rainwater harvesting system could reduce household water demand and stormwater runoff.

The external supply solution (such as water efficient buildings) in this case has also partially addressed the negative externality by generating less greenhouse gases and stormwater runoff from rainwater harvesting systems than the utility supply that includes desalination. It is possible that inclusion of externalities in economic analysis may improve the economic viability of the utility and decrease the costs accruing to society.

Agenda from dominant entities and legacy pathway dependence can also set the boundary conditions in decision making which limits the potential solutions that are considered.[9] Decisions about solutions, strategies or policies for management of water cycle services will involve trade-offs between environmental benefits and lifecycle costs as shown in Figure 2. The optimum solutions available to society, from the perspective of environmental benefits and lifecycle costs, can be presented as the Pareto Frontier.[10]

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[9] Ibid

[10] Kuczera G.A., and Coombes P.J., (2001), *A systems perspective of the urban water cycle: new insights, new opportunities,* Stormwater Industry Association 2001 Regional Conference, Port Stephens, NSW, Australia.

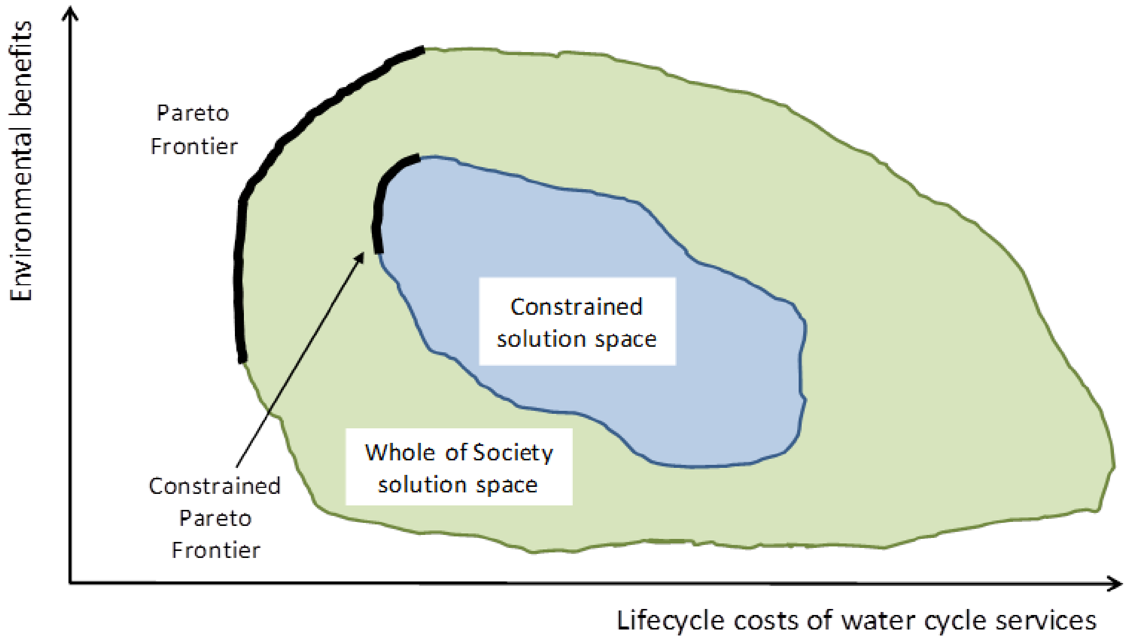

Figure 2: A narrow focus on solutions provides a constrained solution space and Pareto Frontier whilst the whole of society solution space provides a more optimum Pareto Frontier

Figure 2 highlights the high price (such as increased lifecycle costs and decreased environmental benefits) of boundary conditions that act to constrain the solutions available to society. A constrained solution space and Pareto Frontier occurs when institutional constraints, normative values and assumptions exclude the critical evaluation of all feasible solutions.

This discussion also highlights that there is a large solution space with multiple outcomes available to society. The evaluation of this solution space should not be limited to the financial costs or profits of a single entity and needs to focus on economic value to society.[11] We should be mindful that decisions about solutions involve linked impacts that occur at multiple scales across the water cycle as shown in Figure 3.

Figure 3 shows that urban catchments incorporate multiple linked scales including regional, urban catchment and distributed sub-catchments that contain local scale processes. The responses of urban catchments are cumulative rather than static or average and are dependent on spatial and temporal characteristics throughout the catchment. This insight indicates that the impacts of hidden or missed challenges or opportunities within catchments are not linear processes and may be exponential in nature. For example, solutions at the local scale can accumulate throughout an urban area to produce substantial benefit at the whole of city scale.

[11] Coombes P.J., (2015), *Transitioning drainage into urban water cycle management,* 2015 WSUD & IECA Conference, Engineers Australia, Sydney.

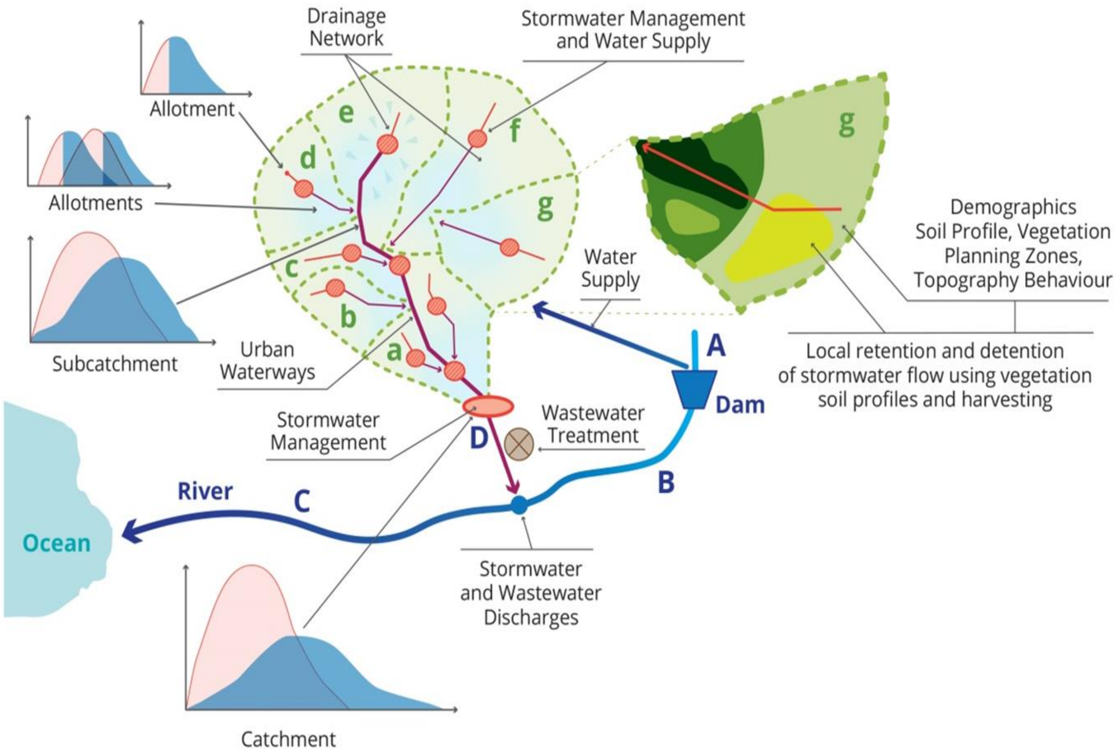

Figure 3: The cumulative impacts of scales across the water cycle

Emerging approaches to stormwater and water supply management utilise multiple solutions that cascade across scales to mitigate these cumulative impacts for example; household rainwater harvesting overflowing to streetscape measures such as rain gardens, infiltration and vegetation that discharge to sub-catchment scale bio-retention and stormwater harvesting is a treatment train that can restore the natural regimes of flow volumes. These accumulative and connected outcomes are unlikely to be understood using average and siloed analysis.

Urban settlements are subject to a continuum of temporal and spatial change. Our policies and solutions must be flexible and able to evolve in response to these changes. There is also change from historical complete reliance on centralised options to diverse water management strategies.[12] These water management strategies are emerging from sole focus on large regional infrastructure and dependence on associated "lumpy" investments.

The historical centralised focus of solutions has defined the urban water sector as essentially a transport industry as demonstrated for water supply in Figure 4 and sewerage disposal in Figure 5 for Melbourne. The growth of cities involves expansion and densification of these systems which dramatically alters the economic characteristics (cumulative costs and volumes in existing networks) of centralised supply solutions as sources are increasingly distant from end uses.[13]

[12] PMSEIC., (2007), *Water for Our Cities: building resilience in a climate of uncertainty*, A report of the Prime Minister's Science, Engineering and Innovation Council working group, Australian Government, Canberra.

[13] Coombes P.J. and Barry M.E., 2014, A systems framework of big data driving policy making - Melbourne's water future, OzWater14 Conference, Australian Water Association, Brisbane.

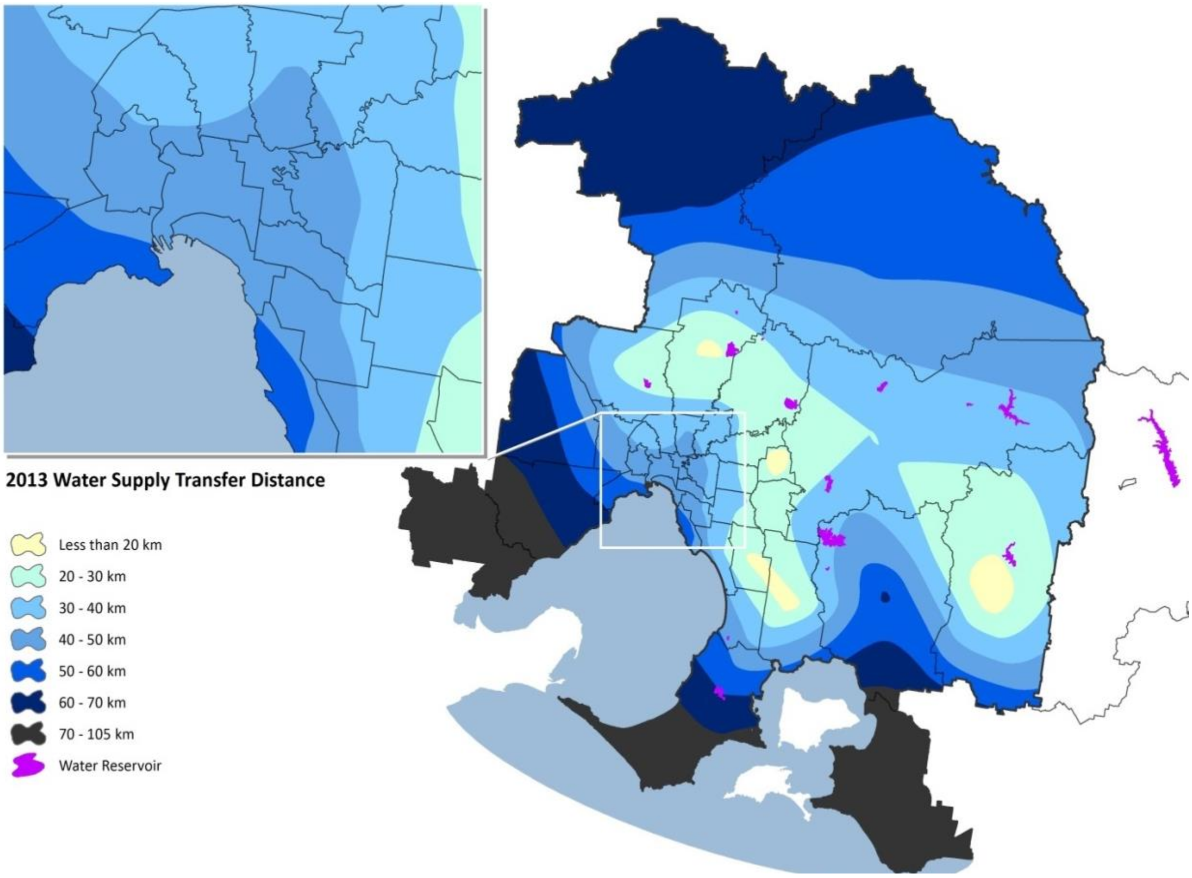

Figure 4: Water supply transfer distances for Greater Melbourne

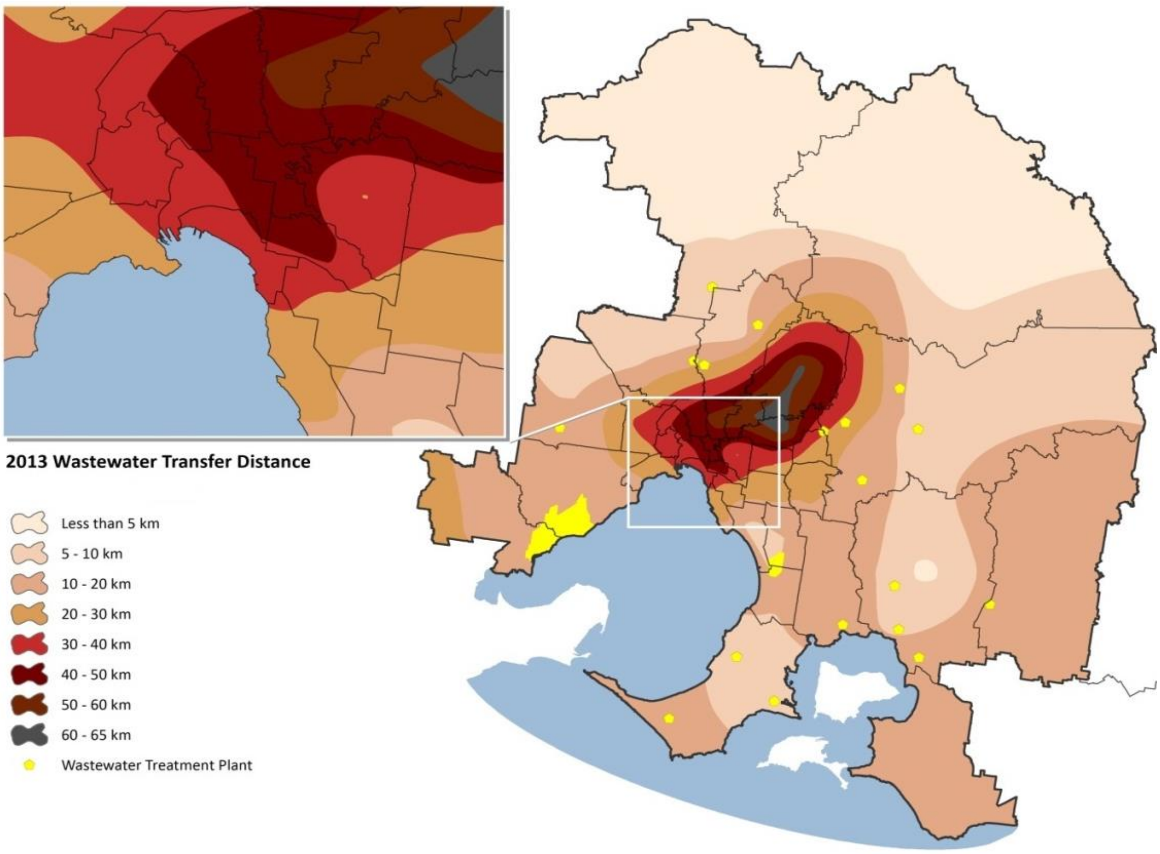

Figure 5: Wastewater disposal transfer distances for Greater Melbourne

Application of transport logistics to these spatial challenges identified in Figures 4 and 5 reveal that local reductions in water demands or local supplies decreases the cumulative costs of transporting water and sewerage throughout networks. This can produce economic multipliers of benefits throughout the system.

Household expenditure is an indicator of economic welfare. Total household water bill (water and sewerage) and the water proportion of household water bills was derived from national accounts for Australia and is presented for the period 2003-04 to 2015-16 in Figure 6.[14]

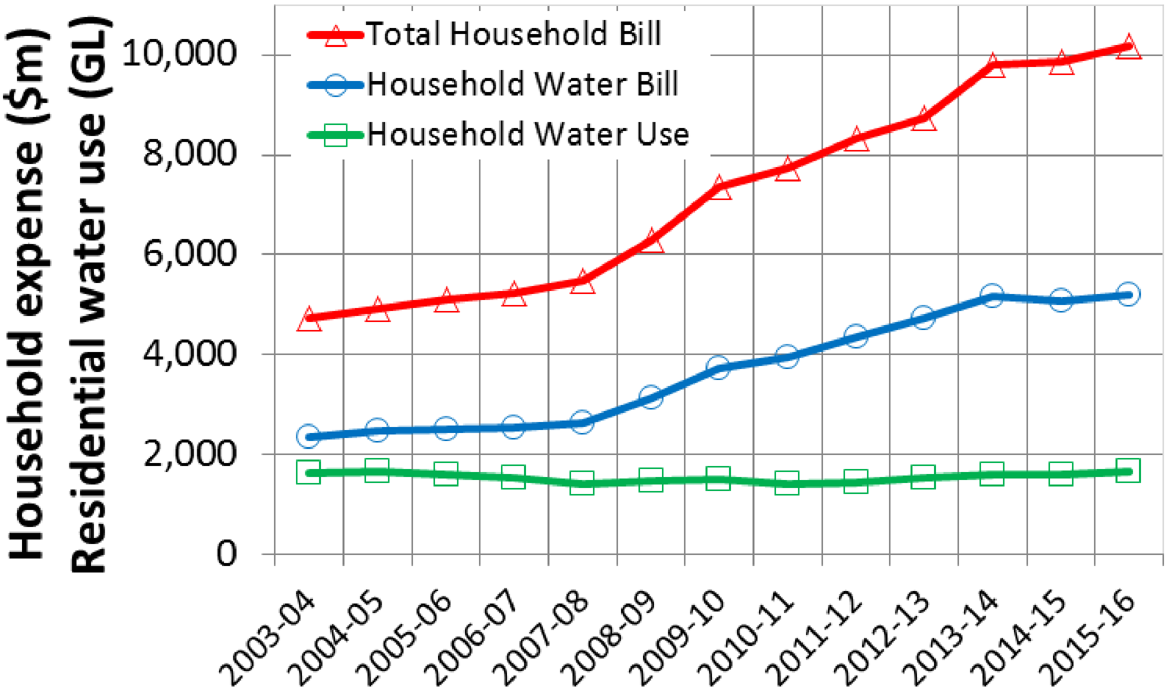

Figure 6: Summation of national household expenses for total water bill (water and sewerage services) and for water proportion of water household water bills

Figure 6 reveals that total household bills have increased by 116% ($5.45 billion) since 2003-04 and the water proportion of household bills increased by 121% ($2.85 billion) in contrast to increases in household water use of only 1.7% (28 GL).

The consumer price index (CPI) has increased by 38% during the same period and real household disposable income has declined in recent times.[15] In addition, Australia is experiencing low wage growth. During a period of declining household welfare and overall higher costs of living, the average increase in household expenditure on water and sewerage services is many times greater than the inflation rate.

These results indicate serious impacts on household welfare and a strong decline in efficiency of centralised water utility model. This problem is also relevant to North America where unaffordable water bills may triple from 12% to 36% during next five years – this

[14] BOM, (2016; 2015), *National performance reports – urban water utilities*, Bureau of Meteorology, Canberra; NWC (2005 – 2014), National performance reports – urban water utilities, National Water Commission.

[15] ABS (2016) *5206: Australian National Account – expenditure and product.* Australian Bureau of Statistics; Commonwealth Government, *Budget 2015-16 Mid-year economic and fiscal outlook* (15 December, 2015), http://budget.gov.au/2015-16/content/myefo

indicates that 36% of American households may not be able to afford utility water and sewerage services in the near future.[16] Similar impacts on household welfare are also experienced in the energy sector.[17] Declining household welfare as indicated by reduced disposable income also reduces consumption throughout the economy which impacts on the economic welfare of firms.

However, Figure 6 provides some more direct insights into economic efficiency of the utility water and sewerage model. Average household expenses for services have increased by 116% to 121% for an increase in water use of only 1.7% - this result suggests a factor of 71 decline in efficiency (over 7,100%). Another way of looking at this issue of efficiency is that the increased household expense for water and sewerage services is $100/kL of additional water services or $192/kL for additional water and sewerage services. These results could be considered to be an average medium run marginal cost.

Whilst the growth in impacts on household welfare provides a macroeconomic perspective on the efficiency of monopoly water services, the growth in water operating costs of utilities can provide a microeconomic perspective. The change in operating costs of major utilities in NSW is compared to the operating costs of Victorian, Queensland and the average of all major utilities outside of NSW in Figure 7. This data on operating costs was sourced from the national performance reports published by the Bureau of Meteorology and the National Water Commission.

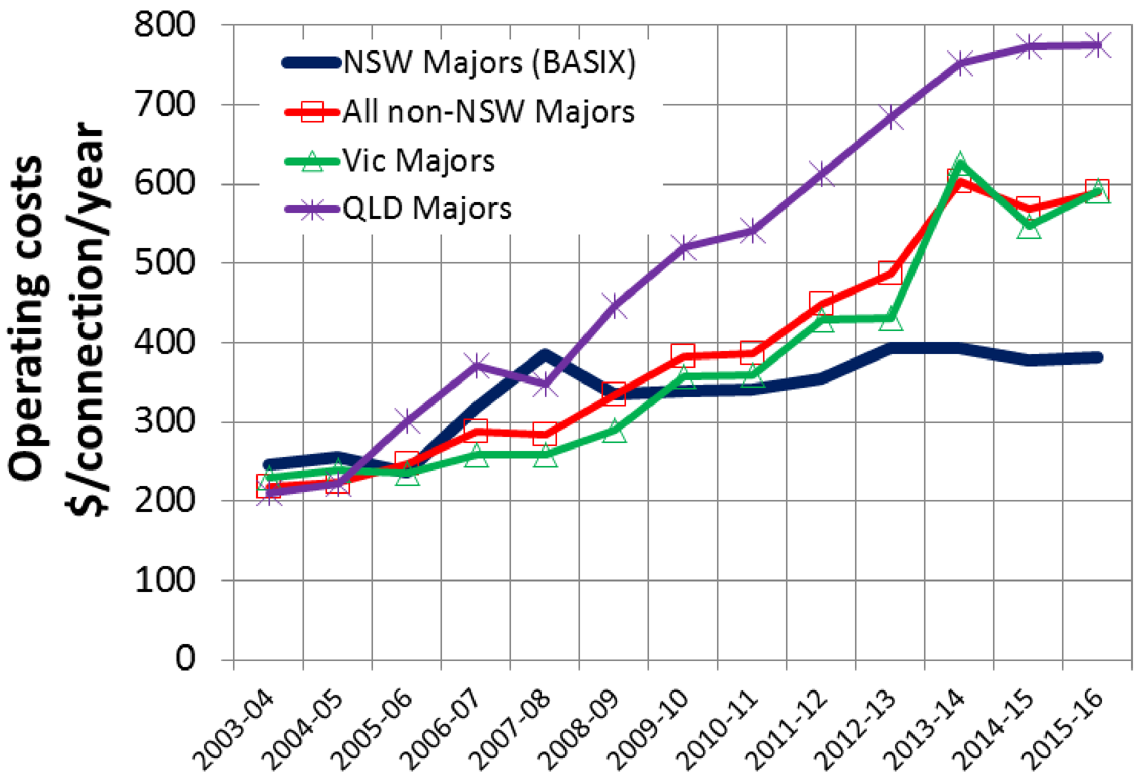

Figure 7: Water operating costs for major utilities

[16] Mack EA., and Wrase S., (2017), *A Burgeoning Crisis? A Nationwide Assessment of the Geography of Water Affordability in the United States*, PLoS ONE 12(1) : e0169488. doi:10.1371/journal.pone.0169488

[17] Saddler H., (2016), *Rising power bills signal the end of an era for Australia's electricity grid.* Article from Australian National University published in the Conversation, December 15.

Figure 7 shows that the growth water operating costs is significant for South East Queensland (267%), Victoria (157%) and for the average of all major utilities outside of the NSW (171%). Major utilities in Adelaide (140%) and Perth (77%) have also experienced significant growth in water operating costs. Similar to the results for impacts on household welfare, these results indicate declining efficiency of the model for monopoly supply of water services.

In contrast, the growth in water operating costs of NSW major utilities (55%) is substantially less than the other areas. The significant impact of dependence on water grid infrastructure (long pipe transfers between regions) in South East Queensland seems to be driving the highest growth in costs whilst the BASIX policy for sustainable buildings is driving the smaller increases in utility operating costs.[18] BASIX is a state environmental planning policy that specified 40% reduction in water and energy use in comparison to regional benchmarks for residential buildings. It is supported by an online calculator and assessment process.

BASIX was implemented in 2004 and has been operating for more than 10 years. Water savings are delivered by water efficient appliances, rainwater harvesting and sustainable gardens. We wanted to see if this major cumulative impact on supply and demand would be reflected in household water bills. So we separated the data. We restricted the data to average annual water bills for connected properties to normalise differences in the number of connections and new connections. We also restricted the range to major water utility providers and we separated NSW major utilities, Sydney Water and Hunter Water, from major utilities in the rest of Australia. The average household expense for water services for dwellings supply by major utilities in NSW, the average of all other regions (non-NSW), Queensland and Victorian regions is presented in Figure 8.

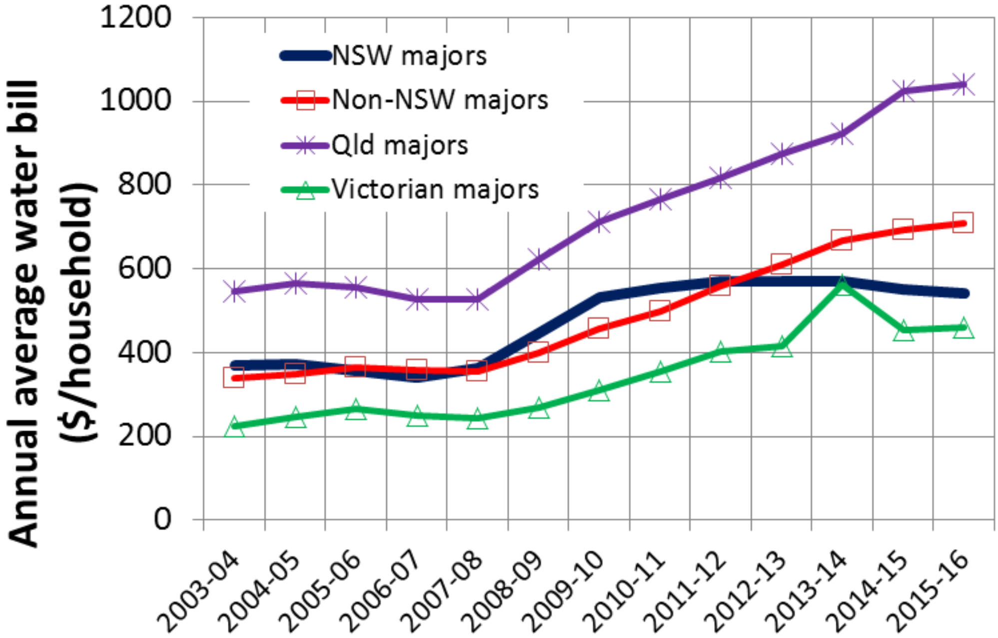

Figure 8: Average household water bills for major water utilities in NSW, Queensland, Victoria and all regions outside of NSW.

[18] Coombes P.J., Smit M., and MacDonald G., (2016), *Resolving boundary conditions in economic analysis of distributed solutions for water cycle management.* Australian Journal of Water Resources, Vol 20, 11-29.

Figure 8 reveals that since 2003, average household water bills increased by 110% for all major utilities outside of NSW, by 105% for Victorian major utilities, by 91% for Queensland major utilities and for NSW major utilities household bills increased by only 47%. In addition, average household water expenses have increased in Perth (81%) and Adelaide (134%). There is a clear anomaly between household expenditure on water bills for the rest of Australia as compared to NSW.

In the medium run (based on the last 15 years of economic data), increases in water costs (household expenditure and utility operating costs) throughout Australia were between 12 and 71 times more than increases in water use. This indicates that local water efficiency and sources of water is a high value economic proposition due to greater reductions in utility operating, augmentation and security costs than any reduction in revenue[19] – this drives lower growth in water bills in the medium run as demonstrated for Sydney.[20] This result implies that each kilolitre of water saved at buildings has a value of approximately 12 to 71 times any reduction in revenue from water charges provided that all costs are counted in the analysis.

The contribution of water efficient appliances and rainwater harvesting in each region was derived using comprehensive data from BOM and BASIX in systems analysis and is presented in Figure 9.

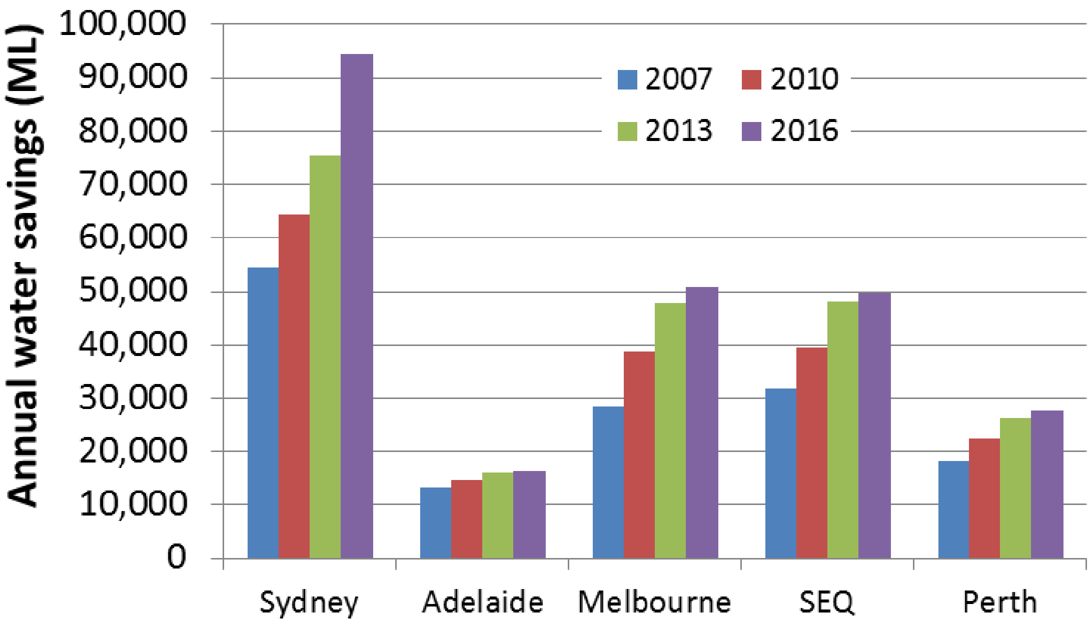

Figure 9: Total water savings produced by water efficient appliances and rainwater harvesting

The BASIX targets in Sydney are producing substantial water savings in comparison to the other regions that have optional programs or have ended programs for rainwater harvesting and water efficiency. These local savings for each city support the earlier findings for economic efficiency.

[19] Ibid n13

[20] Coombes P.J., (2017), Why the water supply needs a splash of competition, Australian Financial Review, 18 January

The supplementary effect of local solutions is creating competition that is improving the economic efficiency of water utilities and is generating better outcomes for households and society. The reductions in costs created by supplementary solutions are many times greater than any loss in revenue. These results indicate that water utilities can no longer been seen as natural monopolies that are the sole and most efficient solution to providing water resources. This insight is supported by the dramatic increases in average medium run marginal costs of up to $172/kL of water supply. Similarly these results indicate that solutions that avoid transfer of a proportion of water demand across long distances can improve the economic efficiency of utility water supply and decrease the urgency of water augmentation decisions allow more prudent investment.

In addition, household water efficiency and behaviours, and local water sources ensured that water supplies for cities were not exhausted during the millennium drought. The mains water demand of cities was substantially reduced. This historical experience highlighted the importance of solutions that both increase local supply and reduce demand for mains water, and the effectiveness of strong demand management programs in uniting the community in meeting water saving targets.

Nevertheless, the value of local water sources and household efficiency is contested and not considered to be viable by water utilities, their consultants and associated state bureaucracies. Indeed, the substantial contribution of rainwater harvesting (>102 GL/annum in urban areas; 6% of urban water supply) and household water efficiency (>96 GL/annum in urban area; 6% of urban supply) is not acknowledged.

Classic economic theory maintains that a monopolist will argue that no other solution is viable, and will also lobby for conditions (legislation, regulations, policies and design assumptions) that maximise market share and monopoly power. Thus it is expected that the state water bureaucracy will argue that only centralised solutions provided by water utilities are viable. These discussions are supported by a thesis that increases in water prices and consumption is needed to produce greater revenue that can be utilised to pay infrastructure induced debt. However, given the results presented in this submission, this process may result in greater increases in costs than growth in revenue which will drive higher prices and greater debt. Households and Australian society are paying the costs.

In addition, a preference for fixed tariffs by utilities and state government regulators may be favoured to guarantee revenue supply but this process also ensures negligible incentives for efficient use of water.

Increased competition from water efficiency and local water sources is likely to improve the overall economic performance of water utilities and across society. This is not an argument for privatising state government water monopolies – such an action may produce worse outcomes. Our water utilities are important but their value to society will be greater if utilities or their state government owners do not arbitrate on the viability or approval of supplementary water solutions provided by others – similarly pricing and legislation should not be set by state government regulators and bureaucracy to maximise the viability of their water utilities at the expense of otherwise beneficial supplementary solutions.

We need to move away from an assumption that economic markets are self-regulating and do not require intervention and individuals can fend for themselves. Similarly, the assumption that centralised supply of water is a natural monopoly process and all other contributions are not viable may no longer be valid. These assumptions have diminished the role for government in the economy which shifts power to dominant entities – such as corporatized government entities. The outcome of these processes is dominance of powerful economic clusters or oligopolies in government decisions. Citizens and entrepreneurs are disenfranchised from democratic involvement and decision making in water solutions but pay the costs and encounter declining disposable income.

There is a need to move away from triangular regulatory processes for water supplies that are state owned and regulated, assessed by state selected experts and governed by state selected board members. These processes also generate substantial asymmetry of information and barriers to supplementary access at multiple scales to the potential water market. These types of processes ultimately lead to political and economic instability.

There is need for external intervention from the Productivity Commission and the ACCC to maximise supplementary contributions from households and firms throughout water supply areas to improve the economic viability of water utilities and society. These entities will need to provide independent and transparent arbitration from the perspective of whole of society to maximise the diversity of contributions to water supplies across all scales.

This decision making process will need to focus on whole of water cycle and society outcomes – for example some solutions will provide multiple benefits to society such as improved health of waterways, local employment opportunities, mitigated climate change impacts and reduced water demands but may not maximise revenue to the water utility – this should not lead to dismissal of the solution.

A transition from separate reductionist methods to expansive linked analysis of systems is needed to realise the costs and benefits of these types of whole of society welfare functions. These processes will need to provide understanding of cumulative impacts and trade-offs that are fundamental to policy decisions – the opportunities may not be realised by average assumptions or pathway dependence.

There is now sufficient timeline of Big Data to reveal substantial new insights – such as effectiveness of sustainable dwellings and the importance of supplementary solutions at multiple scales. Systems analysis and local ground truth projects have confirmed these potential benefits – we live in a system. These processes have also revealed other hidden whole of society processes such as the importance of community involvement and wellbeing.

There are also important stormwater and climate change insights that must be included in evaluation of water resources solutions. There is a need to evaluate government policy and strategy using systems frameworks, and to seriously include sustainable dwellings in government policy and strategy.

Yours sincerely

Professor Peter Coombes