THE WILDERNESS SOCIETY

Beyond Tillegra:

A Sustainable water strategy for the Lower Hunter

Front Cover: The Upper Williams River (photo by Vanessa Culliford)

Beyond Tillegra:
A Sustainable Water Strategy for the Lower Hunter

December 2010

Naomi Hogan, The Wilderness Society Newcastle
Dr Simon Fane, Institute for Sustainable Futures

Table of contents

Executive Summary 1

1 Scope of this report 4

2 The Lower Hunter water supply 5
- 2.1 Future water for the Lower Hunter 5
- 2.2 The Tillegra Dam proposal 5

3 Demand and supply projections 7
- 3.1 Estimates of the available supply 7
- 3.2 Projections of water demand 8
- 3.3 A future in further water conservation 9

4 An alternate water future for the Lower Hunter 11
- 4.1 Demand management and water conservation programs - An alternate strategy 11
- 4.2 Current demand management efforts in the Lower Hunter 12
- 4.3 Demand management success in other regions 12
- 4.4 Water conservation for additional water supply 18

5 The indicative cost of an alternate strategy 21
- 5.1 How much would it cost the Lower Hunter? 21
- 5.2 Additional savings – green house gases 22

6 Water planning decision making and governance 23
- 6.1 The National Urban Water Planning Principles 23
- 6.2 Other government commitments 25

7 Community engagement in water planning 27
- 7.1 Drought management planning and the 'level of service' 27
- 7.2 The Lower Hunter process 29
- 7.3 CASE STUDY: Central Coast community engagement 30

8 Conclusions and ways forward 32

9 References 33

Executive summary

By implementing water conservation and demand management programs, similar to those currently in place in Sydney, all future water needs of the Lower Hunter region can be adequately met for many decades to come. This alternative analysis maintains acceptable levels of water security without requiring the Tillegra Dam proposal, while still accounting for the high end prediction of population growth in the Lower Hunter region.

Demand management and water conservation are more economical

Analysis by the Institute for Sustainable Futures (ISF), demonstrates that the cost of implementing the water conservation and demand management programs necessary to meet the projected increases in demand in the Lower Hunter for the next 40 year would be about $44 million in net present value (NPV) terms. When compared to the Tillegra Dam option presented by Hunter Water Corporation ($477 million), a water conservation and demand management strategy is very cost effective.

This price does not include the savings in customer water and energy bills that will occur as a result of using less water, especially the energy savings through avoided hot water heating. If implemented, this alternate strategy could reduce greenhouse gas (GHG) emissions by over 1.5 million tonnes. In contrast, building Tillegra Dam is likely to generate over 300,000 tonnes of GHG emissions within the first 20 years after construction.

The comparatively low cost water conservation and demand management strategy backs up the statements of various independent and pre-2007 reports, which highlighted the relative high cost of the proposed Tillegra Dam when compared to more sustainable initiatives.

Long term water planning and environmental protection

The Tillegra Dam would provide a level of water supply that is far beyond what is necessary for the water needs of the Lower Hunter. The level of water security is at least 50 times that typical of the water supply of other Australian water providers. While extra water security sounds attractive, there are significant economic, environmental and social costs associated with building such an enormous level of water supply. These costs include the financial burden to water rates payers, the debt burden on a State owned enterprise, the loss of a pristine river ecosystem and the fresh water flows down the Williams River to the

internationally listed Hunter Estuary Wetland, the inundation of a fertile farming valley, and the loss of a community.

A water conservation and demand management approach avoids these costly impacts, as well as others, such as greenhouse gas emissions. This approach is a viable alternative to Tillegra Dam that does not require the construction of desalination plant.

There are other ways for the Lower Hunter to be able to maintain its current safe level of drinking water supply, through tried and tested drinking water saving programs being run successfully by other water authorities. In fact, the Lower Hunter could maintain a similar demand with a high level of population growth by implementing the water conservation and demand management programs currently in place in Sydney.

Business and community benefits from demand management and water conservation

Community-based research has shown residents are ready to take up opportunities to save water if supported to do so. There have also been shown to be sizable, money saving opportunities for business to significantly reduce potable water use without changing work practices, through the installation of water saving appliances and local reuse and rainwater storage facilities.

Options for water saving include demand management and conservation measures. Demand management measures include business partnerships, pricing incentives, home retrofits, and water wise rules. Water conservation measures include rainwater tanks on new buildings, small scale non-potable recycling, and storm water harvesting initiatives. Other measures include improved catchment management to ensure water quality, and to avoid a repeat of the recent algae blooms that polluted the Lower Hunter's water supply system in 2009 and 2010.

Based on research from other Australian water authorities, demand management and water conservation are very popular with a range of water users, are comparatively inexpensive, environmentally friendly and effective.

Community involvement is necessary for good urban water planning

Significantly, there are National Urban Water Planning Principles designed to assist this process. The Council of Australian Governments (COAG) adopted the

National Urban Water Planning Principles in 2009. These principles were signed onto by the Federal government and all state and territory governments.

Importantly, through these principles the NSW Government has agreed to select water sources resulting in the lowest environmental, social and economic costs over the long term. It agrees to consider the impact of possible demand management measures, and to ensure that stakeholders are able to make an informed contribution to urban water planning with consideration of the appropriate supply/demand balance. The government has also agreed to the principle of engaging the community in setting the level of water services they expect and are willing to pay for.

This report finds that the NSW Government and Hunter Water process for water planning and decision making in the Lower Hunter is inconsistent with the National Urban Water Planning Principles.

Therefore, while this report can highlight one alternative water supply strategy, meeting the National Urban Water Planning Principles will require the Lower Hunter community's involvement in determining the level of service that residents expect and are willing to pay for, and the options they would like to see implemented.

There is time for good urban water planning in line with national policy

There is no immediate water crisis in the Lower Hunter and no possibility that the region will face a water shortage in the next few years. Various reports have confirmed that even with a large projected population increase in the Lower Hunter region, current supplies would be sufficient for decades (ISF 2009b, DoP 2006, IPART 2005). By removing the currently perceived urgency around water planning for the Hunter, the NSW Government and Hunter Water have time to conduct thorough research into water options and facilitate genuinely inclusive and informed community participation in urban water planning into the future.

1 Scope of this report

This document has been prepared to provide background for decision makers and interested community members on the alternative water supply and demand options for the Lower Hunter. This information can be used to help direct community consultation and consideration of all water planning options.

It examines various opportunities to provide water security to the Lower Hunter at the lowest possible cost to the community and the environment, while also creating projects that are jobs rich and have the full support of the broad Hunter community. It attempts to answer the questions: ""If the Tillegra Dam had not been announced, what might the alternative future urban water strategy for the Lower Hunter look like?" and “Can a growing Hunter population meet its future water supply needs through water conservation and demand sustainable water management practices if the proposed Tillegra Dam does not go ahead?”

There is a deliberate focus on case study examples from neighbouring water authorities of current water savings, demand management initiatives, and community engagement. It also considers the Australian and NSW Governments’ own water planning principles and compares the Tillegra Dam approval process with the community-based decision making process recently undertaken on the NSW Central Coast.

2 The Lower Hunter water supply

Hunter Water Corporation is the water authority for the Lower Hunter Region. It currently services a population of about 530,000 people with an annual consumption of approximately 70 billion litres (70 GL) per year (NWC, 2010). The major water sources of supply are Chichester Reservoir (38%), Grahamstown Reservoir (46%) and the Tomago Sandbeds (4%) (Sinclair Knight Merz, 2008).

Water restrictions in the Hunter have not been in place since the early 1980s and since that time, demand for water has dropped by 25 percent to the current level. Meanwhile, water supplies for the region have increased, most recently through improvements to the Grahamstown Dam completed in late 2005, adding an additional 60 GL of storage. In the five years since, water demand in the Lower Hunter has not increased while water storage levels remained high.

2.1 Future water for the Lower Hunter

According to the 2006 Lower Hunter Regional Strategy, it is estimated that the population of the Lower Hunter region will increase by approximately 160,000 people by 2031. Various key documents indicate there is no urgent need for increasing the water supply to the Lower Hunter, even with the high population increases projected in the Regional Strategy. The Strategy states, “Provided demand for water in the non-residential sector does not exceed current expectations and there is no significant unpredicted change in climatic conditions, there will be sufficient water for the anticipated population growth in the Regional Strategy” (DoP 2006).

2.2 The Tillegra Dam proposal

In 2005 the Independent Pricing Authority and Regulatory Tribunal (IPART) considered the cost effectiveness of future water planning options for the Lower Hunter. At that time IPART responded negatively to Hunter Water’s property spending in the Tillegra Dam inundation area, stating:

> While the Tillegra Dam is a future supply option, on current demand forecasts, there will be no need to build it for another 30 years. In addition to this, Hunter Water’s Integrated Water Resource Plan (IWRP) states that on a levelised cost basis, building the Tillegra Dam would be far less cost effective than many demand management initiatives and alternative supply options (IPART 2005).

The 2003 IWRP by Hunter Water found not only was Tillegra less cost effective than alternatives, but building a new dam in the upper catchment area had far greater environmental and social impacts than other supply augmentation options (Hunter Water 2003). This was reinstated in the October 2006 update of the report, where Hunter Water committed to a range of demand management initiatives, and continued efforts to limit demand in water growth and minimise the economic and environmental cost of creating new sources (Hunter Water 2006).

The Tillegra Dam was announced out of the blue by the NSW Government in the lead up to a State election in November 2006. The State Government instructed Hunter Water to build the dam and restricted IPART from assessing the economic efficiency of the Tillegra proposal.

The previous statements by IPART and Hunter Water raise significant concerns in light of the ongoing justification for the fast tracked Tillegra Dam project to be completed by 2013, as outlined in Hunter Water's 2007 – 2010 reports. The building of the large dam, approximately the size of Sydney Harbour, is now Hunter Water's key future water supply option. The currently estimated cost of the dam is $477 million dollars. The money will be borrowed and repaid by Lower Hunter rates payers through increased water bills for at least 60 years.

The proposal has been met with sustained and increasing criticism, as it threatens to dam one of the few remaining ecologically healthy rivers in NSW, inundating thousands of hectares of agricultural land with potentially devastating impacts on downstream fishing industries and internationally listed wetlands (Kingsford and Hankin 2010).

3. Demand and supply projections

3.1 Estimates of the available supply

In Australia, public water providers typically plan to provide sufficient water resources to ensure that water restrictions are required no more frequently than 1 in 25 years (Marsden Jacob Associates 2007). A Sinclair Knight Merz (2008) analysis of Hunter Water's supply capacity and projected future demand for water shows that by 2025, Hunter Water users will be demanding 85GL of water per year. This will result in a 1 in 21 chance of level 1 restrictions without Tillegra, as shown in Table 1.

Table 1 Probability of restrictions and low storage levels – Year 2025 (Sinclair Knight Merz 2008)

Storage level	Without Tillegra	With Tillegra
60% (Restriction level 1)	0.047 (1 in 21)	0.0008 (1 in 1,250)
50% (Restriction level 2)	0.016 (1 in 63)	0.0001 (1 in 10,000)
40% (Restriction level 3)	0.004 (1 in 250)	<0.0001
30% (Restriction level 4)	0.001 (1 in 1,000)	<0.0001
20%	0.0001 (1 in 10,000)	<0.0001
10%	<0.0001	<0.0001
5%	<0.0001	<0.0001

Based on analysis in the Sinclair Knight Merz report, ISF (2009b) considered 85 GL/yr to 90 GL/yr to represent a conservative estimate of the available supplies from the Lower Hunter's existing water supply system. Before the Tillegra Dam was announced, Hunter Water estimated the available supplies from the existing system at 90GL/yr. After the announcement this was revised down to 67.5 GL/yr.

It is interesting to note that the table shows that if Tillegra is built with an annual demand for water at 85GL, the likelihood of requiring water restrictions is projected to be one year in every 1,250 years. This provides a probability about 50 times lower than is typical for water supply planning used by other Australian water providers.

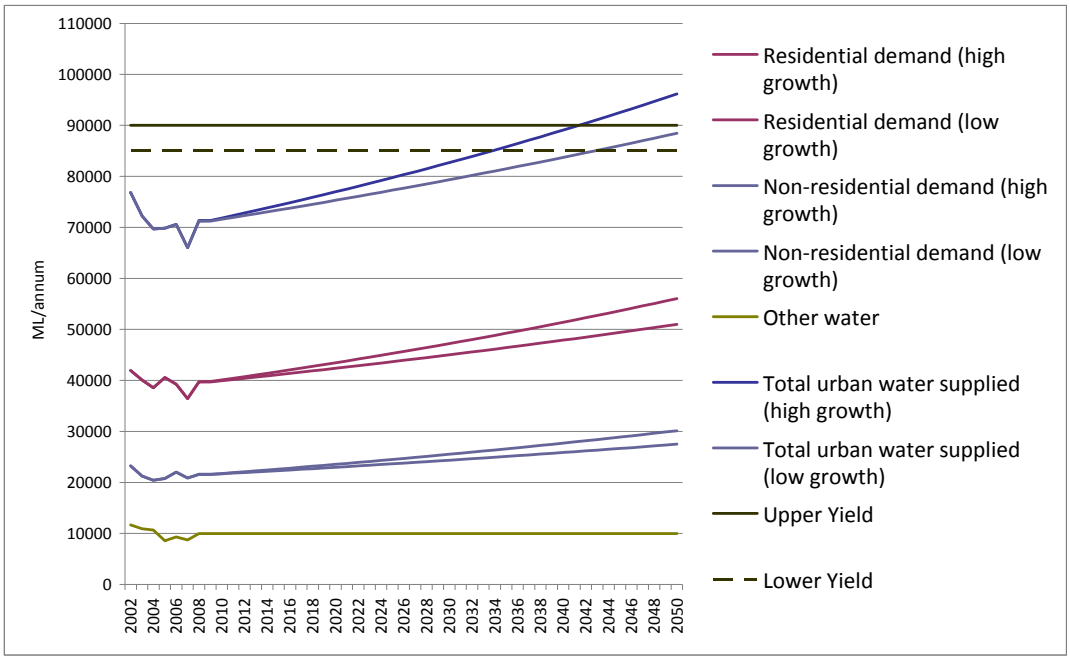
3.2 Projections of water demand

The Sinclair Knight Merz demand projection of 85GL/yr in 2025 is based on Hunter Water figures. In 2005, IPART highlighted flaws in Hunter Water's projected water demand figures, as Hunter Water did not consider demand management and water savings programs. Nor did Hunter Water account for the requirement for new housing estates to meet a 40 percent reduction of water target, limiting the water needs of the projected population increases.

The ISF analysis showed that the Lower Hunter's demand will not increase to 85 GL per year until well after 2025 with no further action to conserve potable water supplies. ISF's modelling shows water demand projections produced by Hunter Water failed to adequately factor in the effect of the BASIX mandatory water savings policy or correctly project non-residential growth (ISF 2009b).

The ISF modelling showed that if BASIX legislation is included, a demand of 85GL per year will not occur until 2032 even at the highest population growth.

Figure 1 Base case demand forecast for the Lower Hunter, with BASIX reduction and corrected growth in non-residential water use (ISF 2009b)



Box 1 BASIX

The BASIX policy is one of the NSW Government's key initiatives in promoting a water efficient future for NSW and reducing water use in all new residential developments (Sydney Water 2009). This policy requires that all new households reduce their water consumption by 40% from a baseline figure.

The baseline figure is calculated by multiplying the pre-BASIX average NSW drinking water consumption from the residential sector (247.5 litres of potable water per person per day) by the assumed number of occupants to live in the dwelling. For example, if a new house built in a green field site in outer Newcastle is estimated to have four occupants, the household would now be expected to use 594L per day, down from 990L.

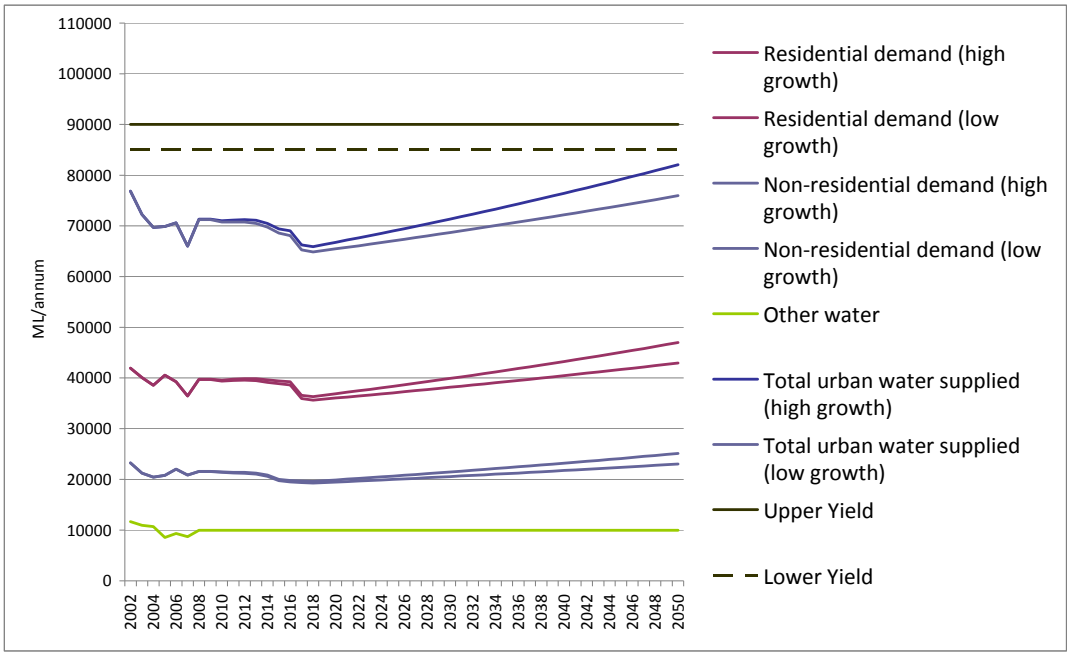
BASIX allows the developer to choose the best design to reach the 40 percent target. The range of options and water design features to meet the BASIX reduction target include water efficient devices for showerheads, toilet flushing and taps, water efficient appliances such as clothes washers and dishwashers, and the use of recycled water such as rainwater, stormwater and treated wastewater/greywater (Centre for International Economics 2005).

3.3 A future in further supply conservation

ISF analysis in 2009 also considered the potential for further action to manage water demand and conserve water supplies in the Lower Hunter (ISF 2009b). This was done by applying the actual water saving that had been achieved by Sydney Water in its demand management and water conservation programs and applying these proportionately to the number of people that are serviced by Hunter Water (Figure 2).

Their modeling showed that even with the high population growth estimated in the Lower Hunter Regional Strategy, there would not be an 85 GL/yr demand for water until after 2050. This was simply with the water conservation and demand management programs similar to Sydney put in place in the Lower Hunter.

Figure 2 Lower Hunter demand forecast with demand management similar to Sydney Water's existing program (ISF 2009b)



4. An alternate water future for the Lower Hunter

Tillegra Dam is being put forward by Hunter Water as the ideal solution to secure the Lower Hunter's future water supply. Other independent and pre-2007 Hunter Water reports state otherwise, highlighting the high economic cost of the dam and the opportunities for increased water conservation and demand management activities to meet water users' needs into the future.

Modelling from ISF (2009b) clearly shows there are a variety of cost-effective alternatives to the Tillegra Dam proposal that can meet the Lower Hunter's future water demands. The following overview provides further information about what an alternative future water strategy for the Lower Hunter could include. It provides the details of water conservation and demand management activities, gives examples of water savings achieved by neighbouring water authorities and provides an estimate of what it will cost to achieve the water savings identified in the ISF modelling.

4.1 Demand management and water conservation – an alternate strategy

Demand management is increasingly playing a major role in water planning across Australia. It has shown to be extremely successful and cost effective in bringing down annual per person water use. Successful demand management is now factored into future water use planning and projections. Acceptance of sustainable water consumption has recently grown across all Australian states and territories, as the Australian public recognise the benefit of conserving precious and limited water resources (Sydney Water 2010).

There are recent examples from major cities right across Australia where water conservation and demand management initiatives have proven extremely popular, cost effective and successful in significantly decreasing water demand. Residents are ready to reduce the amount of water they consume, taking up opportunities to save water if supported to do so. There have also shown to be sizable opportunities for business to significantly reduce water use without changing work practices, through the installation of water saving appliances and local reuse and storage facilities.

4.2 Current demand management efforts in the Lower Hunter

Hunter Water has made some efforts to encourage demand management in the Lower Hunter. Examples of the water efficiency programs currently run by Hunter Water include:

- Community awareness about saving water through local radio and schools
- Distribution of free tap aerators and shower flow restrictors at community events
- Interest free microcredit loans to eligible disadvantaged households to purchase 5-star rated efficient washing machines;
- $10 point-of-sale rebates at Bunnings stores for water efficient shower heads;
- Business retrofit of 27 commercial kitchens
- Smart meter installation planned for 40 Lower Hunter schools to identify leakage, resulting in water savings of up to 31% (Hunter Water 2010).

These relatively modest Hunter Water programs have a high potential to lead to far greater water saving success if funding and organisational support is broadened and improved.

4.3 Demand management success in other regions

The current demand management and water conservation measures carried out by Hunter Water appear limited when compared to those implemented across Sydney and the Central Coast.

For example, Sydney Water Authority has ambitious targets for the future. The NSW State Plan (2010) outlines clear goals for the Sydney region, aiming to save 145 billion litres of water per year by 2015, representing almost a 25% reduction from Sydney's projected water demand in that year.

There is a growing suite of cost-effective water conservation and demand management programs currently in place across Australia. Programs with potential to be implemented or significantly expanded in the Lower Hunter include:

- Long-term water savings rules or 'water wise rules'
- Water conservation audits and retrofits
- Washing machine rebates for residents
- Outdoor water saving appliances

- Mandatory water savings action plans for high users and industry
- Business water savings programs and partnerships
- Rain water tank rebates

A breakdown of what is involved in these programs and the outcomes of program implementation in other regions is outlined in the following pages.

Water wise rules

According to Sydney Water (2010), 'Water wise rules' are simple, common sense actions that apply to everyone using drinking water. This includes residents, businesses, local councils and government agencies. These loose 'rules' provide a guide for the activities people can undertake everyday to save water. These activities do not involve making sacrifices or significant changes to daily water-using activities; however they do achieve significant financial savings on water bills.

The specific 'water wise rules' for the greater Sydney region are:

- All hoses must now have a trigger nozzle
- Residents should avoid watering in the heat of the day, instead watering before 10am and after 4pm
- No hosing of hard surfaces such as paths and driveways
- Washing vehicles is allowed
- Fire hoses must only be used for fire fighting activities.

Water wise rules have proven to be extremely effective. According to the 2010 Sydney Metropolitan Water Plan, Sydney's 'Water Wise Rules' alone will save an estimated 19 billion litres of drinking water each year. If applied to the Lower Hunter, this same program has the potential to save around 2.2 billion litres of drinking water each year for the Lower Hunter.

Household retrofits

Sydney Water has rolled out a program to install water efficient showerheads, tap flow regulators, and water efficient dual flush toilet cisterns, and to repair minor leaks to a large percentage of residential households. These residential water improvements have been offered at low cost (as little as $22) to residential customers, with no cost to low income concession cardholders (Sydney Water 2009b). Over 700,000 houses in Sydney have been retrofitted.

Data collected from these installations has shown that each household saves an average of $66 a year in energy and water bills.

Washing machine rebate

Data has shown choosing water efficient products makes a huge difference to water use in the home. For example, from March 2006 to 31 July 2008, Sydney Water provided a rebate of $150 to residential customers who bought a new washing machine with at least a 4-star water efficiency rating. By August 2008, technology had improved and the rebate was only valid for washing machines with a 4.5 star water efficiency rating (Sydney Water 2009b).

Since this rebate was offered, the market share of 4.5-star water efficient washing machines has increased from around 5.3% to almost 36.8% in May 2009. The water savings from the 157,599 rebates paid since March 2006 equal an average of 3 GL/year.

Outdoor water efficiency

Across most of Australia, the largest use of drinking water for residential users is outdoors on the garden. There are a variety of ways residents can be encouraged to make better garden choices to save significant amounts of water.

One example forms a part of Sydney Water's website: the 'Plant Selector'. This tool enables residents to choose plants suited to their local soil and weather conditions, helping them save water without restricting their choice of garden design (Sydney Water 2010). This sort of map and info based tool is likely to be of high interest to Lower Hunter water users and gardeners.

Another popular and highly successful Sydney Water program, *Love your garden*, involves a qualified horticulturist visiting a customer's home and evaluating the garden's water needs. Tools such as tap timers, rain gauges and tap tags are provided along with a detailed report. This service is valued at an estimated $180 but is provided to customers for $33.

Since it began in 2007, Sydney Water has advised 18,964 residential properties, saving about 2 GL/year through better watering practices and smart water tools (Sydney Water 2009b).

Water saving programs for business

There are various different forms of business water saving programs, but the key is to require major water users to create and adhere to a water conservation plan for their business. This is the case in Sydney and on the Central Coast but not in the Lower Hunter.

On the Central Coast, a Water Saving Fund provides support to businesses to make significant improvements to their water demand, saving water, energy and money. Funds are harnessed through a competitive process from the NSW Department of Environment Climate Change and Water.

The Central Coast Water Savings Fund provides up to $2 million to a range of successful applicants each year. To date, three funding rounds have been held, allocating $5.3 million to 55 projects, saving 790 million litres of water a year. They include recycling and stormwater harvesting projects for industry and sporting clubs and efficiency programs for schools and households (DECCW 2010).

A few examples of recently funded projects include:

- Rainwater Harvesting for Woolworths Wyong
  With funding of $150,000, rainwater tanks will be installed at Woolworths Regional Distribution Centre in Wyong. These tanks will harvest, store and supply 90% of water needed for the centre's cool room cooling towers and truck washing. Smart meters will also be installed to ensure any leaks are detected immediately. The project is expected to save 12.8 million litres of water every year.

- Rainwater Harvesting for Elite Plug Production at Lowes TC
  With funding of $30,110, two 239,000 litre tanks will be installed at Lowes TC commercial nursery. The tanks will capture enough rain from the greenhouse roof area to replace more than 50% of its potable water use. The project is expected to save more than two million litres of water a year.

- Sulo MGB Water Saving Project for Factory Cooling Towers
  This is an example of an intelligent technology solution. With funding of $185,000, this manufacturing plant will save almost 7 million litres of drinking water a year by replacing existing condensing type cooling towers with cooling technology widely used in Europe and America. The project also

involves installing new rainwater tanks to harvest water for use in the new cooling system.

Business water efficiency partnerships

One of the most cost effective and successful ways to save large volumes of drinking water is to foster partnerships with business. In Sydney, business partnerships have been built with major industrial, commercial and institutional water users to enhance water efficiency.

The partnerships involve:

- Water management assessments to understand and improve water management
- Water efficiency audits to identify potential cost effective water saving opportunities
- Assistance in trials of new technologies and implementing commercially viable water saving projects

The data from Sydney Water's '*One to One Partnerships'* provides a clear indication of the success of these business partnerships. Due to the joint funding nature of this program, each dollar spent by a business and Water Authority can achieve double the water savings.

Since 2001, Sydney Water has worked in partnership with businesses and government organisations through targeted water efficiency projects to achieve sustainable water savings. 411 large water using businesses have signed up to their *Every Drop Counts Business Program*, achieving water savings of 23 GL/year to date (Sydney Water 2009b).

Rainwater tanks

Structural water conservation measures such as rainwater tanks mean demand for mains drinking water is permanently reduced. Recent studies show installing a 2250L water tank for non-drinking purposes can reduce household consumption of mains water by about 30 per cent (Marsden Jacob Associates 2007).

Householders and businesses obtain a range of benefits from rainwater tanks. These may include: reducing annual water bills, limiting the effects of water conservation on their lifestyle, increasing property values, and fostering an

improved sense of water stewardship. Rainwater harvesting has the added benefit of reducing power consumption, decreasing greenhouse gas emissions.

The use of rainwater tanks to supplement the existing water supply can also reduce localised urban flooding, improve stormwater quality and minimise the influx of stormwater into the drainage system. New housing estates in particular benefit as the cost of installing tanks is partially offset as less costly investment is required in the capacity of the stormwater system. Tanks also have environmental benefits for urban rivers and streams (with reduced storm water runoff, reduced sedimentation and bank erosion).

Rainwater tanks are a largely untapped option for water conservation in NSW. Currently, only 3.6 per cent of residents in the Lower Hunter harvest rainwater for non drinking uses. There are significant opportunities for improving this number.

Currently, the Commonwealth Government is delivering the National Rainwater and Greywater Initiative, providing rebates of up to $500 for households to install rainwater tanks or greywater systems, and grants to surf lifesaving clubs of up to $10,000 to install a rainwater tank or undertake a larger water saving project (DEWHA 2010).

Remove perverse price incentives for industry

For commercial and industrial water customers in particular price signals are critical to how business view their own water consumption. Water pricing needs to be designed in a way that encourages the sector to ‘do the right thing’ and use water more efficiently while also exploring alternative water supplies such as recycled water.

Currently in the Lower Hunter, industries do not have pricing incentives promoting water conservation but instead receive a discounted rate for using very large amounts of water. This tariff structure is perverse because it discourages efficient use and recycling. Changing this system, in consultation with major water users, would lead to increased incentives to recycle and conserve water.

There are numerous water recycling grants on offer by the Federal Government. There is also an ambitious target in the NSW State Plan (2010) that commits to increasing water recycling in NSW from 15 billion litres per year in 2005 to 70 billion litres of water per year by 2015.

Appropriate water pricing would encourage industry uptake to help reach these targets, while significantly reducing the amount of drinking water extracted from the Lower Hunter water supply system.

4.4 Water conservation for additional water supply

In addition to demand management opportunities, there are further water supply enhancements to be achieved through improved catchment management and the roll out of non-potable water recycling and reuse technologies.

Water recycling

Recycled water contributes to drinking water savings, as recycled water can be used without controversy for non-drinking purposes. Water is recycled when wastewater (stormwater, greywater or sewage) is treated and then supplied to farms, parks, golf courses, business, industry and homes for non-drinking uses. It can be used for a large number of purposes including irrigation, industrial cooling towers, toilet flushing, garden watering and clothes washing.

Significantly, wastewater recycling is not a rainfall dependent supply option. Therefore, increasing the portion of recycled water can reduce the impact of future droughts as it reduces demand on the drinking water supply (GWCWA 2007).

Currently in the Lower Hunter, recycled water accounts for an extremely low percent of annual water consumption, especially when considering business, medium industry and residential opportunities. There are billions of litres of drinking water to be saved through an increased uptake and funding for implementing water recycling technologies to limit unnecessary use of drinking water.

In order to drive investment, there are numerous water recycling grants on offer by the Federal Government. There is also an ambitious target in the NSW State Plan (2010), making a commitment to increasing water recycling in NSW from 15 billion litres per year in 2005 to 70 billion litres of water per year by 2015.

Box 2: Water recycling at Rouse Hill

Water Recycling Case Study – Rouse Hill, Sydney

In Sydney, recycled water is providing a source of town water supply to the Rouse Hill community. Here, recycled water is used for watering gardens, flushing toilets and other non-drinking uses. In 2009, NSW Health approved this recycled water to be used in washing machines. The scheme, which is Australia's largest residential water recycling project, supplies about 4.7 ML/day to over 18,000 homes and businesses (Sydney Water 2009). Building on the success of the Rouse Hill Recycled Water Plant, it has recently been expanded, giving it the capacity to provide recycled water to up to 36,000 homes in Rouse Hill and surrounding areas.

This scale of residential water recycling requires significant upfront financial investment, providing significant long term water savings. During the period 2005 to 2009, Sydney Water made a gross investment of over $61 million into the Rouse Hill Recycling Plant. Since 2005, the average drinking water savings have been about 1,614 million litres per year, with this number set to increase along with the recent expansion. This recycled water is directly replacing the need for drinking water.

Storm water harvesting

Harvesting, storing and reusing collected storm water is a growing area of interest for water authorities across Australia. There are potentially huge gains to be made as technology for storm water harvesting improves. A feasibility study is currently underway in the City of Sydney council for a major park in the metropolitan area. The outcome of this scheme will help assess the feasibility of other full scale schemes across Sydney Water's customer base.

The Gosford Wyong Councils Water Authority (2007) is also further developing their cost effective storm water harvesting projects to generate additional water for non-drinking purposes such as irrigation of parks and sporting facilities. A similar investigation could be taking place in the Lower Hunter.

Improved catchment management for water reliability

During the period of 2008 to 2010, Hunter Water was unable to fill the Grahamstown Dam due to poor catchment management resulting in a blue green

algal bloom. The Balikera Pump to Grahamstown Dam was not switched on due to concerns over water toxicity (Hunter Water 2010). The dam's storage levels dropped over this period, but there was no physical shortage of water in the catchment.

This example shows water toxicity and poor catchment management currently outweigh drought as the greater threat to the Lower Hunter's water supply. This threat will not be alleviated by building another dam.

Water quality management is a well recognised and integral role of any water supply authority. Prioritising a healthy catchment could significantly increase the yield of the Lower Hunter's current water supply capacities through improved water resource management.

5 The indicative cost of an alternate strategy

The financial cost of various water supply options is an important factor in determining the options to be adopted. In the Lower Hunter this is especially true, as there are proportionately higher numbers of low income earners and pensioners in the region. Hunter Water's residential customers have lower household incomes, on average, than Sydney Water's customers (IPART 2005).

As outlined in Section 3, ISF (2009b) produced two graphs to enable a comparison of projected water demand for the Lower Hunter to the year 2050. Figure 1 showed the water demand projection if Hunter Water is only to implement the legislated water conservation policies currently in place. The results showed water demand reaching water supply with a high population growth in 2040. Figure 2 showed the effect of implementing a range of demand management programs similar to those currently employed by Sydney Water. This resulted in demand staying well within supply at 2050, even with a high population growth.

The demand management effort would save a total 423GL of water from 2010 to 2050. The modeling assumes the demand management programs begin in 2010. The demand management programs would be saving 14GL/year in the year 2050.

5.1 How much would it cost the Lower Hunter?

In order for the Lower Hunter to reach the water savings modeled over the next 40 years, a concerted and appropriately funded effort would be required.

The cost of this effort can be extrapolated using the unit cost and estimated savings of the demand management programs underpinning the ISF and Acil Tasman (2006) Sydney Metro Water Plan Final Report 2006. These unit cost figures provided the basis of the 2006 Sydney Metro Plan, incorporating the same demand management programs used to produce the water savings modeled in Figure 4.

An average cost has been calculated to account for the expected water savings and unit costs to achieve those savings. Escalated to 2010 dollars, it would cost approximately **$0.40 per thousand litres** to reach the level of water savings modeled.

By applying this figure to the stream of savings estimates required until 2050, the cost of an alternate strategy for the Lower Hunter (similar to Sydney's) would be in the order of **$44 million** in present value terms.

To be clear, the demand management classes included in this cost estimate are: residential indoor, retrofits and rebates, residential outdoor, raintank rebates (residential and schools), non-residential, and pressure and leakage reduction.

On top of these programs there are opportunities for other non-potable supplies (as discussed above). Significantly, many of these options have existing funding schemes at a State and Federal government level, with grants and incentive funds to conserve water or to use stormwater and wastewater. The Lower Hunter could receive funding, draw on sustainable water sources and help the State and Commonwealth government to reach their water conservation targets.

These costed results clearly show there is an opportunity for Hunter Water to use the on-ground experience of Sydney's demand management implementation to initiate similar programs in the Hunter. At a cost of $44 million, (compared to current Tillegra Dam cost estimates of $477 million) it appears cost effective to do so.

5.2 Additional savings - green house gases

The cost data supplied above does not include the savings in energy bills that will occur as a result of using less water. Also worthy of consideration is the correlating reduction in greenhouse gas emissions through lowered energy requirements, especially through avoided hot water heating.

ISF (2009) estimate that by implementing this alternate demand management based strategy, the Lower Hunter would avoid emitting 1,539,000 tonnes of CO2 equivalent. This compares to the expected greenhouse gas emissions to occur as a result of building the Tillegra Dam of an additional 327,421 tonnes of CO2 equivalent over the first 20 years.

6 Water planning decision making and governance

Various reports have suggested that the Lower Hunter region has at least until 2032 to reassess water supply options, even with its large projected population increase (ISF 2009, DoP 2006, IPART 2005). By removing the currently perceived urgency around water planning for the Hunter, the NSW government and Hunter Water have time to conduct thorough research into water options and facilitate genuinely inclusive and informed community participation in urban water planning into the future.

6.1 The National Urban Water Planning Principles

There are water planning principles designed to assist this process. The Council of Australian Governments (COAG) adopted the National Urban Water Planning Principles in 2009. These principles were signed onto by the Federal government and all state and territory governments.

The Principles have been created to, “provide Australian governments and water utilities with the tools to better plan the development of urban water and wastewater service delivery in a sustainable and economically efficient manner” (DEWHA 2009). These are already being applied in NSW and form a basis for the current Metropolitan Water Plan for Sydney (NSW Government 2010).

The eight key water planning principles are listed below. Information has been included under headings where there is a direct relevance to current water planning for the Lower Hunter, especially in regards to demand management, water efficiency, community engagement, and catchment management for water quality.

Importantly, through these principles the NSW Government has agreed to select water sources resulting in the lowest environmental, social and economic costs over the long term. It agrees to consider the impact of possible demand management measures, and ensures that stakeholders are able to make an informed contribution to urban water planning, with consideration of the appropriate supply/demand balance.

The planning principles include:

1. Deliver urban water supplies in accordance with agreed levels of service.

2. Base urban water planning on the best information available at the time and invest in acquiring information on an ongoing basis to continually improve the knowledge base.

Knowledge of existing customers (including who is using water, how much and for what end uses, and an understanding of the differences between customers and geographic locations) is important when forecasting both future water demands by end users in a particular category of use, and the impact of the possible demand management measures under consideration.

3. Adopt a partnership approach so that stakeholders are able to make an informed contribution to urban water planning, including consideration of the appropriate supply/demand balance.

Stakeholder input is essential to ensure that the proposed levels of service and the supply and demand management options required to deliver that level of service are considered in terms of consumers' attitudes, including willingness and ability to pay.

Community information and education programs should be an integrated part of urban water planning and should be designed appropriately, based on community input, to increase knowledge, understanding and informed participation in urban water planning, as well as increase water efficient behaviours.

Urban water planning should be based on a process that is transparent and inclusive, recognising different consultation approaches are appropriate in different circumstances.

4. Manage water in the urban context on a whole-of-water-cycle basis.

Water quality of potable supplies should be protected through appropriate catchment management practices and management of wastewater. This will involve a range of activities, from land use planning and management that protects the quality of natural water resources, through to addressing the disposal, treatment and reuse phases of the water cycle.

5. Consider the full portfolio of water supply and demand options.

Selection of options for the portfolio should be made through a robust and transparent comparison of all demand and supply options, examining the social, environmental and economic costs and benefits and taking into account the specific water system characteristics.

Options considered could include the following:

- *optimising the use of existing infrastructure through efficiency measures*
- *residential, commercial and industrial demand management initiatives*
- *purchasing or trading water entitlements from other sectors, and*
- *development of additional centralised and/or decentralised water supply options, including manufactured water sources (such as recycling and /or desalination), where appropriate.*

These sources would be drawn upon in differing combinations depending on the local and regional climatic conditions, and the mix of sources selected would be those resulting in the lowest environmental, social and economic costs over the long term.

6. Develop and manage urban water supplies within sustainable limits.

7. Use pricing and markets, where efficient and feasible, to help achieve planned urban water supply/demand balance.

8. Periodically review urban water plans.

6.2 Other government commitments

According to the NSW State Plan (2010), the NSW government plans to: "Protect our native vegetation, biodiversity, land, rivers and coastal waterways, [through meeting] state–wide targets for natural resource management to improve biodiversity and native vegetation, sensitive riverine and coastal ecosystems, soil condition and socio–economic wellbeing."

Meanwhile, the threat of Tillegra Dam has begun to appear in international media as part of the United Nations International Year of Biodiversity. UK research has identified Tillegra Dam as one of the largest current threats to wetland and river biodiversity in Australia (Chapron et. al. 2010).

The Lower Hunter Regional Strategy (DoP 2006) identified the projected population growth and corresponding development as key environmental challenges, acknowledging the need for:

- protecting and managing the biodiversity and conservation values of the key green corridors of the Region
- maintaining or improving the biodiversity value of the Region
- protecting the rural character and viable agricultural lands of the Region

Based on the environmental impact assessment of the proposed Tillegra Dam (outlined in the following section), it would appear the impacts of building Tillegra Dam are in direct conflict with the Regional Strategy.

7 Community engagement in water planning

State and Federal Governments recognise the importance of stakeholder and community engagement in urban water decisions through the COAG principles. Delivering water services based on 'levels of service' agreed with the community is the first of the COAG principles and the third principle highlights three areas were stakeholder input is 'essential', these being:

1) Setting the 'level of service'
2) Deciding on the supply and demand management options required to deliver that level of service
3) In relation to customers willingness and ability to pay for the 'level of service'.

7.1 Drought management planning and the 'level of service'

In their key paper for the Water Services Association of Australia (WSAA) on urban water supply planning, Erlanger and Neal (2005) define the 'level of service' as *"the frequency, severity and duration of water restrictions that a community can expect"* (Erlanger & Neal 2005). Setting an agreed 'level of service' therefore requires a choice from customers between the frequency, severity and duration of water restrictions and the amount of their money spent on water services.

Erlanger and Neal (2005) point out that, "restrictions will be required from time to time in Australia because of the variability of rainfall, unless water supply systems are 'gold plated'". It is therefore important that water utilities seek community input into 'willingness to accept' drought measures and 'willingness to pay' for increased drought security (Erlanger and Neal 2005)

Setting the agreed levels of service for a water system is then intrinsically linked to drought management. All major water utilities in Australia have drought management documents that set out a drought plan with information about water restrictions and drought contingency options. These plans include trigger points for restrictions and contingencies, as well as the water savings that can be expected at various levels of restrictions, and the volumes that might be expected from the contingency options. The defining feature of drought contingency options is that that are supply options that are planned for but not built until, like water restrictions, a predefined drought trigger point is met.

Drought management alternatives in the Lower Hunter include different configurations of water restrictions as well as various contingency options.

In its pricing submission to IPART in October 2008 (Hunter Water Corporation 2008), Hunter Water identified their alternative drought security measures to the

Tillegra Dam as being additional bores in the sand beds at North Stockton and Tomago, followed by desalination. These drought security measures had a present value cost of $155 million in 2008 (Hunter Water Corporation 2008) presumably in risk-weighted dollar terms. This would be consistent with a need to trigger the construction of the desalination plant as the result of drought only once in every 600 years (ISF 2009 referencing Hunter Water modeling).

There are also other drought contingencies available to the Lower Hunter that have not been considered by Hunter Water. In a supplementary submission to the Tillegra Dam Environmental Assessment in April 2010 (obtained in a NSW Upper House 'call for papers') the NSW Office of Water stated that:

> There appear [to be] other drought options available to Hunter Water including:
> - The purchase of existing water licenses from upstream water users in the Williams River,
> - Securing access to water from other water authorities such as State Water. It should be noted that during the worst drought on record for Hunter water, the Upper Hunter Dams (i.e. Glenbawn Dam and Glennies Creek Dam) would have been between 80% and 90% of storage capacity based at their current size

Lostock storage is a similar option. Further, when the Mardi-Mangrove pipeline on the Central Coast is completed, the Lower Hunter will, at no additional cost, gain the drought management option of buying water through the existing Hunter-Central Coast pipeline.

Including any of these other drought contingency options in the Lower Hunter's drought management plan would reduce the (already low) chance of triggering the need for a desalination plant still further.

If the Tillegra Dam is built there would be a one in 1,250 years chance of entering first level water restrictions in the Lower Hunter. The Tillegra Dam proposal is then a massive 'gold plating' of the supply system without full consideration of the alternatives, and without stakeholder and community input to determine the agreed 'levels of service'.

These two issues have even been raised by IPART. In its 2009 price determination the regulator noted that the NSW Government had prevented it from examining alternatives to the Tillegra Dam proposal, and stated that the "very high level of drought security" provided by building Tillegra Dam had not been coupled with "evidence regarding the value of customers' willingness to pay for this increased level of security" (IPART 2009).

7.2 The Lower Hunter process

It is illustrative to consider the different approach to water planning undertaken by Hunter Water in comparison to that of other water authorities and that adopted under the National Urban Water Planning Principles. A very brief overview of the process shows a lack of necessary community engagement. Hunter Water's current water planning document, the H250 Plan, admits that the Tillegra Dam was an external decision made without community consultation, describing "the announcement in November 2006 by the New South Wales Government of the proposal to construct a new dam" (Hunter Water 2008).

Following the late 2006 announcement, Hunter Water established the Tillegra Dam Community Reference Group (TDCRG) in 2007. The name of this group indicates the predetermined water supply option on which discussions would be based. The stated purpose of this group was to "facilitate the flow of information between HWC and the local community, support the community engagement process and, where necessary, to provide advice to facilitate improved Project [Tillegra Dam] and community outcomes." (Hunter Water 2009).

Hunter Water published a justification paper in 2007, entitled '*Why Tillegra Now?*' It provided a section comparing options for new supply sources. This paper did not openly overview any environmental impacts of the Tillegra Dam proposal, simply stating, "The dam would inundate around 2000 ha of predominantly cleared farming land" (Hunter Water 2007).

It was not until the Environmental Impact Assessment of the Tillegra proposal was released in 2009 that the community was able to see a more detailed list of the environmental and socio-economic impacts of the proposed dam. This paper did not allow for a comparison of the potential impacts of other future water supply options, only detailing the Tillegra Dam proposal. Some of the impacts and impact-inducing processes listed in the assessment include:

- The permanent presence of a significant barrier within the Williams River, i.e. the dam wall and its storage
- The loss of approximately 19 kilometres of existing aquatic and riparian habitat upstream of Tillegra (i.e. the location of the dam wall) through inundation
- Changes to the existing hydrological regime affecting downstream aquatic habitats, particularly between Tillegra and the confluence with the Chichester River
- The water quality of releases made from the storage. This is especially significant where there are significant differences between the water

> quality of the storage and that downstream of the dam, with this especially important in the reach above the confluence with the Chichester River (Hunter Water EA 2009)

The EIA summary goes on to state that the "Tillegra Dam project would achieve acceptable environmental and social outcomes, deliver substantial economic benefits and provide drought security well into the foreseeable future. The Project is, therefore, considered justified" (Hunter Water EA 2009).

Unlike the Sydney, Brisbane and Melbourne water authorities, Hunter Water has not provided any costed information about concerted demand management and water conservation options for the future water security of the Lower Hunter.

In 2010, Ron Robson, Chairman of Hunter Water, sent a letter to the No Tillegra Dam Group stating, "Opponents to the Tillegra Dam have not offered detailed, costed alternatives to the Dam" (Robson 2010). It could be inferred from this comment that Hunter Water is not aware of the National Urban Water Planning Principles, especially the requirement for a "robust and transparent comparison of all demand and supply options" (DEWHA 2009).

7.2 CASE STUDY: Central Coast community engagement

Hunter residents do not need to look far to see clear examples of good water planning process involving genuine community consultation. In 2007, the Gosford/Wyong Councils' Water Authority (GWCWA) undertook a process to decide on the future balance of water supply and demand in their region.

To produce their Water 2050 water plan, they seriously considered the government guidelines at the time, including a focus on:

- demand management;
- drought management; and
- integrated water cycle management (GWCWA 2007b)

Community responses and inputs from public consultation (prior to any major water planning decisions being made) were taken into consideration in the completion of the WaterPlan 2050. A community consultation process was developed for deciding on the future options, the agreed 'level of service', and how the community would like to balance various costs involved with each option.

The consultation process included focus group meetings, community presentations, media advertising, fact sheets, community surveys and the establishment of a Community Liaison Group (GWCWA 2007).

A *Preliminary Working Draft* was created to provide 10 possible options that could help secure the water supply system over the next 45 years. Each option was reviewed in a one page overview to assess how much additional water could be harvested, potential drought recovery times, likely costs, benefits, challenges and environmental and social impacts.

The consultation outcomes

The key themes emerging from the community consultation were the need for continual gains in water efficiency, reuse, long-term sustainability, affordability and long-term supply security (GWCWA 2007b). Respondents favoured demand reduction measures, the continued use of recycled water for non-drinking purposes, the plan to link Wyong River and Mardi Dam to Mangrove Creek Dam, and the retrofitting of rainwater tanks.

Certain options proved to be very unpopular. The Central Coast community called for four options to be discarded, finding them unacceptable due to the financial, social and environmental costs of supply. These options included impacts such as additional road construction, unacceptable environmental impacts on farming land, and the loss of more than 100 hectares of forest.

Significant changes to stream flows, fish ways and river bed movements were found to be of concern to the community, as were flow on effects to downstream river systems.

The final decision not to pursue these options was also based on feedback from the local Councillors and further technical reviews. No one option was seen to be the answer to water supply, with the water authority leaving room for future engagement:

> GWCWA understands that future generations may have access to new technology or approaches to securing our water supply and may face different challenges, so it has developed a staged approach. The GWCWA needs to consider a combination of options to gain early benefit for our system and maintain the greatest flexibility and opportunity for the future (GWCWA 2007).

8 Conclusions and ways forward

There are a variety of proven and cost effective water saving options being rolled out by water authorities across Australia. These programs can be transferred to the Lower Hunter to ensure long term water availability. The options provided in this paper are taken from real life examples effectively undertaken by other water authorities. They are jobs rich, inexpensive and likely to be very popular, based on other community water planning feedback.

At a cost of about $44 million (2010 dollar value), the Lower Hunter could implement a demand management and water conservation based water strategy. This would meet the water needs of a growing Lower Hunter population until at least 2050. This can be achieved with far lower financial, social and environmental costs to the region than the proposed $477 million Tillegra Dam option.

There is flexibility in making these relatively small investments in demand management and water conservation programs over coming years. Such options can meet demand as it grows and are likely to become increasingly effective as the technology improves. They also provide significant savings in greenhouse gas emissions, likely to be increasingly important in the future.

There is ample time for the community to be able to be genuinely included in water planning and decision making in the Lower Hunter. The Federal and State governments have committed to this through the COAG agreement, signing on to the National Urban Water Planning Principles to ensure stakeholders are able to make an informed contribution to urban water planning, including consideration of the appropriate supply/demand balance.

Hunter Water now has the opportunity to act on these principles – engaging the Lower Hunter community in producing a water strategy for the future, undertaking robust and transparent water planning, and allowing the costs and benefits of all water supply options to be considered.

9 References

Acil Tasman and Institute for Sustainable Futures 2006, *Review of the Metropolitan Water Plan: Final Report*.
http://www.waterforlife.nsw.gov.au/__data/assets/pdf_file/0016/1483/isf_acil_review_april06_final_1.pdf

Aurecon 2009, *Tillegra Dam Planning and Environmental Assessment - Volume One Environmental Assessment Report*, for Hunter Water Corporation under Part 3A of the Planning and Assessment Act 1979.
http://majorprojects.planning.nsw.gov.au/files/40178/Tillegra%20Dam%20EA%20Vol%201%20-%20Cover%20Page%20and%20Executive%20Summary.pdf

Centre for International Economics 2005, *Direct Costs of BASIX compliance for multi unit dwellings*.

Chapron, G. Ottery, C. Holmes, T. Monbiot, G. and Randerson, J. 2010, *Biodiversity 100: actions for Australia*, Guardian News and Media Limited 2010.
http://www.guardian.co.uk/environment/2010/oct/04/biodiversity-100-actions-australia

Department of Environment Climate Change and Water 2010, *Central Coast Water Savings Fund*.
http://www.environment.nsw.gov.au/grants/ccwsf.htm

Department of Environment Water Heritage and the Arts 2009, *National Urban Water Planning Principles*.
http://www.environment.gov.au/water/policy-programs/urban-reform/nuw-planning-principles.html

Department of Environment Water Heritage and the Arts 2010, *National Rainwater and Greywater Initiative*.
http://www.environment.gov.au/water/programs/nrgi/index.html

Department of Planning 2006, *Lower Hunter Regional Strategy, through the* State of New South Wales.
http://www.planning.nsw.gov.au/PlansforAction/Regionalplanning/HunterRegion/tabid/187/language/en-AU/Default.aspx

Erlanger, P. & Neal, B. 2005, *Framework for Urban Water Resource Planning – Occasional Paper no. 14*, Water Services Association of Australia.

Gosford/Wyong Councils' Water Authority 2007, *Water Plan 2050 - A long term water supply strategy for the Central Coast*.
http://www.gwcwater.nsw.gov.au/images/PDF/WaterPlan/wsc_waterplan_2050_adopted.pdf

Gosford/Wyong Councils' Water Authority 2007b, *Water Plan 2050 - Options Report for the Long Term Water Supply Strategy*.
http://www.gwcwater.nsw.gov.au/images/PDF/WaterPlan/waterplan2050_options_270508.pdf

Hunter Water Corporation 2003, *Integrated Water Resource Plan*

Hunter Water Corporation 2006, *Integrated Water Resource Plan – Report to IPART*.

Hunter Water Corporation 2007, *Why Tillegra Now?*

Hunter Water Corporation, 2008, Submission to IPART on prices to apply from 1 July 2009, Hunter Water Corporation, October 2008

Hunter Water Corporation 2009, *Hunter Water's Annual report 08/09, Section 9 – Statistical Information*.
http://www.hunterwater.com.au/files/Annual_Report_0809_Chapter_9.pdf

Hunter Water Corporation 2009b, *Tillegra Dam Environmental Assessment Volume 1 - Cover Page and Executive Summary*.

Hunter Water Corporation 2010, *Open Board Report, Water and Wastewater Performance Report – May 2010*.
http://www.hunterwater.com.au/files/open-board-agenda-papers-24-june-2010.pdf

Independent Pricing and Regulatory Tribunal of New South Wales 2005, *Prices of Water Supply, Wastewater and Stormwater Services – Final Report*.
http://www.ipart.nsw.gov.au/files/Final%20Determination%20and%20Report%20%20SWC%20HWC%20SCA%20-%20website%20document.PDF

Independent Pricing and Regulatory Tribunal of New South Wales 2009, *Review of prices for water, sewerage, stormwater and other services for Hunter Water Corporation: Water – Draft Determination and Draft Report*.

Institute for Sustainable Futures 2009, *An Assessment of Green House Gas Emissions from the proposed Tillegra Dam*, University of Technology Sydney, for The Wilderness Society.

Institute for Sustainable Futures 2009b, *An Independent Review of the Need for Tillegra Dam*, University of Technology Sydney, for The Wilderness Society.
http://www.isf.uts.edu.au/publications/faneetal2009tillegrareview.pdf

Kingsford, R. and Hankin, C. 2010, *The Impact of the proposed Tillegra Dam on the Hunter River Estuary, its Ramsar wetlands and migratory shorebirds*, University of New South Wales and the Australian Wetlands and River Centre.

Marsden Jacob Associates 2007, *The cost-effectiveness of rainwater tanks in urban Australia*, on behalf of the National Water Commission.

Naji, F. and Lustig, T. 2005, *On-Site Water Recycling- A Total Water Cycle Management Approach*.
http://www.uniofwollongong.biz/science/chem/aquarec/icwr/x/Naji.pdf

NSW Government 2010, *NSW State Plan 2010, Chapter 5: Green State*.
http://www.nsw.gov.au/sites/default/files/pdfs/chapters/5.%20Green%20State_WEB.pdf

NSW Office of Water, NSW Office of Water Comments on HWC submissions report, Tillegra dam project (MP 07/0156), Attachment A, April 2010

Robson, R. 2010, *Letter to Linda Bowden dated 6 August 2010*, endorsed by the Hunter Water Board of Directors.

Sinclair Knight Merz 2008, *Review of Yield Estimates for the Hunter Region - Final Report, IPART NSW.*
http://www.ipart.nsw.gov.au/files/Consultant%20Report%20-%20SKM%20-%20Review%20of%20Yield%20Estimates%20for%20Hunter%20Region%20-%20Final%20Report%20-%2012%20December%202008%20-%20WEBSITE%20DOCUMENT.PDF

Sydney Water 2009, *BASIX Water Saving Monitoring, for the NSW Department of Planning as part of the BASIX Water Monitoring Project Data Sharing Agreement*.
http://www.basix.nsw.gov.au/docs/monitoring/water_monitoring_report-2008-09.pdf

Sydney Water 2009b, *Water conservation and Recycling Implementation Report 2008-09*.
http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=Reports/WaterConservationAnnualReport.pdf

Sydney Water 2010, *Online Plant Selector*.
http://www.sydneywater.com.au/Water4Life/Inyourgarden/PlantSelector/

The Wilderness Society Newcastle
90 Hunter St
Newcastle NSW
(02) 49294395
newcastle@wilderness.org.au