Submission
No 52

INQUIRY INTO A SUSTAINABLE WATER SUPPLY FOR SYDNEY

Organisation:	Total Environment Centre
Name:	Leigh Martin
Position:	Urban Campaigner
Telephone:	02 9299 5599
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Subject:

Summary

TOTAL ENVIRONMENT CENTRE INC.
LEVEL 2, 362 KENT STREET, SYDNEY, NSW 2000
Ph: 02 9299 5599 - 02 9299 5680 Fax 02 9299 4411
www.tec.org.au

General Purpose Standing Committee No 5
Inquiry into a sustainable water supply for Sydney

Total Environment Centre (TEC) welcomes the opportunity to comment on options for a sustainable water supply for Sydney. With the recent shelving of the unnecessary and unsustainable desalination plant at Kurnell the opportunity now exists for Sydney to embrace a sustainable long term solution to water supply and demand challenges.

TEC strongly believes that sustainable water management for Sydney requires a combination of demand management, pricing reform, rainwater tanks and recycling of treated sewage effluent. TEC acknowledges that there has been progress in some of these areas such as pricing reform and water use efficiency through the introduction of BASIX. There remains, however, enormous scope for improvement in all areas of urban water cycle management.

In 2004 the Peak Environment Non-Government Organisations (PENGOs) comprising TEC, Nature Conservation of NSW, Australian Conservation Foundation, National Parks Association, Colong Foundation for Wilderness and Sydney Coastal Councils Group released *Sydney's Water – Going to Waste?,* the report of the fourth Sydney Water Project. The project reviewed Sydney Water's *Water Plan 21* and provided a range of recommendations for reform. These recommendations were designed to prevent the need for an environmentally destructive new dam on the Shoalhaven River at Welcome Reef; recognise the imperatives of climate change; and place urban water cycle management in Sydney on a sustainable footing. These recommendations would create an 'invisible dam' consisting of demand management, rainwater tanks, effluent re-use and other water conservation measures.

Key recommendations included:

- setting the sustainable yield of the catchments at 500 gigalitres (GL) per year to allow 100 GL for environmental flow purposes,
- a major shift to large scale effluent reuse for both new urban release areas and the existing metropolitan area,
- permanent low level water restrictions on specified outdoor uses,
- revising security of supply criteria relating to acceptable frequency of additional water restrictions from 97% to 95% to provide water for environmental flows (with consideration given to further revision to 90%),
- reforming pricing arrangements to reflect environmental costs and introduce step pricing for residential customers to encourage water conservation,
- introducing a wholesale step price to penalise Sydney Water for any bulk water purchases in excess of demand management targets and remove perverse incentives to under invest in demand management,
- improving the water efficiency of new and existing homes by mandating minimum standards of water efficiency,
- ensuring widespread adoption of rainwater tanks

These recommendations remain valid and we urge the Committee to examine the full report. A copy is attached to this submission.

TEC has also developed a strategy for a major indirect potable reuse strategy recycling highly treated effluent from western Sydney sewerage treatment plants via prospect reservoir. A copy of this strategy is also attached for the Committee's consideration.

Yours sincerely

Leigh Martin
Urban Campaigner

TOTAL ENVIRONMENT CENTRE

THE SUSTAINABLE ALTERNATIVE TO DESALINATION

In 2004 the Peak Environment Non-Government Organisations (PENGOs) released *Sydney's Water – Going to Waste?,* the report of the fourth Sydney Water Project (PENGOs, 2004).[1] The project reviewed Sydney Water's *Water Plan 21* and provided a range of recommendations for reform. These recommendations were designed to prevent the need for an environmentally destructive new dam on the Shoalhaven River at Welcome Reef; recognise the imperatives of climate change; and place urban water cycle management in Sydney on a sustainable footing. These recommendations would create an 'invisible dam' consisting of demand management, rainwater tanks, effluent re-use and other water conservation measures.

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- improving the water efficiency of new and existing homes by mandating minimum standards of water efficiency,
- ensuring widespread adoption of rainwater tanks through increased incentives.

Since the release of this report a number of changes have been made to the management of urban water in Sydney. Some of these have been positive steps toward sustainability while others are regressive and environmentally damaging. This current review assesses progress to date and responds to new government proposals.

[1] See http://www.tec.org.au/member/tec/projects/UrbanESD/swgw1.html

Pricing

The NSW Independent Pricing and Regulatory Tribunal (IPART) has recently released a pricing determination recommending phased increases in the price of water from 1 October 2005 to 30 June 2009 (IPART, 2005), including step (or inclining block) pricing for residential customers. Customers using in excess of 400 kilolitres per year will pay a higher price for each additional kilolitre. This will be coupled with a reduction in fixed charges to provide increased incentives to conserve water. The Tribunal did not, however, recommend a wholesale step price.

Recycling and Water Conservation

The NSW Government has introduced the BASIX scheme to mandate water and energy standards for new homes. This will be extended to all existing properties sold after 1 July 2007. The rainwater tank rebate scheme has also been extended.

In its October 2004 Metropolitan Water Plan *Meeting the Challenges – Securing Sydney's water future* (DIPNR, 2004) the NSW Government also announced requirements for local Councils and the top 200 water using businesses in the Sydney metropolitan area to prepare water efficiency plans by March 2006 and implement efficiency measures by September 2007. A $30 million per annum Water Savings Fund was also established to businesses and local government to implement water conservation projects.

As part of this plan the NSW Government announced that non-potable reuse schemes would be developed in new urban release areas to reduce demand on drinking water supplies. It should be noted, however, that the claimed 70GL saving will take a long time to eventuate, meaning that Sydney's water management will be unsustainable for decades. (However this does not mean that the greenfield sites should not adopt reuse, stormwater harvesting and other efficiency measures as reviewed by the PENGOs.) [2]

These are to varying degrees, important steps toward curbing demand and moving towards greater sustainable water management. The gains are diminished, however, by other aspects of the government's metropolitan water plan.

Extra Dam Capacity

Of particular concern are increased water transfers from the Shoalhaven Dam and the raising of Tallowa Dam. These measures simply transfer the impact of Sydney's unsustainable water use practices to another river system. A key weakness of this strategy is its dependence on rainfall in a warming climate where rainfall is likely to be increasingly unreliable, particularly in the Blue Mountains catchments. Development of capacity to extract water from the bottom of dams that is currently unobtainable provides only a short term fix (although it does increase water availability) and also fails to address the problem of less reliable rainfall. Further it does not reuse urban water (and the investment with it), rather it releases more waterborne wastes into the coastal environment.

[2] The CRC for Water and Waste Technology undertook Life Cycle Assessments of various reuse scenarios and reported major environmental savings, including by recycling off site. The results are found in *Sydney's Water – going to waste?* (PENGOs, 2004)

Desalination

Perhaps the most environmentally regressive measure of this set of responses being undertaken by the state government is the current push for a desalination plant at Kurnell in Sydney's south east. Desalination reinforces 'one use' of water – the most devastating impact on water cycle management.

Such a plant would require massive quantities of electricity to drive the desalination process, thus increasing greenhouse emissions and exacerbating the effects of climate change. Indeed former NSW Premier Bob Carr is on record as referring to desalinated water as "bottled electricity".

Other serious environmental concerns are the mortality of young fish and other marine life entrained with or impinged against screens when the seawater is taken up through the desalination plant intakes. It is considered impractical for plants of over about 80 ML/d to use the safer approach of seabed filtration of seawater. Careful design of the desalination plant effluent outfall is also required so that the highly saline, deoxygenated reject water does not accumulate and cause anoxia of marine life. Chemicals used during the desalination process may also result in harm to marine ecosystems, such as disinfection by-products (California Coastal Commission, 2003). Further, blooms of jellyfish may well be impinged against intake structures and not only be killed but potentially shut down the plant due to blockages (Ashbolt. N, pers comm)

To date the government has not been able to adequately address these concerns, stating only that desalination is "beyond public debate".

AN ALTERNATIVE RESPONSE

The recommendations of the fourth Sydney Water Project provide a viable and sustainable alternative in the medium term to desalination and inter-basin transfers. The new leadership of the NSW Government must adopt a more visionary approach and embrace the need for major reform to achieve sustainable water cycle management. In particular the government must adopt large scale effluent recycling as a more sustainable and cost effective solution.

For example, recent government research shows 48% support for 'shandying' recycled water with current supplies by returning highly treated water to Warragamba Dam. This is a very significant result given that the government has made no attempt to promote this concept and has, in fact, been publicly antagonistic to indirect potable reuse. It is clear that a more formal and independent public consultation on this option is warranted.

One of the driving forces behind the push for desalination is the Government's fear that the present drought will persist and that an alternative supply must be produced as a matter of urgency. Analysis of data from Sydney Water's 2004 Annual Report (SWC, 2004) reveals that the 'shandying' option or indirect potable reuse of effluent from western Sydney STPs could provide a viable and environmentally sustainable alternative to desalination.

The NSW Government has recently asked three consortiums to submit proposals for three sizes of desalination plant: 125 megalitres (ML) per day or 45.5 GL per year, 200 ML per day or 72.8 GL per year and 500 ML per day or 182 GL per year (Hansard NSW Legislative Assembly,

2005). The largest of these should be seen as an unrealistic and highly expensive ambit claim. If built its 182GL per annum output would equate to 29% of current (pre-restrictions) demand of 630GL per annum. Capacity in excess of demand would represent a major stranded investment that would require a major increase in water bills to fund. There is also a serious danger that in order to pay for such a plant water users would be encouraged to use more water and that demand management and future recycling options would be abandoned. This would sacrifice progress achieved in recent years toward demand management and sustainable water cycle management.

Indirect potable reuse

At present almost 49 GL per year of treated effluent is discharged into waterways in Western Sydney each year (Table 1). Apart from one small STP at Richmond which uses secondary treatment with disinfection and one small STP at Blackheath which uses secondary treatment and microfiltration all of this effluent is tertiary treated and disinfected. If approximately 72% of this effluent was further treated to drinkable standard and utilised for indirect potable reuse it would immediately render a desalination plant unnecessary by producing 35GL of drinkable water per year.[3] This represents 5% of current sustainable yield. This means that slightly less than 6% of annual consumption would come from reuse water.

A number of options exist for such an approach. Treated effluent could be redirected into Warragamba Dam or into Prospect Reservoir. Alternatively effluent from some STPs could be directed to Warragamba and some to Prospect. Final choice of approach would depend on assessment of costs and benefits.

If directed into Prospect Reservoir 35GL per annum would represent approximately 0.67GL per week into a reservoir with a capacity of 13GL (i.e. approximately 5.2% of its capacity). Further dilution would occur as it is fed into the delivery system throughout Sydney. This is more equitable than having only a proportion of customers receiving reuse water and is less than the planned 14% indirect potable reuse for the expanding Singapore water supply system. It is important to note that such recycled water would be of higher quality than the raw (Hawkesbury River) water currently treated at the North Richmond water filtration plant for North West Sydney's sole drinking water supply.

It should be noted that the government is already proposing a recycled water pipeline linking the Western Sydney STPs and could gravity feed to Prospect Reservoir, saving more energy. This water would then go to the Prospect Water Filtration Plant (which treats water from Warragamba) where it would be (again) treated from a high quality level, now to drinkable standard. The Prospect WFP already takes water out of Prospect Reservoir a few times a year (to improve its quality) and during peak water demand by Sydney, hence no further modification to the WFP would be required.

A second stage could increase water availability by 23GL pa, (72% of current output) if the Liverpool and Glenfield STPs are brought into the system. The plants would have to be upgraded to tertiary treatment plus disinfection, as already appears the case with the proposed dual

[3] This allows no reliance on secondary treatment plants at Richmond and Blackheath; or the small Mt Victoria STP; and the possibility of varied outputs from year to year.

reticulation to the south west sector.[4] This would increase indirect potable reuse in Prospect to 8.6% or 9.7% of present annual sustainable yield.

Permanent Water Restrictions

Other options which could be immediately employed to avert the construction of an unsustainable and expensive desalination plant include permanent water restrictions and increased uptake of rainwater tanks and/or domestic greywater recycling systems.

Since the introduction of mandatory restrictions on 1 October 2003, consumption has been reduced by 10% of the 10 year average saving to around 63GL (DIPNR, 2004). This points to the contribution that permanent restrictions (such as have been adopted in Melbourne and Adelaide) could make. Permanent restrictions would include restrictions on outdoor water use, no hosing of hard surfaces and requirements that cars and boats must be washed with a bucket, trigger nozzle, or low volume, high pressure cleaner. Such an approach should be further supported with public information and incentives, like whitegoods star branding for low water-using plants and irrigation systems.

While permanent restrictions would be less stringent than those currently in place, even restrictions that were less that two thirds as effective would save 40 GL per annum. The actual type of permanent restrictions adopted should be set at such a level so as to save at least this volume of water, reflecting the essential move to more sustainable water use practices and cultural change amongst users in response to the challenges of recent years. Reducing security of supply criteria to allow more frequent higher level restrictions would further reduce consumption. Significantly a household survey conducted for IPART in late 2004 as part of the metropolitan water price review found that 70% of respondents supported some form of permanent water restrictions (IPART, 2005).

Taken together, 35GL per annum from Western Sydney STP's and 40GL per annum from permanent restrictions equates to 75 GL per annum, thus providing a viable and sustainable alternative to 45.5GL and 72.8GL desalination plants. When the second STP phase is added in, this results in 98GL or 16.3% of present sustainable yield.

Conclusion

Addressing Sydney's water supply problems requires both an immediate drought response and a longer term rebalancing of the supply and demand equation. The recommendations of the 4th Sydney Water Project provide sustainable long-term solutions including increased environmental flows and recycling.

The immediate drought response should include development of indirect potable reuse from Western Sydney STPs; consideration of incentive programs for domestic greywater recycling and permanent outdoor water restrictions.

Concerns about using treated wastewater should be alleviated by the fact it is treated twice by high standard plants and diluted twice.

[4] These STPs would have been used for recycling if the Georges River recycle pipeline scheme proposed in 2004, had been constructed.

Table 1: Annual Discharge Volumes From Western Sydney Sewage Treatment Plants (STPs)

Treatment Plant	Annual discharge (GL)
Hawkesbury-Nepean catchment	
North Richmond	0.3276
West Camden	3.1304
Richmond	0.0728
Penrith	8.0808
Warragamba	0.1238
Total for catchment	**11.7354**
Blue Mountains catchment	
Blackheath	0.3349
Glenbrook	1.2012
Mt Victoria	0.0473
Winmalee	5.4964
Total for catchment	**7.0798**
South Creek catchment	
Quakers Hill	11.7936
St Marys	12.5944
Riverstone	0.6916
Total for catchment	**25.0796**
Cattai Creek catchment	
Castle Hill	2.5116
Rouse Hill	2.5844
Total for catchment	**5.0960**
Total for Western Sydney STPs	**48.9908**

Source: Sydney Water Annual Report 2004 Environmental Indicators Report Volume 1 (SWC, 2004)

References

California Coastal Commission (2004). Seawater Desalination and the Californian Coastal Act

Department of Infrastructure, Planning and Natural Resources (2004) "Meeting the challenges. Securing Sydney's water future", DIPNR.

Independent Pricing and Regulatory Tribunal (2005) "Sydney Water Corporation, Hunter Water Corporation, Sydney Catchment Authority. Prices of Water Supply, Wastewater and Stormwater Services. Final Determination and Report", IPART.

Hansard NSW Legislative Assembly (2005) Comments by Premier Hon Morris Iemma MP 20/9/05, NSW Parliament.

Peak Environment Non-Government Organisations (2004) "Sydney's Water – Going to Waste? Project Report 4th Sydney Water Project" , Australian Conservation Foundation, National Parks Association, Nature Conservation Council, Sydney Coastal Councils Group, Colong Foundation, Total Environment Centre.

Sydney Water Corporation (2004) "Sydney Water Annual Report 2004", SWC.

TOTAL ENVIRONMENT CENTRE
Level 2, 362 Kent Street
Sydney 2000
Ph: 02 9299 5599
www.tec.org.au

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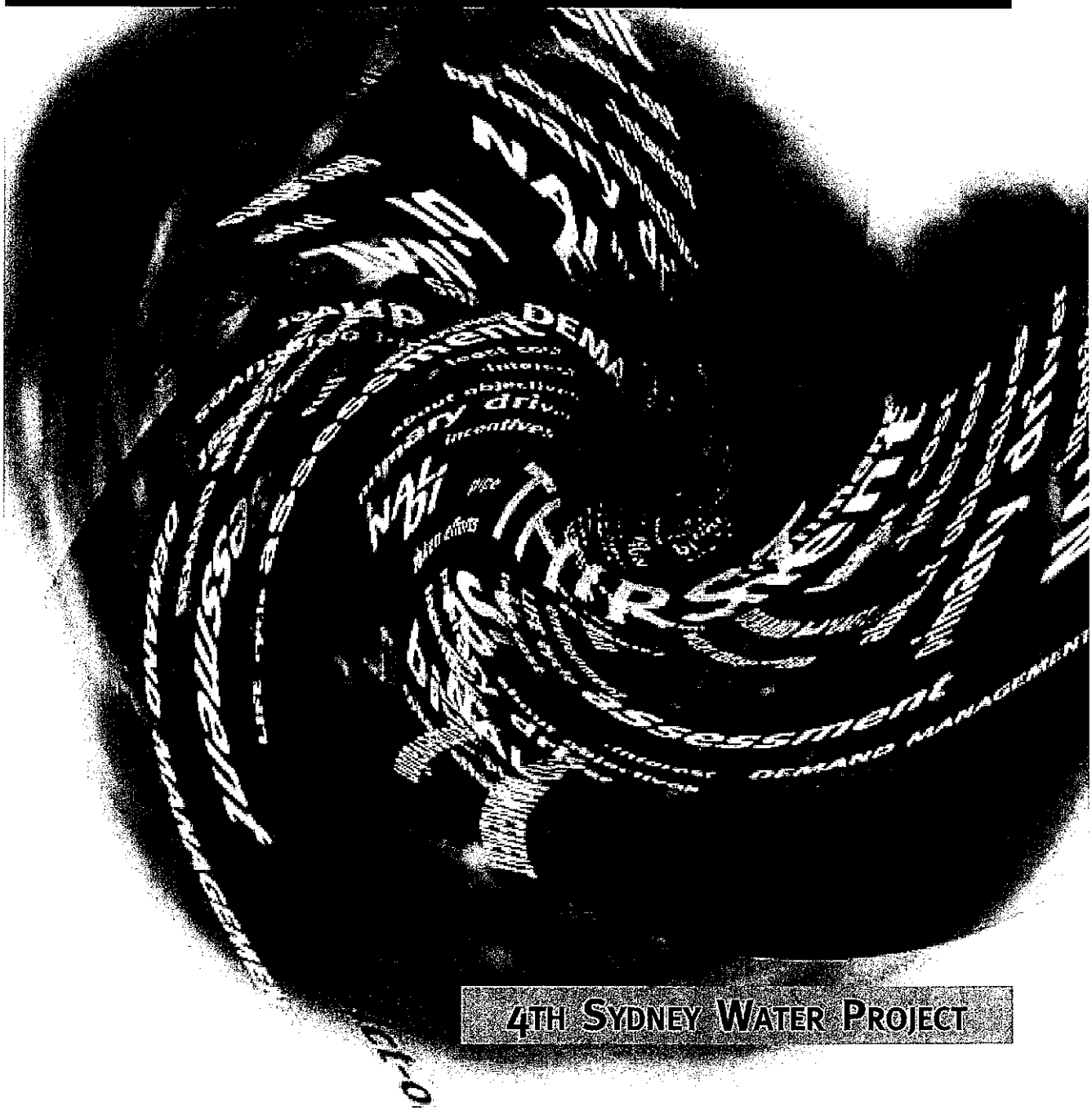
SYDNEY'S WATER ~ GOING TO WASTE ?



4TH SYDNEY WATER PROJECT

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report for the 4th Sydney Water Project
written by Michael Dean and Ellen O'Brien.

The **PENGOs** acknowledge the assistance and contributions of:

Members and observers on the project steering committee: Jeff Angel, Ross Coster, Brigid Dowsett, Tom Fink, Brooke Flanagan, Rebecca Hamilton, Leigh Martin, Peter Prineas, Kathy Ridge, Les Sedden, Geoff Withycombe

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Project consultants: Michael Dean (PENGO PROJECT MANAGER), Peter Coombes (UNIVERSITY OF NEWCASTLE) Paul Beavis and Sven Lundie (CENTRE FOR WATER AND WASTE TECHNOLOGY, UNSW), Ellen O'Brien (ENVIROSTRATEGY), Graham Mawer and Robyn Roy (NEXT ENERGY), Jenny Kent and Jill Merrin (PENGO SCA PROJECT), Jennifer Shanley (COUNTERDESIGN).

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PEAK ENVIRONMENT NON-GOVERNMENT ORGANISATIONS

| Australian Conservation Foundation | National Parks Association |
Nature Conservation Council Sydney Coastal Councils Group | Colong Foundation
| Total Environment Centre | OzGreen |

CONTACT

Jeff Angel | 02 9299 5599

Total Environment Centre, Level 2, 362 Kent St, Sydney 2000

Brooke Flanagan | 02 9279 2466

Nature Conservation Council, Level 5, 362 Kent St, Sydney 2000

EXECUTIVE SUMMARY

Sydney Water has a unique and particularly rigorous operating environment. Australia's largest water utility must comply with three principal objectives, namely: the corporation must be as successful as any comparable business; protect the environment by conducting its operations in compliance with the principles of ecologically sustainable development; and protect public health by supplying safe drinking water.

Since corporatisation, Sydney Water has exerted significant effort to achieve these objectives. Notably, it has adopted a wastewater strategy designed to reduce degradation of the environment (the original *WaterPlan 21*); developed a set of ecologically sustainable development (ESD) indicators to monitor its performance an produced an extensive sustainability report. Nevertheless, more work remains to be done to meet present obligations and future targets.

The 4th Sydney Water Project was undertaken by the peak environment non-government organisations (PENGOs) to coincide with Sydney Water's own review of its twenty-year water, wastewater and stormwater management strategy, *WaterPlan 21.*

Preliminary efforts by Sydney Water to produce a consolidated model of its operations (the 'base case' or business-as-usual scenario) and the first use of **environmental life-cycle assessment** by the corporation for organisation-wide scenario modelling should facilitate consideration of a range of options for meeting urban water needs. However, prerequisites for decision-making to achieve sustainability include the immediate adoption of strategic environmental assessment at program level; replacement of 'least-cost planning' methods (which Sydney Water apply to demand management and recycling options) with true environmental cost-benefit planning: and further life cycle assessment (which Sydney Water has investigated as a support to its review of *WaterPlan 21*).

This review has identified the need for Sydney Water to develop **decision tools for ecological sustainability** that are directly based on the key high-level goals and criteria outlined in the special objectives and specific means identified in the *Sydney Water Act 1994.* The limited evaluation presented in the *Toward Sustainability Report* series, an initially impressive attempt, must be replaced by more comprehensive and rigorous reporting that can assist in translating environmental performance information into informed decision-making. Consequently, the recognition of shortcomings of conventional approaches has been slow and uptake of less conventional but cost-effective innovation has been delayed (Next Energy, 2002a).

The evaluation of options to determine whether management of the water cycle and provision of services are ecologically sustainable needs to be made with reference to the impacts on the supporting ecosystems. Broader focus on sustainability requires a major shift for Sydney Water in terms of how the Corporation evaluates programs and strategies, the types of treatment and operational technology it implements, the mode of delivery of services (centralised versus decentralised) and how it can encourage and empower community engagement in the decision-making processes. These changes need to be supported by **institutional reform** within Sydney Water and its regulators.

Sydney Water's *Operating Licence* includes **targets for water efficiency**, which were designed to avoid the need for a new dam. A program of 'weak' demand management has not delivered the expected results and Sydney Water has not met its first tranche of *Operating Licence* targets for demand management (2000-2001:

379 litres per capita per day) and looks set to fail to meet the 2004-2005 targets for per capita consumption of 364 litres per capita per day, with demand currently exceeding 400 litres. The Corporation appears to be relying on a dramatic increase in use of recycled water by industry to make significant progress in the near future, but this is a high-risk strategy, as potable water is availabler for a low price, and success relies on decisions (to take up recycled water) by a small number of potential users.

The Corporation is also failing to meet its statutory objectives for **water conservation and recycling**. Water recycling remains less than 30ML/day. The original recycling target gazetted in 1995 (58ML/day to be recycled by 1999) was not achieved by 2003, 4 years later. On an annual basis, recycling is less than 11GL/year This compares to total water consumption exceeding 600 GL/year and wastewater flows exceeding 450GL/year. This represents unsatisfactory progress towards the long-term statutory goal of eliminating dry weather discharges to waterways and the ocean. Most recycling occurs at STPs themselves. This approach is is complemented by weak demand management in the residential and commercial sectors, with most savings resulting from the effect of water restrictions and leakage reduction in Sydney Water's own supply system. These programs barely reach beyond the Corporation's direct operations. The overall water conservation and recycling effort (including demand management) is not increasing at a rate that is sufficiently strong to prevent the need for a new dam.

Previous analysis undertaken for Sydney Water by the *Institute for Sustainable Futures* has supported the that centralised infrastructure is the preferred 'least-cost' option. However, recent research and analysis for IPART and PENGOs reveals critical flaws in the least-cost and levelised-cost evaluation used by Sydney Water, which takes into account costs (not environmental costs) but excludes benefits. For example, costs of environmental degradation, or benefits from water conservation and recycling are not accounted for. An example of economic evaluation for a major project for the Georges River Project where re-use of a massive 52 gigalitres of water per annum is assigned a zero dollar value is discussed in s.4.3). While least-cost planning can be a useful preliminary input, decision-making based on least cost is inconsistent with ESD principles, and inappropriate for Sydney Water.

Sydney Water's priorities are further distorted when genuine alternative options are not well specified, and potential innovation is poorly understood. Both option development and the consultation process appear to be driven by public relations and issue management considerations from Sydney Water's perspective, instead of engaging stakeholders in shared, informed decision-making for sustainability. Environmental groups consulted by the PENGOs described difficult, narrowly-defined consultation which did not involve them in option development or decision-making. Groups resorted to Freedom of Information Act requests to obtain basic information.

Moving beyond wastewater management to **total water cycle management** will mean Sydney Water shifting its capital expenditure focus away from wastewater infrastructure and toward integrated solutions. Currently, Sydney Water's annual investment in big pipes is one-to-two orders of magnitude greater (typically hundreds of millions of dollars) than investment in demand management or innovative distributed supply-treatment-re-use solutions (currently millions to tens of millions of dollars).

Proposed upgrades to 'big pipe' infrastructure, such as upgrades of ocean sewage treatment plants (STPs) to achieve primary treatment, should be assigned a lower priority than upgrades for the protection of more sensitive waters. The PENGOs preferred approach in the ocean outfall catchments is to progressively de-volume sewerage system flows in order to meet Sydney Water's recycling objectives. Financial resources traditionally spent on end-of-pipe solutions must be diverted to develop distributed supply-treat-re-use solutions at multiple locations in growth and infill areas. Clear targets to reduce sewage flows should guide progress in de-voluming the ocean outfall sewerage systems, reducing dry weather discharges to the ocean and providing water cycle services to commercial, industrial, residential, agricultural and environmental uses closer to source.

The need for **greater innovation** applies at both the project level and at the strategic level. The PENGOs commissioned environmental life-cycle assessment of detailed project level scenarios for new development in greenfield areas (Beavis and Lundie, 2003). The 'business-as-usual' base case was usually the worst option and never the best option, while innovative decentralised scenarios were usually the best option and never the worst option (see section 3.4) when assessed against a range of environmental criteria.

Similarly, analysis undertaken for the PENGOs on strategic approaches, indicate that current programs with 'weak' demand management (for example, AAA rated shower roses and tap fittings) do not defer the requirement to augment the water supply headworks system subject to current reliability criteria. This contrasts with 'strong' demand scenarios including compulsory adoption of rainwater tanks and water efficient appliances which defer the need for a new dam beyond 2090.

Institutional constraints and political will remain as significant unknown factors in decision-making and option selection. The PENGOs recommend that more effective regulation would follow a review of IPART and its legislation to ensure that determinations by the Tribunal, including price setting, are truly independent. The Tribunal should be no less independent than the Auditor-General. The Tribunal's decisions must have proper regard for ecological sustainability, and achieve better pricing and valuation of natural resources. If the environmental targets are not met by Sydney Water, the Tribunal must apply effective penalties.

This also applies to the Sydney Water's de facto monopoly position in a what should be an open market for total water cycle services. Critical **obstacles to competition** must be removed. Sydney Water should not be a regulator and an operator in this market. The role of plumbing regulator should be transferred, for example, to the Ministry of Energy and Utilities and overseen by an independent review body. Representation from Sydney Water on or to standards bodies must be ethical, and promote sustainability, and not be used to erect barriers to innovative technologies and systems. Barriers to entry for competitors and competing technologies must also be addressed, including access to Sydney Water infrastructure. Subsidies provided to Sydney Water for centralised water, sewerage and stormwater services must be available to competitors wishing to provide innovative or decentralised systems. These include capital works grants to Sydney Water from all sources, and cross-subsidies to new schemes and augmentation projects supported by the existing customer base.

This project would not have proceeded without generous funding from Sydney Water Corporation to the PENGOs. However, the project was difficult to undertake and bring to completion. Sydney Water contracted the PENGOs to provide independent best practice and policy advice focusing on the review of their *WaterPlan 21* strategy. Despite this, Sydney Water reneged on its agreement to provide the draft strategy to the PENGOs for review. In addition, documents were often delayed, or difficult to obtain. Key documents, which were to be provided in the draft stage and subject to PENGO comment, were instead provided in final form only. Most critically – as with the first PENGO Sydney Water Project – Sydney Water's decision-making processes were never clearly open to scrutiny. This is unfortunate, as it is clear that the people and environment of Sydney — and Sydney Water itself — will ultimately benefit from a more innovative, open and accountable approach to Sydney's water future.

RECOMMENDATIONS

The following recommendations outline a detailed programme of improvements that Sydney Water and the NSW Government will need to implement in order for Sydney Water to make substantive progress towards sustainability. Some actions are Sydney Water's direct responsibility, and some actions require a lead role by other responsible agencies. Where Sydney Water does not have the lead role, it must be an affective advocate for change, and not use its lack of jurisdiction as an excuse for inaction. There are some recommendations, which are considered to require immediate action. These are listed in the first section.

IMMEDIATE ISSUES

In order for Sydney Water to achieve the objectives of the WaterPlan 21, the following programmes should be actively developed and urgently implemented:

SAFE, SUSTAINABLE WATER SUPPLY

1. Ensure that public health risks from the reticulated water system are adequately and comprehensively monitored and reported (including minimum contaminant levels of disinfection by-products such as trihalomethanes and haloacetic acids). The results of any and all research to date and in the future must be made public.
2. Initiate permanent low-level water restrictions on specified outdoor uses (e.g. daytime use of sprinkler systems, hosing paths) for residential, commercial and public sector users, to make water available for environmental flows and promote long-term change in water use behaviour.
3. Revise the security of supply criteria relating to acceptable frequency of additional water restrictions in association with Recommendation 2 (above). The security of supply should be set at 95% (compared to the current 97% level) to provide additional water for environmental flows, and consideration given to further revision to 90%.
4. Fast track retrofit of enhanced demand management for existing development (housing stock, commercial and industrial) in the Sydney Water operational area (including rainwater/stormwater tanks and mandatory water efficient appliances). Sydney Water must promote the use of water efficient devices through mechanisms such as rebates (including extension of current rebates) and inclusion of such devices must be mandatory for development and re-development.
5. Revise demand management targets to ensure safe yield and sustainable yield for Hawkesbury-Nepean and Shoalhaven River systems including existing per capita targets and a new total consumption target of 500GL/year.
6. Set penalty pricing for Sydney Water (for bulk water purchased from the Sydney Catchment Authority) applicable where the Corporation exceeds demand management targets, based on per capita and

proposed total water use targets. Initially, Sydney Water should pay the current price for water used up to the target, and a higher price for additional water. The higher price must be based on the marginal cost of the next increment of water supply, and be sufficiently high to counter the existing conflict of interest between selling and conserving water. Revenue raised by the SCA must be hypothecated for demand management programmes.

7. Reassess the outlook for potable water recycling in addition to non-potable and establish trial process (ideally at a location where high-grade re-use can be undertaken).

8. Set meaningful short, medium and long-term targets for water recycling, for example, an increase equivalent to 3% of total water consumption per annum to achieve the Corporation's statutory long-term goal to reduce discharges to oceans and waterways (Sydney Water Act s.27). This would allow the recycling objective to be met by approximately 2030, and provide incentive to reduce total water use at the same time. Quality of recycled water should be based on meeting appropriate levels that are fit-for-purpose.

9. Establish a clear, effective pricing signal to reflect natural resource scarcity for water, such as a rising block pricing regime for retail water with equity provisions including low-income rebates and pensioner discounts.

10. Review water pricing, including bulk water extractions from the river systems, to incorporate environmental externalities (such as impact on river flows) and correct market failure (where price does not indicate resource scarcity) to provide a viable market for recycled water. Sydney Water should liaise with EPA and the PENGOs and seek a price from IPART which is consistent with sustainability.

Clean Beaches, Oceans, Rivers and Harbours

11. Assign a lower priority to proposed end-of-pipe upgrades to major ocean STPs than to upgrades for the protection of more sensitive waters. The preferred approach in the ocean outfall catchments is to progressively de-volume sewerage system flows in order to meet Sydney Water's obligations under the s.27 of the Sydney Water Act, 1994.

12. Divert financial resources proposed for end-of-pipe solutions, including upgrade and amplification of ocean STPs, into distributed supply-treat-re-use solutions at multiple locations in growth and infill areas in these sewerage zones.

13. Develop progressive targets to reduce flows and discharges to the ocean in order to guide progress in de-voluming ocean outfall sewerage systems.

14. Develop and implement a comprehensive monitoring program for ecosystems affected by discharge of sewage from the deep ocean outfalls, including sediments, in addition to the limited monitoring currently undertaken.

Wise Resource Use

15. Reduce the impacts of Sydney Water's use of carbon energy by increasing the use of green power to 10% of total electricity use (including any green power generation by the Corporation - representing an increase of 4.2% from the current total of 5.8%) and set short, medium and long-term targets for increasing sustainable energy use (for example, a series of targets at five year intervals) beyond this level.

16. Present IPART with clear environmental priorities set jointly by the EPA, Sydney Water and environment groups. This will allow IPART to devise price paths to fund the priorities at its next pricing inquiry.

Smart Growth and Redevelopment

17. Fast track development and implementation of decentralised water, sewerage and stormwater systems for Sydney's growth areas (including greenfield and infill, detached and multi-unit development) to ensure future sustainability.

18. Extend and further promote the rebate scheme for rainwater tanks indefinitely (i.e. beyond the previous deadline of September 2003) and reassess to ensure indoor connections (e.g. toilet) are included. Any remaining impediments to full implementation of the scheme must be removed.

19. Ensure that rainwater tanks are minimum requirements for all new homes and substantial renovations with indoor connection required (e.g. to toilet as a minimum).

20. Undertake a public process/open competition to elicit proposals for non-traditional technologies and in particular, decentralised options, with significant reward commitments ($20 million over two years).

21. Consider the retrofitting of treatment and delivery of recycled water via "third pipe" systems in existing housing areas.

STRATEGIC PLANNING AND DECISION-MAKING (IMPLEMENTING THE REVISED WATERPLAN 21)

22. Undertake an independent review of decision-making processes within Sydney Water (for both programs and capital works).

23. Undertake an independent review of the economic evaluation methodology used by Sydney Water and develop an appropriate methodology that incorporates full environmental costs and benefits.

24. Develop community engagement programmes that build capacity within the community to empower public participation in informed decision-making for future water, wastewater and stormwater management options (with sustainable solutions tailored for community needs in the context of total water cycle management).

25. Substantially improve information management within Sydney Water so that all knowledge processes including research are shared between the divisions within Sydney Water.

26. Overhaul the link between strategy and innovation so that a comprehensive and co-ordinated research strategy can be integrated into the operation and management of Sydney Water.

27. Develop an integrated water management strategy for the Sydney, Blue Mountains and Illawarra regions that incorporates strengthened demand management strategies, effective re-use programmes and penalty pricing regimes.

28. Integrate the water cycle management system to optimise the various alternatives (including decentralised options) for rain and stormwater collection and recycled water use (greywater and effluent). The integration of these systems must account for the different characteristics of areas (such as rainfall, access to farmland and industrial uses, social demographics) so that the best combination of solutions is provided for each area.

29. Improve substantially the interpretation of environmental data into information that can be used in the assessment and decision-making processes. Rigorous evaluation of scientific and operational performance data must be undertaken to provide detailed assessment of environmental performance that can be used to inform the day-to-day management of the water cycle.

30. Undertake Life Cycle Assessment widely to assess and compare scenarios and options at the organisation, program and project levels. Wherever LCA is used, identification of the most important impact categories must be based on a realistic approach and normalisation must be undertaken with primary reference to the Sydney Region.

INSTITUTIONAL REFORM

31. Amend IPART's legislation to provide a tribunal position for the appointment of a person (not being a government employee) with expertise and experience in the protection of the environment.

32. Review IPART to ensure that determinations by the Authority, including price setting, are truly independent. The Authority should be no less independent than the Auditor-General.

33. Review IPART's legislation to ensure that the Tribunal has proper regard to ecological sustainability, and achieves better pricing and valuation of natural resources.

34. Review IPART to ensure the Authority applies effective penalties if utilities, including Sydney Water, fail to meet environmental targets. Penalties or sanctions affecting senior management are preferred to fines affecting a corporation).

35. Separate regulator and operator functions in the total water services market. For example, transfer Sydney Water's role regulating plumbing standards to the Ministry for Energy and Utilities (with oversight by an independent review body including community, industry and environmental representatives).

36. Make subsidies provided to Sydney Water for centralised water, sewerage and stormwater services available to competitors wishing to provide innovative or decentralised systems. Subsidies include capital works grants from all sources, and cross-subsidies to new schemes and augmentations supported by the existing customer base.

DETAILED RECOMMENDATIONS

A detailed programme that provides the framework for delivering on the key issues described above, must include the following recommendations:

SUSTAINABLE WATER SUPPLY

37. Implement more frequent water restrictions that are related to climatic conditions, as well as water storage levels and the use of permanent water restrictions for different water use categories (such as daytime outdoor use and hosing of paths).

38. A strategy to increase water transfers from the Shoalhaven River is not supported nor recommended.

39. Change the benchmark for reduction in per capita water demand to the lowest per capita water demand in recent times, so that it reflects drought and water restriction conditions (e.g. 1995 to 1996). In addition, the actual demand level during those years should be used as a benchmark for comparison to actual future demands.

WISE RESOURCE USE (RESOURCE RECOVERY)

40. Include more explicit recognition in the WaterPlan 21 LCA that water recycling and demand management activities may have environmental benefits greater than those indicated by the metrics alone (since there is no metric directly relating to the construction of a new dam such as Welcome Reef for supply augmentation).

41. Revise the draft WaterPlan 21 with respect to the use of biosolids for purposes other than land application and update and enhance the 1999 Sydney Water Biosolids and Residuals Management Strategy. The use of biosolids for land application is strongly supported and the PENGOs encourage Sydney Water to continue research in this area. However, Sydney Water must recognise the requirement for further investigation of sustainable re-use of biosolids. Sydney Water must consider transport mechanisms for biosolids other than road transport (due to inefficient use of fossil fuel). An investigation of sustainable transport options must include existing pipelines (e.g. Northside Sewerage Tunnel) and rail transport.

42. Reassess the market outlook and portfolio targets for agricultural markets and other land application of biosolids in light of developments in commercial, environmental, and regulatory arenas.

43. Undertake a public process/open competition to elicit proposals for emerging biosolids technologies, with significant award commitments (e.g., $5 million per year over four years).

SMART GROWTH

44. Implement, as a priority, a policy for the compulsory inclusion of rainwater tanks for new homes and renovations (where appropriate) for more effective water demand and stormwater management.

45. Implement on-site and cluster scale wastewater treatment and re-use strategies in new development areas as alternatives to traditional wastewater disposal techniques.

STRATEGIC PLANNING AND DECISION-MAKING (IMPLEMENTING WATERPLAN 21)

46. Revise the Sydney Water programme evaluation models of non-zero costs for environmental impacts and ensure that the full range of environmental costs and benefits are accounted for.

47. Extend the modelling process to include life cycle cost-benefit analyses and financial analyses including calculation of resulting water service prices and aggregate costs.

48. Develop a rigorous process to ensure valid and internally consistent results from models.

49. Make clear distinctions between (a) key Sydney Water business decisions (e.g. upgrade of a sewage treatment plant, installation of energy recovery system) that are to be assessed for their costs and benefits; and (b) inputs that are external to Sydney Water.

50. Identify and consider wastewater options that have demand management benefits and ensure that those options are credited with those benefits, including the broader environmental benefits of deferring or eliminating the need for new water supply.

51. Evaluate demand management alternatives from a community perspective using the true resource price of water paid, zero discount rates and whole of water cycle benefits in comparative investment models.

52. Undertake a public process/open competition to elicit proposals for non-traditional technologies, and in particular, decentralised options, with significant reward commitments (e.g. $20 million over two years). The PENGOs could assist Sydney Water in achieving a successful competition by assisting in design of the solicitation, promotion, evaluation and ongoing oversight of the competition and in securing regulatory approval from IPART for recovery of the costs.

53. Include a 1% discount rate based on long-term natural resource and intergenerational equity considerations in addition to the 7% discount rate based on the Weighted Average Cost of Capital (as indicated by NSW Treasury). Where triple bottom line accounting is adopted, differential discount rates should be employed: -1% to 1% to natural capital goods and services to reflect scarcity, natural resilience and non-substitutability, and the standard rate (i.e. 7%) applied to built (i.e. human-made or technological) capital goods and services as is current practice to reflect opportunity cost and depreciation.

DECISION- TOOLS

54. Implement fully a process of strategic environmental assessment that incorporates life cycle assessment of possible modes of integrated water and wastewater service delivery.

55. Further development of economic models that address fully the principles of ecologically sustainable development and to enable an appropriate level of substantiation of the key investment decisions and allow appropriate external scrutiny.

56. Incorporate community participation in the decision-making process, so that option selection for programs and projects delivers the best ESD outcome for the community.

57. Further develop a project appraisal process that identifies strategic planning elements such as interaction with other projects, cumulative effects in terms of environmental impact and social equity.

58. Develop decision tools for achieving ecological sustainability that are based on the key high-level objectives and criteria outlined in the special objectives and specific means identified in the Sydney Water Act 1994 (s.22.1 and s22.2).

59. Develop a strategic investment plan for innovation in technology/operation/performance assessment and related fields to ensure that there is effective management and delivery of innovation into the operational sector of Sydney Water so that the innovation translates into best management practice.

60. Develop implementation plans that are sufficiently detailed that will allow the broad strategies identified in WaterPlan 21, for pursuing and trialling alternative technologies and practices, to be implemented.

61. Adopt emerging sustainability paradigms of water management and investment in alternate technologies and practices.

REPORTING AND COMMUNITY CONSULTATION

62. Provide greater transparency in environmental and sustainability reporting by interpreting the substantial volumes of data into information that can be used in environmental assessment, as well as decision-making.

63. Reconsider or redefine the 'ecological footprint' that Sydney Water uses as part of its sustainability assessment, since there is a broader array of environmental indicators identified in the WaterPlan 21 LCA.

64. Develop and implement consultation protocols that engage the community in shared decision-making regarding the selections of options for projects, rather than considering information supply and public exhibition as the only forms of consultation.

ABBREVIATIONS

CMB	Catchment Management Board
CMC	Catchment Management Committee
CWWT	Centre for Water and Waste Technology
DCB	dichlorobiphenyl
DLWC	(former) Department of Land and Water Conservation
DIPNR	Department of Infrastructure Planning and Natural Resources
EIS	environmental impact statement
EPA	NSW Environment Protection Authority
ESD	ecologically sustainable development
GWP	global warming potential
IPART	Independent Pricing and Regulatory Tribunal of NSW
ISF	Institute for Sustainable Futures
LCA	life cycle assessment
LPSS	low pressure sewerage system
MCA	multi-criteria analysis
NSOOS	Northern Suburbs Ocean Outfall System
NST	Northside Storage Tunnel
OVS	on-site vermiculture system
PENGOs	peak environment non-government organisations
POCP	photochemical oxidation creation potential
SCA	Sydney Catchment Authority
SEIP	Stormwater Environment Improvement Program
SMP	stormwater management plans
SWC	Sydney Water Corporation
SWSOOS	South Western Suburbs Ocean Outfall System
TSR	Towards Sustainability Report
UWCS	Urban Water Cycle Solutions
WSA	water supply area
WWSA	wastewater supply area

CHAPTER 1

BACKGROUND

The Sydney Water Projects: The peak environment non-government organisations (PENGOs), as represented by the Australian Conservation Foundation, Colong Foundation for Wilderness, Nature Conservation Council of NSW, National Parks Association of NSW, Total Environment Centre and the Sydney Coastal Councils Group, established a project with Sydney Water Corporation that coincides with the first review of *WaterPlan 21*, which is Sydney's 21-year water, waste water and stormwater strategy. The 4th Sydney Water Project was funded by Sydney Water to provide an independent evaluation of *WaterPlan* 21 as part of the review.

1.1 THE FIRST SYDNEY WATER PROJECT – A New Course for Sydney Water

The peak environment non-government organisations have undertaken a series of projects in conjunction with Sydney Water, with the first of these projects being undertaken during 1994-95 when the former Water Board was being reformed into a government owned corporation. The new corporation was established with a statutory responsibility, unique at that time, to operate in compliance with the principles of ecologically sustainable development as defined in NSW legislation and subject to a binding Operating Licence that contained detailed obligations across a range of activities.

The first Sydney Water Project was a year-long study of the area of operations of the (then) Water Board. The focus of the studies was ecologically sustainable development through water conservation and wise use, resource recovery and re-use, as well as protection of environment through waste minimisation and prevention of pollution. The research was based on the range of policy, management and technical options outlined as part of the Sydney Water Board *Clean Waterways Program.* The proposed scope of detailed work was reduced after three studies were discarded from the program by Sydney Water, including (i) management of the headwater catchments, (ii) the quality and treatment of drinking water (with reference to Build Own Operate schemes) and impoundments and (iii) a review of Sydney Water's involvement in public participation and its decision-making processes. Nevertheless, the nine research studies completed as part of the Sydney Water Project covered a large part of the water cycle:

- Indicators of Environmental Quality (Mather, 1994);
- Ecological Implications for Riverine Environments (Pearson, 1994);
- The Efficiency of Water Use (White, 1994);
- Ecological Implications for Marine and Estuarine Environments (Mercer, 1994);
- Sewage Treatment (Gerson, 1994);
- Sludge Management (Vincent and Munoz, 1994);
- Source Control (Munoz, 1994);

- **Stormwater Management (Dowsett, 1994); and**
- **Water Re-Use (Denlay and Dowsett, 1994).**

The Sydney Water Project was novel, in that it was the first time a major government utility engaged in an extensive investigative project in conjunction with peak environment groups.

The groundbreaking report *A New Course for Sydney Water* (Dowsett *et al.*, 1995) brought together the major recommendations from the nine separate study reports and additional views on the head catchments and decision-making systems to provide a framework for directions for managing the total water cycle over the following ten years. The Report provided constructive review and a description of opportunities for reform as well as a new direction for the new corporation. The new course report also outlined a set of key programmes for Sydney Water to pursue over the next ten years, that is from 1995 to 2005. [see Table 1] Good results have been achieved in three of these program areas, with some progress made in three more, but minimal progress (or none at all) in the remaining eleven program areas, as Sydney Water has failed to move beyond a highly centralised approach to water cycle management based on conventional technologies.

TABLE 1: "THE NEXT TEN YEARS" FROM 1995 *A NEW COURSE FOR SYDNEY WATER*

	RECOMMENDED PROGRAM	PROGRESS	RESULT (1995-2005 ESTIMATED)
1	Rejection of inter-basin transfers as a way to augment supply.	No	Transfers from Tallowa Dam (Shoalhaven River system) have been reduced but continue at up to 150ML/year. Transfers now the responsibility of SCA but are determined by demand from Sydney Water.
2	Cessation of planning for new water supply dams or augmentation of existing dams.	Yes	NSW government current policy to indefinitely defer a new dam. Nature Reserve proclaimed over part of the land in 2002.
3	Development of sewer mining and other water re-use schemes to provide alternative supplies.	Very limited	Effluent re-use schemes have been developed but total volumes and numbers of customers external to Sydney Water's own STPs remain low. Re-use targets were initially set at 58ML/day but minimal re-use has been achieved – approx. 27ML/day by 1999 (less than 2% of water used) with no further increase until recently. "Sewer mining" remains rare (SWC, 2002i) and access to Sydney Water's infrastructure is problematic.
4	Water efficiency and other conservation measures for domestic and commercial customers.	Limited	Strong demand management targets included in the Operating Licence were designed to prevent the need for a new dam. Demand management strategy has yet to be fully implemented and is facing major challenges. For example, demand management targets set by Operating Licence for 2000-2001 were not met and significant change in water use will be required to meet 2004-2005 target. All recycled water is for non-potable use.
5	Dual reticulation and on-site stormwater retention for new developments.	Very limited	Dual reticulation installed at Rouse Hill and Newington – with re-use of 7ML/day by 2002 – highly centralised system is expensive and no implementation beyond this example.
6	Water audits and retrofitting for existing buildings.	Limited	Whist an extensive advertising campaign through the *Every Drop Counts* programme offered 1.5 million households subsidised plumbing retrofits for inexpensive devices such as shower roses and tap washers, the take-up rate was only about 12% (approx. 176,500 households) who installed water saving devices under this scheme. Some water savings resulted but more substantial measures, such as widespread retrofitting for rainwater tanks, efficient washing machines and greywater recycling would be necessary to

	RECOMMENDED PROGRAM	PROGRESS	RESULT (1995-2005 ESTIMATED)
			achieve significant results in reducing water consumption (Coombes, 2002).
7	De-voluming of sewage flows, with sewage treatment plants treating lower volumes of more concentrated waste.	No	Sewage flows to STPs have increased as population growth continues and volumes increase. Instead of de-voluming and developing local re-use and recycling, Sydney Water has built more big pipes and increased flows. Proposed upgrades, including duplication of the SWSOOS from growth areas in the south-west to Malabar STP (the Georges River Project pipeline), will continue this trend, even if some recycling is achieved. Decentralised alternatives, always ruled out by biased Sydney Water analysis, are required to reverse the trend.
8	Greater capture of biosolids and wider use made of the material now sent to landfill or incinerated.	Yes	Substantial recovery of solids from the sewage stream at inland (92-99%) and small ocean STPs (73-99%) but lower at major ocean STPs (32- 58%) where full primary treatment is not yet achieved (SWC, 2002a[1]). The Sydney Water ESD16 indicator for biosolids is misleading, as the high re-use rate (98.9%) refers only to the re-use rate for the biosolids which are captured by treatment plants, not the thousands of tonnes which are dumped in the ocean each year. The overall rate of capture of solids for recycling is not stated but is approximately 55% (estimated from total suspended solids in effluent versus total biosolids capture rate – derived from Sydney Water data: SWC, 2002e).
9	No new connections to deep ocean outfalls in greenfield developments or urban renewal projects.	No	Connections continue unabated. Substantive studies of alternatives for greenfield areas were not undertaken for Sydney Water until 2002, and despite promising results for alternative decentralized servicing, have not yet been made public (Lundie and Beavis, 2002; CSIRO and ISF 2002). Sydney Water is proceeding with duplication of the main trunk to the SWSOOS from Liverpool to the ocean outfall at Malabar under the guise of a recycling scheme (which so far has no customers). This will allow massive greenfield development in Sydney's south-west to flow direct to the ocean.
10	No additions to infrastructure where there is lack of capacity due to failure to optimise operation of the existing system.	Limited	Sydney Water is not proactive on this issue. However, NSW Government responed when Hornsby Council enacted a development moratorium in the catchment of overloaded Sydney Water STPs on Berowra Creek, by negotiating the first whole-of-government ESD agreement – driven by targets for receiving water quality. Healthy Rivers Commission recommends this model for broad adoption (HRC, 1998 and 2000).
11	Moves to localised (decentralised) and individual water and wastewater systems.	No	Sydney Water has appeared to resist decentralised systems, even when local communities request them. The *WaterPlan 21* life cycle assessment undertaken by Sydney Water in 2002 indicated substantial benefits for this approach (Lundie and Beavis, 2002) but the studies have not been made public (see item 9 above).
12	Reductions in toxic pollution discharged to sewers through promotion of clean production techniques such as source control.	Yes	Pollution reduction targets have been established by EPA for STPs – targets based on outcomes of ecological risk assessments. Load-based licensing provides incentive to reduce some pollutants from discharge. However, significant toxic waste still discharged to sewers through negotiated trade waste agreements in conjunction with EPA.
13	Energy efficiency measures such as	Limited	Signs of progress by 2002. However, improvements in

[1] Data source: Draft Base Case Technical Document, Appendix 1 Table 1-2 (SWC, 2002a).

	RECOMMENDED PROGRAM	PROGRESS	RESULT (1995-2005 ESTIMATED)
	audits and cogeneration of electricity from sludge digestion.		energy management and green power initiatives have not kept pace with energy requirements for new infrastructure (Sydney Water, 2002e).
14	Development of a regime of environmental indicators that measure long-term and cumulative impacts, for instance, sewage treatment plants and weirs and dams.	Limited	Environmental indicators developed by Sydney Water. CSIRO evaluation (Maheepala *et al.*, 2002) found only four of the suite of 32 indicators as satisfactory for the range of sustainability criteria covering the Sydney Water operations. Maheepala *et al.* (2002) found that all other currently used indicators require modification or new indicators must be developed
15	Catchment-based containment of stormwater and its utilisation for non-potable purposes through means such as artificial wetlands and seeps.	No	Sydney Water is investigating opportunities for stream rehabilitation through the Stormwater Environment Improvement Program (SEIP). However, the EPA (2003) has reported that Sydney Water has spent lower than expected expenditure on stormwater management (approximately 34% of scheduled expenditure for 2001-2002).
16	Installation of prototypes of preferred systems in greenfield and urban renewal projects (for example, the Olympic Village) which promote recycling of water and community self-sufficiency.	Limited	The promotion to mainstream of recycling and self-sufficiency has been limited
17	Resource management and urban land use planning by all relevant agencies, that takes account of cumulative effects on the environment on (at least) a catchment-wide basis.	Limited	Several iterations of catchment-based planning were attempted by government before the Total Catchment Management program was cut and replaced by advisory Boards from 2000 (with the Hawkesbury-Nepean hardest hit by abolition, without replacement of the well-resourced Hawkesbury Nepean Catchment Management Trust). Whole-of-government approaches have so far failed to overcome agency inertia and inter-departmental wrangling, and despite the announcement of new Catchment Management Authorities, no integrated catchment-scale planning mechanism is indicated.

1.2 The Second Sydney Water Project – Review of *WaterPlan 21*

The second project was undertaken at the invitation of Sydney Water and provided a critique of the new wastewater management strategy, *WaterPlan 21*, which the corporation was developing during 1997. The project was perceived as an opportunity to assess the progress of the recently corporatised organisation against the recommendations made in *A New Course for Sydney Water*, as well as the extent to which a total water cycle management framework was being adopted.

However, the PENGOs could not endorse the draft *WaterPlan 21* as they believed that Sydney Water had failed to fully adopt the vision of sustainable water management and had defined the issues too restrictively. Sydney Water did not provide a comprehensive statement of *WaterPlan 21* to the PENGOs, rather the strategy was issued as a collection of poorly integrated fragments. Following the consultation sessions with the environment groups, *WaterPlan 21* remained as an unreleased internal strategy until its publication in the form of summary fact sheets in hard copy and summary information on the internet prior to the 2002 review.

The PENGOs made 22 key recommendations as part of their 1997 review of the draft strategy and the progress Sydney Water has made is outlined in Table 2. Some progress has been made in areas of demand management, sewer overflows and environmental reporting, with specific additions to the Sydney Water Operating Licence. However, Sydney Water has not adopted strategic environmental assessment based on full costs and benefits of a wide range of options, consistent with a true ESD approach. Consequently, there has been no change to the Corporation's reliance on

centralised infrastructure, with limited progress on re-use options and inadequate integration across the areas of water supply, wastewater and stormwater.

Appendix 1 discusses the recommendations made by the PENGOs (as described in Table 2) to the milestones identified by Sydney Water and the achievements made.

TABLE 2

TABLE 2: KEY RECOMMENDATIONS FROM 1997 PENGOS REVIEW OF *WATERPLAN 21*

	RECOMMENDATIONS	PROGRESS	RESULT (1997-2003)
1	Sydney Water should investigate specific sewage flow reduction techniques as a matter of urgency, especially for areas where sewerage systems are facing capacity problems because of increasing population [Section 6].	Some	Inflow/infiltration programs have commenced and maintenance has been accelerated via the Sewerfix Program. However, the reduction in volume of sewage generated has not been addressed, other than as a side benefit of demand management. Sydney Water is not requiring non-compliant customers to fix private sewer lines following defect notices (see 8 below).
2	Future versions of *WaterPlan 21* should discuss the benefits of reduced sewage generation on sewerage operations [Section 6].	No	The 2002 review of *WaterPlan 21* (Sydney Water 2002b) fails to discuss these benefits and concedes that flows and loads to the major coastal sewage treatment plants are increasing.
3	Sydney Water's future water bills should show the total volumes of water supplied and re-used across the Sydney region and wastewater discharged from Sydney Water's sewage treatment plants [Section 6].	No	Bills show volumes consumed by each individual user, compared to previous billing periods, but no information about overall water consumption or re-use is provided.
4	Sydney Water's *Operating Licence* should impose a suitable timetable for the completion of investigations required to carry out the Corporation's Demand Management Strategy [Section 6.1]	Yes	The 1998 operational audit required Sydney Water to produce a revised demand management strategy by December 1999 and annual reporting is mandated with specified criteria.
5	Per capita water consumption reduction targets, required under Sydney Water's *Operating Licence,* Clause 5.14, should be met on the basis of underlying (weather-adjusted) consumption [Section 6.1].	Yes	A climate-corrected model was developed for Sydney Water by the Institute for Sustainable Futures.
6	A new clause should be added to Sydney Water's *Operating Licence* that aims to defer building a new water supply dam to beyond 30 years from the expiration of each licence [Section 6.1].	Some	NSW government adopted a policy to indefinitely defer the construction of a new dam. However, this is not an *Operating Licence* condition and the Nature Reserve boundary is the only barrier to subsequent policy changes.
7	Sydney Water's *Operating Licence* should include specific short-term targets for reducing the volume of effluent discharged from each of the three major ocean sewage treatment plants, above and beyond flow reductions expected from water conservation measures [Section 6].	No	No targets have been developed and no measures are in place to progress toward the statutory long-term target of no dry weather discharges. Lobbying by community groups and local government to argue for options to reduce flows to North Head STP has been resisted by Sydney Water. The major ocean STPs do not achieve full primary treatment. North Head is scheduled for upgrade in 2006, Bondi and Malabar in 2009 (SWC, 2002a)
8	Given the very large call on funds generated by the overflows component of *WaterPlan 21* and for reasons of equity and program effectiveness, that owners of faulty private sewers should partially or	Limited	No detail available, but Sydney Water undertakes relining and re-grouting of some private sewer lines as part of the Sewerfix programme (SWC, 2002e). Sydney Water is not requiring customers to fix

	RECOMMENDATIONS	PROGRESS	RESULT (1997-2003)
	fully fund their repair [Section 8.1].		private sewer lines following defect notices. A proposal to ensure properties comply when sold appears to have been abandoned.
9	The Independent Pricing and Regulatory Tribunal should require Sydney Water to provide funding details for overflow abatement, including individual customers' contributions, in the 1998 mid-term review of the Corporation's pricing determination [Section 8.1].	Unknown	No detailed information available.
10	Sydney Water should not proceed with the Northside Storage Tunnel but should take the time needed to appropriately address sewerage overflows, through the sealing of existing sewers and by means of other supportive works [Section 8.2].	No	The Tunnel was approved during the period of the 2nd Sydney Water Project, completed in September 2000, commenced operation in January 2001 and became fully operational in July 2002. There have been significant improvements in wet weather water quality at the major overflow sites due to use of the NST. During 2001-2002, there was an 88.9% reduction of potential overflows to Lane Cove River and Middle Harbour (SWC, 2002f). The *WaterPlan 21* target = 90% reduction. However, overflows at these major sites have represented between 49% (1997-98) and 68% (1999-2000) of flows since 1996-1997 (SWC, 2002f). In contrast, volumes from overflows at Chipping Norton have increased by more than 300% since 1996-1997 and now represent approximately 65% of the total volume from key overflow points (SWC, 2002f). Sydney Water has indicated that the number of wet weather overflows reported is an underestimate due to the method for field verification (SWC 2002f[2]). Sydney Water reported to customer councils that since commissioning and as at 16 May 2003, NST had operated 40 times and overflowed 4 times - 10% failure rate (Sydney Water informed Corporate Customer Council). The NST represents a very high capital cost ($470 million) and is not considered by environment groups to be a sustainable solution.
11	Clause 5.5.4 of Sydney Water's Operating Licence should be amended such that Sydney Water will ensure that, each year, sewage surcharges from its systems onto any customer's land, either directly or indirectly, will meet the following performance criteria: 1 surcharge incident – less than 4% of customers 2 incidents – less than 0.4% of customers 3 incidents – less than 0.04% of customers 4 or more incidents – less than 0.004% of customers. After the sewage overflow licences are determined, surcharges to customer land should cease to be the parameter for Sydney Water's	No	Sydney Water's *Operating Licence* Schedule 4 target remains at more than 96% unaffected (i.e. less than 4% affected) and this base target is currently being met (1.02% affected in 2001-2, up slightly from the previous year). However the stepped criteria relating to frequency of repeated overflow incidents affecting the same customer have not been adopted.

[2] Source: page 23 SWC (2002e)

	RECOMMENDATIONS	PROGRESS	RESULT (1997-2003)
	performance in relation to sewer surcharges. In other words, all sewer surcharges, to all land or waters, would form the basis for assessing Sydney Water's performance [Section 8.3].		
12	Sewage overflow abatement should be prioritised according to the sensitivity of individual receiving environments and not whether the sewage happens to flow through a stormwater channel before it reaches that receiving environment [Section 9].	Some	Overflow Abatement Programme now known as SewerFix. Not clear how priorities are set in *WaterPlan 21*, other than the general reduction of overflows and prevention of discharge to rivers and oceans.
13	Sydney Water should meet quantitative performance targets for both the quantity and quality of stormwater that it handles through its drains and that these standards be written into the *Operating Licence* [Section 9].	Yes	No targets for stormwater have been included in the *Operating Licence*, but Sydney Water is now required by clause 9.3 to prepare an Environment Plan which must contain details of Sydney Water's water, wastewater and stormwater strategies. Sydney Water has now developed a Stormwater Environment Improvement Plan with an implementation schedule for 2000-5.
14	Capacity targets for Sydney Water's drains should reflect the need to reduce both the quantity and velocity of stormwater which runs off urban catchments [Section 9].	Not clear - due to lack of available information	No detailed information available.
15	Funds received by Sydney Water for drainage services should be spent exclusively on achieving the Clean Waterways objective to minimise pollution of receiving waters and the consequences of flooding [Section 9.1]	Not clear - due to lack of available information	No detailed information available. The EPA (2003) has reported that Sydney Water has spent lower than expected expenditure on stormwater management (approximately 34% of scheduled expenditure for 2001-2002).
16	Given the impacts of Sydney Water's sewage overflows, particularly in wet weather, the Corporation should have a continuing role in stormwater policy development, such as ongoing contribution to the State Stormwater Advisory Committee and assisting local councils in developing stormwater management plans [Section 9].	Some	Sydney Water is represented on the State Stormwater Advisory Committee and had input to 17 Stormwater Management Plans (for catchments in which it has stormwater responsibilities) including consultation with government agencies, community groups and other stakeholders.
17	A NSW Stormwater Utility or Board should be established to set policy goals and act as administrator of funds, oversee implementation and auditing of Stormwater Management Plans and ensure accountability through an appointed board with community and catchment management committee or trust representation [Section 9].	Some	EPA was assigned the role of stormwater management and a Stormwater Trust was established to fund Stormwater Management Plans (SMP) and local government projects. Catchment Management Committees (CMCs) participated in SMP development. However, SMPs are not specifically audited and the EPA provides limited information to the public regarding the review of the plans. Catchment Management Boards (CMBs) have replaced CMCs with changes to role and function, such that there is a reduced direct role for the CMB and limited resources. DIPNR (formerly DLWC) now has an increased role/influence in relation to urban catchment management through its responsibility for supporting CMBs. The former DLWC Urban Water Programme (Town Water Treatment and Recycling) has been transferred to new Energy and Utilities Ministry.
18	Sydney Water should place more emphasis on community education as a strategic management tool [Section 8].	Some	Community education is primarily aimed at program, not strategic level.

	RECOMMENDATIONS	PROGRESS	RESULT (1997-2003)
19	A new clause in the *Operating Licence* should require that Sydney Water publish domestic wastewater objectives and performance indicators, and report on progress in satisfying these objectives and indicators [Section 12].	No	No progress.
20	The Environmental Indicators clause of the *Operating Licence* should be changed to read: "Environmental indicator reports are to be compiled on an annual basis. Where comparable long-term indicator data are available, these data are to be presented in a manner which will show any underlying changes in environmental quality, such as long-term trends. An explanation of environmental changes, including declines, attributable to Sydney Water's actions and operations is to be given. Where insufficient indicator data are available to assess underlying changes, these data should be presented in the form of summary statistics. The report is to be forwarded to the Licence Regulator and made available to the public..." [Section 12].	Yes	The *Operating Licence* now contains comparable clauses, requiring annual reporting at clause 9.1.3 and trend information at clause 9.1.4. Sydney Water provides detailed reports in electronic format on its website and publishes an Annual Environment Report in the form of the Towards Sustainability Report.
21	A new clause should be included in the *Operating Licence* which sets increased targets for Sydney Water's use of electricity generated from renewable resources, cogeneration of electricity at sewage treatment plants and cleaner fuels. [Section 12].	Limited	Whilst the *Operating Licence* now refers to the Energy Management Policy released by the NSW Department of Energy (now the Ministry of Energy and Utilities) in 1998 and includes staged targets for reduction of energy consumption of buildings, there is no reference to renewable energy. Sydney Water's 2000-2005 Environment Plan suggests that the Corporation achieve these targets only "where cost effectively feasible". However, the Plan sets a target of purchasing a minimum of 2.5% of total electricity consumption as Green Power In practice Sydney Water achieved 5.8% from renewable sources (both green power and co-generation) in the last reporting period TSR 2002 (Sydney Water, 2002e). Co-generation increased to nearly 13MW but the total load increased at a greater rate.
22	A new clause should be included in the *Operating Licence* which lays down an appropriate process by which Sydney Water's Environment Plan can be amended. The process should include mechanisms for public input, not restricted to Customer Councils [Section 12].	Some	The *Operating Licence* requires Sydney Water to engage in public consultation in developing the 2000-2005 Environment Plan and when subsequently amending it. However, appropriate process or mechanisms are not detailed.

1.3 THE THIRD SYDNEY WATER PROJECT – Sydney Water's Operating Licence and Environmental Plan

During 1999, the PENGOs (including Total Environment Centre, Nature Conservation Council of NSW, Friends of the Earth Sydney, Australian Conservation Foundation, Colong Foundation for Wilderness, Sydney Coastal Councils Group, National Parks Association of NSW and Ocean Watch) participated in the IPART review of the Sydney Water Operating Licence. The review included discussions with IPART and Sydney Water in relation to various aspects of the licence.

The PENGOs provided Sydney Water with a number of documents to assist them in the preparation of their submission to IPART, including three key documents:

- *Sustainability Indicators for Sydney Water* **(PENGOs, 1999c) – PENGOs recommended the development of a set of indicators of sustainability for inclusion within the Operating Licence and that Sydney Water report its environmental performance in terms of sustainability. The PENGOs also recommended the establishment of baseline conditions and targets, regular auditing and review of performance against the indicators, annual sustainability reporting and independent verification of the sustainability performance reported;**

- *Sydney Water Corporation Indicative Environment Plan Final Report* **(PENGOs, 1999b) – recommendations were made in relation to the objectives and targets to be achieved over the course of a five year Environment Plan for each of Sydney Water's eleven ESD commitments. The PENGOs also recommended that the environment plan must include measures to change the culture and decision-making processes of the organisation; and**

- *Review of the Operating Licence for Sydney Water Corporation Final Report* **(PENGOs, 1999a) – this report brought together the recommendations of the sustainability indicators and the review of the Environment Plan and included a draft of what the PENGOs believed was an appropriate Operating Licence.**

1.4 The Fourth Sydney Water Project – 2002 Review of *WaterPlan 21*

It has now been eight years since the PENGOs worked with Sydney Water on a strategic policy document which investigated water, wastewater and stormwater within the context of the total water cycle. During that period, Sydney Water has implemented some of the key recommendations made previously by the PENGOs and water and wastewater treatment technologies have rapidly advanced.

This fourth project coincides with Sydney Water's first review of *WaterPlan 21* and the project was intended to evaluate Sydney Water's performance and provide advice on best practice and policy development as the corporation attempts to reposition itself as a 'provider of total water cycle services'.

The project objectives were to:

- **provide a desktop review of the performance of Sydney Water versus the recommendations made by the environment groups in *A New Course for Sydney Water*;**

- **undertake independent reviews of Sydney Water's research on resource recovery, demand management as well as the corporation's modelling of economic and environmental factors in the total water cycle;**

- **provide advice to Sydney Water on drafts of documents relating to the 2002 review of *WaterPlan 21*;**

- **consult with the environmental community; and**

- **articulate the direction and targets put forward by the environment groups for water, stormwater and sewerage systems, in the context of the total water cycle.**

The ability of the PENGOs to provide critical review and strategic advice to Sydney Water in the development of key Sydney Water strategies and documents throughout this project was hampered by the inability of Sydney Water to provide access to the internal documents in the draft stage. Contrary to the agreed process for the project, Sydney Water released the key reports once they had already been completed. This was most striking where the PENGOS were contracted to comment on the first draft of the revised *WaterPlan 21,* providing input to the final strategy. The draft document was never released and the revised *WaterPlan 21* was not provided to the PENGOs until the corporation had received approval from its Board for the final (not the draft) strategy.

In contrast to the detailed definition of issues contained in the original *WaterPlan 21,* the revised strategy produced by Sydney Water for their 2002 review of *WaterPlan 21* included very broad objectives. In addition, the strategy developed in

2002 is severely constrained by the lack of performance targets, milestones, timeframes and a framework for delivery. This means the environment groups cannot endorse the revised strategy.

The PENGOs commissioned a number of independent investigations of Sydney Water's research to assist in the overall review process, including:

- opportunities for resource recovery from Sydney Water's systems including re-use and energy to waste recovery within a framework of sustainability.
- Next Energy reviewed Sydney Water's life-cycle assessment for biosolids (Next Energy, 2002b);
- the relative cost and benefits of demand management solutions across water, stormwater and sewage systems.
- Urban Water Cycle Solutions (UWCS) were engaged to review Sydney Water's research on costs and benefits of demand management solutions across these systems, as well as to evaluate whether the corporation was implementing these in the operation of the business. Where short-comings were identified, UWCS recommended options which could better address the need for Sydney Water's operations to protect the environment and comply with the principles of ecologically sustainable development, as well as meet their operating licence requirements (Coombes, 2002).
- UWCS provided a comprehensive evaluation including original research and modelling demonstrating that installation of rainwater tanks has environmental and demand management benefits for stormwater, water and sewage systems. The report found significant economic benefits to the community and to natural ecosystems that underpin the urban water cycle, that can be realised with more imaginative infrastructure and policies;
- the Corporation's model examining the broad conventional costs and benefits of the approach to the urban water cycle (i.e. economics analysis, environmental impacts, etc.).
- Next Energy examined Sydney Water's Base Case Model for WaterPlan 21. The Corporation is at an early stage in developing the type of company-wide economic modelling envisaged by the environment groups. Accordingly, Next Energy was also requested by the PENGOs to review the Sydney Water *Hawkesbury-Nepean Wastewater Strategy's* economic and financial evaluations as an example of strategic economic evaluation of wastewater treatment options and their environmental impacts; and
- an independent life cycle assessment to evaluate environment group scenarios, including decentralised options for greenfield development.
- The Centre for Water and Waste Technology (CWWT) was engaged to assess scenarios devised by the environment groups through the life-cycle assessment (LCA) model which had been developed by CWWT for the *WaterPlan 21* model. These scenarios were compared to Sydney Water's base case and best practice scenarios for greenfield development to accommodate Sydney's rapid growth.

1.5 CORPORATE CHANGE – The Last Ten Years

Water supply and catchment protection have been dramatically affected since the preparation of *A New Course for Sydney Water* (Dowsett *et al.*, 1995) and Sydney Water has made some effective changes to the management of water and sewerage services since then. These changes have been driven by: the introduction of the *Sydney Water Act 1994;* the implementation of the conditions of the Operating Licence, the introduction of the *Protection of the Environment Act 1997;* and its associated Regulations, such as Load Based Licensing and the *Contaminated Land Management Act 1997* (affecting catchment management and disposal options).

The corporatisation of the former Sydney Water Board transformed the organisation into the state owned enterprise, the Sydney Water Corporation. The organisation was subsequently re-structured after the McClellan Sydney Water Inquiry (established to investigate the water quality incidents of July and September 1998) as a statutory corporation and the water supply and water delivery functions of the corporation were split. The Sydney Catchment Authority (SCA) commenced operation in July 1999 as a direct consequence of the McClellan Inquiry.

The SCA operates under the *Sydney Water Catchment Management Act 1998* and many of the previous functions of Sydney Water are now undertaken by the SCA, which has responsibility for the management of bulk water supply, the protection of catchments and the regulation of activities within the catchment areas.

The PENGOs have also undertaken a review of SCA operations and regional planning instruments. The project report can be viewed as a companion document to this report (PENGOs, 2003: see Appendix for a summary).

The Sydney Water Operating Licence has governed the development of environmental and sustainability performance indicators for Sydney Water. In order to achieve licence compliance, Sydney Water must report annually to its regulator, the Independent Pricing and Regulatory Tribunal of NSW (IPART), on its performance against a suite of environmental and ESD indicators.

Since 1994, Sydney Water has reviewed its methodology for environmental impact assessment and business operation. The key process has been *WaterPlan 21* which has been the subject of varying degrees of public consultation. *WaterPlan 21* has provided a framework for integrated long-term strategic planning for Sydney Water and now incorporates specific programs that relate to supply and treatment of drinking water, water conservation and recycling and wastewater treatment and management. However, *WaterPlan 21* lacks a high quality community engagement and consultation strategy.

Sydney Water has made considerable progress in relation to the key recommendations made in *A New Course for Sydney Water* (Dowsett *et al.*, 1995). However, in key areas, the Corporation has made little progress, notably the development of truly strategic environmental assessment, implementation of decentralised approaches to reducing water consumption and increasing water recycling.

CHAPTER 2

WATERPLAN 21 - SYDNEY WATER'S VISION

Sydney Water describes its vision "to be a water services provider that achieves world class performance in everything it does, that enjoys the trust and support of the communities it serves and whose people take pride in their contribution to its success. In our pursuit of this vision we recognise that we must understand and adopt sustainable business practices" (Sydney Water, 2002e). However, it is not made clear in the document what the intended relationship between sustainable business practices and the statutory objective of ecologically sustainable development will be.

During 2002, Sydney Water undertook an extensive review of WaterPlan 21, the 21-year strategy for water, wastewater and stormwater. The revision included:

- development of a 'Base Case' – the *Draft Base Case Technical Document* - prepared by Sydney Water (Sydney Water 2002a);
- a Peer Review of the organisation's strategies by an independent Expert Panel (Expert Panel, 2002);
- development of a life cycle assessment – *LCA for WaterPlan 21 Review - Base Case and Scenarios* – prepared for Sydney Water by Centre for Water and Waste Technology (Lundie and Beavis, 2002);
- an evaluation of decision-making for Sydney Water – *ESD Decision Tools - Recommendations for Developing a Framework for Assessing Sustainability of Urban Water Systems* Final Draft May 2002 – prepared for Sydney Water by CSIRO Urban Water (Maheepala et al., 2002);
- contracting the PENGOs to undertake a review of the revised strategy by providing comment and advice with regard to a number of documents prepared on behalf of Sydney Water, including:
- first draft of revised WaterPlan 21 - prepared by Sydney Water (Sydney Water, 2002b);
- draft Base Case Technical Document (Sydney Water 2002a);
- draft Life Cycle Assessment (Lundie and Beavis, 2002); and
- draft ESD Decision Tools (Maheepala et al., 2002).

In addition, the Institute for Sustainable Futures and CSIRO prepared the draft Greenfield Manual (ISF and CSIRO, 2002) as a guideline for new development. A feasibility study (CSIRO and ISF, 2002) was undertaken for Edmondson Park

(a development area in Sydney's southwest) using sustainability criteria developed from the process outlined in the ESD Decision Tools document (Maheepala et al., 2002). These are discussed further in section 3.6.

2.1 Sydney Water's Review of WaterPlan 21

Sydney Water has made some significant and credible achievements against the original WaterPlan 21 strategy. The milestones included in the original WaterPlan 21 provided a mechanism for measuring progress and allow an assessment of:

- **achievements to date;**
- **the remaining components of the strategy to be implemented or completed; and**
- **appropriateness of the 1997 milestones remaining as the best way forward.**

However, the 2002 review of WaterPlan 21 (Sydney Water, 2002b) replaced the 1997 milestones with broad, high-level goals and directions as shown in Table 3.

In contrast to the 1997 goals which relate to wastewater, the new goals and direction for WaterPlan 21 attempt to cover the total water cycle. The new goals define an holistic approach which better complies with ecologically sustainable development principles. However, the strategy is now very broad and requires a more complex and rigorous assessment for determining progress against the objectives.

Whilst the directions identified for the wastewater goal are comprehensive (they are essentially those of the original 1997 strategy), the directions for the new sustainability goals are not as well articulated. The progress in developing comprehensive high level goals needs to be matched by a more rigorous framework, including clear performance targets and timeframes.

Where the 1997 strategy identified programs and indicated costs and timeframes, Sydney Water is proposing to devolve these elements of the strategy to other policies and plans, including four detailed area plans to be developed, commencing in 2003. There is no indication of any process of consultation or shared decision-making and no detail regarding the mechanisms for accountability or review have been provided. This is discussed further in the following sections.

TABLE 3: GOALS AND DIRECTIONS AS DESCRIBED IN *WATER PLAN 21 THE 2002 REVIEW FOR SUSTAINABLE WATER SERVICES* (SYDNEY WATER, 2002B)

GOALS	DIRECTIONS
Clean, safe drinking water	Continue to deliver high quality, safe drinking water to our customers
Sustainable drinking supplies	Reduce per person water use Create products for different end uses Develop sustainable water supplies
Clean beaches, ocean, rivers and harbours	Reduce overflows Minimise dry weather discharges from the sewerage system Reduce wet weather overflows from the sewerage systems Unsewered areas Improve wastewater management in unsewered urban areas Managing stormwater Improve stormwater management by working with stakeholders to integrate stormwater into the total water cycle Beaches and Ocean Seek to reduce additional flows and loads to the ocean

	Continue to operate the coastal sewage treatment plants to serve the coastal catchments Minimise local impacts of sewage treatment plants Hawkesbury Nepean River Meet the water needs of the Hawkesbury Nepean River by integration of effluent management into the total water balance for the system Georges River No discharge of effluent to the Georges River during dry weather
Wise resource use	Solids Continue to recycle the majority of biosolids by improving the reliability of biosolids products and markets Energy Reduce non-renewable energy use Reduce greenhouse gas emissions
Smart growth	Minimise the impact of new development on the Hawkesbury-Nepean and Georges rivers Smart approaches to servicing growth to reflect WaterPlan 21 directions including creating products for different end uses and preventing additional flows and loads to the ocean

2.2 Base Case Model

As part of the review of WaterPlan 21, the Corporation "decided to build a picture of the operations of Sydney Water over the next twenty years" and describe "a base case that can be used for considering alternatives" (Sydney Water, 2002a).

The Base Case Model (BCM) is a 20-year projection of forward capital and operating costs based on a "business as usual" scenario. The model was designed to provide input to economic evaluations (Sydney Water, 2002c).

The technical report (Sydney Water, 2002a) provided an inventory of major operations of Sydney Water, including water, wastewater and stormwater, and summarised financial and environmental information used by the Corporation. The model outlines these major Sydney Water operations and describes linkages between operational activities, including the flow, or potential flow, of water. The model identifies the customer as the focal point of the framework.

However, the model boundary is restricted and does not explicitly account for the natural resource consumption at source, throughput to and impacts on sinks, which is a consequence of Sydney Water's operations. This is discussed further in Section 3.2.

2.3 Life Cycle Assessment, Base Case and Scenarios

The University of NSW Centre for Water and Waste Technology (CWWT) was engaged by Sydney Water to undertake a life cycle assessment (LCA) of Sydney Water's base case or business as usual scenario and compare it to a range of options. Whilst the report refers to 'environmental costs', this type of assessment should not be confused with the calculation of life cycle financial costs. The LCA method used for this study compiles a comprehensive inventory for materials and energy inputs and calculates environmental impact results in terms of a set of environmental indicators, which are based on a standardised methodology. CWWT worked with Sydney Water to develop a WaterPlan 21 LCA model using proprietary software tools, based on data inputs from the Sydney Water base case model:

> "This assessment covered the entire business and has enabled ecological sustainability to be assessed in terms of quantitative indicators. The LCA was performed by firstly examining a base case, which would eventuate if Sydney

Water maintained its current operations with only the modifications, augmentations and upgrades planned for implementation between now and 2021" (Lundie and Peters, 2002).

The base case projection of Sydney Water's operations is described:

"In 2021, Sydney Water (SWC) is expected to supply potable water to 55 customer areas. The projected annual water demand is 622.0 GL/a for all. Almost the entire quantity is freshwater (603.9 GL/a), while only a small quantity is recycled water (18.1 GL/a).

The freshwater is supplied by bulk water areas (i.e. Hawkesbury-Nepean River, Sydney Catchment Authority) and filtered by nine water filtration plants (WFPs) ... The water is distributed from WFPs via thirteen water system areas (WSAs) to customer areas. WFPs treat 652.2 GL/annum out of which 603.9 GL/annum reach the customer areas, while 48.3 GL/a are lost in the WSAs.

At the customer areas water is used for indoor and outdoor purposes. Water used indoors is sent to sewer (505.7 GL/a), while water used outdoors becomes part of the stormwater system (116.4 GL/a).

Forty wastewater system areas (WWSAs) transport the wastewater to inland and ocean STPs where treatment occurs. 487.7 GL/a are discharged to marine and freshwater environment after treatment. 18.1 GL/a are recycled and sent back to the customer areas" (Lundie and Peters, 2002).

TABLE 4: SUMMARY OF ENVIRONMENTAL IMPACTS POTENTIAL FROM THE BASE CASE

ENVIRONMENTAL INDICATORS / IMPACT CATEGORIES	TOTAL ENERGY USAGE	WATER USAGE	CLIMATE CHANGE	FRESHWATER EUTROPHICATION	SMOG	TOXICITY			
						Human	Freshwater ecosystem	Marine ecosystem	Terrestrial
Total	Tera-Joules	Giga-Litres	'000 tonnes CO_2-equiv.	'000 tonnes O_2-equiv.	Tonnes ethylene-equiv.	Kilotonnes dichlorobiphenyl-equiv.			
	8,110	655	721	231	127	63	76	506,218	43

NOTE: ALL INDICATOR CATEGORIES EXCEPT ENERGY USE REPRESENT POTENTIAL IMPACTS ONLY AND EMISSIONS ARE CONVERTED TO REFERENCE SUBSTANCE EQUIVALENT (E.G. '000 TONNES CO_2 MEANS CO_2 EQUIVALENT)

DATA SOURCED FROM LUNDIE ET AL., (2002)

RANKING THE IMPACT CATEGORIES

Normalisation is a process of comparison where results - in this case for the Sydney Water system - are calculated as a percentage of a well-defined reference contribution of a given community over a given period of time - in this case the Sydney region over the timeframe of WaterPlan 21 as a per-capita proportion of the Australian total. Sydney was assigned 21% of the Australian total and the relative contribution of the Sydney Water system expressed as a percentage. The results in each impact category were ranked as 'very important', 'important' and 'average' (see Table 5):

The stated intention of the comparison was to "clarify the importance of environmental impacts of the base case against the overall environmental impacts of 4,900,000 people in the Greater Sydney area; and identify the most relevant impact categories".

TABLE 5: NORMALISED ENVIRONMENTAL INDICATOR AND IMPACT CATEGORY RESULTS

ENVIRONMENTAL INDICATORS / IMPACT CATEGORIES	TOTAL ENERGY USAGE	WATER USAGE	CLIMATE CHANGE	FRESHWATER EUTROPHICATION	SMOG	TOXICITY			
						HUMAN	FRESHWATER ECOSYSTEM	MARINE ECOSYSTEM	TERRESTRIAL
Sydney Water's relative contribution	0.8%	13.8%	0.7%	47.2%	0.2%	0.2%	5.3%	13.2%	1.3%

NOTE: GREYSCALE INDICATES THE IMPORTANCE OF THE IMPACT CATEGORY: ■ 'VERY IMPORTANT', ▨ 'IMPORTANT' , □ 'LESS IMPORTANT'

DATA SOURCE: LUNDIE *ET AL.*, 2002.

The report suggests that:

> "The results indicate that relative contribution of the Sydney Water system to the freshwater eutrophication impact category is by far the most important category (47.2%) being 3 times more relevant than water usage and marine aquatic eco-toxicity" (Lundie et al., 2002).

However, we note that eutrophication potential is compared to a Sydney region reference, whereas other indicators are normalised to Sydney's per capita share of the total results for Australia. This per capita share includes, for example, water used to produce a bottle of wine in Western Australia, or process a tonne of uranium ore at Roxby Downs in South Australia. Thus a lower relevance is given to water consumption (which is considered 'important' but not 'very important' when expressed as Sydney's per capita percentage of Australia's total consumption) compared to freshwater eutrophication (which is considered "very important" when expressed as a percentage of Sydney Water's contribution to total nutrient loads to inland rivers in the Sydney region, ie the Hawkesbury-Nepean system):

> "Water usage (13.8%), marine (13.2%) and freshwater aquatic eco-toxicity (5.3%) are important. Their relative importance is higher by one order of magnitude than the relative contribution of Sydney Water to energy usage (0.8%), climate change (0.7%), photochemical oxidant formation (0.1%), human toxicity (0.2%) and terrestrial eco-toxicity potential (1.3%)" (Lundie et al., 2002).

Unfortunately, this gives an impression that the results have been applied to de-emphasise the impacts of water consumption (an area where Sydney Water is having limited success in meeting clear statutory targets) compared to nutrient discharges to inland rivers (where the Corporation has completed tertiary treatment upgrades to relevant STPs to prevent eutrophication and algal blooms).

The reduced emphasis on water consumption follows Sydney Water's ecological footprint, which to date has ignored water use and defines a fairly modest 'footprint' based largely on energy consumption (Sydney Water 2002e). The use of the Sydney Water's LCA normalisation and ranking method raises serious issues in relation to its application. For instance, the Hawkesbury-Nepean River system would run dry before water use is registered as 'very important' in the relevance ranking. Whilst the comparison to the Australian total is a useful reference, the PENGOs recommend that identification of the most important impact categories needs to be based on a more realistic approach, consistent with impacts on the available Sydney region water resource.

FUTURE SCENARIOS: "PUSHING IT"

Two 'packages' of alternative scenarios were investigated for the *WaterPlan 21 LCA*. The first package 'pushing the existing system' was based on making changes to Sydney Water's current infrastructure, representing increased effort in various program or operational areas, in comparison to the business as usual projections (see Table 6). Scenarios augmenting the water supply via building another dam were not evaluated. The scenarios were:

demand management

the demand management scenario examined the implementation of additional water saving initiatives;

energy efficiency

replacement of water and sewage pumps with more expensive, high-efficiency pumps; the installation of low-watt lighting and reducing the average size of Sydney Water car motors;

energy generation

Sydney Water maximises its potential to generate hydroelectricity in the water supply system and uses more biogas from STPs to generate electricity and heat;

energy recovery from 50% biosolids combustion

using 50% of the biosolids produced by Sydney Water for energy recovery - as a replacement for coal in NSW power stations - was considered in a separate scenario;

desalination

obtaining additional potable water using reverse osmosis technology; and

upgrades of major ocean STPs

the ocean STPs will be upgraded to primary treatment in the base case; for the LCA both secondary and tertiary treatment were assessed.

The results were calculated against a set of environmental indicators. While the scenario augmenting the water supply via desalination resulted in increased environmental impact in all categories except water use, other scenarios demonstrated that significant environmental improvements are available to Sydney Water if operational changes are made, compared to the business as usual projections.

TABLE 6: ENVIRONMENTAL IMPACTS OF 'PUSHING THE SYSTEM' RELATIVE TO THE WATERPLAN 21 BASE CASE (SOURCE: SWC, 2002G)

ENVIRONMENTAL INDICATORS / IMPACT CATEGORIES*	TOTAL ENERGY USAGE	WATER USAGE	GLOBAL WARMING	EUTROPHICATION	PHOTOCHEMICAL OXIDANT FORMATION	HUMAN TOXICITY	FRESHWATER AQUATIC ECOTOXICITY	MARINE AQUATIC ECOTOXICITY	TERRESTRIAL ECO-TOXICITY
Percentage change in environmental impact relative to 'base case' (negative values are better)									
Energy efficiency (motors)	-13	-	-11	-1	-6	-1	-	-	-2
Energy generation	-8	-	-7	-	-1	-	-	-	-1
Energy recovery (biosolids)	-4	-	-2	-	-2	-9	-29	-	-39
Desalination	27	-	23	1	5	1	-	1	3
Demand management	-4	-6	-4	-6	-6	-6	-6	-6	-6
Population +7%	3	7	4	7	6	7	7	7	7
Population +16%	8	16	10	16	15	16	16	16	15
Population –7%	-4	-6	-5	-6	-6	-6	-6	-6	-6
Population -16%	-8	-12	-8	-12	-11	-12	-12	-12	-11
Ocean STPs to secondary	23	-	21	-8	16	2	2	-	51
Ocean STPs to tertiary	26	-	21	-10	17	2	3	-	60

*ALL INDICATOR CATEGORIES EXCEPT ENERGY USE REPRESENT *POTENTIAL* IMPACTS ONLY.

DOING IT DIFFERENTLY

The second 'package' the LCA examined was a 'doing it differently' scenario which assesses innovative wastewater concepts in new urban areas, based on a greenfield development of 12,000 houses in Sydney's southwest development area (see Table 7). Alternative decentralised approaches were based on readily available technologies including rainwater tanks, water saving appliances and neighbourhood scale wastewater treatment.

TABLE 7: SUMMARY OF GREENFIELD SCENARIO VERSUS BUSINESS-AS-USUAL

ENVIRONMENTAL INDICATORS / IMPACT CATEGORIES*	TOTAL ENERGY USAGE	WATER USAGE	GLOBAL WARMING	EUTROPHICATION	PHOTOCHEMICAL OXIDANT FORMATION	HUMAN TOXICITY	FRESHWATER AQUATIC ECOTOXICITY	MARINE AQUATIC ECOTOXICITY	TERRESTRIAL ECO-TOXICITY
Base Case					100%				
Greenfields	83%	27%	82%	6%	25%	3%	7%	2%	33%
Potential improvement	**17%**	**73%**	**18%**	**94%**	**75%**	**97%**	**93%**	**98%**	**67%**

*ALL INDICATOR CATEGORIES EXCEPT ENERGY USE REPRESENT POTENTIAL IMPACTS ONLY.

> "This showed quantitatively that, since connecting new fringe suburbs to the existing system requires significant expenditure on energy for pumping, major improvements in the sustainability of water and wastewater systems can be achieved by using localised, water-saving alternatives" (Lundie and Peters, 2002).

Successful application of LCA is a new development for Sydney Water and is an important strategic planning process for the overall business, with a unique capacity to compare options quantitatively in terms of their ecological sustainability. This is discussed further at section 3.4.

2.4 Decision Tools

CSIRO Urban Water was commissioned by Sydney Water to provide recommendations on the most suitable processes for assessing sustainability for urban water systems. The study objectives were to provide a review of current theories on sustainability, as well as the methodologies and tools currently available for measuring sustainability in the urban water context, and to provide recommendations for developing a framework for assessing sustainability and implementing the framework, as well as assessing the suitability of the current Sydney Water sustainability indicators (Maheepala et al., 2002).

The CSIRO group discussed emerging paradigms of urban water management (see Table 12 in section 3.6) and concluded that the concept of sustainability is the main driver for the emergence of the new paradigms of integrated management across the total water cycle.

Whilst CSIRO provided an overview of a wide a range of methods, including life-cycle assessment (see above) the report focused on multi-criteria decision analysis (MCA). This is a comparative approach for dealing with the complex of information and decision criteria from a variety of perspectives. The decision-making framework recommended by CSIRO would be based on the identification of options, criteria and indicators. These were not fully articulated in the report but were developed later by CSIRO and ISF for the draft Greenfield Manual (ISF and CSIRO, 2002) and applied for the feasibility study for Edmondson Park, a development area in Sydney's southwest (CSIRO and ISF, 2002).

CSIRO also assessed the suitability of the suite of 32 indicators currently being used by Sydney Water for measuring the progress towards sustainable provision of water services (Sydney Water, 2002e), by redefining sustainability criteria in terms of economic, social, environmental and financial parameters. The report suggests four of the indicators are suitable for this purpose and the remainder require modification or replacement.

The report identifies key issues to be addressed before urban water sustainability can be achieved, including:

- **articulation of a shared vision for sustainable water systems;**
- **understanding of social equity issues and interaction with the urban ecosystem; and**
- **devising methods for measuring and monitoring sustainability.**

CSIRO discussed research relating to decision-making and suggested that both government organisations and community groups believe the process should be one of "shared planning and decision-making between the government department and the community" (Maheepala et al., 2002). The report argues that there is a significant difference between the preferred type of public involvement (shared decision-making) and type of public involvement which is believed to be occurring.

The PENGOs recommend that Sydney Water must develop a community engagement process that empowers public participation in decision-making for future water, wastewater and stormwater management options (with sustainable solutions tailored for community needs).

Whilst MCA is Sydney Water's preferred method for decision-making (Ian Hammerton, pers. comm., 2002), the PENGOs have advised Sydney Water that the subjective nature of option selection and decision criteria - and the weighting mechanism in the process - have significantly detracted from the effectiveness of the MCA. If MCA is used without ecological limits as a basic threshold, it is not an appropriate assessment tool within a sustainability framework.

Therefore, the PENGOs advise that the use of MCA should be confined to comparative evaluation, since this methodology cannot be used to set objective standards for sustainability. This is discussed further in section 3.6.

2.5 Peer Review

Sydney Water sought advice through a peer review process from a review panel which included participants from the University of Queensland, the St James Ethics Centre (Sydney), the Rocky Mountain Institute (RMI) and a United States of America-based water consultant who had previously been extensively involved with the Sydney Water Clean Waterways Program during the 1990s. The PENGOs attended a review forum as observers. The Review Panel assessed the processes and the directions of the revised WaterPlan 21 through a four-day review of information provided in written and presentation format during April 2002.

The Panel stated that the broad goals of integration and sustainability established by the revised WaterPlan 21 were consistent with the internal capabilities of Sydney Water (Review Panel, 2002). However, the Panel indicated that the rationale for the goals had not been sufficiently articulated nor effectively communicated.

It was noted by the Panel that an expanded role for Sydney Water (as identified in the revised WaterPlan 21) that included enhanced stewardship and a greater focus on sustainability was not without political and commercial risk. However, the Panel identified that these risks would be greater if the corporation concentrated only on service delivery (Review Panel, 2002).

Whilst the Panel recognised that there had been significant improvement in areas of water quality and demand management, which the Panel called the 'easy wins', they identified a number of additional challenges for Sydney Water, including:

- **stormwater impacts;**
- **balancing water supply and demand in a sustainable manner;**
- **cost-effective re-use; and**

- further reductions in water demand.

Key findings of the Panel included:

- under-representation of identification and quantification for social, environmental and economic benefits accruing to the community from specific projects;
- lack of anticipation of possible changes in technology and sociological and political trends during the next 10-20 years that may have an effect on the operations of Sydney Water;
- need for 'more sharply focused implementation plan' that should be strategically directed at:
- addressing the future business operations of Sydney Water;
- identifying and setting priorities for a clearly defined, measurable and transparent targets that will allow Sydney Water to work towards integration and sustainability;
- developing and communicating clear and understandable messages for stakeholders that reflect the higher level strategic goals.
- make clear distinctions between essential strategies/programs and those that may be popular choices; and
- 'further changes in culture and organisational structure that go beyond annual staffing plans' in order to interact and collaborate in new ways and at a higher frequency with other government agencies, developers and the community.

CHAPTER 3

WATERPLAN 21 - A CRITIQUE

For the 4th Sydney Water Project, the PENGOs were asked to provide best practice and policy advice with regard to specified documents relating to the WaterPlan 21 review. These included:

- the first draft of the 2002 revision of ***WaterPlan 21*** - prepared by Sydney Water (Sydney Water, 2002b);
- the ***Draft Base Case Technical Document*** - prepared by Sydney Water (Sydney Water 2002a);
- the draft Life Cycle Assessment – ***LCA for WaterPlan 21 Review - Base Case and Scenarios*** – prepared for Sydney Water by the Centre for Water and Waste Technology (Lundie and Beavis, 2002); and
- the draft ESD Decision Tools - Recommendations for Developing a Framework for Assessing Sustainability of Urban Water Systems. Final Draft May 2002 - prepared for Sydney Water by CSIRO Urban Water (Maheepala et al., 2002).

Sydney Water agreed to provide these documents to the PENGOs at the first draft stage, in order for the PENGOs to provide best practice and policy advice as the review of *WaterPlan 21* progressed. In the event, the Corporation provided the documents in final form only. In the case of *WaterPlan 21*, Sydney Water's Board of Directors signed off the reviewed strategy before the PENGOs were permitted to review the document. This is discussed further in section 3.7

The PENGOs commissioned independent reviews of Sydney Water's research and relevant aspects of the corporation's operations, including:

- desktop review of the performance of Sydney Water - comparison of current Sydney Water practice with recommendations made by the PENGOs in the final report of the first Sydney Water Project, A New Course for Sydney Water (envirOstrategy, 2002);
- a review of Sydney Water's modelling of economic and environmental costs and benefits across the total water cycle, including modelling a PENGO scenario for Sydney's future (Next Energy, 2002a; see Appendix 2);
- evaluation of the costs and benefits of demand management solutions (Coombes, 2002; see Appendix 4 for Executive summary);
- identifying opportunities for resource recovery (Next Energy, 2002b; see Appendix 3); and
- an extension of the WaterPlan 21 life cycle assessment model.

When it was determined that Sydney Water did not have a total water cycle model and that a PENGO scenario could not be modelled with the available tools, the PENGOs commissioned an extension of the *WaterPlan 21* LCA in order to explore innovative technologies for greenfield development (Beavis and Lundie 2003). Resources were not sufficient to model a PENGO scenario covering all of Sydney Water's operations, but this exercise is essential for the future.

3.1 Sydney Water's Revised WaterPlan 21

The goals and directions developed by Sydney Water for the revised *WaterPlan 21* are listed above in Table 3. These goals are now sufficiently broad to encompass sustainability. This addresses concerns raised by the PENGOs in the 2nd Sydney Water Project.

However, the revised strategy now lacks targets against which the performance of the corporation can be measured. This means that as a strategic planning tool, *WaterPlan 21* is inadequate for the assessment of progress towards sustainable water services and therefore cannot be endorsed by the PENGOs in its current form. Table 8 provides PENGO comment on the *WaterPlan 21* goals.

TABLE 8: PENGO COMMENT ON 2002 GOALS FOR WATERPLAN 21

GOALS	PENGO COMMENT
Clean, safe drinking water	Goals relating to sustainable water supply are supported. However, the two goals listed here are repetitive and narrowly focused. Unsafe drinking water would be unsustainable by definition. It is not only *drinking* water supply which must be sustained, but water for all uses, including water for ecosystems. As the 2002 version of *WaterPlan 21* suggests only one 'direction' for the first goal and only three for the second, the PENGOs recommend combining the two goals into one coherent statement, '**Safe, sustainable water supply.**
Sustainable drinking supplies	See above.
Clean beaches, ocean, rivers and harbours	The goal is supported. The separate elements of the original 1997 version of *WaterPlan 21* are now components of this goal. Some of the "directions" under this goal are not supported. For example, the directions under "Beaches and Ocean" are contradictory, where it states that Sydney Water will "seek to reduce additional flows and loads to the ocean" and "continue to operate the coastal sewage treatment plants". The PENGOs emphasise that the Corporation must make significant progress toward its statutory objectives and increase recycling to eliminate dry weather discharges to the ocean. This is part of the total water cycle and will provide benefits for water supply. *WaterPlan 21* must set clear directions which reflect Sydney Water's statutory and corporate obligations.
Wise resource use	The new goal is supported. The distinction between the water resource identified under the second goal and energy and waste resources under this goal, means that Sydney Water must ensure the integration of policy and works programmes across goals to avoid a fragmented approach.
Smart growth	The new goal is supported to the extent that substantial change will be required in order to make provision for Sydney's population increase. We suggest that '**Eco-efficient growth**' is more appropriate terminology for an environmental strategy such as *WaterPlan 21*. Eco-efficiency must be promoted, both within Sydney Water and across government, industry and community, in order to make real progress towards sustainability.

WaterPlan 21 was completed in 1995, but was not released to the public as a strategy document at that time. However, it was used by Sydney Water as an internal reference document for decision-making. It became available to the public in 1997 when published in Fact Sheet form and on the internet, where Sydney Water summarised their key milestones.

An alternative approach to the current WaterPlan 21 to provide improved transparency and specificity in delivering sustainability must be to include the key milestones for 2005-2010 and 2020 which were part of the original 1997 strategy, and add new targets for environmental goals.

WaterPlan 21 was conceived as a wastewater strategy and the key milestones published in 1997 relate, for the most part, to wastewater objectives. A progress report against the key milestones is provided at Appendix 1, the full report (envirOstrategy 2002) is appendix X on CD:

3.2 Modelling Costs and Benefits for the Total Water Cycle

The Sydney Water WaterPlan 21 Base Case Model is outlined in section 2.2. The PENGOs engaged Next Energy to evaluate Sydney Water's modelling of costs and benefits for the total water cycle. Next Energy was asked to "...review Sydney Water's model examining the broad conventional costs and benefits of the approach to the urban water cycle (including economic analysis and environmental impacts), identify shortcomings and propose options for a PENGO scenario enhancing the sustainability of the corporations operations."

To this end, Next Energy reviewed the following documents:

- **Review of WaterPlan 21 - Draft Base Case Technical Document Sydney Water 2002,**
- **WaterPlan 21: The 2002 Review for Sustainable Water Services Sydney Water, July 2002.**

The anticipated *Life Cycle Assessment for WaterPlan 21 Review - Base Case and Scenarios* prepared by the Centre for Water and Waste Technology, June 2002 was not made available by Sydney Water during the course of the consultancy undertaken by Next Energy for the PENGOs. The LCA report was made available to the PENGOs in October 2002 and Next Energy reviewed the LCA with respect to resource recovery (see section 3.3). The PENGOs also engaged the University of NSW Centre for Water and Waste Technology to undertake an extension of this study (this is discussed at section 3.4).

The key finding was that Sydney Water has not yet developed suitable modelling or evaluation tools for the total water cycle. It was also not possible to model a PENGO sustainable water cycle scenario using the existing collection of evaluation methods in use by the corporation.

The *WaterPlan 21* Base Case Model was reviewed and provides useful groundwork in describing a business-as-usual scenario and as a point of reference. Extensions to the Base Case Model were suggested by the PENGOs to indicate macro level natural resource flows resulting from Sydney Water operations, at both source and sink (see Appendix 6).

It was not possible to identify a clear strategic assessment and decision-making process from the information provided by Sydney Water. A range of economic evaluation documents were requested from Sydney Water, however none included full economic costs and benefits of environmental goods and services. Sydney Water advised that economic evaluation was focused on meeting regulatory requirements rather than informing decision-making (Ian Hammerton, pers comm.). A decision-making document was provided by Sydney Water. However, this document was in fact a guideline for internal project assessment.

The *Hawkesbury-Nepean Wastewater Strategy* (SWC, 1997) was the highest-level document provided and was evaluated in detail. Next Energy recommended that Sydney Water should revise this strategy (Next Energy, 2002a)

Next Energy found significant flaws in Sydney Water's economic evaluation when measured against sustainability principles (Next Energy 2002a). In most cases, environmental capital, goods and services were implicitly given a zero value. Only the value of environmental benefits of meeting specific regulatory criteria was assigned a value and this was through contingent valuation.

A contingent valuation survey undertaken by AC Neilsen was found to contain a bias against potable water re-use, a recycling option strongly favoured by the PENGOs. One of the survey questions was framed in such a manner that it

would have also lead the thinking of respondents. Respondents were asked to agree or disagree with the following statement:

"I couldn't drink tapwater if I know there was recycled sewage in it, no matter how well purified it might be."

The results for responses to this question were, not surprisingly, strongly negative, given the framing. It would have been interesting to test a more objectively framed question such as that proposed by Next Energy (2002a):

"I would be happy to drink tapwater sourced from the recovery of purified water from the wastewater treatment process"

It became apparent to the PENGOs during the course of the project that the methodology used for this contingent valuation study was not universally accepted by Sydney Water. In fact, the study was disavowed by Sydney Water's Manager Customer Research (Dr Naomi Roseth, meeting with PENGOs January 2003). It is a matter of serious concern that flawed studies are undertaken on Sydney Water's behalf for the purpose of strategic and environmental impact assessment evaluation, particularly when results are translated into cost-benefit data which influences option selection. The PENGOs are prepared to provide assistance in ensuring that both the options and the descriptions of environmental outcomes are properly incorporated in contingent valuation survey process, and other cost-benefit evaluation.

The Next Energy Report is reproduced in full in Appendix 2 (Next Energy, 2002a) and makes a series of key recommendations, including:

OVERALL RECOMMENDATIONS ON WATERPLAN 21 ECONOMIC MODELLING

1. Sydney Water is at a preliminary state in developing company or catchment-wide economic models as envisaged by the PENGOs. To be able to substantiate the appropriateness of its key investment decisions and to enable appropriate external scrutiny, it needs to be strongly encouraged to develop such models.
2. Company-wide economic modelling for water utilities as envisaged by the PENGOs (i.e., that addresses the principles of ecologically sustainable development, decentralised options, and the total water cycle) appears to be in an immature state. As a consequence, it may be most effective for Sydney Water to collaborate with other parties that are also pursuing such an analytic approach.

SPECIFIC RECOMMENDATIONS ON KEY ENHANCEMENTS FOR WATERPLAN 21 ECONOMIC MODELLING

3. Extend the modelling process to include life cycle cost-benefit analyses, and financial analyses including calculation of resulting water service prices and aggregate costs.
4. Develop a process to ensure valid and internally consistent results.
5. Clearly distinguish between: a) key Sydney Water business decisions (e.g. upgrade of a sewage treatment plant, installation of energy recovery system) that are to be assessed for their costs and benefits; and b) inputs that are exogenous to Sydney Water.
6. Enhance the analytic process to readily allow assigning non-zero costs for environmental impacts, and ensure that the full range of environmental costs and benefits are properly identified even if they cannot be fully quantified.

RECOMMENDATIONS BASED ON REVIEW OF THE HAWKESBURY-NEPEAN WASTEWATER STRATEGY

7. Update and revise the Hawkesbury-Nepean Strategy to the extent that it will provide the framework for future Sydney Water decisions.

CONSIDERATION OF THE TOTAL WATER CYCLE

8. Distinguish between effluent re-use that offsets actual supply requirements, and that which is applied to artificially created demand (i.e., from new woodlots).

9. Identify and consider wastewater options that have demand management benefits, and ensure that those options are credited with those benefits, including the broader environmental benefits of deferring or eliminating the need for new water supply.

10. Broaden the identification of non-potable re-use options for water recovered from effluent treatment, and ensure that those options are properly characterised in terms of the value and volume of re-use water.

CONSIDERATION OF DECENTRALISED OPTIONS

11. Consider a broader array of suitably defined decentralized wastewater options, such as cluster systems (which provide treatment to small groups of households, e.g. 3 to 50).

12. More adequately describe and justify the assumed cost and performance of non-traditional technologies, in particular, decentralized options

13. To assist in obtaining more meaningful options, undertake a public process/open competition to elicit proposals for non-traditional technologies, and in particular, decentralized options, with significant reward commitments (e.g., $20 million over two years).

14. The PENGOs can play an active role in this effort. Two activities that could assist Sydney Water in achieving a successful competition are the following:

    - assistance in formulating the competition itself, including design of the solicitation, promotion, evaluation and ongoing oversight; and
    - assistance in securing regulatory approval from IPART for recovery of the costs.

VALUATION OF NON-FINANCIAL ESD ATTRIBUTES

15. Ascertain that the contingent valuation survey encompasses an appropriately full list of environmental attributes.

16. Involve the PENGOs in ascertaining that the contingent valuation process to ensure that the scenarios and options to be assessed are properly defined and communicated to survey participants.

DISCOUNT RATE

17. In addition to the 7% discount rate based on the weighted average cost of capital as indicated by the NSW Treasury, use a 1% discount rate based on long-term natural resource and intergenerational equity considerations.

OTHER COMMENTS

18. It appears there may be some significant data errors contained within the *Base Case Technical Document* report.

19. Develop more in-house expertise and consistency by reducing the role of external consultants.

3.3 Resource Recovery

The PENGOs engaged Next Energy to:

- **review Sydney Water's research on opportunities for resource recovery from their systems, including re-use and energy recovery from waste;**
- **identify shortcomings; and**
- **propose options for a PENGO scenario enhancing the sustainability of the corporations operations.**

LCA OF NOVEL AND DECENTRALISED TECHNOLOGIES

In particular, Next Energy reviewed the LCA for WaterPlan 21 Review - Base Case and Scenarios (Lundie et al. 2002) with respect to biosolids, water recycling and pumping energy (this document is discussed in more detail at section 2.3).

Next Energy concluded that decentralised technologies which showed promising results in the initial analysis (Sydney Water's 'doing it differently' scenario) should be further examined. At a minimum, this would involve performing economic and financial analyses of the greenfields scenario or, perhaps more usefully, a range of distributed wastewater treatment scenarios. Additional examples of technologies that are worthy of consideration in decentralised scenarios include:

- **cluster systems serving 3 to 50 households;**
- **household systems that do not mix toilet and greywater;**
- **biolytic (vermiculture) composting options;**
- **household systems with no re-use;**
- **community systems with no re-use; and**
- **community systems with indirect or direct potable re-use.**

The PENGOs undertook a more detailed study of decentralised technologies and this is discussed in section 3.4.

OPEN COMPETITION TO IMPLEMENT EMERGING TECHNOLOGIES

Next Energy recommended that Sydney Water effectively explore sustainable technologies by establishing a dedicated funding mechanism and staging a competitive process to build demonstration sites.

Sydney Water has found substantial benefits may result from 'doing it differently' and the next step is to implement these solutions in future development. If these solutions and corresponding benefits are applied to future greenfield and infill development in Sydney over the WaterPlan 21 timeframe, the aggregate improvement (compared to 'business-as-usual') will be many times greater than the results from Sydney Water's demand management programs to date (Coombes et al., 2003). This is discussed further in section 4.

Next Energy recommended that WaterPlan 21 be revised to address the absence of a discussion of Sydney Water's research and development program in order "to identify and encourage novel technologies such as those represented by the greenfields scenario, and in biosolids use for energy generation" and recommended that Sydney Water "highlight Sydney Water's ongoing research and development program to identify and promote suitable new solutions."

FULL COST-BENEFIT ANALYSIS

Next Energy recommended that the environmental benefits of avoiding the construction of a new dam must be addressed more directly in decision-making, particularly with respect to water recycling and demand management. Whilst the NSW government has decided to indefinitely defer construction of the proposed Welcome Reef dam on the Shoalhaven River, it remains true that if Sydney's thirst is not reduced to compensate for population growth, the dam - or an equivalent supply-side augmentation such as desalination - will become necessary.

Sydney Water (2002c) responded to the Next Energy report that the LCA metrics compared different scenarios against qualitative indicators but the failure to undertake full cost-benefit analysis has not been explained by Sydney Water. The costs and benefits of water conservation and recycling options must be evaluated by taking into account the economic benefit resulting from deferring augmentation of supply infrastructure. In order for decision-making to reflect sustainability, scarce natural resources such as water must be assigned a zero value. Otherwise, conventional options (which do not use water efficiently or provide recycling) will continue to outrank the more sustainable options in Sydney Water's decision-making processes. This is discussed further in section 4.

BIOSOLIDS

Next Energy suggested that efforts to develop renewable energy production from biosolids are worthy of further consideration given the favourable LCA results relative to land application. However, they concluded that it would be unfortunate if energy recovery issues distracted from other resource recovery issues (e.g. in effluent water recovery and recycling and biosolids) that are arguably more central to Sydney Water's operations. Reassessment of the market outlook and targets for biosolids in both agricultural and energy applications is recommended.

ECOLOGICAL FOOTPRINT

Sydney Water's ecological footprint methodology was evaluated by Next Energy and the focus on energy as the largest direct or indirect ecological impact was compared unfavourably to the broader scope of the WaterPlan 21 LCA. Next Energy recommended that the ecological footprint criteria be redefined accordingly.

RECOMMENDATIONS

The Next Energy report is reproduced in full at Appendix 3 (Next Energy, 2002b) and identifies a series of key recommendations:

OVERALL COMMENTS ON THE WATERPLAN 21 LIFE CYCLE ASSESSMENT

1. The LCA for the WaterPlan 21 review (WP21 LCA) provides a useful environmental assessment tool that should be helpful in revisiting elements of Sydney Water's strategies.
2. In applying this LCA to WaterPlan 21 (and to other Sydney Water strategies), it is important to appreciate that there are inherent limitations in life cycle assessment generally, and that it would be premature to apply the results of the WP21 LCA directly.
3. The WP21 LCA raises some useful scenarios and issues that merit further detailed evaluation.
4. Given the informative nature of the WP21 LCA work, it would be appropriate to disseminate it more widely than currently planned to facilitate community consultation.

DETAILED COMMENTS

5. Given the strongly positive WP21 LCA results, it is essential to perform further detailed analyses of decentralized strategies such as those in the 'Doing it Differently' greenfields scenario.
6. Given that there is no metric directly relating to the construction of a new dam such as Welcome Reef for supply augmentation, the WP21 LCA should more explicitly note that water recycling and demand management activities may have environmental benefits greater than indicated by the metrics alone.
7. Given the positive environmental WP21 LCA results for electricity generation using biosolids, it is essential to perform further detailed analyses of the relative merits of using biosolids for land application versus electricity generation.
8. Based on the WP21 LCA results to date, it would be appropriate for Sydney Water to revise the draft revised WaterPlan21 with respect to the use of biosolids for purposes other than land application, even prior to further detailed analysis as discussed in Item 6. It would also be appropriate to update and enhance Sydney Water's 1999 Biosolids and Residuals Management Strategy (SWC, 1999a).
9. There is an opportunity for a broader definition of energy efficiency opportunities than characterized in the WP21 LCA.
10. Given the broader array of environmental indicators identified in the WP21 LCA, it is worth reconsidering or redefining the 'ecological footprint' that Sydney Water cites in the "Towards Sustainability Report."

ADDITIONAL OBSERVATIONS ON SYDNEY WATER'S BIOSOLIDS RESOURCE RECOVERY AND WATER RECYCLING PROGRAMS

11. In light of ongoing developments in consumption levels, environmental flow requirements, and experience with demand management and recycling opportunities, it would be useful to more explicitly reassess the

outlook for potable water demand and the ability to indefinitely defer construction of a new dam, and to accelerate demand management and recycling efforts accordingly.

12. It would be useful to reassess the market outlook and portfolio targets for agricultural markets and other land application of biosolids in light of developments in commercial, environmental, and regulatory arenas.

13. It would be appropriate to reassess the market outlook and portfolio targets identified in the Biosolids and Residuals Management Strategy for using biosolids for energy production, in light of several recent positive developments.

14. To assist in obtaining more meaningful demand management and recycling options, undertake a public process/open competition to elicit proposals for non-traditional technologies, and in particular, decentralized options, with significant reward commitments (e.g. $20 million over two years).

15. To assist in obtaining more meaningful options and information, it would be appropriate for Sydney Water to undertake a public process/open competition to solicit proposal for emerging biosolids technologies, with significant award commitments (e.g. $5 million per year over four years).]

3.4 Life Cycle Assessment

The Sydney Water WaterPlan 21 LCA is outlined in section 2.3 and the report by Next Energy relating to resource recovery and the WaterPlan 21 LCA is discussed in the previous section.

The application of LCA methodology to Sydney Water's current operations and options for the future is creditable. However, it is disturbing that the projection of 'business-as-usual' twenty years into the future reveals potential failure to make significant progress toward sustainability. For example, the base case projection indicates extremely limited progress in water conservation and recycling and no substantial progress towards the statutory long-term goal of eliminating dry weather discharges to rivers and the ocean. The base case projection suggests that more than twice as much water will be lost in the distribution system than will be saved by recycling.

Sydney Water is planning to increase recycling by delivering secondary treated effluent to industrial and domestic customers via duplication of the SWSOOS from the substantial urban development areas in Sydney's south-west to Malabar STP (the Georges River Project 'recycled water pipeline') However, the projections for re-use remain uncertain and by 2021 the Corporation may still be losing more water through leakage and transfer losses than it recycles.

LIFE CYCLE ASSESSMENT OF PENGO SCENARIOS

Following the PENGO review of the Corporation's modelling for WaterPlan 21 (Next Energy 2002a; 2002b), the PENGOs engaged the Centre for Water and Waste Technology to undertake a more detailed evaluation of scenarios for greenfield development using the WaterPlan 21 LCA model. The results of this PENGO LCA are reported by Beavis and Lundie (2003) and the executive summary of the report is included at Appendix 5.

The estimate of environmental benefits of 'doing it differently' were made through the WaterPlan 21 LCA for a greenfield site in one of Sydney's growth areas (Lundie et al., 2002). The results were remarkable (see Table 7) and were considered by PENGOs to warrant more detailed investigation. A range of novel and decentralised technologies were evaluated for the PENGOs, using scenarios applied to the same functional unit as the WaterPlan 21 'doing it differently' scenario (12,000 allotments using data for Edmondson Park, near Glenfield in south-west Sydney). The site represents one of 16 greenfield areas announced by the NSW Government in December 2001, for 89,000 dwellings. Within the timeframe of WaterPlan 21 some 370,000 new dwellings are anticipated in greenfield and infill development, according to PlanningNSW estimates (PlanningNSW data provided to PENGOs by Sydney Water). These estimates appear to be conservative, given that Sydney Water's own estimates in the Base Case Model (based on population projections) were higher (Sydney Water 2002a).

The decentralised scenarios were conceived for the PENGO project as a progressive development from traditional on-site systems. This is based on:

- improving conventional on-site septic system allotment-scale absorption by substituting neighbourhood-scale cluster filtration and irrigation to land;

- substituting on-site septic tank (primary anaerobic digestion) by on-site primary biolytic filter (primary/secondary aerobic vermiculture) to reduce greenhouse emissions and increase system resilience;

- reducing water consumption by collecting rainwater (stormwater) and recycling greywater and/or treated wastewater; and

- additional resource recovery (nitrogen fertiliser) by adding urine separation.

Sydney Water requested that the PENGO scenario include consideration of low pressure sewerage system reticulation (LPSS) which has been proposed for the Northern Towns priority sewerage scheme project.

The scenarios are illustrated in the schematics to clearly show the technologies, treatment processes (see Figures 1 to 3). The novel technologies are described briefly in the following points:

- Low Pressure Sewerage System (LPSS) uses an on-site grinder pump to macerate sewage for reticulation via low-pressure polyethylene pipe to conventional STPs. Advantages include a flexible well-sealed reticulation system with reduced number of in-line pumping stations and reduced infiltration/exfiltration and consequent surcharge/overflow of sewage at pumping stations and the STP (unpublished data provided by Sydney Water);

- Biolytic filtration is an on-site aerobic vermiculture (worm farm) chamber to compost sewage solids and filter liquids for disposal at the allotment and/or neighbourhood scales. Compatible with dry (water-saving) or conventional flush toilets. Advantages include aerobic treatment reducing greenhouse emissions, higher effluent quality and treatment resilience compared to conventional on-site septic or composting. In addition, optimised configurations permit low energy operation with biological systems (macro-invertebrates), converting waste to energy for effluent treatment (unpublished data provided by AquaClarus P/L and VermiTech P/L);

- Recirculating Cluster filters are scaleable secondary/tertiary treatment modules using sand and/or other filter media. Advantages include location at neighbourhood scale to permit convenient effluent re-use or recycling (unpublished data provided by InnoFlow);

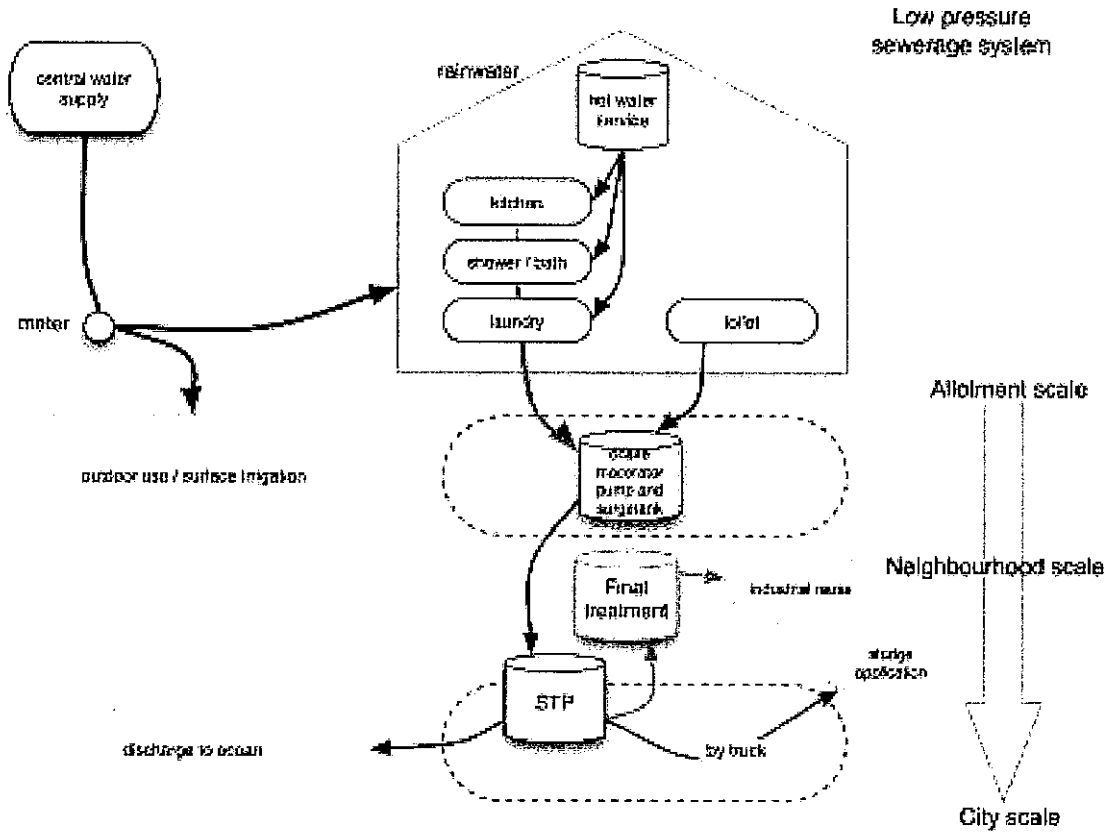
- Rainwater collection from individual (detached residential) or shared (multi-unit) using steel or concrete tanks connected to household indoor uses (toilet, laundry, HWS) and mains trickle top-up. Advantages include substitution for centralised potable supply and stormwater retention (unpublished data provided by Urban Water Cycle Solutions);

- Greywater recycling via allotment scale collection and pumping to toilet flushing with surplus to garden. Advantages include substitution for centralised potable supply (unpublished data provided by Centre for Water and Waste Technology); and

- Urine separation via purpose-designed toilet with diversion of yellowwater to storage tank and transport to land application. Advantages include recovery of nitrogen for fertilizer substitution (unpublished data provided by Centre for Water and Waste Technology).

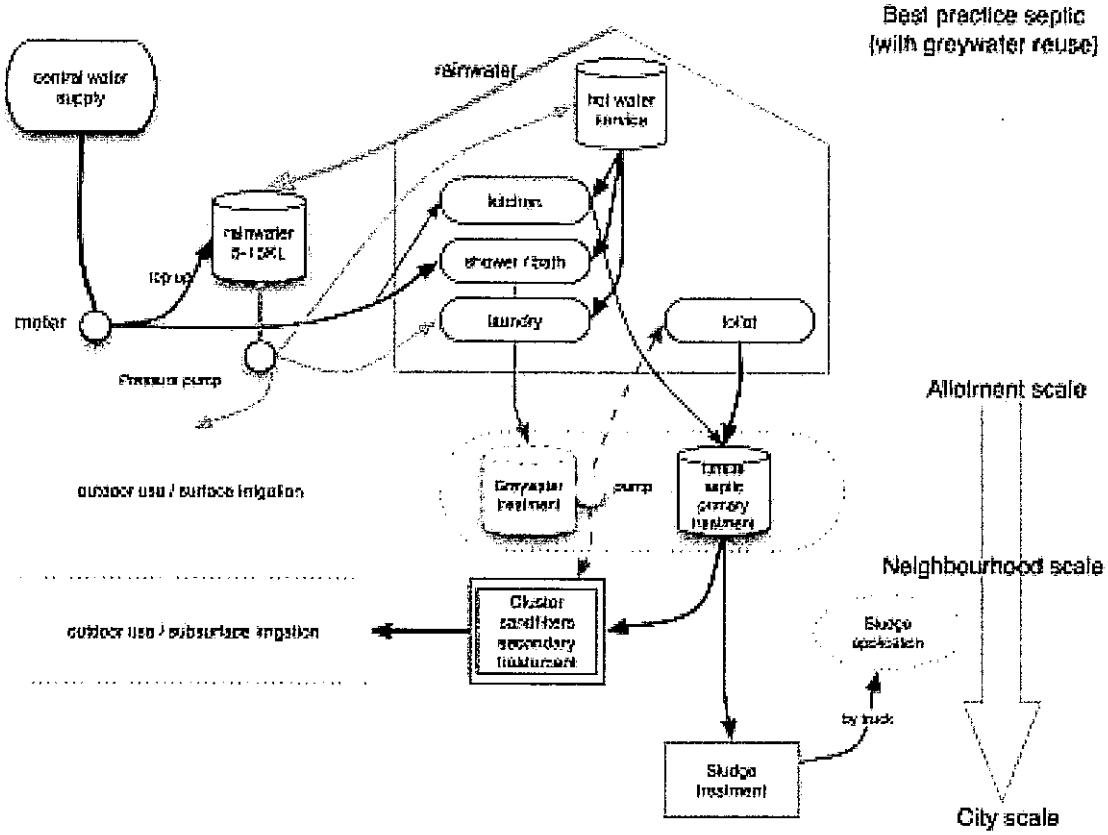
SCENARIOS

FIGURE 1: LOW PRESSURE SEWERAGE SYSTEM SCENARIO



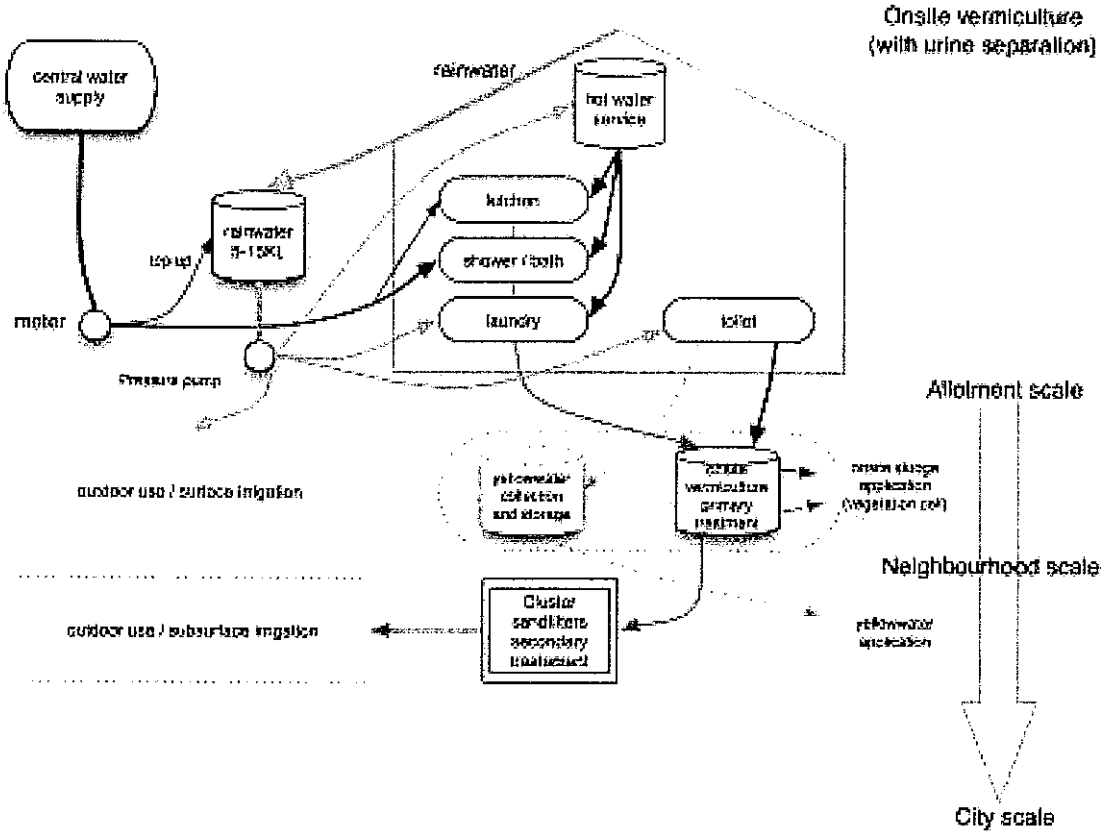
LPSS discharging via Glenbrook STP to Malabar with discharge to the ocean (see Figure 1). An allowance was made for 30% recycling via the Georges River pipeline to industrial re-use. An additional iteration was modelled with rainwater collection and discharge of tertiary effluent to local waterways (LPSS 1).

FIGURE 2: SEPTIC SCENARIO



On-site Septic tanks combined with neigbourhood-scale secondary filters (see Figure 2), based on systems proposed for Rodney District Council in New Zealand (RDC, 2002). Greywater recycling to toilet use and rainwater collection were included for maximum savings of potable water use.

FIGURE 3: VERMICULTURE SCENARIO



On-site vermiculture system (OVS) with biolytic filtration and neighbourhood-scale secondary filters (based on environment group submission to Picton STP EIS - SHURE, 1994), plus yellowwater separation and rainwater collection (see Figure 3). An additional iteration was modelled without the redundant on-site secondary treatment recirculating pump (specified by AquaClarus for their stand-alone retail product), as cluster filtration performs this function more efficiently from a life-cycle perspective. Half of the allotments were also assumed to drain to filter locations via gravity (OVS 1).

TABLE 9: SUMMARY OF RESULTS FOR NOVEL AND DECENTRALISED TECHNOLOGIES

		LPSS	LPSS I	SEPTIC	OVS	OVS I
Total Energy	terrajoules	62.6	59.3	52.1	70.1	51.4
Potable Water Use	L	2,210	984	900	984	984
Water use for commodities	ML	25	13	13	13	8
Global warming potential	tonnes CO2 equiv	4,990 (5,926)	5,030	11,900	5,420	4,150
Eutrophication Potential	tonnes O2 depletion equiv	98	96.1	336.2	149 (93)	137.0 (81)
POCP	tonnes Ethylene equiv	0.47 (0.78)	0.42	2.77	0.94	0.91
Human Toxicity Potential	tonnes DCB equiv	128.00	49.80	36.80	35.30	31.20
Terrestrial eco-toxicity potential		234	226	319	286	278
Freshwater Aquatic Eco-toxicity		16.6	1240	65.8	43.7	43.3
Marine Aquatic Eco-toxicity Potential		1,310,000	197,000	103,000	130,000	108,000

NOTE: SENSITIVITY TEST DATA IN BRACKETS

RESULTS IN TABLE ARE COMPILED FROM DATA IN BEAVIS AND LUNDIE (2003)

Results were calculated for the WaterPlan 21 impact categories (see Table 9) and compared to the base case on a per capita basis (see Table 10). The interpretation of these results should be undertaken with several caveats. Firstly, in order to maintain comparability with WaterPlan 21 LCA, Sydney Water's assumptions for potable water use were retained. Coombes gives more conservative results from modelling for rainwater collection in several areas of Sydney, including Macarthur where the Edmondson Park scenario was specified, due to drier climate and likely demographics (Coombes, 2002).

Secondly, scenarios were combined to give coverage of a range of novel and decentralised technologies. However, the optimum system would be configured on the basis of further investigation at the project scale. It was not possible to model a number of promising technologies in this study. However, these should also be further investigated by Sydney Water to ensure that all potentially beneficial options are explored.

Thirdly, except for rainwater collection, assumptions used for the LCA model were generally conservative for decentralised systems, but less conservative for centralised systems. Key sensitivities to the results are fugitive emissions and material use. If volatile organic carbons (such as methane) were to be included in centralised emissions, an additional 936 tonnes of global warming potential (GWP) is added to each of the LPSS options. Additionally, the LPSS impacts to photochemical oxidation creation potential (POCP) would increase by 0.31 tonnes (Beavis and Lundie, 2003).

OVS system contributions to eutrophication potential are also variable. The emission was based on a 5% volatilisation of the ammonia created in the yellowwater storage tank. If these emissions were assumed to be 1%, the ammonia contribution to eutrophication potential would reduce by 56.4 tonnes. This would produce a result similar to the LPSS scenario (Beavis and Lundie, 2003). A reduction in this indicator result for OVS systems would also occur if urine (yellowwater) separation was excluded from this scenario.

TABLE 10: COMPARISON OF LCA RESULTS FOR NOVEL AND DECENTRALISED TECHNOLOGIES WITH 'BUSINESS-AS-USUAL' (ANNUAL PER CAPITA BASIS)

	BASECASE		LPSS	LPSS I	SEPTIC	OVS	OVS I
Total Energy	1.66 GJ	100%	105%	99%	114%	118%	**86%**
Potable Water Use	0.13 ML	100%	45%	**20%**	**19%**	**20%**	**20%**
Water Use-LCA	0.57 kL	100%	120%	84%	61%	92%	**39%**
Global Warming	146.9 kg CO_2	100%	94%	95%	225%	103%	**81%**
Eutrophication	47.1 kg O_2	100%	**6%**	**6%**	20%	**9%**	**8%**
Photochemical Oxidant Creation	0.03 kg ethylene	100%	**40%**	**42%**	236%	81%	76%
Human Toxicity	12.9 kg DCB	100%	27%	**11%**	**8%**	**8%**	**7%**
Terrestrial Ecotoxicity	8.7 kg DCB	100%	**75%**	**72%**	102%	91%	89%
Freshwater Ecotoxicity	15.4 kg DCB	100%	**3%**	220%	**12%**	**8%**	**8%**
Marine Ecotoxicity	103.3 t DCB	100%	35%	**5%**	**3%**	**3%**	**3%**

NOTE: BEST RESULTS ARE SHOWN BOLD, RESULTS WITHIN 10% ARE CONSIDERED EQUIVALENT.

RESULTS IN TABLE COMPILED FROM DATA IN BEAVIS AND LUNDIE (2003)

At one end of the scale, the 'business-as-usual' base case is often the worst option and never the best option. At the other end of the scale, the optimised decentralised scenario using on-site biolytic filter is usually the best option and never the worst option.

Results may also be applicable to retrofit situations, including priority sewerage program areas. If decentralised cluster systems are to be retrofitted to existing stand-alone decentralised systems, such as to a septic tank, there are significant improvements across all indicators (see Table 11). The calculation of these benefits is for the saved material requirement and does not consider the benefits of further product offsets (avoided products).

TABLE 11: PERCENTAGE IMPROVEMENTS IN SEPTIC SYSTEM WITH CLUSTER RETROFITTING

TOTAL ENERGY	WATER-USE LCA	GLOBAL WARMING POTENTIAL	EUTROPHICATION POTENTIAL	TERRESTRIAL ECOTOXICITY POTENTIAL	HUMAN TOXICITY POTENTIAL	FRESHWATER AQUATIC ECOTOXICITY POTENTIAL	SMOG
9.5%	3.5%	4%	5.9%	1.3%	0.5%	nil	0.4%

SOURCE: BEAVIS AND LUNDIE (2003)

The results indicate that all scenarios would benefit from LPSS-style reticulation systems (which use flexible polypropylene pipes instead of rigid PVC) which exhibit better life-cycle impact results as well as improved infiltration/exfiltration performance. However, biolytic filtration gives better results than either grinder-pump to centralised STP or anaerobic septic treatment across the indicator categories. All scenarios would benefit from rainwater harvesting, and greywater re-use is likely to provide additional benefits in lower rainfall areas. Recycling of treated effluent from

neighbourhood-scale filtration may also be an effective substitute for greywater recycling, although this was not specifically modelled.

Generally, decentralised systems were found to be competitive with centralised systems. The results of the PENGO LCA indicated that decentralised technologies should convincingly outperform conventional solutions across all impact categories (Beavis and Lundie, 2003). Feasibility studies undertaken for Sydney Water for the greenfield site at Edmondson Park (CSIRO and ISF, 2002) indicated that these solutions are also likely to be cost competitive and would score well under other sustainability assessment criteria.

If the benefits of 'doing it differently' are realistic, then the aggregate result of using the novel and decentralized technologies for new development are likely to be significant, and form a key part of the effort to achieve a sustainable Sydney. This is discussed further in section 4.

3.5 Demand Management

An evaluation of the costs and benefits of demand management solutions was undertaken by Urban Water Cycle Solutions on behalf of the PENGOs. The objectives of the consultancy were to:

- **review Sydney Water's research on costs and benefits of demand management solutions across water, stormwater and sewer systems;**
- **evaluate whether Sydney Water is putting this research into practice;**
- **investigate comparable examples in Australia and overseas, and provide a summary of research and findings;**
- **provide a critique of clarity of intent and execution, scientific accuracy, and comprehensive coverage of the Sydney Water research;**
- **where shortcomings were identified, provide options which will better address the need for the Sydney Water operations to protect the environment and comply with the principles of ecologically sustainable development, and meet their operating licence requirements; and**
- **make recommendations as to the options which will best meet these principles.**

The study investigated alternative urban water cycle management strategies in the context of current and historical application of conventional and innovative technologies. Coombes highlights the significant benefits to the community and the environment that can be gained by innovative use of policy and infrastructure (Coombes et al., 2003). The study criticised the approach taken by Sydney Water in various areas of its management of the water, waste water and stormwater system. This is discussed further in Chapter 4.

RECOMMENDATIONS

Coombes makes a series of recommendations for improving environmental, social and economic outcomes from water management in the Greater Sydney region, including:

INTRODUCTION / HEADWORKS OPTIONS

1. More frequent water restrictions that are related to climatic conditions as well as water storage levels should be considered as a method of demand management. The use of permanent water restrictions for different water use categories (such as outdoor uses) should also be considered.
2. The use of different pump marks for water extractions from the Shoalhaven River is suggested to increase the expected reliability of the headworks system. The environmental impact on the Shoalhaven River system, economic costs and emissions of greenhouse gases of such a strategy will be considerable. A strategy to increase water transfers from the Shoalhaven River is not supported nor recommended.

WATER CONSUMPTION

3. The benchmark for reduction in per capita water demand should be the lowest per capita water demand achieved in recent times of 411 L/day in 1995. In addition, an actual level of demand such as the 550 GL from 1995-6 should be set as a benchmark for comparison to current actual demands.

DEMAND MANAGEMENT

4. Sydney Water should evaluate demand management alternatives from the community perspective using the true resource cost of water, zero discount rates and whole of water cycle benefits in comparative investment models.

5. In order to meet the demand targets set in the Operating Licence and to avoid the construction of the Welcome Reef Dam, Sydney Water needs to implement a greater range of demand management measures than those currently preferred.

RAINWATER TANKS

6. The rainwater treatment chain of the roof, first flush device, rainwater tank and hot water service provides acceptable water quality for outdoor, toilet, laundry and hot water uses. The addition of an ultraviolet disinfection unit or a water filter to the rainwater treatment chain should produce water quality acceptable for all household uses.

7. Capture of roof water in rainwater tanks to partially supply domestic water demand will significantly reduce regional water demand by 5.8% to 21% by 2050, resulting in a delay in the requirement to construct new dams by 8 to 41 years, and reduce stormwater discharges from domestic allotments by 28% to 62%. The net present value of a rainwater tank strategy ranges from a benefit of $2639/lot to a cost of $810/lot. The cost of rainwater supply varies from a benefit of $0.57/kL to a cost of $0.17/kL. A policy for the use of rainwater tanks for water demand and stormwater management should be implemented as a priority. A demand management strategy that only includes rainwater tanks will not allow Sydney Water to achieve the demand targets mandated in the Operating Licence.

8. The use of AAA rated shower roses is a preferred Sydney Water strategy for domestic water demand management. Unfortunately, the effectiveness of the AAA rated shower roses has been over-stated and the AAA rated shower roses will produce insignificant reductions in regional water demand. Clearly, a combination of demand management approaches is required to achieve a significant reduction in mains water demand.

9. The combined use of AAA rated shower roses, taps regulators, 6/3 flush toilets and AAA rated washing machines will reduce Sydney regional water demand by 5% to 10% resulting in delays in the requirement to construct a new dam of 6 to 15 years. The strategy has net present values ranging from a benefit of $487 ($0.24/kL) to a cost of $1095 ($0.54/kL) per allotment. Although the use of demand management measures alone will not achieve Sydney Water's demand management targets, a policy to encourage installation of a greater range of demand management measures should be pursued.

WASTEWATER RE-USE

10. The use of treated wastewater should be restricted to outdoor and toilet flushing purposes until treatment techniques are developed or confirmed to remove endocrine disrupters, viruses and protozoa. Rainwater from tanks has minimal risk in comparison to treated wastewater, therefore additional household uses such as laundry and hot water uses should be supplied by either rainwater or mains water.

11. On-site and cluster scale wastewater treatment and re-use strategies should be implemented in new development areas as alternatives to traditional wastewater disposal techniques. The treatment and delivery of wastewater via a 'third pipe' system should be considered in existing housing areas.

COMBINED SUPPLY AND DEMAND MANAGEMENT

12. The analysis of the combined supply and demand management strategy (wastewater re-use, rainwater tanks and demand management measures) shows very significant opportunities for the people of Sydney. The combined approach is shown to defer indefinitely the requirement to construct a new dam, reduce water demand, wastewater and stormwater discharges and to provide economic benefits. These results show that the currently preferred approach of selecting a small set of 'least cost' approaches is far from optimum, notwithstanding that the 'least cost planning' process is also flawed. A wide range of supply and demand management options should be encouraged.

PRICING AND POLICY

13. A two stage pricing regime should be implemented. Stage 1 pricing should be based on expected indoor water use with a small outdoor allowance for each socio-economic zone in the Greater Sydney region. The stage 1 price should be less than the current price of water. Stage 2 price of water for water use above the stage 1 allowance should be far greater than the stage 1 price, preferably twice the stage 1 price. All fixed charges for water supply should be eliminated.

14 Sydney Water should pay two phase bulk water charges to the Sydney Catchment Authority and 'dividends' taken by the government should not be a proportion of water revenues collected by Sydney Water. For bulk water demands that are within demand targets for the Greater Sydney region, Sydney Water should pay a bulk water charge that allows a normal profit on water sales (6% to 7%). However, for bulk water demands that are in excess of the demand targets, Sydney Water should pay a bulk water charge that ensures a loss of 10% on excess water sales. A proportion of the bulk water revenue and all of the excess bulk water revenue should be tied to sustainable funding of whole of water cycle programs. The funds should be administered by a trust convened by the Ministry of Energy and Utilities comprising government representatives, PENGOS and independent experts.

15. Sydney Water should not retain membership of standards committees and regulatory bodies that set standards or make regulations that have influence on the Corporation's sphere of operation or water cycle markets. Sydney Water should provide a range of alternative supply approaches and services as well as the currently preferred approaches.

3.6 Decision Tools

The CSIRO Urban Water Program report Recommendations for Developing a Framework for Assessing Sustainability of Urban Water Systems (Maheepala et al., 2002), outlined at section 2.4, recommends a decision-making framework based on identification of options, criteria and indicators for multi-criteria decision analysis (MCA). However, the CSIRO report does not address the Sydney Water sustainability objectives in the NSW context, nor does it discuss implications, thereby limiting the value of the report as an appraisal for selecting assessment frameworks.

However, the CSIRO report acknowledges (and the PENGOs strongly agree) that Sydney Water needs to define objectives and sustainability criteria, develop options (at both strategic and program levels) and involve the community in shared decision-making.

The use of MCA as a key decision support tool was strongly endorsed by the CSIRO team. However, MCA is a comparative approach for dealing with the complex of information and decision criteria from a variety of perspectives, but it is not one that can be used to set standards or goals (normative tool). Consequently, MCA provides little guidance when the goal is sustainability.

MCA is also characterised by a high degree of subjectivity. Consequently, these methodologies should be employed with care. For example, MCA could be used appropriately to undertake comparisons of many complex but normatively consistent options (those options which can be measured against similar standards) but would be more problematic when applied to comparison of options representing fundamentally different approaches. In other words, whilst MCA is designed to deal with multiple criteria, comparison becomes increasingly subjective the more these criteria differ in kind from each other. In these circumstances, MCA can operate legitimately as a 'what-if' tool. However, MCA cannot determine the best

outcome, as the ranking of options is a product of manipulation of the decision-making and weighting criteria (Dodgson et al., 2001). That is, MCA can illustrate what the outcome may be for a certain set of decision criteria and can demonstrate what happens if some criteria are weighted differently to others. However, MCA cannot determine which criteria should be given weight.

The PENGOs suggest that MCA may be used as a decision tool once agreement can be reached on the fundamental axioms for decision-making, or scenario, based on statutory sustainability criteria (PENGOs, 2002). In order for future decision-making in relation to total water cycle management in the Sydney region to be effective and sustainable, this agreement must include NSW government authorities, environment groups and community interests, including industry. The PENGOs evaluated a range of MCA processes undertaken by Sydney Water and there was no evidence to suggest that such an agreement on process has been made (PENGOs 2002). In the absence of the incorporation of sustainability criteria into the decision-making process, there is a risk that MCA (as used by Sydney Water) could provide flawed justification for decisions, both retrospectively and in the future.

The PENGOs are in disagreement with the CSIRO findings that dismiss a range of methods which the PENGOs consider will be required to guide both strategic and program level decision-making. Specifically, Sydney Water is required to operate within a statutory framework, informed by a carrying capacity approach to ESD. The analytical methodologies consistent with this framework include ecological footprint analysis, factor X (eco-efficiency) and life cycle assessment (see section 2.3).

The PENGOs consider that Sydney Water needs to use this range of decision tools, based directly on the special objectives and the particular means specified in the legislation (notably the Sydney Water Act, 1994, s.22). The advice provided by the PENGOs to Sydney Water on the Base Case Technical Document (PENGOs, 2002) described this regulatory environment and recommended that a Sydney Water operational model be developed and extended to clearly describe natural resource inputs and outputs.

Previously, the PENGOs have recommended that Sydney Water should develop and adopt strategic environmental assessment (SEA) (Dowsett et al., 1995; PENGOs, 1999b). However, the current review of Sydney Water operations identified that there has been limited progress in development or implementation in this area (envirOstrategy, 2002). SEA is critical for a holistic or integrated approach to water cycle management. SEA needs to incorporate life cycle assessment of possible modes of integrated water and wastewater service delivery, as well as fitting within an overall framework which can establish Sydney Water's environmental bottom line, including the need to accurately circumscribe Sydney's ecological footprint.

Sydney Water has also described the process it uses for project appraisal, including financial and economic evaluation, value management, risk management and environmental impact assessment, depending on the scale of the project (Sydney Water, 2002d). However, the process is strongly weighted to financial and cost-related aspects and fails to identify strategic planning elements such as interaction with other projects and cumulative effects in terms of environmental impact and social equity.

DECISION-MAKING IN PRACTICE

Sydney Water has indicated it is embracing new paradigms in water service delivery and management (Howe, pers. comm., 200212). The old paradigms or 'hard' paths rely on centralised infrastructure and decision-making that are based on non-integrated systems where water is delivered generally at potable quality and waste water is discarded after treatment (Gleick et al., 2002). The new paradigms of the 'soft' paths for water are characterised by extensive use of decentralised and efficient technologies with highly integrated systems, both physically and institutionally (RMI, 2003).

The PENGO evaluation of Sydney Water's progress in making the paradigm shift is given in Table 12. This assessment is based on the Rocky Mountain Institute characterisation of the paradigms of water management (RMI, 2003). The old paradigms are based on methodologies which were established more than one hundred years ago and could be simplistically described as pump, treat and discharge. Whilst new paradigms include new technologies, these also include the refinement of conventional methods (institutional and managerial) in ways that present new options for the management of water systems.

TABLE 12: PROGRESS IN SHIFTING PARADIGMS IN WATER MANAGEMENT (AFTER RMI, 2003)

OLD PARADIGM	EMERGING PARADIGM	PENGO ASSESSMENT
Human waste is nuisance. It should be disposed of after treatment.	*Human waste is a resource.* It should be captured and processed effectively, and should be used to nourish land and crops.	*Some Progress.* Approximately 50% of biosolids are captured and re-used, a considerable achievement, but the remainder is still discharged to receiving waters. Upgrades to the large ocean STPs are planned but it is not clear what level of improvement in recovery will be achieved. Plans to upgrade solids recovery from the worst performing plant at North Head have been revised to incorporate up to 65% recovery, but end-of pipe capture may not be the most cost-effective or sustainable option.
Stormwater is nuisance. Convey stormwater away from urban area as rapidly as possible.	*Stormwater is a resource.* Harvest stormwater as a water supply through infiltration or retention to support aquifers, waterways and vegetation.	*Stormwater capture is recognized, but insufficient action.* Local government is starting to implement water sensitive urban design and State Government is working on developer tools (BASIX). Rainwater tanks are now recognised as a water conservation tool but only after strong lobbying from outside the Corporation. Sydney Water's work in this area is limited to a rainwater tank rebate (with low uptake rates to date). Environment groups have identified significant potential (Coombes, 2002) but Sydney Water has not developed implementation plans to improve the use of rainwater as a resource.
Demand is a matter of quantity. Amount of water required or produced by different end-users is the only parameter relevant to infrastructure choices. Treat all supply-side water to potable quality and collect all wastewater for treatment in one system.	*Demand is multi-faceted.* Infrastructure choices should match the varying characteristics of water required or produced different end-users in terms of quantity, quality, level of reliability, etc.	*Recognition but insufficient action.* Extensive and long-term investment in centralised infrastructure is constraining the adoption of sustainable options. The rate at which potential clients have agreed to receive recycled wastewater from the proposed Georges River System 'recycled water pipeline' are still uncertain.
One use (throughput). Water follows one-way path from supply, to a single use, to treatment and disposal to the environment.	*Re-use and reclamation.* Water can be used multiple times, by cascading from higher to lower quality needs and reclamation treatment for return to the supply side of infrastructure.	*Current levels of re-use are insignificant.* Re-use targets are very low. Extensive and long-term investment in centralised infrastructure is constraining the adoption of sustainable options.
Grey infrastructure. Infrastructure is made of concrete, metal or plastic.	*Green infrastructure.* Infrastructure includes not only pipes and treatment plants, made of concrete, metal and plastic, but also soils and vegetation.	Grey infrastructure remains as the dominant strategy.
Bigger/centralised is better for collection system and treatment plants.	Small/decentralised is possible, often desirable for collection system and treatment plants.	*Sydney Water continues to resist decentralisation.* Research shows considerable benefits from decentralisation (CSIRO and ISF, 2002; Lundie, Beavis and Peters, 2003). However, Sydney Water continues with the centralised process of questionable sustainability.
Limit complexity and employ standard solutions. Small number of technologies used by urban water professionals defines water infrastructure.	*Allow diverse solutions.* Decision makers are multidisciplinary. Allow new management strategies and technologies.	*Known standard technologies still rule.* Minor variations are occurring at the margins of existing infrastructure. Pockets of knowledge are developing but Sydney Water still has no co-ordinated research strategy which is integrated to the operational or planning processes within the organisation.

Integration by accident. Water supply, wastewater and stormwater may be managed by the same agency as matter of historical happenstance. Physically, however, three systems are separated.	*Physical and institutional integration by design.* Linkages must be made between water supply, wastewater and stormwater, which require highly co-ordinated management.	*Integrated water service remains speculative.* Integrated area plans are promised under WP21 review, but the degree of integration is uncertain, with no provision to involve environment groups or community in their development.
Collaboration = public relations. Approach other agencies and public when approval of pre-chosen solution is required.	*Collaboration = engagement.* Enlist other agencies and public in search for effective solutions.	*No real engagement.* Sydney Water restricted the level of engagement with the PENGOs during the preparation of the draft and then released the revised *WaterPlan 21* to the community as a finished product without any public consultation. Consultation on specific Sydney Water projects is inconsistent, since some "consultation" occurs after options have been defined narrowly, which results in community disaffection.

3.7 Community Involvement

Sydney Water agreed to provide specific documents in draft form to the PENGOs in order for the PENGOs to provide advice as the review of WaterPlan 21 progressed. Despite this the agreement, the Corporation provided the documents only in final form. In the case of WaterPlan 21, Sydney Water's Board of Directors signed off the reviewed strategy before the PENGOs were permitted to review the document.

Strong community opinion, action and expectation, especially in relation to environmental performance, have compelled Sydney Water to become more open with regard to its operation and management. The community's expectation of the consultative process is that it will have input at option selection stages of major projects and strategic policy decisions.

In order for the key sustainability goals of the revised WaterPlan 21 to be delivered, the community, along with other stakeholders, must be engaged in a partnership that allows frank and informed dialogue. However, as identified by the Peer Review Panel, WaterPlan 21 lacks clear and understandable messages for stakeholders (Review Panel, 2002).

The PENGOs consulted with the environmental community during 2002 through three workshops (at Manly, Penrith and Sutherland) and held a forum in the Sydney CBD. The forum was held (despite initial concerns from Sydney Water) and appeared to be successful in both demonstrating community concern about sustainability issues, as well as exchanging information about new research, problems and solutions. Attempts by the PENGOs to widen discussion around the Sydney Water Project, including requests to address the Sydney Water Customer Councils regarding the Project, were not agreed to by Sydney Water.

Common concerns amongst the community and non-government organisations were population growth, sustainable water supply, environmental flows and support for innovation including decentralised solutions. Similar views were expressed by local government representatives.

Criticism of Sydney Water's consultative methods was also common at all workshops, with specific problems described with both past processes (Northside Sewage Tunnel) and new proposals (coastal and inland STP upgrades). For example, participants in the Corporation's consultation on the proposed upgrade of the North Head STP (via the Manly Key Stakeholders Forum) were critical of protocols developed by Sydney Water for the consultation process and expressed the view that discussion was too narrow in scope for a genuine integrated water cycle approach. The process was believed to exclude ecologically sustainable options. One Forum member resigned from this process, and both environment and local government participants reported extremely strong criticisms (Manly Daily 2nd June 2003). Participants reported that they believed Sydney Water was not open to their views regarding decentralisation, de-voluming and sustainable options and that the only way forward was to lobby government. The Manly group, among others, resorted to *Freedom of Information Act* requests to obtain what they considered to be basic information.

CHAPTER 4

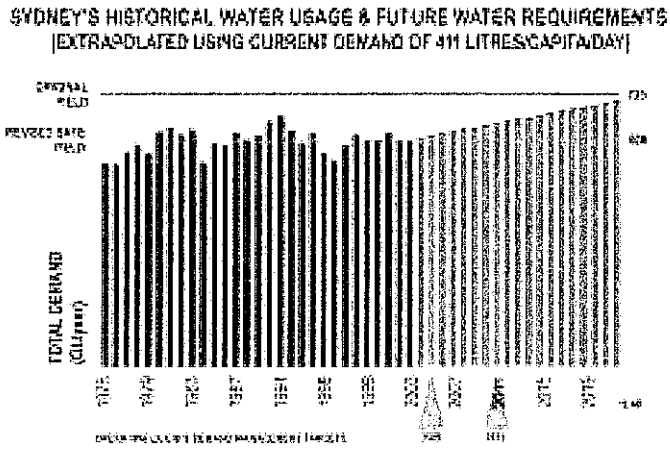
SUSTAINABILITY

4.1 Sydney's Growth

One of the challenges for sustainability is that historically, urban development has been initiated on the most hospitable areas (good soil and rainfall) but consumes these as the city grows in physical size. The original water supply for Sydney at the Tank Stream was polluted and built out by 1825. Additional sources of water from the Lachlan Swamps in the Centennial Parklands were depleted by the late 1850s and the third source of water for Sydney, the Botany Wetlands, were exhausted within 20 years (SCA, 2003a). Diversions of water from the Cataract, Cordeaux, Avon and Nepean rivers through the Upper Canal to the Prospect Reservoir constituted the fourth response to population growth and water demand. Dams built on these rivers between 1907 and 1935 augmented the Upper Nepean Scheme. However, Sydney's population continued to grow and water demand was met by the construction of six water supply dams in the Blue Mountains between 1905 and 1942, the Woronora Dam in the south, completed in 1942, the Warragamba Dam in 1960 and the Shoalhaven Scheme in 1977.

The mid-term review undertaken by Montgomery Watson Harza (MWH) for IPART of Sydney Water's demand management program illustrated the water supply and growth scenario for Sydney (see Figure 4) in terms of both the sustainable yield from the rivers supplying water to4: Sydney Sydney's Historical Water Usage and Future Water Requirements (based on current demand of 411 Litres/Capita/Day)

FIGURE 4:



SOURCE: IPART (2002B)

MWH concluded that:

- **Current water use approximates to the yield of available water storages. Lower rainfall in 2001-2002 might have increased Sydney's demand.**
- **Achievement of the 2004-2005 water conservation targets would reduce total demand on the raw water storages to a level marginally below the revised yield of 540 GL/a.**
- **A demand reduction of approximately 80 GL/a will be required to meet the 2004-2005 target.**
- **Achievement of the 2010-2011 water conservation targets would reduce total demand to 10% below the yield.**

The current water consumption targets appear to be within the correct range to reduce overall water consumption. However, the targets are formulated in per capita terms and would be weakened by faster than estimated population growth.

Sydney's population growth has accelerated in the years since the first Sydney Water Project (1994-95) and is currently increasing at a rate of approximately 56,000 per year. Population is expected to reach approximately 5 million within the timeframe of WaterPlan 21. Residential growth for both greenfield and infill is given in Table 13. Proposed residential development up to 2021 is shown in Figure 5.

TABLE 13: PROJECTED RESIDENTIAL GROWTH IN SYDNEY TO 2003-2004 - 2020-2021

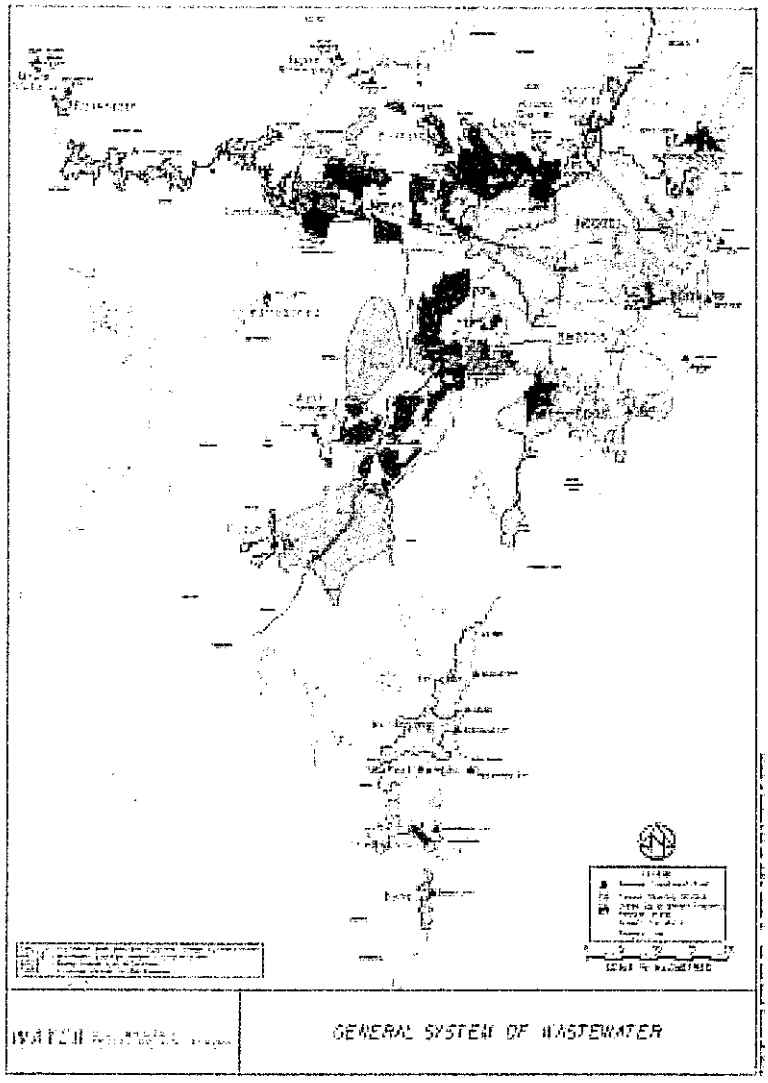
WATER SYSTEM AREA	SINGLE DWELLING GREENFIELD GROWTH 2021	MULTI DWELLING GREENFIELD GROWTH 2021	SINGLE DWELLING INFILL GROWTH 2021	MULTI DWELLING INFILL GROWTH 2021	
Avon	0	0	8,623	8,135	**16,758**
Blue Mountains	0	0	1,572	283	**1,855**
	0	0	161	18	**179**
Macarthur	21,263	197	3,640	2,823	**27,923**
Nepean	0	0	2,334	546	**2,880**
North Richmond	0	0	1,736	2,512	**4,248**
Orchard Hills	8,461	230	1,903	4,882	**15,476**
Potts Hill	0	0	2,505	112,764	**115,269**
	0	0	0	5,133	**5,133**
Prospect East	1	0	1,320	9,893	**11,214**
Prospect North	38,565	305	8,802	29,605	**77,277**
Prospect South	21,064	0	885	5,806	**27,755**
	9,516	0	917	2,721	**13,154**
Ryde	3,221	0	5,577	36,524	**45,322**
Warragamba	0	0	182	19	**201**
Woronora	617	0	168	4,887	**5,672**
Total Greenfield	**102,708**	**732**			**103,440**
Total Infill			**40,325**	**226,551**	**266,876**
Total					**370,316**

SOURCE: PLANNINGNSW DATA SUPPLIED BY SYDNEY WATER 2003

Sydney Water Base Case Model projections indicated higher growth in dwelling numbers (to 405,300) based on population estimates and occupation rates than the data released by PlanningNSW (now DIPNR) and supplied to the PENGOs by Sydney Water, so the projected growth shown in Table 13 may be conservative.

The WaterPlan 21 LCA indicates significant benefits from 'doing it differently' in greenfield areas and many of these benefits would be expected to be applicable to new infill development. Sydney Water indicated to the PENGOs (Ian Hammerton, pers. comm.) that the interpretation of the LCA results by the Corporation suggested that the aggregate benefits of the modelled greenfield scenario may not be significant compared to the scale of Sydney Water's operations.

FIGURE 5: SYDNEY RESIDENTIAL DEVELOPMENT TO 2021



SOURCE: SYDNEY WATER

Sydney Water's informal hypothesis needs to be tested against a scenario where we 'do things differently' for all of Sydney's projected future growth. The PENGOs were not resourced to undertake LCA modelling for all projected growth areas and have formally recommended that Sydney Water undertake LCA modelling of options for all greenfield sites. More detailed analysis of greenfield scenarios by the PENGOs (Beavis and Lundie, 2003) described in section 3.4

supports the WaterPlan 21 LCA conclusions that innovative decentralised solutions, based on available technologies, will have significant environmental benefits compared to the base case.

The demand management review undertaken for PENGOs by Urban Water Cycle Solutions (described above in section 3.5) modelled detailed water savings for a range of scenarios for the residential sector, taking into account the characteristics (rainfall, demographics) of Sydney Water water system areas. For scenarios using 5kL and 10kL rainwater tanks for outdoor and indoor non-potable uses with mains trickle top-up, savings ranged from 12-21% in the lower rainfall, inland areas (e.g. Warragamba) to 31-50% in the higher rainfall coastal areas (e.g. Avon) with savings per allotment ranging from 28-130kL/year (Coombes, 2002). Table 14 shows aggregate savings in relation to proposed new development in each water system area.

TABLE 14: REDUCTIONS IN WATER DEMAND FOR NEW DEVELOPMENT (5KL TANKS)

WATER SYSTEM AREA	REDUCTION IN WATER DEMAND PER ALLOTMENT (%)	REDUCTION IN PEAK WATER DEMAND (%)	WATER SAVINGS FOR MULTI-UNIT DWELLINGS (ML/YEAR)	WATER SAVINGS FOR DETACHED DWELLINGS (ML/YEAR)	TOTAL (ML/YEAR)
Avon	31%		311	544	855
Blue Mountains	26%	18	18	180	199
Macarthur	27%	20	157	1,686	1,843
Nepean	28%	21	17	127	144
North Richmond*			42	766	*808*
Orchard Hills	18%	15	407	890	1,297
Potts Hill*			1,885	613	*2,499*
Prospect East	25%	19	625	90	715
Prospect North	26%	20	1,575	6,803	8,378
Prospect South	24%	19	379	977	1,356
Ryde*			502	501	*1,003*
Warragamba	12%	11	1	10	11
Woronora	28%	20	436	85	521
Totals			**6,357**	**13,272**	**19,629**

* NORTH RICHMOND, POTTS HILL AND RYDE WATER SYSTEM AREAS NOT MODELLED, ESTIMATES BASED ON SIMILAR AREAS. ESTIMATES FOR POTTS HILL AND RYDE ARE DISCOUNTED 75% TO ACCOUNT FOR REDUCED SAVINGS FROM THE PROPORTION OF HIGH-DENSITY DEVELOPMENT. THIS IS CONSERVATIVE IF DEMAND MANAGEMENT AND RE-USE IS ALSO APPLIED TO HIGH-DENSITY DEVELOPMENT.

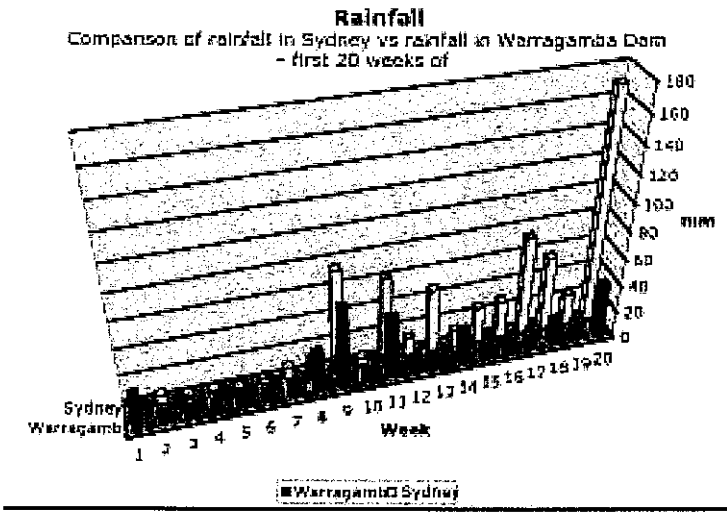
The reductions in demand modelled by Coombes (2002) are more conservative than Sydney Water's assumptions for the WaterPlan 21 LCA (the LCA described above at section 2.3 and the assumptions are discussed in section 3.4). However, the data are considered to be more reliable as they are based on empirical results from detached residential (Maryland) and multi-unit (Figtree Place) installations, adjusted to rainfall and demographic data for each Sydney Water water system area. Nevertheless, reductions in potable water demand are considerable for the smaller (5kL) rainwater

tank scenario for all new residences in Sydney, estimated at 19.6 GL/annum at 2021. This estimate indicates potential for 5-13 times the savings achieved by the demand management program to date (Sydney Water versus Coombes estimates as reported in Coombes, 2002).

Water savings from scenarios using 10kL tanks are likely to be even more effective, saving an additional 11 GL/year, a total of over 30 GL/year. This is achieved with significantly less environmental impact than an equivalent sized desalination plant. (Lundie et al., 2002).

As noted above, Warragamba is the driest area modelled in the work undertaken for PENGOs. Consequently, rainwater collection in the Sydney area is considered to be an effective augmentation of existing water supply infrastructure due to the positive difference in rainfall between the urban area and the dam catchment. Rainfall for the first half of 2003 for Warragamba and Sydney is given in Figure 6.

FIGURE 6: RAINFALL AT SYDNEY AND WARRAGAMBA



SOURCE: SYDNEY CATCHMENT AUTHORITY (2003B)

Warragamba Dam in particular provides massive storage over the long dry periods (which can last for several years and are influenced by the el Nino cycle) but the big dam does not respond as quickly to small rainfall events. At the same time, considerable quantities of water fall on hard surfaces in the higher rainfall urban areas (see Figure 6) but this water is not collected. Instead, rainwater becomes stormwater and a potential resource becomes a waste problem. Scenarios described by Coombes and CWWT for the PENGOs propose that rainwater collection and storage capacity be distributed across new and existing development areas to take advantage of the higher rainfall of the metropolitan area and ease the pressure on supplies in major storages.

Further work by Coombes indicates that a wide range of water conservation and demand management scenarios are more effective, more economical and less environmentally damaging than conventional scenarios (Coombes et al., 2003).

4.2 Assessing and Reporting Progress Towards Sustainability

The reporting of environmental performance by Sydney Water has improved. The environmental and social responsibilities of Sydney Water are defined in the Sydney Water Act and the organisation has developed a suite of environmental and ESD indicators against which progress can be measured, in terms of meeting regulatory and ESD goals. The indicators were developed though consultation with other government agencies, the community and the peak environment groups.

Sydney Water has made some moves towards triple bottom line reporting through the introduction of sustainability reporting. The first Towards Sustainability Report included an estimate for the ecological footprint of the organisation (Sydney Water, 2001a; Sydney Water, 2002e). However, it is not completely clear how the calculations were made or the how far the parameters included in the footprint extended.

The Towards Sustainability Report 2002 Sydney (Water, 2002e) provides an ambiguous assessment of sustainability. The summary table rating progress for the organisation (Sustainability Snapshot 2002-) indicates only one of twenty objectives that "needs more work" (energy use and management), one that is inconclusive (elimination of discrimination and promotion of equal employment opportunities) and two that have no requirement for reporting as yet. The rating for Objective 1 (conserve water supplies and prevent the need for new dams) indicates that Sydney Water is "on track" to "meet demand management targets and offset population growth and supply availability issues". This is in direct contrast to the data provided in the two recent sustainability reports (Sydney Water, 2001a and 2002e) that show that Sydney Water has failed to meet per capita water use targets set for 2000-2001 (usage was 12.7% above the original target) and is unlikely to meet the 2004-2005 per capita targets.

There is another issue in relation to meeting these water conservation targets. Whilst per capita water consumption is decreasing, total water consumption is increasing. The demand management strategies employed by Sydney Water are failing to achieve the goals of reducing water demand to offset population growth or the need to provide alternative supply. The options for providing alternative water supply through cross-catchment transfers (on-going pumping from the Shoalhaven River) or the construction of further dams must be considered as unsustainable.

The NSW Environmental Protection Authority (EPA) is required under the Sydney Water Act 1994 to undertake an annual review of the Sydney Water statement on Progress Towards the Special Objectives (referred to as the Sydney Water Statement) which is contained in Appendix 5 of the Sydney Water Environmental Indicators Compliance Report 2001 Volume 1 (Sydney Water, 2001b).

In the last two annual reviews, the EPA has identified that there have been improvements in environmental performance by the Corporation and has noted areas where further effort would be required by Sydney Water to meet the targets identified in the special objectives (EPA, 2002 and 2003). In the 2002 review, the EPA criticised the reporting of environmental outcomes as lacking "consistency, transparency and clarity" (EPA, 2002) and indicated that further effort was required by Sydney Water to achieve the best environmental outcome, especially in relation to:

- **per capita water consumption;**
- **energy consumption;**
- **water quality in South Creek;**
- **frequency of dry- and wet-weather overflows; and**
- **the slow progress of the planning processes associated with approved Priority Sewerage Projects and Sydney Water Re-use and Recycling.**

Benefits (both water supply and wastewater) from demand management programs have been overstated by Sydney Water, for example (errors in original):

> "Sydney Water's existing demand management program to achieve the 35% reduction in per capita water consumption will achieve a 34% reduction in per capita sewer flows from 1991-2021. Allowing for population growth, this equates to a 20% reduction in dry weather effluent discharges from STPs over thirty years, of which about 80% will be at ocean plants" (SWC 1999).

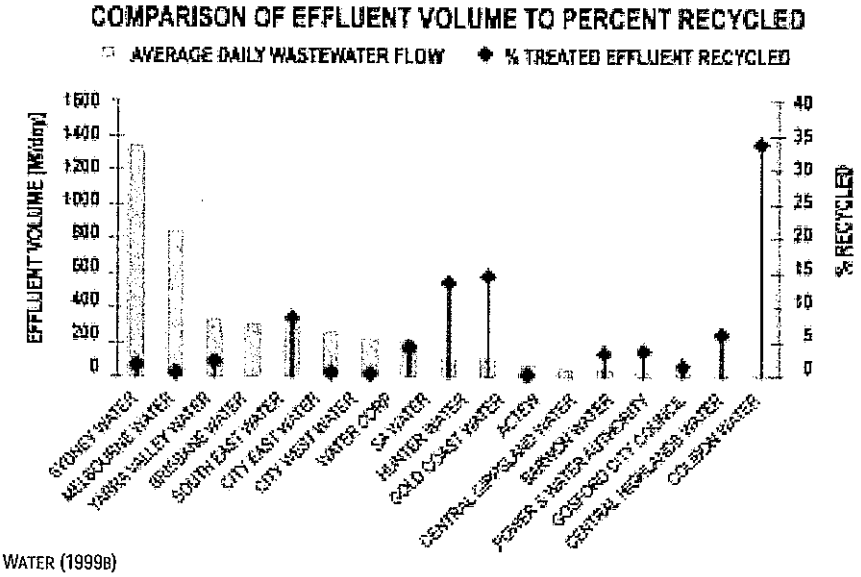
The current program of weak demand management - which includes giveaways of water-efficient showerheads and public education leaflets - contrasts with strong demand management advocated by water sensitive urban design practitioners - which would include mandatory use for water efficient appliances, rainwater and/or stormwater collection, water use restrictions and rising block pricing (Coombes 2002). Sydney Water claims that the demand management program has reduced water consumption by 18% per capita (Alex Walker, pers. comm. at meeting with PENGOs 2002) but these reductions predate the demand management program and have been attributed to introduction of water

metering, user pricing and drought (Coombes 2002). Assessments of the demand management program by ISF for Sydney Water (ISF 1998, 2001) and by Montgomery Watson Harza for IPART (IPART 2002b) indicated that program performance has not been as effective as anticipated and several key elements have been delayed or postponed indefinitely. Standards for water efficient washing machines proposed in the 1999 demand management strategy are unlikely to be implemented by 2005.

Attempts to provide incentives for water conservation are being applied on an ad hoc basis. A rebate for efficient washing machines has just been introduced in 2003, but will be available for only 8 weeks. The introduction of a rainwater tank rebate was undertaken only after intensive lobbying from environment groups and is also short-term, running for less than one year. Where the water price is capped below true environmental cost, incentives for water saving appliances must be applied on a consistent, long-term basis to affect behaviour.

Despite a statutory recycling objective, Sydney Water's performance in recycling as a proportion of total water use lags behind other water utilities (see Figure 7).

FIGURE 7:



SOURCE: SYDNEY WATER (1999B)

The most recent review by the EPA recognised improved reporting by Sydney Water. However the review indicates that further "improvement and rationalisation" would be required so that the "community can readily assess if the best environmental outcome has been achieved" (EPA, 2003). The review also identified three outstanding issues from the previous reporting period, namely:

- **slow progress in reducing the demand for water;**
- **increases in electricity consumption and greenhouse gas emissions; and**
- **the water quality in South Creek continued to be poor;**

as well as:

- **lower than expected expenditure on stormwater management (approximately 34% of scheduled expenditure for 2001-2002).**

This PENGO project has identified the need for Sydney Water to develop decision tools for achieving ecological sustainability that are based on the key high-level objectives and criteria outlined in the special objectives and specific means identified in the Sydney Water Act 1994 (s.22).

The evaluation of options to determine whether management of the water cycle and provision of services are ecologically sustainable needs to be made with reference to the impacts on the supporting ecosystems. It makes no

difference whether multi-criteria analysis (MCA) indicates a "preferred option" if the environmental impacts are beyond the ability of the supporting ecosystems to both maintain the full range of natural capital and deliver environmental services in the future. Options need to be developed holistically and evaluated rigorously against standards and goals, as well as empirical criteria (not merely against relative criteria). Similarly, decision-making tools need to be based on actual natural resource inputs and outputs, as well as on the ability of ecosystems to be sustained (and the impacts of related activities) over time.

In order to support the transition of Sydney Water from a wastewater management approach to a holistic or integrated water cycle approach, strategic assessment needs to be informed by LCA of possible modes of integrated water and wastewater service delivery.

4.3 Investment in Innovation and Alternate Technologies

The PENGO review of Sydney Water did not find a strategic investment plan for innovation in technology/operation/performance assessment or related fields. The management and delivery of innovation into the operational sector of Sydney Water is constrained by lack of information management and the capacity to translate information into best management practice.

Whilst *WaterPlan 21* identifies broad strategies that relate to pursuing and trialling alternative technologies and practices, the strategy fails to develop implementation plans that are sufficiently detailed to allow the broad strategies to be achieved. This limitation to *WaterPlan 21* was also identified by the Peer Review Panel established by Sydney Water (Review Panel, 2002).

Whilst Sydney Water develops options for water conservation and recycling, which have significant potential, evaluation to date has been largely confined to a least cost/levelised cost planning approach (ISF 1998, 2001).

The PENGOs acknowledge the utility of least cost planning in option selection. However, this approach is inconsistent with Sydney Water's statutory obligation to operate in compliance with principles of ecologically sustainable development, where economic and environmental factors must be integrated in decision-making processes and valuation of natural resources is a core principle. For example, when ACIL evaluated Sydney Water's options to implement the Georges River Strategy, improved valuation of natural resources was explicitly acknowledged as essential. Despite this, re-use of up to 52 gigalitres of water per annum was assigned a zero value (ACIL 2000). This is clearly inconsistent with the Corporation's statutory obligations.

Sydney Water often claim that it is difficult to assign precise values to environmental benefits (Michael English, SWC pers. comm.). However, the key criteria in determining whether a given value should be assigned to an environmental benefit is not whether the value is exact, but whether it represents an improved valuation compared to assigning a zero value, that is, consistent with sustainability principles.

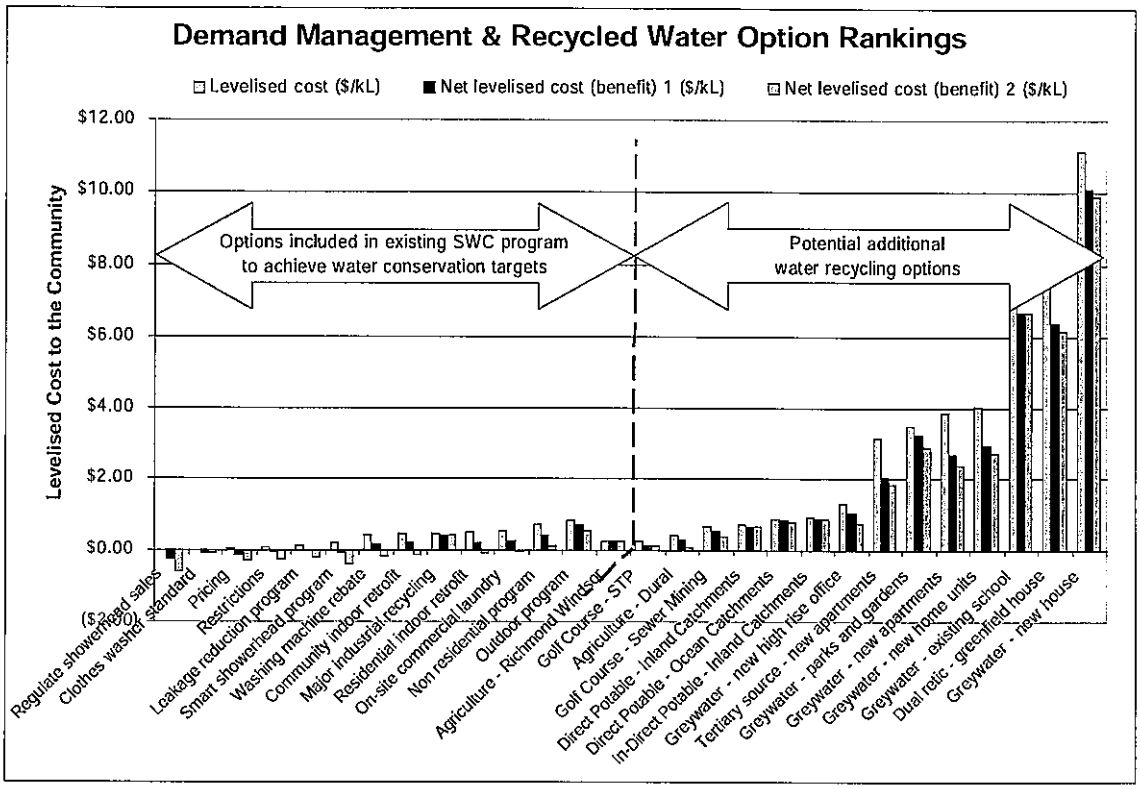
An evaluation of options, which is consistent with the approach preferred by PENGOs and which includes environmental costs and benefits, has been undertaken for Sydney Water by the Institute for Sustainable Futures and an example appears in the Corporation's Water Recycling Strategy (SWC, 1999b).

Figure 8 shows Sydney Water's expressed option preferences for demand management and water recycling which are based primarily on least cost/levelised cost (blue bars). However, when environmental costs and benefits are taken into account via two methods of levelised cost-benefit (red and orange bars) option ranking varies compared to the Corporation's preferred least cost approach.

Sydney Water appears to prefer financial criteria as a basis for decision-making over environmental criteria and sometimes over economic criteria. It is normal practice for Sydney Water's evaluation to assign financial value to increased house prices (resulting from provision of sewerage services) but assign zero value to water saving (for example, see ACIL 1997, 2000). Unfortunately, scenarios and options which vary significantly from business-as-usual often rely on environmental benefits (such as saving water). Reliance on a least cost/levelised cost approach usually introduces bias to the option ranking to the disadvantage of innovative options.

The PENGOs have not been provided with any further development of full environmental cost-benefit analysis by the Corporation. It is essential for Sydney Water to begin to operate on valid decision-making criteria, consistent with the Corporation's statutory obligations.

FIGURE 8: DEMAND MANAGEMENT & RECYCLED WATER OPTIONS



SOURCE: SYDNEY WATER (1999B)

In many instances, innovation is initiated from outside the Corporation. A key innovative approach to integrated water cycle management is the shift from discrete centralised water supply, sewerage and stormwater systems to decentralised, distributed systems which integrate water supply and stormwater management, and wastewater treatment and re-use, closing the loop at a variety of scales. Decentralisation was advocated by community and environment groups during the 1990s. Sydney Water took an issue management approach (holding a decentralisation workshop with stakeholders) rather than an innovation approach (researching, trialling and implementing decentralised solutions). Whilst proceedings of the stakeholder workshop were recorded (Integrated Analysis, 1995), the PENGOs were unable to locate any evidence of subsequent progress on workshop recommendations.

Decentralisation appeared as a strong theme in the subsequent Hawkesbury-Nepean Wastewater Strategy (SWC, 1997), but the associated studies took a defensive approach and decentralised options were ruled out. Decentralised options were incorrectly specified as resulting in higher costs and demand management benefits were not included, resulting in lower benefits for decentralised solutions. Despite these shortcomings, this result is still given weight by the Corporation as recently as 2002. For example, in the environmental impact statement for the upgrade of Penrith STP where decentralised options are explicitly dismissed from consideration on the basis of the outdated studies (SWC, 2000).

Coombes (2002) and Coombes et al. (2003) demonstrated that integration can occur optimally at the allotment scale, where water supply, stormwater and wastewater systems strongly overlap. Conventional rainwater tanks (traditionally used for stand-alone water supply) were deployed in an innovative water supply/stormwater management function. The study included ground-breaking water cycle modelling work, including economic evaluation pointing to favourable cost-benefit analysis when the scope of benefits was broadened to reflect water supply and stormwater management benefits.

Sydney Water has once again adopted an issue management approach when convening a rainwater tank seminar. Rather than provide a forum for vigorous debate by inviting innovative practitioners such as Coombes to participate, a body of work critical of rainwater tanks was presented (one paper, by ISF, was colourfully titled Putting Rainwater Tanks in their Place). These documents were requested by the PENGOs, however the Corporation has not produced them for review.

Progress in the promotion and use of rainwater tanks was not initiated by Sydney Water, rather the successful lobbying of the PENGOs and Coombes persuaded the NSW Government of the potential benefits. In October 2002 Minister Yeadon announced a rebate for residential installation of rainwater tanks, to be paid by Sydney Water. Sydney Water did not issue their own press release or aggressively market the rebate and was criticised initially (Peter Coombes, pers. comm) for using artificial barriers, such as requirements for non-standard plumbing fittings. The relevant plumbing standards have been revised, but supply of required components such as signage and flow restrictors has not been assured. As recently as May 2003, attendees at Sydney Water workshops on rainwater tanks reported to the PENGOs that the seminar content is one-sided and fails to adequately describe the range of options and opportunities for using residential rainwater tanks (Ross Coster, pers. comm.)

In addition to removing bias against innovative options, a means must be found to provide incentive for innovation. It is unlikely that Sydney Water's bureaucratic culture provides reward for innovation beyond meeting (or at least avoiding penalties associated with) statutory objectives. Consequently, the PENGOs recommend that a process of opening the field to innovation from outside should be fully explored. An open competition with significant reward incentives to encourage innovative water cycle management solutions is recommended. A significant budget allocation from Sydney Water and a link to penalty pricing associated with demand management targets is also suggested.

4.4 Institutional and regulatory reform

The current legislative position of IPART as a regulator of water utilities does not guarantee independence in making recommendations or giving advice to a Minister on matters concerning the regulation of the utility. There is too much scope for ministerial intervention which has denied IPART real independence. That is, the Minister can consider recommendations and advice but is not bound to follow it (Prineas, 2001). Recent legislative amendments interpose unlimited policy on IPART processes.

A review of the IPART legislation should be undertaken to ensure that IPART is given a real mandate to independently set prices. IPART should have similar independence and freedom to the Auditor-General in making determinations and reporting to government and the community.

An important component of the review of legislation should include an amendment to provide a position on the Tribunal for a person (not being a government employee) with experience and expertise environmental protection.

Whilst IPART has a level of independence in establishing pricing of water, there has been a lack of significant reform in the pricing structure of water for urban water supply. The current pricing and regulatory system sets licence conditions at levels that Sydney Water can achieve, rather than setting targets that encourage improvement and positive change for the environment. In some cases, such as water conservation and reducing water demand, Sydney Water has not been able to meet the conditions and targets set (SWC, 2002e).

There needs to be a review of IPART and its legislation to ensure that determinations by the Authority, including price setting, are truly independent. The Authority should be no less independent than the Auditor-General. The Tribunal's decisions must have proper regard for ecological sustainability, and achieve better pricing and valuation of natural resources. If environmental targets are not met, the Authority must apply effective penalties.

Sydney Water's operations occur alongside other licensed extractions of bulk water for commercial and agricultural uses, regulated by the Department of Infrastructure, Planning and Natural Resources (formerly DLWC). Whilst Sydney Water takes an average of approximately 80% of total extractions from the river system (Doug Rhodes, DIPNR pers. comm.), maintaining an ecologically sustainable water supply into the future requires management of the total water cycle. The relationship between pricing of bulk water and viability of options to deliver recycled water to replace extraction must also be addressed.

This also applies to the Sydney Water's de facto monopoly position in what should be a more open market for total water cycle services. Critical obstacles to open competition must be removed. Sydney Water should not be both regulator and operator in this market. The role of plumbing regulator should be transferred to the Ministry of Energy and Utilities and overseen by an independent review body. Barriers to entry for competitors and competing technologies must also be addressed. Subsidies provided to Sydney Water for centralised water, sewerage and stormwater services must also be available to competitors wishing to provide innovative or decentralised systems.

Incentives should be provided to encourage development of innovative solutions. Access to Sydney Water infrastructure must also be available at a fair cost, with arrangements similar to those in place for the electricity and telecommunications sectors.

The NSW Government must show leadership in these issues and provide the support required to reform the pricing structure and the regulatory framework to encourage water utilities to move to a position beyond compliance to one of sustainability. The NSW government has established an 'Expert Panel on Water' to investigate how the private sector may become involved in delivering urban water services in Sydney.

4.5 Summary

The challenges for Sydney Water in progressing towards sustainability, as an organisation, must be viewed in the context of a Greater Metropolitan Sydney, which is continuing to expand and demand water, waste water and stormwater services. In order to deliver a sustainable water service (the primary goal of the revised *WaterPlan 21*), Sydney Water must embrace emerging the paradigms of water management, and invest in alternate technologies and practices.

The Rocky Mountain Institute (RMI), a participant in Sydney Water's Peer Review Panel for the revised WaterPlan 21, advocates the creation of a 'soft path' to water service management that can greatly increase efficiency at the end use stage, avoid system losses through the use of precise management systems and match the system components to the capacity and quality required for appropriate locations and uses (RMI, 2002).

Sydney Water will need to use a range of strategic assessment and decision-making tools. The use of strategic environmental assessment; replacement of least-cost planning (which Sydney Water applies to demand management and recycling options) with cost-benefit planning, and full life cycle analysis (which Sydney Water has investigated as a support to its review of WaterPlan 21) are prerequisites for sustainability. In order for Sydney Water to provide integrated services that are ecologically sustainable, genuine strategic assessment is a critical step in determining impacts and benefits for water, sewage and stormwater programs, as well as activities across the total water cycle, and must not be further postponed.

There have been improvements in the manner in which Sydney Water has approached its management and operational responsibilities with respect to the environment and reporting since the first Sydney Water Project in early 1995 (reported in Dowsett et al., 1995). The drivers behind this have mainly been legislative, which have forced a partial cultural shift towards ecologically sustainable development within Sydney Water.

There are still areas that require significant effort if the Corporation is to progress towards its goal of sustainable water service delivery, including:

- **water conservation and demand management;**
- **energy consumption;**
- **water quality at a number of trouble sites downstream of inland STPs (especially South Creek);**
- **providing information to the public with regard to risks to humans and the environment from treatment process by-products; ;**
- **frequency of dry- and wet-weather overflows;**
- **uptake rates of recycled water options;**
- **implementation of the planning process (e.g. under-spending on stormwater programmes and slow progress on priority sewage programmes); and**
- **clarity in environmental reporting processes.**

REFERENCES

ABS (2003) *Domestic Water Use, New South Wales,* Report No. 4616.1. Australian Bureau of Statistics April 2003. Published on web site www.abs.gov.au.

ACIL Consulting (2000) *Upper Georges River Wastewater Strategy - Economic and Financial Evaluation Report - A Report to Sydney Water,* August 2000.

Beavis, P.C. and Lundie, S. (2003) *Extension of Greenfield Scenarios in Sydney Water Corporation's WaterPlan 21 Review,* prepared by Centre for Water and Waste Technology for the PENGOs, as part of 4th Sydney Water Project, June 2003.

Coombes, P.J. (2002) *An Evaluation of the Costs and Benefits of Demand Management Solutions in the Greater Sydney Region,* report prepared for the PENGOs as part of 4th Sydney Water Project, December 2002.

Coombes, P.J., Holz, L. and Kuczera, G. (2003) *The Impact of Supply and Demand Management Approaches on the Security of Sydney's Water Supply,* The Institution of Engineers, Australia 28th International Hydrology and Water Resources Symposium, 10-14 November 2003, Wollongong, NSW.

CSIRO and ISF (2002) *Edmondson Park Feasibility Report. A conceptual report of potential servicing options,* prepared for Sydney Water by CSIRO Urban Water and the Institute for Sustainable Futures, July 2002.

Denlay, J. and Dowsett, B. (1994) *Water Re-use - the most reliable water supply available,* initial Report prepared by the Friends of the Earth (Sydney) for the Water Board as part of the Sydney Water Project, November 1994.

Dodgson, Spackman, Pearman & Phillips, et al. (2001), *Multi Criteria Analysis: A Manual,* National Economic Research Associates for Department for Transport, Local Government and the Regions, UK

Dowsett, B. (1994) *The Management of Stormwater - from a problem to a resource.* Initial Report prepared by the Friends of the Earth (Sydney) for the Water Board as part of the Sydney Water Project, November 1994.

Dowsett, B., Mather, G., Mercer, C., Pearson, B. and Vincent, D. (1995) *A New Course for Sydney Water - The Final Report of the Sydney Water Project.* Published by the Sydney Water Project, Sydney.

envirOstrategy (2002) *Review of 'A New Course for Sydney Water' Recommendations,* prepared for the PENGOs, as part of 4th Sydney Water Project, August 2002.

EPA (2002) *EPA Annual Review of Sydney Water's Statement on Implementing its Special Objectives July 2000 to June 2001,* Environment Protection Authority, Sydney, February 2002.

EPA (2003) *EPA Annual Review of Sydney Water's Statement on Implementing its Special Objectives July 2001 to June 2002,* Environment Protection Authority, Sydney, March 2003.

Gerson, C. (1994) *Sewage Treatment - watershed approaches,* initial Report prepared by the Friends of the Earth (Sydney) for the Water Board as part of the Sydney Water Project, November 1994.

Gleick, P., Burns, W.C.G., Chalecki, E.L., Cohen, M., Kao Cushing, K., Mann, A. Reyes, R., Wolff, G.H. and Wong, A.K. (2002) *The World's Water 2002-2003. The Biennial Report on Freshwater Resources,* Island Press, Washington.

HRC (1998) *Hawkesbury Nepean Inquiry Final Report,* NSW Healthy Rivers Commission, Sydney.

HRC (2000) *Securing Healthy Coastal Rivers - A Strategic Perspective,* NSW Healthy Rivers Commission, Sydney.

Integrated Analysis (1995) *Final Report on the Decentralisation Workshop,* prepared for Sydney Water by Integrated Analysis, Sydney April 1995.

IPART (2002a) *Review of Metropolitan Water Agency Prices. Issue Paper. Discussion Paper DP55,* Independent Pricing and Regulatory Tribunal of NSW, Sydney, June 2002.

IPART (2002b) *Mid-Term Review of Sydney Water's Demand Management Strategy,* prepared for IPART by Montgomery Watson Harza, Sydney, July 2002.

ISF (1998) *Sydney Water Least Cost Planning Study: Phase One Report,* prepared for Sydney Water by the Institute for Sustainable Futures.

ISF (2001) *Least Cost Planning Study - Stage 3,* prepared for Sydney Water by the Institute for Sustainable Futures, Sydney August 2001.

ISF and CSIRO (2002) *The Greenfield Manual,* prepared for Sydney Water by the Institute of Sustainable Futures and the CSIRO Urban Water, May 2002.

Lundie, S., Beavis, P. and Peters, G. (2002) *LCA for WaterPlan 21 Review - Base Case and Scenarios,* prepared for Sydney Water by Centre for Water and Waste Technology, Sydney.

Lundie, S. and Peters, G. (2002) *Sydney Water WaterPlan 21 Life Cycle Assessment.* Paper for the 3rd Australian LCA Conference, July 2002.

Maheepala, S., Speers, A., Brooker, N. and Syme, G. (2002) *Recommendations for Developing a Framework for Assessing Sustainability of Urban Water Systems,* prepared for Sydney Water by CSIRO Urban Water Program.

Mather, G. (1994) *Indicators of Environmental Quality,* prepared by the Friends of the Earth (Sydney) for the Water Board Sydney Water Project, November 1994.

Mercer, C. (1994) *Estuaries, Beaches and Coastal Waters - ecological implications of Water Board Activitie,* prepared by the National Parks Association of NSW for the Water Board Sydney Water Project, November 1994.

Munoz, E. (1994) *Source Control of Industrial, Commercial and Domestic Wastewater - Clean Production is the Key,* prepared by the Friends of the Earth (Sydney) for the Water Board as part of the Sydney Water Project, November 1994.

Next Energy (2002a) *Comments on Sydney Water Economic Modelling,* prepared by Next Energy Pty Ltd for the PENGOs as part of 4th Sydney Water Project, October 2002.

Next Energy (2002b) *Resource Recovery Issues Raised by Sydney Water's Life Cycle Assessment,* prepared by Next Energy Pty Ltd for the Peak Environment Non-Government Organisations 4th Sydney Water Project, November 2002.

Pearson, B. (1994) *Rivers - Ecological Implication of Water Board Activities,* prepared by the Nature Conservation Council of NSW for the Water Board Sydney Water Project, November 1994.

PENGOs (1999a) *Review of the Operating Licence for Sydney Water Corporation – Final Report of Peak Environment Non-Government Organisations,* Total Environment Centre, Nature Conservation Council of NSW, Friends of the Earth Sydney, Australian Conservation Foundation, Colong Foundation for Wilderness, Sydney Coastal Councils Group, National Parks Association of NSW, Ocean Watch, September 1999.

PENGOs (1999b) *Sydney Water Corporation Indicative Environment Plan Final Report of Peak Environment Non-Government Organisations,* Total Environment Centre, Nature Conservation Council of NSW, Friends of the Earth Sydney, Australian Conservation Foundation, Colong Foundation for Wilderness, Sydney Coastal Councils Group, National Parks Association of NSW, Ocean Watch, December 1999.

PENGOs (1999c) *Sustainability Indicators for Sydney Water Corporation.*, prepared by Strategic Environmental Management for the Peak Environment Non-Government Organisations, Sydney.

PENGOs (2002) Sydney Water's Base Case Technical Document. PENGO advice on draft Sydney Water documents. Correspondence from the Peak Environment Non-Government Organisations to Sydney Water, 5 July 2002.

PENGOs (2003) *Can the Catchment Sustain Us? Draft Final Report and Recommendations of the 2nd Sydney Catchment Project,* prepared by the Peak Environment Non-Government Organisations, Sydney.

Prineas, P. (2001) *Operational Auditing and Regulation - What Future Under IPART,* conference paper presented at Future of Market Regulation Nature Conservation Council of NSW seminar, March 2001.

Review Panel (2002) *WaterPlan 21 Peer Review Report,* Prepared for Sydney Water by an Expert Panel, April 2002.

RDC (2002) *Kumeu, Huapai, Waimauku and Riverhead Wastewater Services Options. Preliminary Investigations Summary for Public Consultation. Issue 1: October 2002.* Rodney District Council, Orewa, New Zealand.

RMI (2003) *RMI's Approach to Water Management,* published on the Rocky Mountain Institute web site: www.rmi.org/sitepages/pid120.php.

SCA (2003a) *History of Sydney's Water Supply System,* published on the Sydney Catchment Authority website at: http://www.sca.nsw.gov.au/dams/history.html.

SCA (2003b) *Bulk Water Supply and Storage Reports,* published on the Sydney Catchment Authority website http://www.sca.nsw.gov.au/dams/bydate_index.html

SHURE (1994) *Submission to Picton Sewage Treatment Plant EIS,* Save Hawkesbury's Unique River Environment, Sydney.

Smith, J. (2003) *Sydney Catchment Project. Environmental Flows Strategy for the Hawkesbury-Nepean, Shoalhaven and Woronora Rivers.* A report prepared for the PENGOs as part of the 2nd Sydney Catchment Project.

SWC (1997) *Hawkesbury Nepean Wastewater Strategy,* Sydney Water Corporation, Sydney.

SWC (1999a) *Biosolids and Residuals Management Strategy,* Sydney Water Corporation, Sydney.

SWC (1999b) *Water Recycling Strategy,* Sydney Water Corporation, Sydney.

SWC (2000) *Penrith Sewerage Treatment Plant Amplification & Glenbrook Waste Water Transfer EIS Summary,* Sydney Water Corporation, Sydney.

SWC (2001a) *Towards Sustainability Report 2001,* Sydney Water Corporation, Sydney.

SWC (2001b) *Environmental Indicators Compliance Report 2001 – Volume 1,* Sydney Water Corporation, Sydney.

SWC (2002a) *Review of WaterPlan 21 - Draft Base Case Technical Document,* prepared for the PENGOs by Sydney Water, May 2002.

SWC (2002b) *WaterPlan 21: The 2002 Review for Sustainable Water Services,* Sydney Water, July 2002.

SWC (2002c) Sydney Water's Comments on Next Energy's Report "Comments on Sydney Water Economic Modelling". Correspondence from Sydney Water to PENGOs, September 2002.

SWC (2002d) *Project Appraisal Techniques Used by Sydney Water,* prepared by Commercial and Economic Services, Sydney Water.

SWC (2002e) *Towards Sustainability Report 2002,* Sydney Water Corporation, Sydney.

SWC (2002f) *Sydney Water Environmental Indicators Compliance Report 2002 Volume 1,* Sydney Water Corporation, Sydney.

SWC (2002g) *Introduction to the Life Cycle Assessment for the WaterPlan 21 Review,* Sydney Water Corporation, October 2002.

SWC (2002h) Re-use by Quarter to 2002, Unpublished data provided to the PENGOs by Sydney Water Corporation.

Vincent, D. and Munoz, E. (1994) *Residuals Management: closing the loop.* Initial Report prepared by the Friends of the Earth (Sydney) for the Water Board Sydney Water Project, November 1994.

White, S. (1994) *The Efficiency of Water Use - a preliminary assessment of options for improving water efficiency in the Sydney Region.* Initial Report prepared by the Nature Conservation Council of NSW Inc. for the Water Board Sydney Water Project, November 1994.