ACTEW CORPORATION

ActewAGL Always.

Future Sewerage Options Review Summary

Canberra Sewerage Strategy 2010–2060

Introduction

Increasingly there are new considerations, such as climate change, water scarcity and more efficient and effective technologies, that can impact on sewerage system management and the delivery of sewerage services to the community. Looking forward into the future, how should Canberra continue to develop its sewerage system? To answer this question, a strategic study is being undertaken which examines a range of possible scenarios. The overall objective is to develop a strategic plan to define the future direction for sewerage services over the next 50 years.

A substantial review of the existing sewerage system was undertaken, followed by the implementation of a scenario-based planning approach to develop potential options for future management of the system. Financial and non-financial implications, such as environmental, social and public health were identified and considered, through a sustainability assessment. Importantly this approach embraces the various uncertainties associated with the future and enables planners to consider a variety of potential directions under different scenarios.

The ultimate outcome of the study is to reassess the current approach taken with Canberra's sewerage system, and to consider changes that may otherwise not be apparent.

The study considers many related aspects including:

- How should the sewerage system respond to the effects of long term climate change?
- Should potable water continue to be used in the sewerage system?
- Are there new technologies that provide better solutions to managing sewage?
- How should the sewerage system adapt to more households using grey water?
- Can recycled water be used more productively in the ACT than in irrigation areas downstream?
- How does the Murray-Darling Basin Cap influence the use of recycled water?
- Can the sewerage system be changed to use less energy and reduce greenhouse gas (GHG) emissions?
- Can better treatment and effluent quality achieve better environmental outcomes?
- Can stormwater and roof water play a role in the future sewerage system?
- Which emerging issues in public health, utility management or environmental concerns will require changes in current practices?

This report summarises the comprehensive body of work undertaken during the initial phase of the study and draws on input from a range of key stakeholders within ACTEW, ActewAGL and the ACT Government. The study seeks to address the above questions by exploring different ways to collect, manage and treat sewage in the ACT to a high standard, and the related possibilities for use of recycled water and biosolids.

To request a copy of the full report or copies of the background technical reports, please contact ActewAGL on 02 6248 3555.

Overview of Canberra's Sewerage System

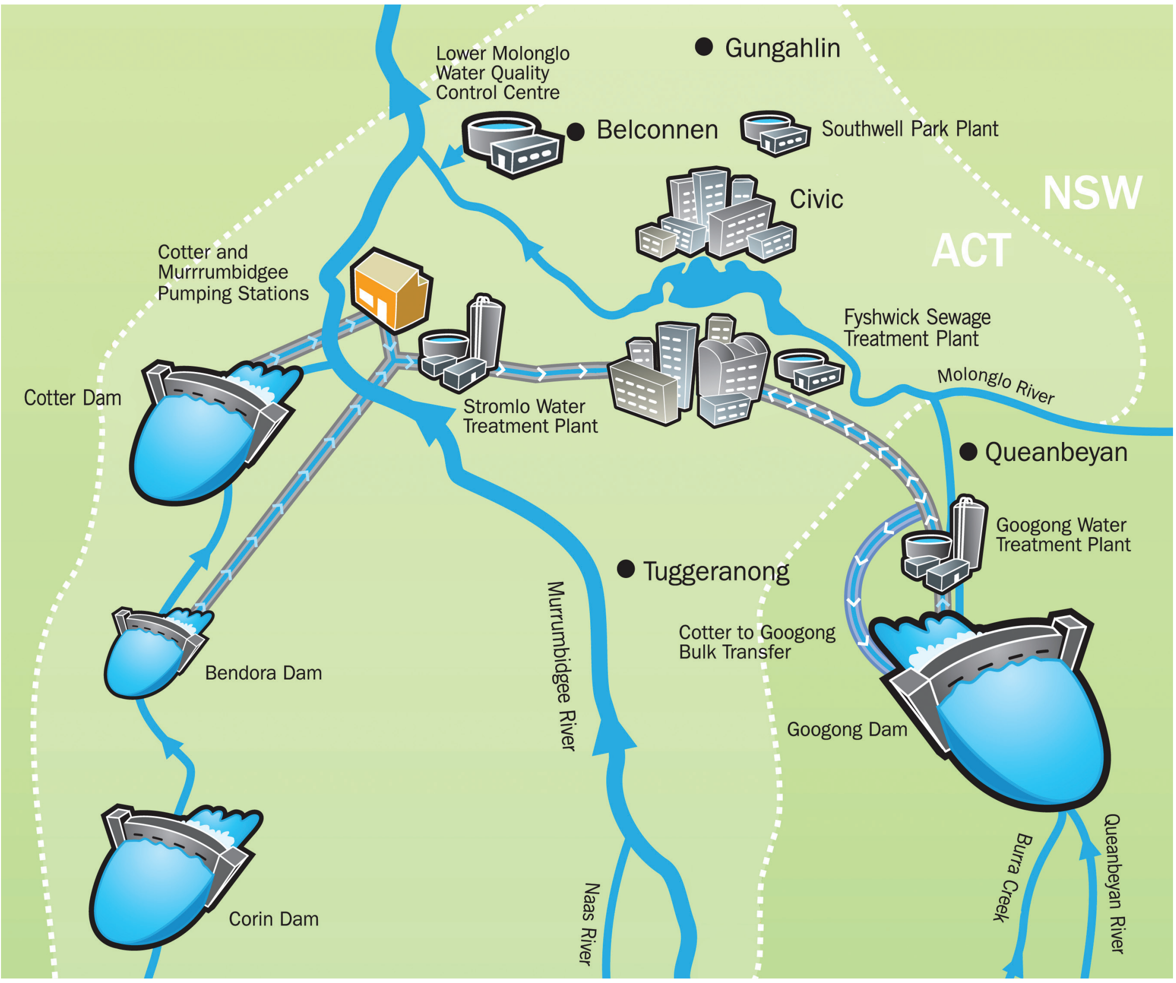
Canberra is Australia's largest inland city and is located in South-Eastern Australia. The Canberra sewerage system has evolved over the last 90 years from septic tanks serving a small population to five regional treatment plants serving about 200,000 people to the current regional sewerage system serving about 360,000 people.

ACTEW provides sewerage (and water) services in the ACT. ActewAGL is the agent responsible for managing the delivery of these services, and is undertaking the study on behalf of ACTEW.

The sewerage system consists of a network of approximately 3,100 km of underground pipes to collect sewage from residential, commercial and educational properties, and convey it to treatment facilities for treatment, with recycling or release to the Murrumbidgee River for downstream users and the environment.

The sewerage system was planned for a future ultimate population of a million people and has an estimated total value of $2.2 billion[1]. ACTEW has three sewage treatment plants, with most of Canberra's sewage treated at the Lower Molonglo Water Quality Control Centre (LMWQCC), a small proportion treated at Fyshwick Sewage Treatment Plant (STP) and an even smaller proportion at the water-mining plant at Southwell Park. The figure below depicts the location of key sewerage and water assets within the ACT.

Key Sewerage and Water Assets in the ACT



[1] 2006 value of $1.81 billion taken from the ACTEW Asset Management Plan and CPI added to bring figure to nominal 2010 dollars.

LMWQCC was designed in the 1970's, initially for a population of 269,000 persons, with provision for the plant to be extended to serve a population of one million. It commenced operation in 1978. The plant was expanded and upgraded following an environmental and process audit in 1992, and further expanded and upgraded in 2009–10.

The plant was designed to achieve an effluent quality matching the background water quality found in the surrounding streams. It uses a sequence of processes, including lime primary treatment, secondary biological treatment, sand filtration and disinfection, to produce a very high quality effluent, with very low concentrations of biological oxygen demand, suspended solids, phosphorus and faecal coliforms in the treated effluent.

Solids removed by treatment are incinerated. The ash is used on farmland which recycles the lime and phosphorus content to agriculture use. The water released from LMWQCC contributes to the flow in the Murrumbidgee River and the Murray–Darling Basin, providing water for a number of purposes including environmental flows and agricultural irrigation.

Fyshwick STP provides recycled water to the North Canberra Water Reuse Scheme (NCWRS) through the Water Reclamation Plant, which produces a high quality effluent using microfiltration processes. All solids generated by the Fyshwick STP are returned to the sewer and the effluent that is not used in the NCWRS is also returned to the sewer.

The Southwell Park Plant was commissioned as a demonstration plant for the Watermining™ technology, to test the concept of mining sewage from a nearby sewer for irrigation purposes. The Plant provides recycled water for irrigation of the adjacent sporting fields. Solids are returned to the sewer for treatment at LMWQCC.

Currently about 4,360 ML/yr of treated effluent is recycled for use as irrigation water.

Planning Perspective

Planning for the Australian Capital Territory is guided both by the Commonwealth Government, through the National Capital Authority (NCA), and the ACT Government, through the ACT Planning and Land Authority (ACTPLA).

Key Planning documents considered in this strategy include:

- *National Capital Plan* administered by the NCA, ensures that the planning for and development of Canberra and the Territory is in accordance with their national significance.
- *Canberra Spatial Plan* administered by ACTPLA, outlines a strategic direction that will help manage change and provide for growth to achieve the social, environmental and economic sustainability of Canberra.
- *Think water, act water* administered by the ACT Government, set targets for the reduction in potable water use and the increased use of non potable water sources.

The population is projected to increase from 360,000 at present to about 430,000 in 2030 and 540,000 in 2060 (median projections). Although the range from low to high growth projections is considerable, it appears that the projected population growth rate is slow, even in the high growth projection. In general there will be 1,800 to 1,900 new dwellings built per year in the ACT over the next decade with more apartments and fewer detached houses.

The projected median sewage flow at 2060 is 39.7 GL/yr (staying relatively constant between 2010 and 2035 reflective the relationship between increasing population growth and decreasing flows per capita). In terms of flows in dry weather, the capacity to treat sewage should be expanded by 5 per cent by 2040 and 15 per cent by 2060.

As the organic and nutrient contributions per person will remain the same as now, reduced water use will cause the sewage to become more highly concentrated.

The current *Think water, act water* strategy has a target to increase recycled water use in Canberra to 20 percent (of the 2004 sewage volume) by 2013. To achieve this target requires an additional 1,640 ML/yr of recycled water use.

ACT Water and Sewage Resources

It is important to understand the volume of water that enters the sewerage system day to day and during wet weather events, particularly as this can impact the ability of the sewerage system to manage flow in the network and at the treatment plants.

The current daily flow entering LMWQCC averages 80 ML/d with a total solids load of 37 t/d (based on figures from 2004 to 2009).

The analysis of ACT water use is made in the context of natural and drought-affected flows in the Murrumbidgee River Basin. This analysis of water resources in the ACT shows that the supply of water is not a sewerage planning restriction, even with an extreme level of climate change. Current figures indicate that indoor water use equates to an average of 164 L per person, per day, and generally all of this water ends up in the sewer. With the expectation that in the future more rainwater will be used for flushing toilets, the average indoor water use per person per day is likely to decrease.

At present almost all of the water used in the sewerage system is returned to the Murrumbidgee River after a high level of treatment and is available for various downstream uses. Between 1990 and 2008 average flows from LMWQCC to the Murrumbidgee River were 81 ML/day, a contribution over 29 GL/year. From the perspective of users downstream of the ACT, the diversion of water for use in the ACT sewerage system does not reduce the quantity available for use downstream, as essentially all the flow is returned to the river. Further, from the perspective of downstream users, it makes little difference whether roofwater or river water are used in the sewerage system, as both constitute a temporary diversion from the ACT water cycle, with the flows subsequently returned to the river.

Analysis shows that there is sufficient water available to continue with a water-flushed sewerage system in Canberra, particularly as all the water used in the sewerage system can be treated to a high standard and returned to the river for subsequent uses downstream of the ACT. During drought periods, the LMWQCC discharge makes an important contribution to river flow.

The discharge to waterways must not have adverse effects on the ecology of the Murrumbidgee River. All available data on water quality and biological conditions in the Murrumbidgee River were analysed in this study, to provide the basis for planning the characteristics of future discharges. A summary of the assessment of environmental monitoring data is provided in the table below.

Summary of Results of Murrumbidgee River Monitoring Program

Parameter	Observed Effects from Monitoring
BOD and Dissolved Oxygen	Very low BOD in effluent. No change in dissolved oxygen in the river
Suspended Solids (SS)	Very low BOD in effluent. No change in dissolved oxygen in the river
Turbidity	Effluent has lower turbidity than river waters
pH (acidity or alkalinity)	Effluent is neutral and there is no change to pH in the river waters
Phosphorus (TP)	Small increase in TP levels in river due to effluent discharge
Total Nitrogen (TN)	Significant increase in nitrogen levels due to discharge, but algal response limited by light and high TN/TP ratio, reducing blue-green algae. Natural loss of nitrogen from river to the atmosphere
Ammonia	Significant increase in ammonia levels due to discharge, but decreases with distance downstream, due to biological uptake
Metals	Minimal difference observed between sites upstream and downstream of LMWQCC
Other Toxicants	Negligible quantities in the effluent
Total Dissolved Solids	Effluent contains elevated levels of nitrates, carbonates and calcium, due to use of lime in treatment. Minimal effects on river. The calcium carbonate is beneficial for irrigation
Bacteria	Effluent is disinfected and has negligible effect on river waters
Green Algae	Small increase in green algae count downstream of ACT, possibly due to input of nutrients from LMWQCC and urban runoff
Diatoms	Small increase in green algae count in river downstream of ACT (to Burrinjuck Dam), possibly due to input of nutrients from LMWQCC and urban runoff
Macroinvertebrates	The LMWQCC discharge has no measurable effect on macroinvertebrate communities. There are similar proportions of sensitive species upstream and downstream of the discharge
Fish	Results suggest LMWQCC discharge may be having a small positive effect on fish populations
Monotremes (platypus)	There are more platypus living near the LMWQCC discharge than at other sites in the river

Monitoring will continue across each of these parameters, however further investigations may be required to better understand how parameters may affect the environment.

Sewerage System Capabilities

The strategy has reviewed the current sewerage system capabilities and has highlighted some key issues, which are described below.

Flows over the last decade have been particularly low because of the drought and widespread effort by the community to conserve water. Reduced flows to the treatment plants due to water conservation measures and the drought, combined with slow growth in the ACT, have made it difficult to predict when plant upgrades need to occur.

From a review of solids loads reaching LMWQCC, it is considered that the current capacity has already been reached, but performance has been maintained due to the low flows during the drought. As a priority the treatment capacity needs to be increased to ensure that high wet weather flow events can be handled by the plant. Recent capacity augmentations of the treatment system have been undertaken.

A detailed analysis of the capacity of the incinerators and related equipment at LMWQCC showed that each incinerator has capacity to handle all solids up to the year 2060. Only one incinerator is operated at a time, so there is adequate backup of incineration capacity. However, licence exceedances for opacity and carbon monoxide in incinerator emissions, and the plume fumigation issue, need to be addressed.

Analysis of the Fyshwick STP indicates that the plant experiences performance difficulties throughout the treatment process. The Fyshwick STP produces only about 60 per cent of the recycled water needed to operate the North Canberra Water Reuse Scheme (NCWRS), owing to significant losses via evaporation, seepage and transfer of sludge back to the sewers. Thus, potable water is used to top-up the recycled water system. All solids generated by the Fyshwick STP are returned to the sewer and the effluent that is not used in the NCWRS is also returned to the sewer. Because of this arrangement, the treatment capacity at Fyshwick STP is duplicated at LMWQCC.

The Southwell Park plant experiences a number of operational problems associated with the plant. Furthermore, it does not meet current irrigation demand and has a high unit cost of production.

The climatic conditions causing the reduction in flows and the more extreme wet weather flows are also impacting on the sewerage network. The reduction in dry weather flows has increased the potential for solids stranding and blockages, gas and odour generation in the sewers. The more extreme wet weather flows place greater strain on network capacity. This combined with on-going tree root intrusion to the pipe network (which leads to cracks and weaknesses which increase the volume of inflow and infiltration into the network) and the ageing of the network assets is resulting in the need for a greater level of on-going maintenance, renewal and replacement.

Emerging Trends and Issues

To successfully plan for 50 years in the future, it is necessary to examine the trends that are emerging now and ensure that the future sewerage system has the flexibility to incorporate or encompass them to a greater or lesser degree.

Emerging issues can be classified in many ways. Issues that need to be taken into consideration in selecting a future sewerage strategy include:

- Salinity in the Murrumbidgee;
- Emerging Technologies for Sewage Treatment;
- Climate Change and Climate Variability;
- Biodiversity and Threatened Species Impacts;
- Urbanisation Impacts;
- Trace and other Emerging Contaminants of Concern;
- Nexus of Water, Energy and Food Production;
- Regulatory Changes; and
- Trends in Government Policy.

These trends have been encompassed in the scope of the study to assess future sewerage strategies.

Approach to Strategic Analysis

A scenario-based approach has been adopted for the exploration of future possibilities in this study. Examination of possible future scenarios is a recognised technique for long-term planning and is widely used by sewerage agencies.

Each scenario addresses a different critical issue. The scenarios include options which address the issue at several scales, extending to what may be perceived as an exaggerated ending. Analysis of these options allows the implications of pursuing the scenario to a greater or lesser extent to be understood. The scenarios are not intended to present alternative strategies for development of the sewerage system, but to define and explore potential options along a particular pathway.

Four scenarios are explored in the study report to examine different challenges in the management of the sewerage system. The scenarios are:

Enhanced Technology Scenario – explores options to upgrade the sewer network and treatment systems with new technologies;

Dispersed Treatment Scenario – explores decentralised treatment at a variety of scales including household or neighbourhood treatment and regional treatment plants;

Increased Recycled Water Use Scenario – explores increasing the use of reclaimed water with an option that recycles 100 per cent of the reclaimed water; and

Low Energy Scenario – explores ways to minimise energy use and increase the generation of power from wastes.

Baseline Scenario

To evaluate the strengths and weaknesses of the options within each scenario, a baseline scenario was developed for the purposes of comparison. The baseline scenario provides the datum for the assessment and comparison of the outcomes, costs and benefits of other scenarios and the options within them.

The concept for the Baseline Scenario involves continuing the existing operations of the sewerage system, including the augmentations included in the ACTEW Asset Management Plan, to provide a sewerage system to serve the present and future population, commercial activities and government facilities in Canberra.

The key components of the Baseline Scenario are to:

- Augment LMWQCC treatment facilities to handle the increasing flows and loads of sewage over the next fifty years in response to population growth;
- Achieve current discharge licence limits at LMWQCC for all parameters, including the current load limits on nitrogen and phosphorus in discharges to the river, and other limits for discharges to air;
- Upgrade the treatment plant at Fyshwick to meet the demand for recycled water in the NCWRS, meet the requirements of the *Australian Guidelines for Water Recycling* and meet current discharge limits for discharge to the Molonglo River;
- Upgrade the NCWRS to distribute recycled water from Fyshwick STP to North Canberra, retire the Southwell Park demonstration plant and provide a pipeline from the NCWRS to the Molonglo River either just upstream or below Scrivener Dam;
- Improve controls on the discharge of exotic and other wastes to the sewer including a community campaign to reduce salt discharges to the sewer; and
- Expand the sewerage network to new development areas, and undertake improvements to the existing network.

Enhanced Technology Scenario

The Enhanced Technology Scenario comprises options to upgrade sewage treatment at the Fyshwick STP and LMWQCC. The options examine increased capacity at the Fyshwick STP (and an increase in the quality of the recycled water to match the licence limits applying at LMWQCC); increased removal of ammonia, total nitrogen, total phosphorus and total dissolved solids in various combinations; improved furnace operation and gas scrubbing; and alternative methods to process sludge and improved disinfection. A total of 15 options were developed as part of the Enhanced Technology Scenario, with a Baseline option included below as a comparison:

Options to upgrade Fyshwick STP

Baseline – New 6 ML/d Biological Nutrient Removal (BNR) plant (total phosphorus = 0.1 mg/L; ammonia = 1 mg/L; total nitrogen = 10 mg/L)

Option A – New 9 ML/d BNR plant (same performance as Baseline Option)

Options to upgrade LMWQCC

Baseline – Expand existing plant (total phosphorus = 0.1 mg/L; ammonia = 3 mg/L; total nitrogen = 15 mg/L)

Option B – Reduce ammonia from 3 mg/L to 1 mg/L

Option C – Reduce total nitrogen from 15 mg/L to 10 mg/L

Option D – Reduce total nitrogen from 15 mg/L to 5 mg/L

Option E – Membrane process (total phosphorus = 0.1 mg/L; ammonia = 1 mg/L; total nitrogen = 10 mg/L)

Option F – Membrane process, reduces total nitrogen from 15 mg/L to 5 mg/L

Option G – Membrane process with no primary tanks, reduces total nitrogen from 15 mg/L to 5 mg/L

Option H – Membrane process arranged across site to lower energy use, and reduce total nitrogen from 15 mg/L to 5 mg/L

Option I – Parallel plant option with new Membrane Bioreactor (MBR) plant, reduces total nitrogen from 15 mg/L to 2 mg/L

Options to reduce salt discharge to the river.

Option J – Add reverse osmosis step to treatment processes to reduce TDS to below 500 mg/L

Option K – Replace lime addition in primary tanks by more secondary tanks and reduce total nitrogen from 15 mg/L to 10 mg/L

Options to upgrade treatment of sludge or develop alternatives.

Option L – Add air emission controls and energy recovery to incinerators

Option M – Replace existing multiple hearth incinerators by fluidised bed incinerators

Option N – Replace existing multiple hearth incinerators by anaerobic digestion

Option O – Replace existing multiple hearth incinerators by lime stabilisation

A wide range of technologies were explored in the enhanced treatment scenario and they provide a range of possible future steps in the development of a plant at LMWQCC to achieve more stringent discharge limits.

A large number of additional enhanced technology options were considered but not developed as there is insufficient data on which to develop preliminary designs. The additional options included anaerobic denitrification, fuel cells and gasification.

Dispersed Treatment Scenario

The Dispersed Treatment Scenario comprises options to change from the current citywide sewerage network and centralised treatment facilities, to either treatment "on-site" at each individual household or commercial premises, or treatment at a series of local or regional treatment plants. The purpose was to explore whether the available technologies would promote water recycling at a local level and meet customer expectations. As part of this scenario four options were developed and assessed:

On-site household scale treatment

- Option A – Aerobic biological treatment
- Option B – Membrane treatment

Catchment scale treatment

- Option C – Three plants plus LMWQCC
- Option D – Plants at Ginninderra, Molonglo Valley, Fyshwick, Belconnen and Tuggeranong, with LMWQCC decommissioned

Increased Recycled Water Use Scenario

The Increased Recycled Water Use Scenario explores increasing the use of recycled water on public open space with an option involving using 100 per cent of the recycled water.

The scenario comprises twelve options to increase the use of recycled water from the present eight per cent of effluent to higher proportions. The baseline option is to increase reuse to ten per cent of effluent by extending the NCWRS. The next nine reuse options increase the number of Canberra suburbs supplied with recycled water for irrigation of parks and public open space until about 40 per cent of recycled water is used, creating an extensive interconnected recycled water scheme. Two further options are examined, involving reuse of recycled effluent on agricultural land in the ACT (or in nearby NSW) with storage of the recycled water in winter months. The largest agricultural option would involve the use of 100 per cent of recycled water, with no discharge to the river.

Low Energy Scenario

The Low Energy Scenario explores ways to minimise energy use and increase the generation of power from wastes.

The Low Energy Scenario comprises nine options ranging from household scale heat recovery from shower and bath water (capture and transfer heat energy to residential hot water heaters) to a large anaerobic treatment facility handling Canberra's sewage plus green and forest waste (and generating 5 MW of power). The options explored in detail were as follows:

Option A –	Heat recovery from household sewage
Option B –	Upflow anaerobic sludge blanket (UASB) reactors to treat sewage
Option C –	Anaerobic lagoons to treat sewage
Option D –	Anaerobic facultative pond followed by algae growth and settling
Option E –	Anaerobic/facultative ponds followed by trickling filters
Option F –	Primary Sedimentation Tanks followed by facultative ponds
Option G –	Generation of power from furnace waste gases
Option H –	Recover incinerator heat to heat aeration process

Comparison of Scenarios

A structured evaluation process was used to assess and compare options within the different scenarios. The aim was to identify the implications of each option in terms of key benefits, advantages, disadvantages and risks.

Sustainability assessment builds on triple bottom line assessment by including criteria based on sustainability principles which aim to:

- Enhance individual and community well-being by following a path of economic development that safeguards the welfare of future generations;
- Provide equity within and between generations; and
- Protect biological diversity and maintain essential ecological processes.

The options were assessed using the following evaluation criteria:

Economic	Capital cost, annual expenditure, intergenerational costs and benefits;
Social	Workforce issues, local nuisance, urban space and community equity;
Environmental	Waterways, downstream flow, net energy footprint, greenhouse gas emissions, reuse and resource recovery, and terrestrial impacts;
Product and Service Delivery	Reliability, flexibility, regulatory implications;
Public Health	Risk of infection, risk of toxic effects.

Throughout the assessment process it was recognised that different secondary criteria may have different levels of importance in the overall decision making process.

Furthermore it was recognised that there may be some interactions between secondary criteria, and therefore some criteria may account for elements of others. For example, capital expenditure for a new treatment plant should account for externality costs such as potential community nuisance issues such as odour control.

For these reasons, in the overall decision making process secondary criteria such as capex and annualised opex may be more critical in determining outcomes. Further refinement of options may need to consider more explicit weighting for different secondary criteria.

A set of four workshops was undertaken, involving the project team, internal stakeholders from key business areas in ACTEW and ActewAGL, and external stakeholders from ACT Government agencies. This broad group of stakeholders discussed the attributes of each option and, noting that all options did not achieve the same treatment outcomes, developed a score for each of the criteria (listed above).

Due to the high number of options within each scenario, the sustainability assessment considered a selection from each scenario. The selected options vary from ones which are not too different to the Baseline Scenario to options which are a complete change. The table below provides a summary of the key details of each option that was selected for the Sustainability Assessment.

Option Name	Option Description	CAPEX ($M)	OPEX ($M/yr)	Operational GHG (000's tCO_2-e/yr[b])
	Existing situation	449[a]	25	78
Baseline	Continued use of existing practices and system, with expansion as required to match population growth. Includes commitments under Asset Management Plan	472	Expected to remain similar to existing situation	90
TDS Reduction – included in Baseline (community source control including changing to low salt detergents, trade waste controls, diverting salt water pool discharges away from sewers)				
Upgrade LMWQCC to remove more Nitrogen and Phosphorus	Augment existing BNR process to achieve greater total nitrogen removal	193	4	79
New BNR Plant at LMWQCC	Augment existing BNR process to maximise ammonia oxidation and total nitrogen removal	265	6	101
Membrane filtration	Convert primary tanks to anaerobic bioreactors and provide membrane BNR process to achieve greater ammonia and total nitrogen removal	285[f]	12	89
New Fluidised Bed Incinerator	Replace multiple hearth incinerator with fluidised bed incinerator and energy recovery	57	4	Abatement of 1.5 (energy recovery)

Option Name	Option Description	CAPEX ($M)	OPEX ($M/yr)	Operational GHG (000's tCO_2-e/yr[b])
Reverse Osmosis to Reduce Salt Discharge	8.3ML/day reverse osmosis plant to reduce Total dissolved solids in effluent	19.5	12	11
Catchment Level Treatment	Regional plants constructed	199–244 (GHD) 295–368 (PB)[cf]	8.3–11.1 (GHD) 9.3–12.3 (PB)	16[d]
Household Plants	Small treatment plants at household or apartment block scale (new developments)	2,500[f]	NA[e]	100
10% reuse – included in Baseline (expansion of existing NCWRS – a pipeline north past Southwell Park to Mitchell, west to discharge nearby to Scrivener Dam and east to Ainslie Reservoir)				
15% reuse	Building on Baseline, expansion to Belconnen area, linking LMWQCC and NCWRS	60	1.5	8
40% reuse	Building on 15% reuse, expansion to Molonglo Valley, central Canberra, north, south and south-western Canberra	262	2	78
100% reuse	Building on 40% reuse, expansion to Kowan, and new agricultural precincts in the ACT	116	5	45
Heat Transfer on a domestic scale	Installing small water-water heat exchangers on shower discharge from transfer heat back to hot water system (new developments)	0.0025 (per shower)	NA[e]	Beneficial recovery 10
Anaerobic Treatment	Replacing primary and secondary treatment system at LMWQCC with a large area of covered ponds	291–357[f]	18–16	33–57
Biogas Generation	Building on Anaerobic Treatment and treating green and forest waste	75	4	21.1
Lime Stabilisation of Sludge	Replacing the incinerators with a lime stabilisation plant	32	6	0.5–2
Anaerobic Sludge Digestion	Replacing the incinerators with anaerobic digesters	58	8	10

Notes:

a – 2006 value of $363 million taken from ACTEW's Asset Management Plan and CPI added to bring figure to nominal 2010 dollars

b – Other than the baseline, these options do not include GHG emissions from the baseline option

c – Two consultant cost estimates

d – Does not include LMWQCC or Fyshwick emissions

e – Not an ACTEW cost

f – Expect baseline capex cost to reduce to reflect less augmentation required at LMWQCC.

Enhanced Technology Scenario

The options in the Enhanced Technology Scenario scored higher on criteria associated with product and service delivery, but with poorer results for economic and social criteria. Some options within this scenario were assessed as having a lack of clear environmental or human health benefits.

The poorest performer in this group of options was reverse osmosis to reduce salt discharge from LMWQCC. This option was assessed to involve greatly increased capital and operating costs, a dramatically large energy footprint, lack of clear environmental benefit and weaknesses in intergenerational cost and benefit (due to the unresolved question of how to manage the brine produced by the reverse osmosis process).

Some options within the Enhanced Technology Scenario were assessed as having value in ACTEW's future strategic direction, including a parallel treatment plant to enhance biological nutrient removal at LMWQCC, upgrading or replacing the furnaces (including energy recovery) and reduction of sodium by community action.

Dispersed Treatment Scenario

Options in the Dispersed Treatment Scenario performed poorly. Both catchment level treatment and household level treatment would have substantially greater economic and social costs than the alternatives, including the Baseline Scenario.

The assessment indicated that dispersed treatment presents opportunities for recovery and reuse of resources and flexibility to meet future changes. However, the assessment indicated that the dispersed treatment options have problems with public health risk, community affordability and local nuisance. Household level treatment was rated as worse than catchment level treatment against the GHG criteria as well as community affordability and reliability of infrastructure.

Significant concerns about aspects of the dispersed treatment options were raised during the assessment workshops by various external stakeholders. The potential public health risk and local nuisance were highlighted.

While the assessment process confirmed the weaknesses of dispersed treatment for a large urban community, it was noted that dispersed treatment could provide advantages for remote or small developments.

Increased Recycled Water Use Scenario

The options in the Increased Recycled Water Use Scenario offered improved public amenity and recovery of resources with an increase in the amount of recycled water used for irrigation of public open space. However, the assessments for other criteria performed much less positively, notably community affordability, downstream water quality, energy and GHG footprints.

Expanding recycled water use above the 40 per cent level was assessed as less favourable as the benefits of increasing urban amenity and resource recovery are progressively negated by poorer results against economic and environmental criteria. A recycled water scheme targeting the range of 20 to 30 per cent is considered to be the most viable approach.

Low Energy Scenario

Somewhat surprisingly, most of the Low Energy Scenario options did not perform well in the sustainability assessment. There was a perception that significant greenhouse and energy benefits could be available from changes to treatment processes which would generate energy from the sewage. Once investigations were undertaken it became apparent that the costs of implementing these options were assessed as being worse or much worse, with no real social benefits and limited environmental improvements.

Detailed examination indicated that there are a number of constraints in Canberra which hinder efficient energy generation from sewage. The sewage is conveyed to the LMWQCC site, very close to the NSW border. The site is on steep topography, with little room for large lagoons or reactors, yet a new sewer network would be required if the treatment units were to be located elsewhere. Canberra’s climate is too cool in winter for the biological processes which are essential to generate energy from sewage.

Assessment also indicated that some of the Low Energy Scenario options would have significant GHG emissions, due to fugitive releases from treatment processes.

Recommendations

This study undertook a review of the current sewerage system in Canberra to define the future direction for sewerage services over the next 50 years.

To enable this process, a wide range of options within the four scenario areas were developed and evaluated against the Baseline Scenario.

The outcomes of the study confirm that the existing sewerage system is operating relatively well under current conditions. However, changes in sewage treatment and effluent reuse are essential to respond to growth, climate change, environmental pressures and other factors. The study recognised that there is substantial community investment in existing infrastructure and it is therefore prudent to maintain and improve on this technological base.

The study did not identify the need for a major change from the present sewerage system. Instead, the recommended approach is for continued evolution of the existing sewerage system, incorporating options from the enhanced technology scenario and the increased recycled water use scenario to deliver a net benefit to the community.

Liquid Waste Management at LMWQCC

The study identified a clear advantage in retaining the existing centralised treatment approach in which the majority of Canberra’s sewage is treated at Lower Molonglo

During future investigations, comparison of alternative site arrangements for expansion of the existing processes is recommended. Work has shown that there is likely to be value in a new biological nutrient removal treatment train combined with membranes at LMWQCC to handle part of the plant flow. There are several options for the configuration and orientation of this concept and there appear to be significant advantages in constructing the process along the elevation contour of the site. The most likely future changes to the discharge licence are likely to be able to be handled by a plant upgrade of this nature. Definition of the value of a changed approach and comparison with the staged expansion of the current LMWQCC process will be required to define the timing of capital works at the plant.

Analysis undertaken for the review does not show detectable environmental impacts on the Molonglo and Murrumbidgee Rivers from the LMWQCC discharge. Noting that salt management is mentioned earlier, two actions are recommended to support the management of potential impacts of the discharge.

- An expansion to the monitoring program is recommended with increases in the monitoring in Burrinjuck Reservoir and at LMWQCC.
- Building on work done for the study, it is recommended that ACTEW undertake follow-up research on the ecological impacts of TDS in the LMWQCC effluent in consultation with the environmental regulator. The objective is to provide scientific information on TDS environmental impacts, based on bioassay work.

Solid Waste Management at LMWQCC

The incineration of solid wastes in the furnaces at Lower Molonglo recovers resources from sewage, allowing reuse on land through Agri-Ash. The furnaces are not, however, reliably operating in accordance with licence limits. The study confirms that the furnaces at Lower Molonglo need to be upgraded to meet limits for opacity and carbon monoxide. Incineration is considered to be a viable means to convert solid wastes to a useful product, although consideration of long term alternatives is recommended for when the existing furnaces reach the end of their useful life.

The incinerator upgrade project which is currently being considered is recommended for review to confirm suitability.

The alternatives with long term potential for LMWQCC include installation of a fluidised bed incinerator, or removal of the incinerators and a change to lime stabilisation of sludge. The implementation of this infrastructure is not considered to be required for 10-20 years. Some investigations will be carried out during future investigations, with a focus on defining externalities which could affect the decision. In addition, one emerging solids management technique will be reviewed during future investigations; gasification of sludge to produce an energy resource.

Fyshwick STP and NCWRS

The study builds on previous work to confirm that the Fyshwick STP requires renewal and upgrade works as soon as possible. The poor performance and high cost of the Southwell Park water mining plant was also highlighted.

It is recommended that future investigations further refine the Fyshwick STP preliminary designs for an upgraded 6 ML/d plant, including verification of process choice and identification of trigger points for staged augmentations from a 6 to 9 ML/d plant. It is recommended that the expanded plant include a waste acceptance facility for contractor wastes including material from grease traps and septic tanks.

Establishment of formal buffer zones around the upgraded Fyshwick STP and NCWRS are considered essential, protecting the plant from encroaching development.

There may be a need to expand the NCWRS plant to match the upgraded Fyshwick STP (or even integrate with the upgraded STP). This is recommended for further investigation. Some expansion to the North Canberra network is recommended, noting that this may form part of a more significant expansion in the recycled water network. As a minimum, network expansions are recommended towards Scrivener Dam and towards Mitchell in the north.

The construction of a new pipeline along the northern edge of Lake Burley Griffin is recommended, running through ANU and past the arboretum to the Molonglo River, just below Scrivener Dam. This pipeline would allow for winter discharge of reclaimed water to the Molonglo River just below the Dam, discharge into Lake Burley Griffin just above the Dam, or delivery to customers who are able to store the effluent on-site. The pipeline will allow the Fyshwick STP to operate year-round, releasing treatment capacity at LMWQCC to serve new urban development.

A small expansion of the NCWRS network to the north will enable Southwell Park to be supplied with reclaimed water from the Fyshwick STP, allowing the Southwell Park plant to be retired.

Recycled Water Scheme

This study indicates that increases in the proportion of water recycled are possible; however recycling to a rate of 40 per cent would require the irrigation of all of Canberra's open space. To increase above this level requires the irrigation of an agricultural precinct. Canberra's soils, topography and climate constrain the potential for reclaimed water use as irrigation demand is summer-dominant, requiring sizeable storages if high proportions of effluent are to be recycled.

Nevertheless, considering the potential community benefits, some expansion in reclaimed water use is recommended for future investigations. The scheme considered to have potential is the extension of the recycled water network to supply public open spaces to the north of Lake Burley Griffin and in the Parliamentary triangle area. This will target effluent use proportions of 15–30 per cent and future work will compare different levels within this band. Coordination of the recycled water scheme with the ACT Government stormwater irrigation scheme will be required.

Summary of Recommendations

The figure below represents the complete list of study recommendations for how to best position ACTEW to respond to the major changes that are likely to occur in the future, whilst maintaining a high level of sewerage services in the ACT.

Investigations are recommended to further refine identified options, and allow works to be scheduled into key regulatory processes and for strategic plans to be developed across specific areas to guide future sewerage management.

LMWQCC	Explore treatment alternatives ie parallel plant option Short-term incinerator augmentations Plan for replacement solids handling and reuse system (in 2025) Complete capacity assessment Explore gasification Audit of energy use and greenhouse gas generation
Fyshwick, NCWRS & Southwell Park	New 6 ML/day plant at Fyshwick STP Retire Southwell Park plant Waste acceptance facility at Fyshwick STP Obtain buffer zone for Fyshwick STP Upgrade connecting pump stations Further feasibility studies of aquifer storage capability Establish ecological value of Fyshwick STP lagoons
Recycled Water Scheme	Expand NCWRS to north Canberra Pipeline to Molonglo River Develop staged expansion to achieve 15–30% reuse Implement Australian Guidelines for Water Recycling Establish feasibility of integration with stormwater
Sewerage Network	Augment wet weather storage Review of requirements for odour control along sewers Watching brief on issues including progress to reduce sewer chokes, development of new technologies for network rehabilitation and replacement Develop framework for determining overflow criteria
Customer and Regulation Management	Salt reduction program Rules for dispersed treatment (and cost recovery) Third party access framework Incorporate exotic wastes into liquid trade waste policy Heat recovery from residences Refine watching brief framework Develop process for managing community sentiment
Environmental Monitoring	Expand monitoring program at LMWQCC and also at Burrinjuck Reservoir Specific changes include: • Expand TDS monitoring • Endocrine disrupting substances Complete macroinvertebrate studies Study nutrient and salt loads in Murrumbidgee River Negotiate with regulator on salt and nutrient limits Negotiate with regulator on incinerator emissions Watching brief on emerging contaminants of concern in sewage

Future Steps

From the study recommendations listed above, priority projects have been identified by ActewAGL in collaboration with ACTEW as being crucial to updating the sewerage Asset Management Plan and meeting the timing requirements of regulatory processes.

The priority projects have been divided into four different program areas, which enable further targeted investigation and implementation across specific areas.

Program area	Priority projects
LMWQCC	Investigate feasibility of expansion of storage dam
	Investigate attenuation points within sewerage network (outside LM)
	Schedule trigger points for capacity augmentations
	Refine Site Master Plan
	Determine long term discharge requirements/assumptions
	Further evaluate long term treatment methods ie additional process
	Refine long term augmentation plan
	Pilot test gasification of solids
	Short-term furnace augmentations
Fyshwick/NCWRS	Determine requirements/assumptions for possible discharge to Lake Burley Griffin or the Molonglo River
	Options and concept development of Liquid Waste Acceptance Facility
	Buffer zone and site planning
	Amend long-term site master plan
	Determine Planning Approval requirements
Customer and Regulation Management	Deliver salt reduction program
	Refine watching brief framework
	Development approach to managing community sentiment
	Stakeholder consultation
Environmental Monitoring	Review and gap analysis of biological monitoring program
	Assess macroinvertebrate community structure downstream of LMWQCC
	Assess river health in terms of nitrogen, phosphorus and ammonia releases
	Validate recent studies on impacts of LMWQCC discharge on macroinvertebrates

A program for future investigations will be developed, to build on the substantial body of work that has already been undertaken. It is anticipated that future project work will commence in 2011.

Strategic Review in the Context of Business Planning

To best position ACTEW to respond to future changes, ongoing review and consideration of strategic issues is essential. Future plans need to be assessed in the context of changes to ACTEWS's operating environment. An explicit review of the assumptions underpinning the strategic approach is also required.

Research partnerships with other utilities, peak bodies and research organisations will encourage the sharing of information and resources to optimise outcomes. This will allow ACTEW to more effectively and efficiently meet future challenges.