Kyogle Council

Kyogle Integrated Water Cycle Management Strategy Study

Final Report

August 2006

DEPARTMENT OF ENERGY, UTILITIES AND SUSTAINABILITY
NEW SOUTH WALES GOVERNMENT

MWH

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Kyogle Council

Kyogle IWCM Strategy Study

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List of Abbreviations

ADD	Average day demand (water supply)
ADWF	Average dry weather flow (wastewater)
ASS	Acid sulphate soils
BASIX	Building Sustainability Index
CAP	Catchment Action Plan
CCD	Collector census district
CMA	Catchment Management Authority
CPI	Consumer price index
DCP	Development Control Plan
DEC	The NSW Department of Environment and Conservation (formerly EPA)
DEUS	The NSW Department of Energy, Utilities and Sustainability
DNR	The NSW Department of Natural Resources (formerly DIPNR)
DOC	The NSW Department of Commerce
DOP	The NSW Department of Planning (formerly DIPNR)
DSS	Decision Support System – a combined end use and least cost planning model
ERP	Estimated residential population
GIS	Geographical information system
HHS	Household size
II	Inflow and infiltration (wastewater)
IWCM	Integrated Water Cycle Management
LGA	Local government area
NRCMA	Northern Rivers Catchment Management Authority
OTR	Other than rock
PDD	Peak day demand (water supply)
PPA	Persons per account
PRG	Project Reference Group – comprised of water management stakeholders
STP	Sewage treatment plant (sewage treatment works or wastewater treatment plant)
TBL	Triple bottom line
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
UFW	Unaccounted-for-water
WATHNET	WATHNET is a suite of Windows programs for simulating water supply headworks systems. It utilises network linear programming to allocate water from multiple sources to competing demands making allowance for capacity and operational constraints.
WELS	Water Efficiency Labelling Scheme
WSUD	Water Sensitive Urban Design
WTP	Water treatment plant (or water filtration plant)
PWWF	Peak wet weather flow (wastewater)

Executive Summary

This report documents the process leading to the development of Kyogle's Integrated Water Cycle Management (IWCM) Strategy Plan. The IWCM Strategy is a long term overarching plan for the management of urban water services at Kyogle, including water supply, wastewater and stormwater. The recommended IWCM Strategy incorporates many aspects of best practice water services management including an 18% reduction target in future water usage. Key features of the recommended IWCM Strategy include:

- Potable water supply sourced from the Richmond River with a new off-stream storage reservoir (200ML), new transfer pipeline, refurbished water treatment plant and new service reservoir. The water supply system design is subject to further assessment. The IWCM Strategy also includes on-going system renewals.
- Wastewater treatment facilities upgraded to allow restricted reuse at the treatment works. The upgrade will include a hydroponic wetland within the existing Council site and the ability to receive and treat septic tank waste (septage). Sewerage system improvements to include a wet weather inflow and infiltration reduction and rehabilitation program. The IWCM Strategy also includes on-going system renewals.
- Stormwater flood mitigation works within the township. Drainage improvements and additional stormwater quality improvement devices. Water sensitive urban design development control plans to reduce outdoor water usage and stormwater runoff impacts from new developments. Local stormwater harvesting opportunities. The IWCM Strategy also includes on-going system renewals.
- Catchment management activities consistent with the Northern Rivers Catchment Management Authority initiatives, including: the water sharing plan, improved on-site wastewater treatment systems and riparian rehabilitation.
- Source substitution through mandatory use of rainwater tanks on new development, a rainwater tank retrofit program (subsidised cost) and promotion of greywater reuse systems. Source substitution will target town water supply currently used for outdoor, toilet flushing and clothes washing purposes.
- Conservation of town water usage through community education (special events, brochures, schools, competitions), water supply system leak detection and repair, high water user audits, inclining block tariff (increased charge rates for high water usage), residential retrofit of dual flush toilet, low flow taps & showerhead, and commercial toilet retrofit (on request), residential washing machine rebate and no new rural town water and wastewater connections.

Significant investment in water facilities is required to provide current levels of service into the future. Increases in water rates and charges are anticipated. The final costs will be dependent on confirmation of water sharing rules, final supply system design and subsidies approval.

Integrated Water Cycle Management Process

IWCM is new best practice approach to water utility strategic planning. It is a requirement of the NSW Department of Energy, Utilities and Sustainability's *Best Practice Management of Water Supply and Sewerage Guidelines* (2004) and forms part of a range of initiatives by the NSW Government to improve water management across the state. A distinctive feature of the IWCM Strategy process is the consideration of opportunities arising through integrated approaches to management of urban water services, such as water reuse and conservation approaches.

An IWCM plan considers issues such as:

- future town water and service needs
- the availability of water including rainwater, effluent and stormwater
- other water users including the environment and future generations.

The IWCM process seeks answers to *What is the problem? How do we fix the problem?* and *How do we know the problem is fixed?* and forms a framework for future strategies to monitor and revise the IWCM Strategy.

The *Kyogle Integrated Water Cycle Management Concept Study* was completed in June 2003. The Concept Study identified water cycle related problems within the Upper Richmond River Catchment. The IWCM Strategy has been developed in response to these issues. To identify the most appropriate solutions for local circumstances, the IWCM approach involves a triple bottom line (economic, environmental and social) assessment of the strategies developed. Consultation is integral to the process. A project reference group (PRG) for the study was established with community, state government and water utility representatives to input to the development and assessment of the IWCM Strategy. The PRG's recommendations were presented to the community for feedback through a workshop and survey.

Water Cycle Issues

Kyogle's identified water cycle issues are summarised below.

Richmond River catchment based issues relate to activities which impact on river water quality and quantity, including:

- agriculture extractions during peak demand periods (August to November) exceed the average river flow
- river water quality objectives are frequently not met for total phosphorus, turbidity, faecal coliforms and salinity
- algal blooms have been reported in the river at the town water intake
- erosion prone areas in upper catchments
- riverbank erosion
- sewage treatment plant effluent loads released to the river, particularly during periods of low river flow
- poor quality stormwater runoff entering the river
- town water supply extraction during low river flow periods.

Town water supply system issues include:

- the aging water treatment plant's current condition presents safety, reliability and capacity problems
- water treatment plant filter backwash increases pollutant loads in the receiving creek and river
- lack of supply reliability and security both now, as evidenced by water supply restrictions, and into the future
- raw water quality from the river can be poor, particularly following rainfall.

The wastewater system issues include:

- the regulator's requirement to improve effluent quality or adopt an effluent reuse scheme controlled by Council
- condition of the aging sewer network
- high wet weather inflow and infiltration rates to the sewer in some areas
- some on-site wastewater treatment systems still exist within the urban service area

- no treatment point for septage from the rural areas.

Stormwater issues include:

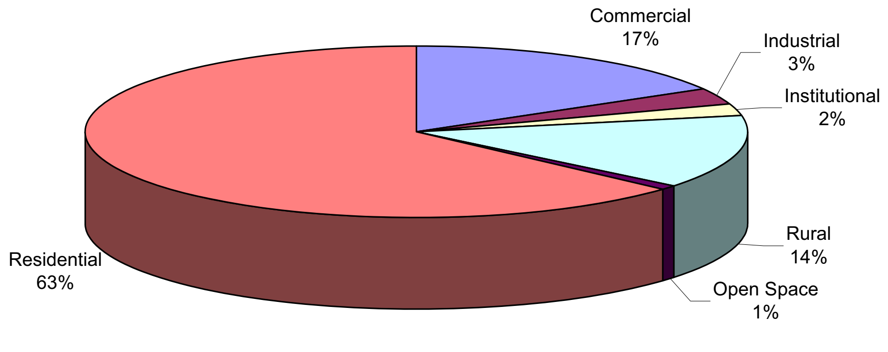
- flooding within the township area, including hydraulic bottlenecks within the commercial area
- inadequate drainage systems in some residential areas, exacerbating erosion issues
- poor stormwater quality runoff from urban areas
- lack of available funding for stormwater management activities.

Future Water Cycle Projections

A baseline analysis of future urban water services needs was made to understand how water is used at Kyogle and allow development of IWCM options to address the water cycle issues. The baseline analysis included the following steps:

1. Assessment of climate corrected water demands, that is, the non-restricted water demands with average climate conditions in place.
2. Assessment of water usage drivers, both now and in the future, including:
   - population served with water and wastewater facilities
   - dwelling types and occupancy rates
   - non-residential usage and growth
   - climate change.
3. Development of an *end use* computer model using climate corrected demands and demand driver assessment to forecast water demands and wastewater production.
4. Assessment of urban stormwater and catchment interaction through simple water and nutrient balances.

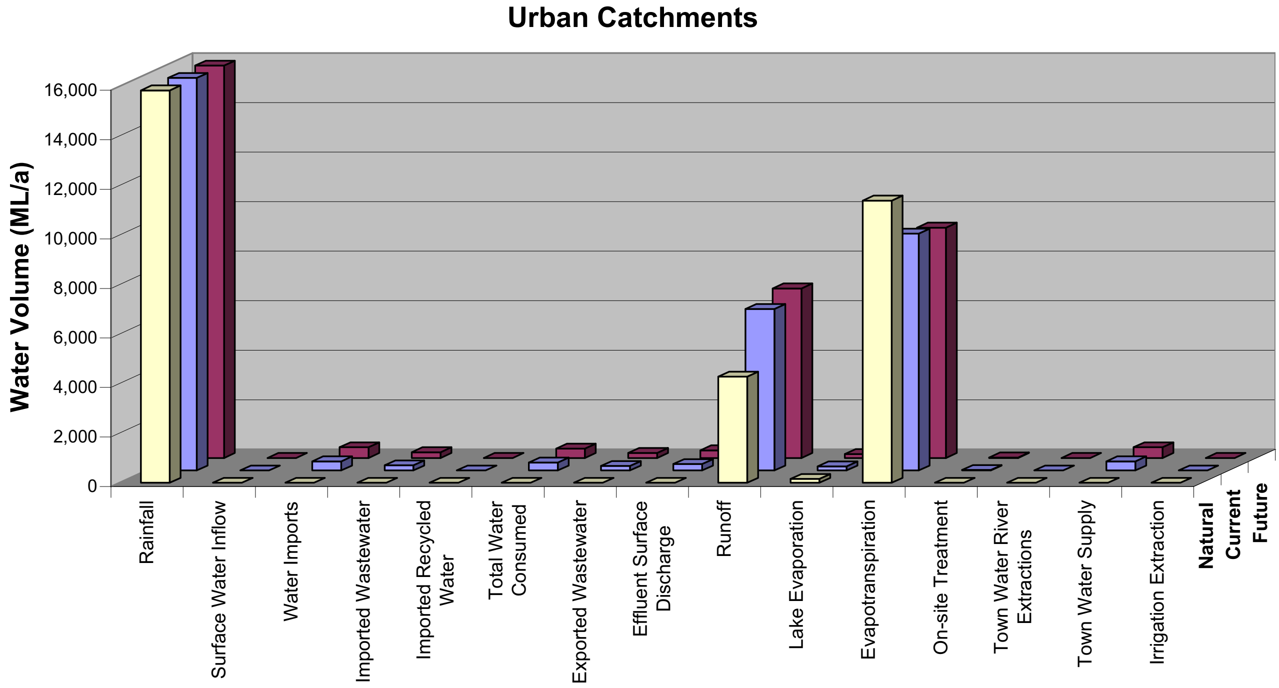
The current breakdown in town water consumption is outlined in the figure below.



The baseline forecasts for town water demands and wastewater production are tabled below.

Baseline Forecast Demand/flow	2005	2010	2015	2020	2025	2030	2035
Per Capita Water Demand (L/c/d)	400	393	387	383	379	377	374
Annual Water Demand (ML/a)	459	462	467	473	481	490	499
Peak Day Water Demand (ML/d)	4.2	4.5	4.7	4.9	5.1	5.3	5.5
STP Annual Inflow (ML/a)	318	313	311	313	316	321	327
STP ADWF (ML/d)	0.8	0.7	0.7	0.7	0.7	0.7	0.8
STP PWWF (ML/d)	9.3	9.7	10.0	10.3	10.6	10.9	11.2

The baseline urban area water balance for natural, current and future development conditions is presented below. Simplified water and nutrient balances were used to assist compare the potential IWCM solutions.



Water Cycle Solutions

There is a wide range of possible water cycle management options to address the issues identified in the Kyogle area. To develop the recommended IWCM Strategy, the following steps were taken:

1. Through consultation with the PRG, IWCM assessment criteria were developed. The assessment criteria reflect project goals and represent triple bottom line factors.

Kyogle IWCM Assessment Criteria		
Environmental	Social	Economic
• Reduces Pollutants Entering the River • Reduces Extractions from the River • Improves Riparian Zone Health	• Improves Public Awareness • Secures Future Supply • Protects Public Health	• Low Rates and Charges • Low Net Present Value

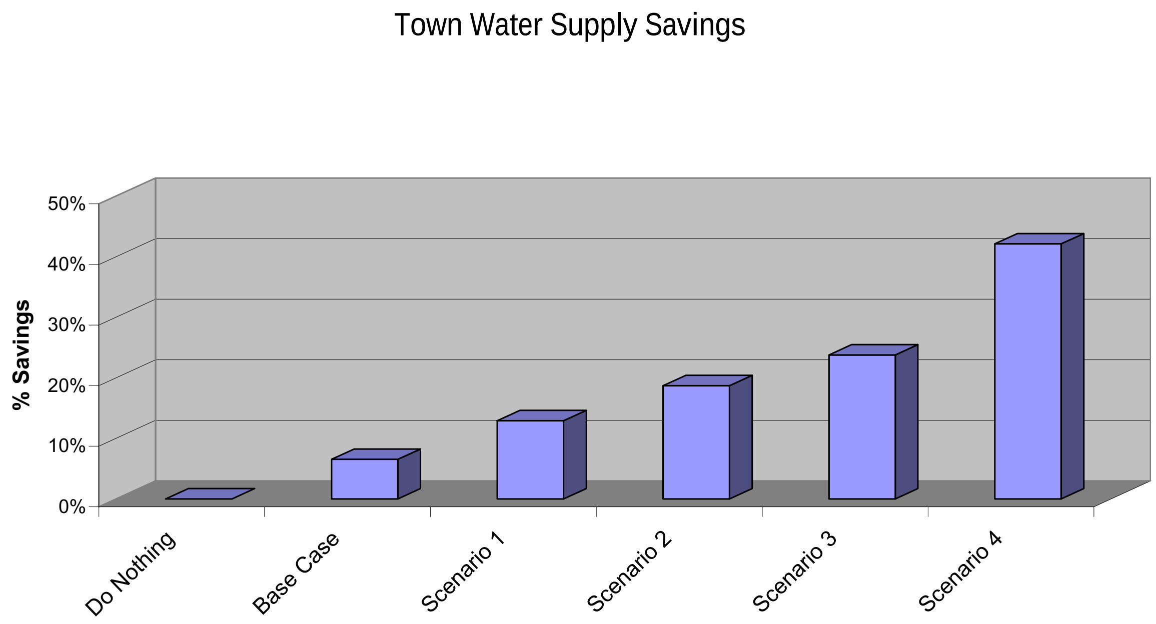
2. An options long list (approximately 65 options) was identified through consideration of the current initiatives, previous studies and PRG suggestions.
3. Each option was discussed and ranked by the PRG according to the environmental, social and economic assessment criteria.
4. The ranking information was used by the PRG to then bundle options together into five IWCM scenarios. Each scenario represents a *picture* of future water management within Kyogle.
5. Future water demands, wastewater flows and stormwater impacts for each of the five IWCM scenarios were estimated. Using this information, benefits and costs associated with each scenario were estimated.
6. The PRG compared the five scenarios using the triple bottom line assessment criteria and selected the preferred scenario.
7. The preferred scenario was refined and is presented as the recommended IWCM Strategy in this report.

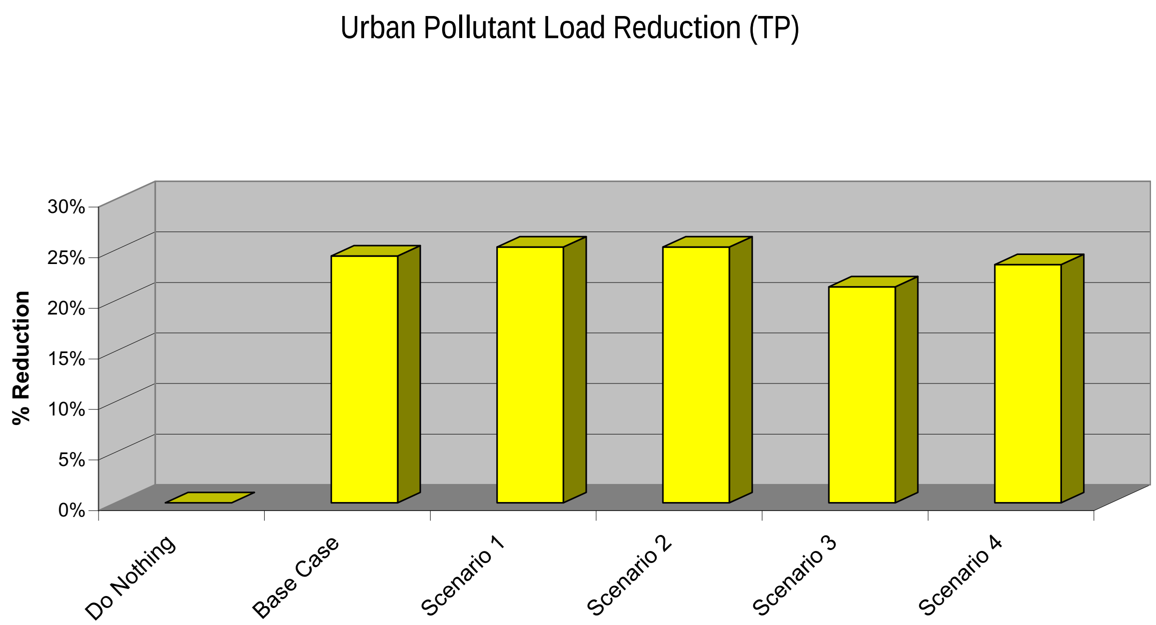
The five IWCM scenarios developed include a *Base Case* representing a traditional approach of undertaking separate water supply, sewerage and stormwater investigations and four scenarios of increasing levels of integration between the urban water services. The activities associated with each scenario are summarised in the following table.

Scenario	Base Case Traditional Approach	Scenario 1 Target New Development	Scenario 2 Target All Development	Scenario 3 Targeted Recycled Water	Scenario 4 Full Recycled Water
Water Source					
Off stream storage and new/upgrade WTP	√	√	√	√	√
Sewage Treatment					
Secondary (land purchase)	√	√			
Secondary + nutrient removal + disinfection			√		
Tertiary + disinfection (+ residual)				√	√
Inflow and infiltration reduction		√	√	√	√
Recycled Water					
100% Non-food crop irrigation at STP	√	√			
Dry weather non-contact irrigation/wetlands			√		
Targeted RE use and discharge				√	
Full RE use and discharge					√
Greywater					
Greywater (diversion)		√	√	√	
Greywater (new development)			√	√	
Greywater retrofit (residential development)				√	
Rainwater					
BASIX tanks (new development)	√				
Mandatory tanks (new development)		√	√	√	
Retrofit/rebate tanks (existing development)			√	√	
Stormwater					
Stormwater current initiatives	√	√	√	√	√
WSUD (new development)		√	√	√	√
WSUD (new and key existing development)			√	√	√
Conservation					
Current initiatives (incl. BASIX)	√	√	√	√	√
Improved community education		√	√	√	√
Fixture retrofits and rebates			√	√	√
Inclining block tariff			√	√	√
Leakage reduction, audits and metering		√	√	√	√
Self-sufficient new rural		√	√	√	√
Catchment					
Catchment current initiatives	√	√	√	√	√
CMA supported activities		√	√	√	√
Other catchment activities			√	√	√

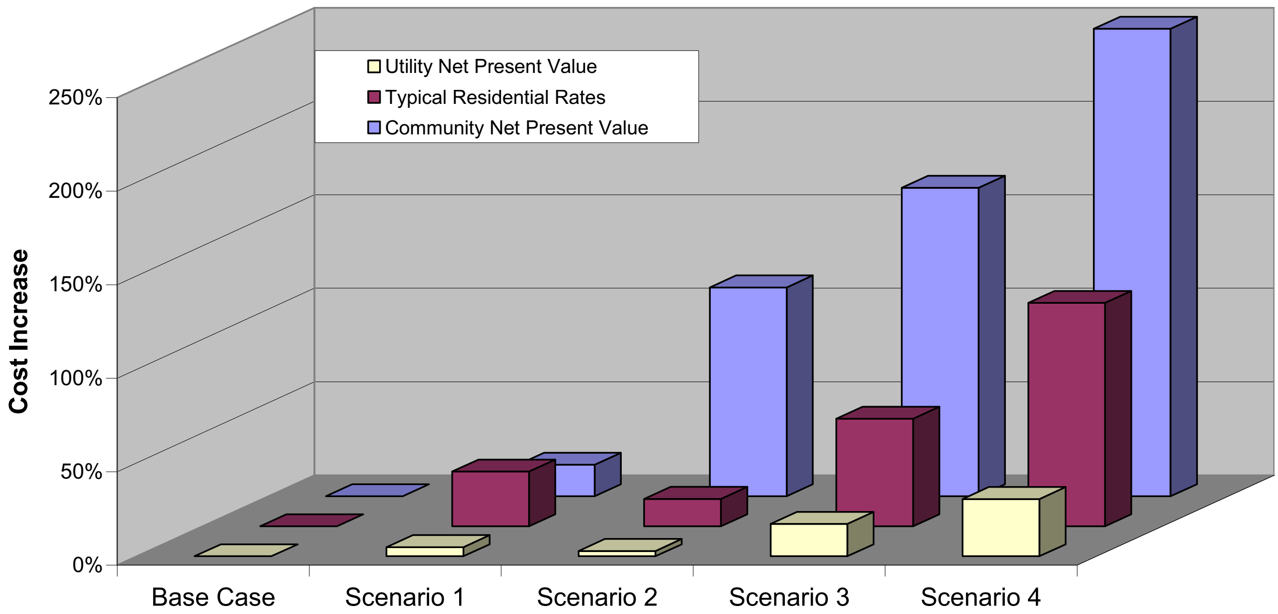
Scenario Benefits and Costs

The benefits and costs of each scenario were compared. Summary comparisons of town water supply water savings and reduction in urban pollutant loads (for total phosphorus) are provided below.





There are significant water infrastructure requirements and investment associated with all scenarios. This is reflective of the current condition and capacity of urban water facilities at Kyogle. Comparative utility (Council) and community (customer) costs, as well as indicative typical residential rates impacts are presented below.



Using the triple bottom line assessment criteria, the PRG ranked each scenario. The sensitivity of each scenario's ranking to each of the triple bottom line criteria was also tested. Results of the ranking exercise are summarised below.

Scenario	Ranking			
	Equal Weighting	High Environmental Weighting	High Social Weighting	High Economic Weighting
Do Nothing	6	6	6	5
Base Case	5	5	5	3
Scenario 1	2	3	4	2
Scenario 2	1	2	1	1
Scenario 3	4	4	3	4
Scenario 4	3	1	2	6

The PRG selected Scenario 2 as the preferred IWCM scenario.

The Preferred Scenario

The preferred scenario incorporates integrated water management practices and an overall 18% reduction target in future water usage. The water supply approach for the preferred IWCM scenario was further developed to include three sub-cases:

1. Richmond River supply at Kyogle, with an off-stream storage (485ML) sized for high environmental flow requirements and a new water treatment plant.
2. Supply transferred from Casino via a pipeline (30km) and pumping station.
3. Low cost supply approach, adopting Richmond River supply at Kyogle, with an off-stream storage (200ML) sized for the draft water sharing plan environmental flow requirements and refurbishment of the existing water treatment plant.

Also, the preferred IWCM scenario costs were reviewed and rate impacts for each case considered, with and without, external subsidies.

The preferred scenario, it's water supply sub-cases, and the process for development of the scenario were presented to an open community workshop in February 2006. This workshop was followed up with a community survey. Based primarily on community responses and the financial risks associated with the more expensive supply approaches, Council adopted the low cost water supply approach (refer to Case 3 above) in the 2006/2007 Management Plan.

The risks associated with implementation of the adopted IWCM Strategy include:

1. Integrated implementation of the IWCM activities is required. The elements of the Strategy are interdependent, require significant infrastructure investment within the next few years and early implementation of water conservation measures to achieve the targeted outcomes.
2. The low cost water supply approach is dependent on acquisition of a site for the off-stream storage and confirmation of the draft water sharing plan cease to pump rules for storage sizing.
3. The adopted low cost water supply approach is dependent on the existing water treatment plant being refurbished to an adequate state to provide safe and adequate treatment of stored river water for drinking purposes, and the capability to meet future peak demands (in combination with the supply system). These aspects are to be considered during concept design.
4. Sewage treatment process upgrade. To avoid any sewage treatment plant licensing issues, continuing development of the treatment process design, in consultation with the DEC, is proposed.

Addressing the Issues

The Kyogle IWCM Strategy Plan responds to the issues raised in the IWCM Concept Study and by stakeholders during the project. The Strategy compliments regional programs, in particular, the Northern Rivers Catchment Action Plan. A summary of how these issues are to be addressed is set out in the following table.

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
Catchment	Agricultural extractions: • during low flow periods, river extractions can exceed the total river flows • fluctuations in agricultural demand may impact on the preferred water cycle management strategy • impacts downstream users, including town water supply.	The Strategy supports the Northern Rivers Catchment Management Authority's (NRCMA) Catchment Action Plan (CAP) which includes initiatives for: • stream rehabilitation and protection • community education • legislative change to prevent water pollution • development of water sharing plans. Future town water extractions and water supply infrastructure based on macro water plan requirements (refer to *Lack of Town Water Supply Security* below).
	Poor river water quality: • reduces the usability of the river water • algal blooms (potential health issues) • impacts on town water supply • reduces ecological diversity of river system.	The Strategy supports the CAP (refer to *Agricultural Extractions* above). The Strategy also includes: • improved sewage treatment • inflow and infiltration reduction • WSUD in new development and at key existing developments • improved community education.
	Dryland salinity in upper catchment areas: • reduces downstream water quality • decreases productivity of land • reduces ecological diversity.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Soil erosion: • reduces downstream water quality • decreases productivity of land.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	River bank erosion: • reduces river water quality • reduces ecological diversity of river bank and river system.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Deforestation and monodiversity: • reduces river water quality • reduces ecological diversity	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Climate change and greenhouse gases: • may impact availability of water resources • potentially exacerbates issues such as soil erosion and dry land salinity. • potentially impacts stormwater quantity and quality.	The Strategy supports the CAP (see *Agricultural Extractions* above). The Strategy also includes: • increased water storage • diversified water sources (rainwater, greywater & stormwater) • reduced energy consumption through improved equipment efficiencies • demand management which is expected to allow Kyogle to cater for future growth without increasing average water consumption • WSUD practices and rainwater tanks for reduced peak flow and pollutant runoff • improved quantity and quality monitoring.

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
	Ecological health of water ways: • threatened species may potentially be impacted by activities in the catchment • changes to Kyogle's water cycle infrastructure (eg the weir) could impact on the rivers environmental flows and fish migration patterns.	The Strategy supports the CAP (see *Agricultural Extractions* above). Environmental flows are to be maintained in accordance with the Surface Water Sharing Plan.
	Increased numbers in small landholders dams: • potential to alter stream flows.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Thought to be a large number of unregistered bores: • difficult to quantify and regulate groundwater extraction • aquifer at "high" risk.	The Strategy supports the CAP (see *Agricultural Extractions* above). The DNR continues to regulate groundwater extractions. Additional information for IWCM Strategy is anticipated at the 5 year review. The Strategy does not rely on aquifer water sources directly (bores maybe used during drought periods).
Kyogle Water Supply Issues	Poor condition of water treatment plant: • increased OH&S risks • reduced reliability and performance	The WTP is to be refurbished.
	Lack of town water supply security: • social and economic ramifications eg water restrictions • potential storage options may have environmental impacts including: altered stream flows; altered catchment ecology and reduced flood impacts • potential source replacements may reduce river extraction however may also not be socially acceptable.	The Strategy addresses future supply security through: • demand management program including conservation and source substitution • diversification of water sources (rainwater, greywater & stormwater) • provision of off-stream storage with river extractions in accordance with the Surface Water Sharing Plan The Strategy was developed through a consultative process with key stakeholders and community.
	Variable poor raw water quality: • impacts on water treatment processes.	Provision of the off-stream storage will change raw water quality characteristics. The WTP and off-stream storage concept design will consider operational protocols for management of the stored raw water quality. The WTP will be refurbished to enable delivery of treated water to drinking water standards.
	Water filter backwash to river: • filter backwash increases pollutant loads in receiving creek and river.	The WTP refurbishment will include suitable filter backwash treatment and/or recycling.
Kyogle Sewerage Issues	Sewerage treatment plant capacity and performance: • higher than ideal hydraulic loads cause short circuits in the treatment process which in turn reduces the receiving water quality • ageing infrastructure also reduces the effluent quality.	The Strategy includes improvement of sewage treatment processes and infrastructure.
	DEC (EPA) Pollution Reduction Program: • aims to improve water quality and increase effluent reuse • requires Council's attention.	The Strategy includes improvement of sewage treatment processes and infrastructure to meet sensitive water quality standards. The Council will continue to liaise with DEC to develop the concept design.

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
	Contribution STP has on Richmond River during low flows: • increased recycling of effluent may cause changes to the extraction/effluent release ratio in the Richmond River • relative nutrient loads on river are increased during low flow periods.	The Strategy includes improvement of sewage treatment processes and infrastructure. All low sewage flow will receive improved treatment. Council controlled reuse.
	Sewerage reticulation infiltration and storm inflow: • causes large peaks in flows during storm events, which in turn results in poor effluent quality and potential system surcharges.	Inflow and infiltration rehabilitation works will continue. Adoption of *smart sewers* in new development areas. Future sewage dry weather flows are anticipated to decrease through indoor conservation efforts and greywater reuse.
	On-site sewerage treatment systems: • potential impact on receiving water quality • some on-site systems within the town service area with potential water quality and health issues.	Connection of urban on-site systems to the wastewater reticulation system. Continued implementation of the *On-site Sewage and Wastewater Management Strategy* (2000). Provision of septage receival and treatment facilities at the STP.
Kyogle Stormwater Issues	Stormwater system hydraulic bottlenecks: • potential flood issues in commercial district.	The Strategy includes flood mitigation works and provision for long term stormwater system operation and maintenance,
	Stormwater quality impacts: • receiving waters can be adversely impacted by poor stormwater quality • lack of formal stormwater litter, sedimentation and erosion control measures.	WSUD in new and key development areas, community education and the provision of improved stormwater system infrastructure (including gross pollutant traps and kerb and guttering) are anticipated to improve stormwater runoff quality.
	Some stormwater discharges to private property: • may impact land holder.	Council to address on a case by case basis.

The Next Steps

The recommended IWCM Strategy provides the framework for the sustainable management of Kyogle's urban water services into the future. For successful implementation, it requires on-going support by Council, the community and relevant government agencies. The actions required to implement the plan are set out in this document and are summarised in the following table.

Kyogle IWCM Strategy Action Plan		
Description	**Further Actions**	**Timetable**
Water Source		
Off stream storage and upgrade WTP (low cost option requiring restricted demand)	Further development of this concept required to determine site for off-stream storage and allow for design and construction works.	Investigation works to commence in July 2006 with funds allocated in the 2008/2009 financial year for construction works.
	Water Treatment Plant backwash water discharge to be addressed as a matter of priority. Treatment concept to be developed to allow for construction.	Investigation works to commence in July 2006 with funds allocated in the 2006/2007 financial year for construction works.
	Drought Management Plan to be reviewed particularly with respect to triggers for imposing of water restrictions. Level 1 Water Restrictions are expected to be permanently imposed.	Drought Management Plan to be reviewed after completion of off-stream storage concept development. May also need to review again following assessment of the WTP refurbishment and peak capacity.
	Investigation of existing Water Treatment Plant to assess the possible peak capacity of the plant and identify works required for refurbishment and improvements.	Investigation works to commence in December 2006 with funds allocated in the 2010/2011 financial year for construction works.
Sewage Treatment		
Secondary + nutrient removal + disinfection	Concept to be developed to detailed design stage to allow construction as soon as possible. Council to liaise closely with the DEC to develop concept to the point where detailed design can commence. Project Specific Reference Group to be formed.	Concept development to commence July 2006 with funds allocated in the 2006/2007 financial year for construction works. Project Specific Reference Group to be formed in July 2006 with the first workshop on August 31, 2006.
Inflow and infiltration reduction	Ongoing program of rehabilitation works and internal plumbing repairs based on detailed CCTV and smoke testing results.	Funds allocated on an annual basis commencing 2004/05. Budget allocations removed from the 2006/2007 and 2007/2008 financial years due to lack of state government subsidy for the upgrade works at the Kyogle STP, program to recommence in 2008/2009.
On-site systems	Connection of remaining township residential properties to the sewer system.	2007 to 2009.
Recycled Water		
Dry weather non-contact irrigation/wetlands	Included as part of the "Sewage Treatment - Secondary + nutrient removal + disinfection" component above.	

Kyogle IWCM Strategy Action Plan		
Description	**Further Actions**	**Timetable**
Greywater		
Greywater (diversion)	Review of NSW Health guidelines and Council policies to be undertaken to determine system standards and approvals process.	Consultation with Council's Planning Department to commence July 2006.
Greywater (new development)	Development Control Plan and/or conditions of development consent to be reviewed to cover greywater systems on new development.	Consultation with Council's Planning Department to commence July 2006.
Rainwater		
Mandatory tanks (new development)	Development Control Plan and/or conditions of development consent to be reviewed to require rainwater tanks as well as compliance with BASIX.	Consultation with Councils Planning Department to commence July 2006.
Retrofit/rebate tanks (existing development)	Detailed rebate program to be established.	Rebate program development to commence July 2006 with funds allocated in the 2006/2007 financial year towards rebate payments.
Stormwater		
Stormwater current initiatives	Stormwater revenue stream to be established to help fund both current and proposed initiatives.	New Stormwater and Flood Mitigation charge of $25 per developed property in each of the villages implemented in the 2006/2007 Management Plan.
WSUD (new development)	Development Control Plan and/or conditions of development to be reviewed to ensure Water Sensitive Urban Design principles are followed for new developments and redevelopments.	Consultation with Council's Planning Department to commence July 2006.
WSUD (new and key existing development)	As above, and investigation works required in each village to identify key stormwater improvement projects and formulate a program of works.	Council to engage a consultant by December 2006.
	Council to review revenue stream to source funding levels required to provide desired levels of service.	Options to be reviewed during 2006/2007 to enable increased charges to be imposed in the 2007/2008 financial year.
Conservation		
Current initiatives (incl. BASIX)	Continue current conservation activities.	2006/2007 and ongoing.
Improved community education	Community education program to be developed in conjunction with rebate program, and to incorporate items such as greywater recycling and water sensitive urban design.	Program and associated information to be developed as part of the implementation of the rebate program in 2006/2007.

Kyogle IWCM Strategy Action Plan		
Description	Further Actions	Timetable
Fixture retrofits and rebates	Detailed rebate program to be established. Including plumbing contracts, marketing materials, quality assurance and reporting procedures.	Rebate program development to commence July 2006 with funds allocated in the 2006/2007 financial year towards rebate payments.
Inclining block tariff	On-going revenue modelling to set adjustments to fixed and variable charges. Revenue Policy to be amended to reflect new water consumption charges.	New charges adopted in the 2006/2007 Management Plan. New charges to be implemented in the first billing period of the 2006/2007 financial year.
Leakage reduction, audits and metering	Identification and metering of un-metered connections.	2006/2007 and ongoing.
	Active participation in the Water Directorate's state-wide Water Loss Program.	2007/2008.
	Audits of high water users on a voluntary basis	2006/2007 and ongoing.
Self-sufficient new rural development	Development Control Plan and/or conditions of development to be reviewed to ensure all new rural development is self sufficient in water and sewerage services.	Consultation with Councils Planning Department to commence July 2006.
	Development Control Plan and/or conditions of development to be reviewed to ensure Water Sensitive Urban Design principles are followed for new developments and redevelopments.	Consultation with Councils Planning Department to commence July 2006.
Monitoring and Review		
Water Quality Monitoring	Continuation of current water quality monitoring program (refer to Appendix J).	2006/2007 and ongoing.
	Development and implementation of revised water quality monitoring program for the Kyogle STP augmentation works.	To be developed as part of the pre-construction activities associated with the Kyogle STP augmentation.
	Involvement in regionally co-ordinated water quality monitoring programs such as the NRCMA Northern Rivers Ecosystem Health Monitoring program and NSW health programs such as pesticide monitoring programs.	2006/2007 and ongoing.
Water Quantity Metering	Continuation of current monitoring program including sectoral consumption records.	2006/2007 and ongoing.

Kyogle IWCM Strategy Action Plan		
Description	Further Actions	Timetable
	Installation of backwash metering at the WTP.	2006/2007
	Maintenance and regular calibration of all existing meters, flow measuring devices and telemetry data recording.	2006/2007 and ongoing.
Integrated Water Cycle Management	Review of the Kyogle IWCM Strategy.	2011/2012
	Consolidation of other village IWCM strategies and long term strategies to allow one IWCM strategy to cover all serviced villages.	2011/2012
Administration	Review of water billing system data to better reflect water and sewerage customer categories	2006/2007
	Review of Developer Contributions for Water, Sewer and Stormwater and Flood Mitigation.	To commence in August 2006 with a view to revised charges being adopted for the 2007/2008 financial year.
	Review of current Water Supply and Sewerage Services Strategic Business Plans to reflect IWCM Strategy outcomes and revision of levels of service.	To commence in August 2006 with a view to revised charges being adopted for the 2007/2008 financial year.

1. Introduction

Kyogle Council, in conjunction with the Department of Energy, Utilities and Sustainability (DEUS) has initiated the preparation of an Integrated Water Cycle Management (IWCM) Strategy Study. The study will aid in the identification and development of management strategies for urban water cycle planning.

This report documents the second stage of the IWCM process, namely the IWCM Strategy. This stage involves development of the IWCM Strategy Plan and includes assessment of integrated water supply, wastewater and stormwater options to address issues identified in the *Kyogle Integrated Water Cycle Management Concept Study* (MEU, 2003). Water supply demand management measures such as low flow fixtures, pricing and rebate programs, and alternative water supply sources and water reuse options will be considered. Comparison of the options will involve consideration of integrated urban water services that align with the broader catchment, as well as social, economic and environmental factors.

1.1 IWCM Plan and Objectives

IWCM is a new best practice approach to water utility strategic planning. It is a requirement of DEUS's *Best Practice Management of Water Supply and Sewerage Guidelines* (2004) and forms part of a range of initiatives by the NSW Government to improve water management.

IWCM is a way of integrating the three urban water services of water supply, sewerage and stormwater to ensure water is utilised optimally, now and in the future. It does this by considering potential savings across the urban water services. IWCM also looks at integrating the provision of urban water services with the management of the water supply catchment and water resources.

An IWCM plan considers issues such as:

- future town water and service needs
- the availability of water including rainwater, effluent and stormwater
- other water users including the environment and future generations.

To identify the issues that require management, the IWCM approach involves community, government regulators and water utility input. Once water cycle issues have been identified, strategies to manage them can be developed. There are often many different ways in which to manage issues. To identify the most appropriate solutions for local circumstances, the IWCM approach involves undertaking a triple bottom line (economic, environmental and social) assessment of the strategies developed.

IWCM is important because it helps to:

1. Balance the needs of water users including towns and the environment (a whole of water cycle approach).
2. Reduce the pressure on water resources by ensuring a wide range of water sources including rainwater, stormwater and treated effluent are considered.
3. Ensure that the measures for supplying urban water services into the future are put in place.
4. Integrate catchment management and urban water service provision.
5. Make sure that local communities can participate in the planning and delivery of urban water services.

When complete, the Kyogle strategic plan will contain:

1. A summary of the water cycle management problems facing Kyogle.
2. Five scenarios illustrating the possible ways that the urban water services of Kyogle can be provided in the future.
3. An economic, environmental and social assessment of the costs and benefits of each of these five scenarios.
4. A capital works plan for implementing each of the possible scenarios.
5. Estimates of the impact of each scenario on the typical water and sewerage bills paid by Kyogle customers.
6. The technical engineering reports utilised in developing the five scenarios.

The process taken to develop the IWCM Strategy will include:

1. Consideration of the IWCM Concept Study findings and baseline forecasts.
2. Development of the long list of options and assessment criteria for decision making.
3. Selection and short list of options for further assessment.
4. Detailed options assessment and development of IWCM scenarios.
5. Identification of the preferred scenario.

The objective of this project is to develop an IWCM Strategy Plan to help the Kyogle community and Council address their immediate urban water challenges and to decide how their urban water services will be sustainably provided in the future.

1.2 IWCM Process

DEUS's *Best Practice Management of Water Supply and Sewerage Guidelines* (2004) sets out a two step process for developing an IWCM Plan:

1. A concept study: a scoping study to provide the context for urban water services and identify urban water cycle issues.
2. A strategy plan: to develop a balanced long-term planning strategy to address urban water cycle needs.

The IWCM framework seeks answers to:

1. What is the problem?
2. How do we fix the problem?
3. How do we know the problem is fixed?

and forms a framework for future strategies to monitor and revise the IWCM Strategy (Figure 1-1).

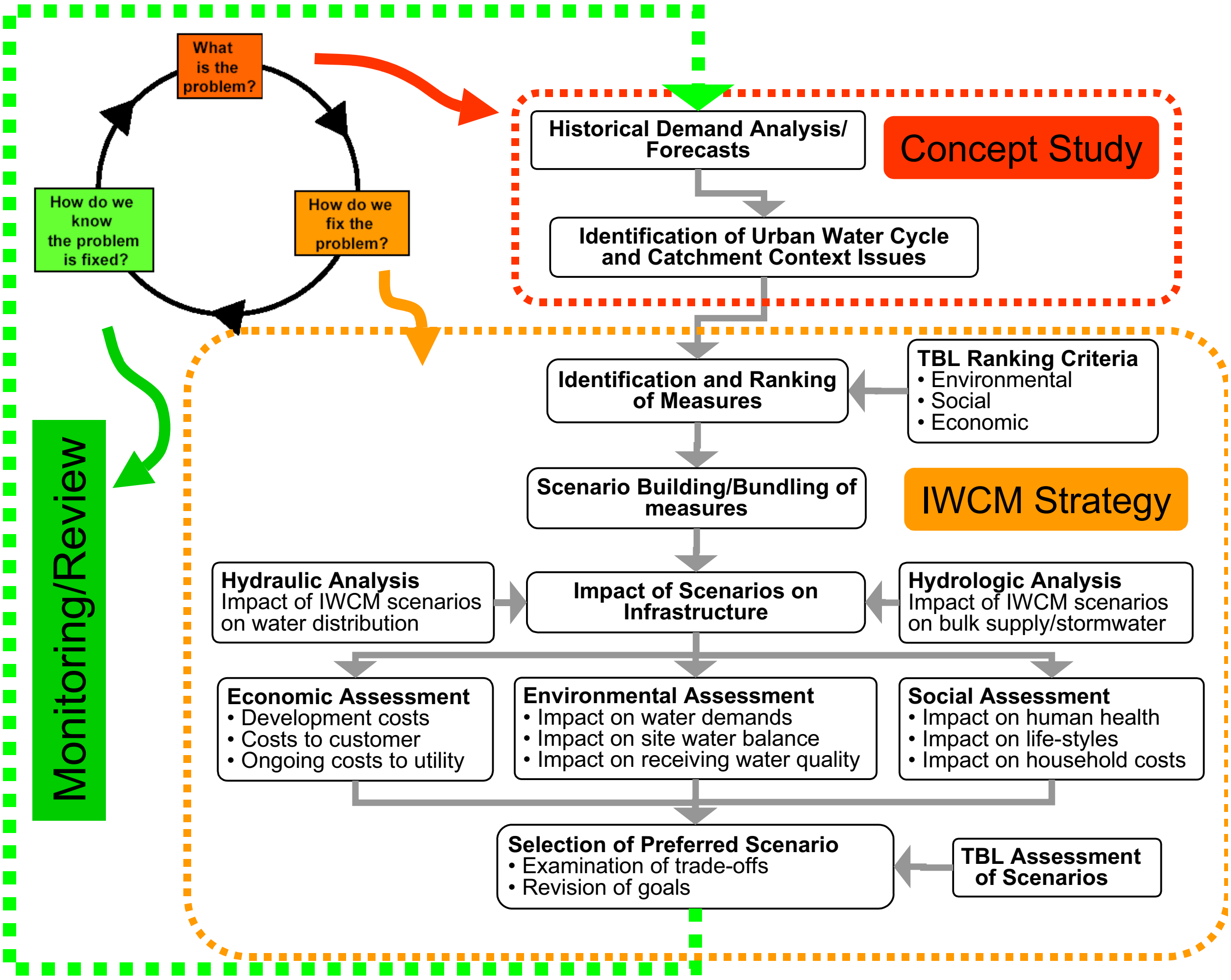


Figure 1-1: The Integrated Urban Water Management Planning Process

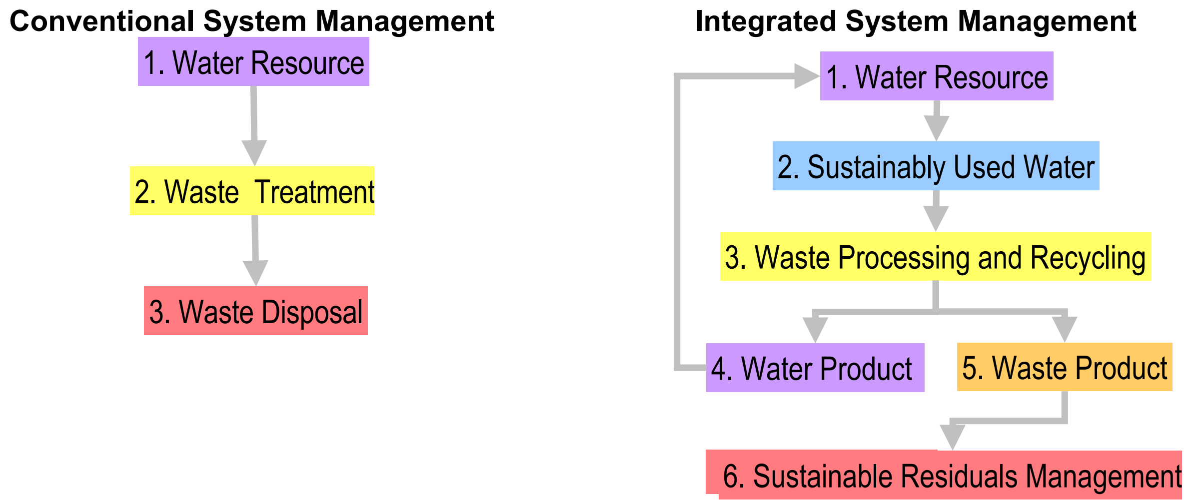
It is anticipated that implementation phases of the preferred options will follow on from the strategic level IWCM study, including concept design, project approvals, construction and operation.

Integrated water cycle management offers the opportunity to examine urban water supply, wastewater and stormwater management in a single planning framework in a whole of catchment context. This opportunity is possible through recent advances in information management and analysis, and seeks to avoid the piecemeal development of water supply, wastewater and urban stormwater facilities which has occurred in the past.

Conventional water system management, where each element of the water cycle is treated sequentially, has provided us many important benefits. It has provided secure sources of clean water for drinking and use in industry and commerce, as well as treating our waste streams to minimise the impacts on the environment. With increasing population growth and its accompanying urban footprint we are increasingly becoming aware that conventional water system management does not facilitate consideration of the "big picture". The current system generally uses water only once, or not at all in the case of stormwater running off impervious surfaces.

Considering all water sources and uses in a single framework creates opportunities for increasing the efficiency of water use and improving management of the water cycle. By examining integrated options for management of the water cycle, we maximise the opportunity of discovering new ways of doing things as well as making ourselves aware of the interactions and synergies in all parts of water cycle management.

It is also becoming apparent that the current and increasing levels of natural resource use, including water and land uses, are not sustainable. The integrated approach to water management seeks to balance the competing demands on the available resources within catchments to develop a strategy to ensure a sustainable water future. It will encourage the following shift in system management:



- Sequential management of individual water system components
- Limited consideration of 'big picture' and resource utilisation impacts

Leads to unsustainable outcomes

- Integrated management of all water system components
- Full consideration of 'big picture' and resource management impacts (including triple bottom line)

Leads to more sustainable outcomes

Figure 1-2– Integrated System Management (Source DEUS, 2003)

1.3 Background

The Concept Study was completed by Kyogle Council and DEUS in June 2003. The Concept Study identified urban water cycle related problems within the Upper Richmond River catchment as well as issues directly associated with urban water cycle services. The Concept Study also identified further work to be completed prior to the initiation of the second stage of the IWCM process.

MWH Australia Pty Ltd was commissioned in July 2005 on behalf of Kyogle Council to prepare the Strategy Study. The project team for delivery of the strategy includes representatives from Kyogle Council, DEUS, Department of Commerce (DOC) and MWH. The Project Reference Group (PRG) consulted during the study includes stakeholder representatives from Council, state government agencies and community groups. The members of the PRG are tabled in Appendix A.

1.4 Study Area

Kyogle is located in Northern NSW adjacent to the Queensland border and approximately 50 kilometres inland of the coast. Kyogle's local government area (LGA) includes the upper reaches of the Clarence and Richmond Rivers. The IWCM study area is directed at the Upper Richmond River Valley as the LGA's major urban area (Kyogle Township) is situated within this valley.

Source image: Council's website (www.kyogle.nsw.gov.au)

Figure 1-3: Study Area Location

2. Urban Water Context and Issues

This section summarises Kyogle's urban water cycle services within the catchment context and related urban water cycle issues. It draws primarily on the findings of the Concept Study, with additional information representing progress since completion of the Concept Study and input from the PRG. Technical analysis using the latest available information is presented in subsequent sections.

2.1 Catchment

2.1.1 Context

Kyogle township is the major urban development within the Kyogle LGA. The township is situated on the upper Richmond River in Northern NSW. As such, the upper Richmond River catchment forms the focus of study. Approximately 6,500 people live with the study area. In recent years, Kyogle's population has been declining and future growth estimates are modest.

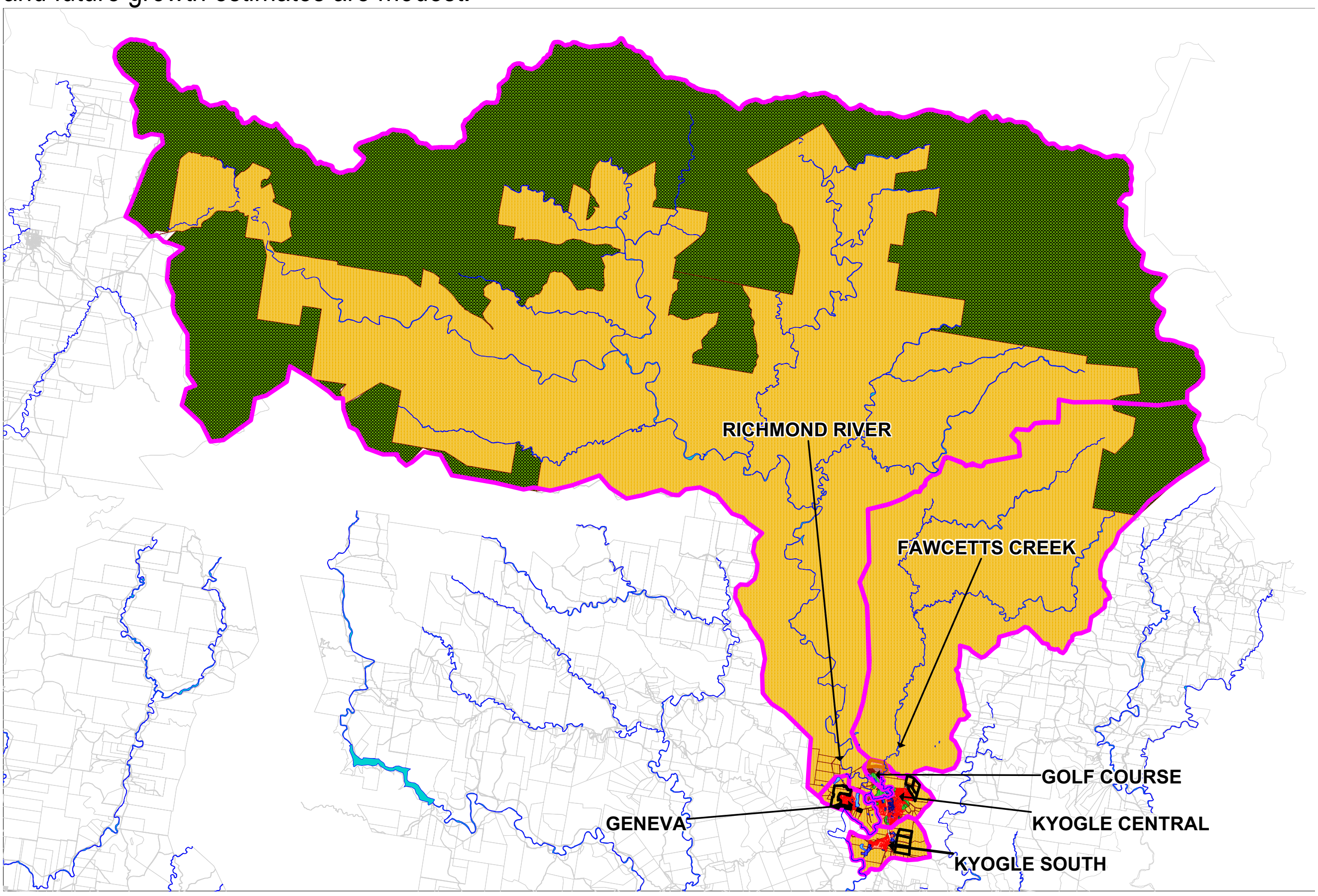


Figure 2-1: Upper Richmond River Catchment

Average temperatures vary between 27-32^{0}C in the summer and 11-16^{0}C in the winter. Rain falls typically over the summer months. The mean annual rainfall is approximately 1,200 mm and evaporation 1,500mm. Soil characteristics vary between low to high fertility and low to moderate water holding capacity.

Agriculture (beef, dairy and pigs) is the prime land use within the LGA. More than 40% of the study area catchment has been cleared for agricultural purposes. Other major industries include forestry and tourism. National Parks and State Forests make up approximately 35% of the LGA.

2.1.2 Issues

Intensive rural land usage within the upper part of the Richmond River catchment impacts water quality. The most productive land in the catchment is situated on the Richmond River alluvial soils between Kyogle and Casino. This area also has the highest demand for water for both urban and agricultural activities. The annual flow in the Richmond River generally exceeds the extractive demands, however the agricultural demand peak is between the months of August to November and for these months extractive demand exceeds the average flow.

Soils in the upper parts of the catchment are prone to erosion, especially gully erosion. Large sections of riverbank vegetation have been removed allowing cattle access to the river, resulting in erosion of the riverbanks under medium to high flows. The previous Northern Rivers Catchment Management Board's Catchment Blueprint has identified the Kyogle Area sub-catchment as a priority for revegetation.

Areas of dryland salinity occur in the upper sub-catchment, above Kyogle and in southern sub-catchments of the Richmond River.

The PRG also noted the following catchment issues:

1. Changes in irrigation practices may have influenced recent extractions:[1]
   - the closure of irrigated dairy farms may have reduced irrigation use
   - conversion of forest to plantation timber may increase extractions and runoff rates
   - with increasing beef prices, irrigation may have increased again
   - there has been little irrigation in the last four years due to water shortages.
2. DPI Fisheries concerns in the Upper Richmond include threatened species; weirs and barriers to fish migration; and, environmental flows.
3. Small holdings in the catchment increase the numbers of dams on creeks and gullies and may reduce water runoff to streams. Although some of these dams are not used and may increase dry weather low flows through dam seepage.[1]

[1] Anecdotal evidence.

2.2 Resources

2.2.1 Context

The primary water source within the study area is the Richmond River with an average annual flow of 508GL (MEU, 2003). The river's low flow condition is estimated at approximately 30GL/a (MEU, 2003). Irrigation and town water extraction requirements in the upper Richmond River are approximately 13GL/a (MEU, 2003). There are high levels of groundwater use within the catchment, however actual extraction is difficult to determine. It is thought that a large number of unregistered bores exist within the Richmond River catchment and the aquifer is assessed at 'high' risk.

2.2.2 Issues

Water quality in the Richmond River catchment fails consistently for aquatic ecosystem protection, drinking water and primary recreation. These failures are generally based on the following water quality parameters not meeting the environmental objectives:

- total phosphorus
- turbidity
- faecal coliforms
- salinity.

Algal blooms have been reported in the Kyogle weir pool used as the off-take point for the town water supply.

The PRG also noted the following resource issues:

1. The Toonumbar Dam water storage, a potential alternative source of supply, has poor water quality and questionable reliability during dry weather.
2. Climate change may result in potentially higher temperatures, lower rainfall and more severe wet and drought cycles.

2.3 Urban

2.3.1 Context

The existing water supply system serves approximately 3,000 people located in the Kyogle township area. Raw water is sourced from the Richmond River at a small on-stream weir (20ML). Raw water pumps deliver water the water filtration plant (WTP) for treatment. The WTP has two treatment trains:

1. Original plant (c1933) – rectangular horizontal flow sedimentation tank and three rapid gravity sand filters (1.5ML/d capacity).
2. Newer plant (c1950s) – radial flow flocculation tank/clarifier and eight in-ground pressure sand filters (1.5ML/d capacity).

The treated water gravitates to a clear water tank before pumped delivery to the water supply system. Treated water is stored at three service reservoirs and distributed via a pipe network throughout the township (Figure 2-2).

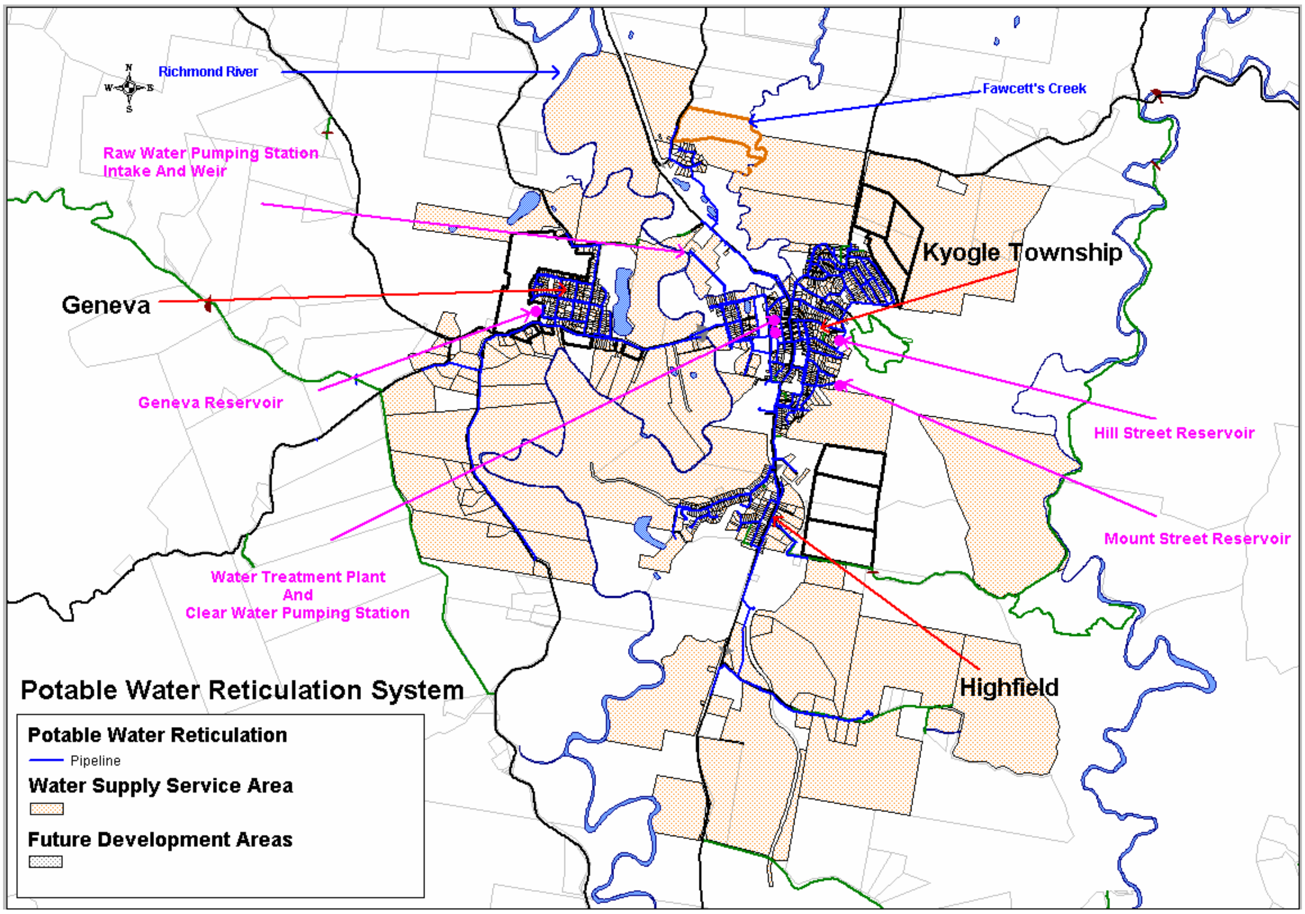


Figure 2-2: Town Water Supply System

Reticulated wastewater services are provided to the Kyogle township area (Figure 2-3). A network of reticulation mains and seven sewage pumping stations deliver wastewater to the sewage treatment plant (STP). The STP treats the sewage prior to discharge to the Richmond River via a privately owned agricultural dam. Wastewater treatment consists of the following stages:

1. Screening.
2. Imhoff tank.
3. Primary sedimentation.
4. Trickling filters with humus tank.
5. Chemical phosphorus removal (liquid alum).
6. Effluent ponds.
7. Constructed wetland.

A portion of the effluent in the privately owned dam is used to irrigate grazing pasture and crops. Sludge treatment includes digestion and drying at on-site drying beds. Dried sludge is disposed of on-site. A sludge lagoon is used to capture the alum/phosphorus sludge following treatment, with drying and disposal on-site.

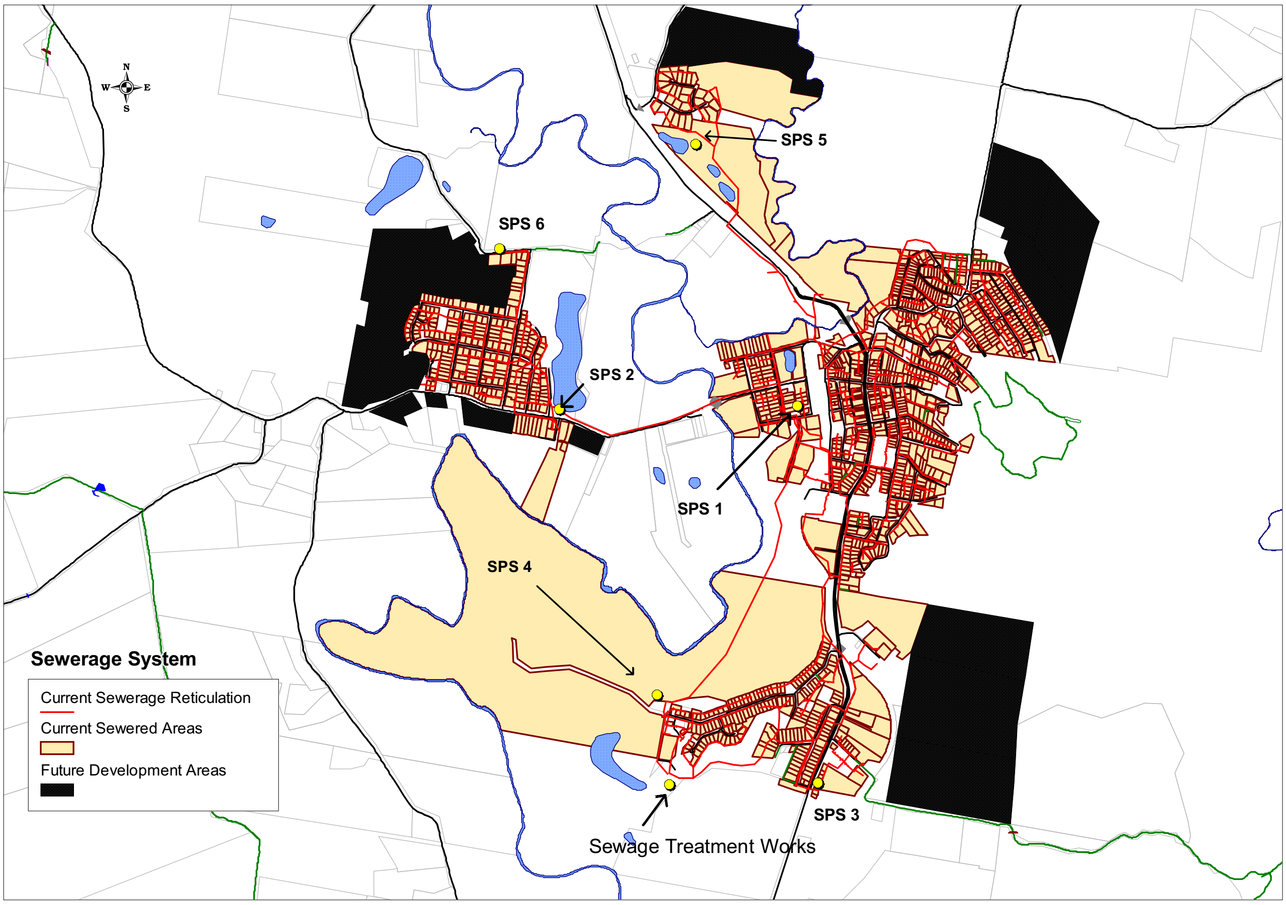


Figure 2-3: Sewerage System

Kyogle's urban stormwater drainage network consists of a number of catchments from which overland flow paths transport stormwater runoff to either shallow grassed or earth channels and the engineered drainage system comprising of concrete kerb and gutters, drainage pipes and open drainage channels (Figure 2-4). Stormwater drainage discharges to either the Richmond River or Fawcetts Creek (tributary of the Richmond River). An Urban Stormwater Management Strategy has been developed (David Ardill & Associates, 2002) which identifies a range of preferred stormwater management activities for the township.

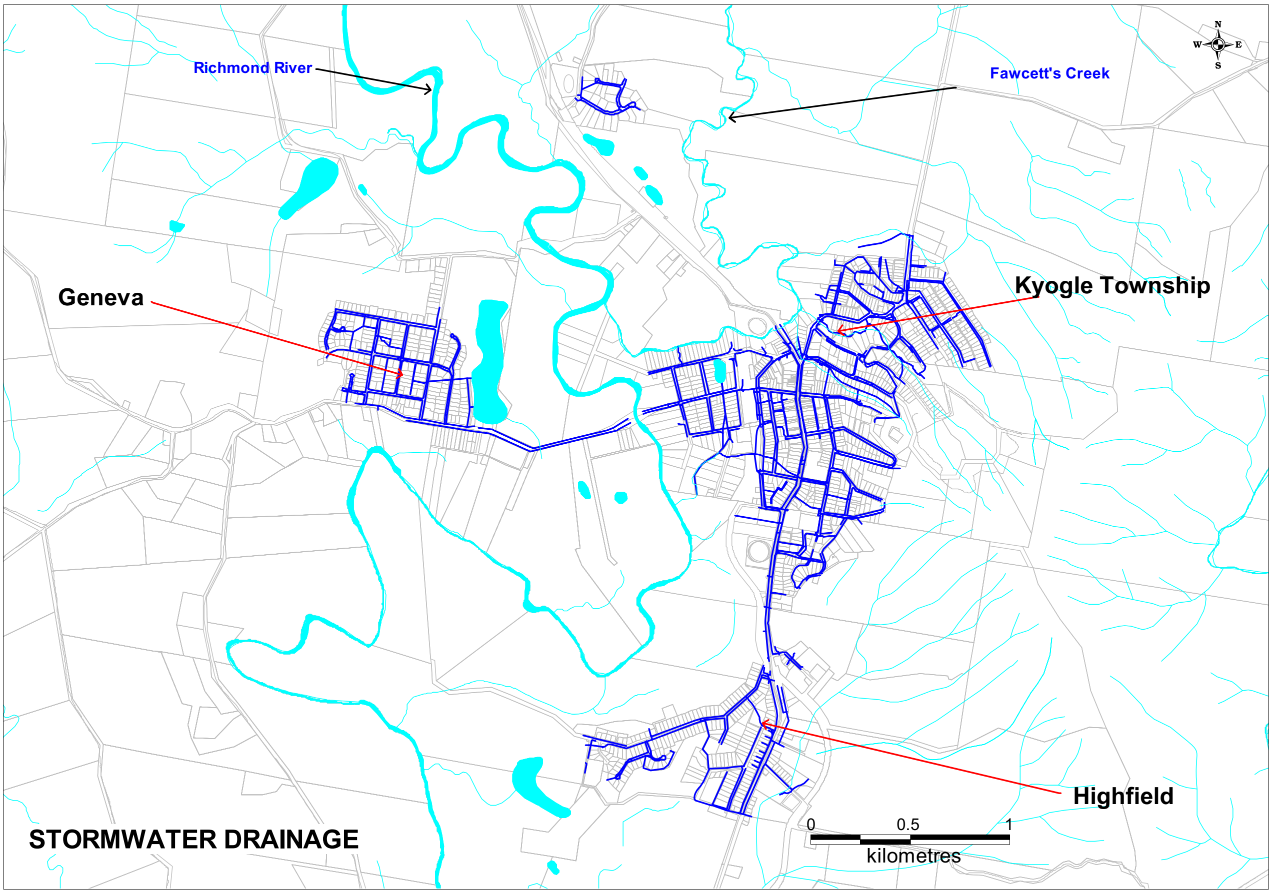


Figure 2-4: Town Stormwater System

2.3.2 Issues

Kyogle has aging urban infrastructure and as a result is experiencing service problems with both the water supply and sewerage systems. These problems include:

- lack of secure (safe yield) town water supply
- variable raw water quality impacting on water treatment processes
- aging water supply infrastructure with identified structural problems
- aging sewerage infrastructure producing poor quality effluent, which impacts on receiving water quality under low flows
- variable demand for water
- discharge of water filter backwash to the river
- high level of stormwater infiltration into sewer
- structural stormwater management only.

Significant periods of enforced water supply restrictions have occurred (refer to Section 3.3.1). Also, the stormwater system includes areas prone to flooding and issues associated with urban pollutants and erosion.

The PRG also noted the following urban water issues:

1. Level 1 Restrictions may initially increase water consumption as consumers prepare for the restrictions.[2]
2. Volumetric charges have significantly reduced water consumption, however this impacted Council revenue in 2002.
3. There are several properties with on-site wastewater treatment systems within the township.
4. The process for septage treatment and disposal is inadequately defined (includes cost recovery) with potential impact to the catchment.
5. There is an increasing awareness of water management issues within the community, for example, shopkeepers are no longer daily washing down footpaths and the community should be commended for changing water use patterns and saving water.[2]

2.4 Summary of Issues

A summary of the key issues related to the urban water cycle is presented in Table 2-1. For further details refer to the Concept Study and PRG Workshop 1 Meeting Notes (Appendix A).

Table 2-1: Summary of Issues

Context	Issue	Possible Impacts
Catchment	Agricultural extractions	• During low flow periods, river extractions can exceed the total river flows • Fluctuations in agricultural demand may impact on the preferred water cycle management strategy • Impacts downstream users, including town water supply
	Poor river water quality, including faecal coliforms, total phosphorus, turbidity and salinity. Consistently fails requirements for aquatic ecosystem protection, drinking water and primary recreation.	• Reduces the usability of the river water • Algal blooms (potential health issues) • Impacts on town water supply • Reduces ecological diversity of river system
	Dryland salinity in upper catchment areas	• Reduces downstream water quality • Decreases productivity of land • Reduces ecological diversity
	Soil erosion	• Reduces downstream water quality • Decreases productivity of land
	River bank erosion	• Reduces river water quality • Reduces ecological diversity of river bank and river system
	Deforestation and monodiversity	• Reduces river water quality • Reduces ecological diversity
	Climate change and greenhouse gases	• May impact availability of water resources • Potentially exacerbates issues such as soil erosion and dry land salinity • Potentially impacts stormwater quantity and quality

[2] Anecdotal evidence.

Context	Issue	Possible Impacts
	Ecological health of water ways	• Threatened species may potentially be impacted by activities in the catchment • Changes to Kyogle's water cycle infrastructure (eg the weir) could impact on the rivers environmental flows and fish migration patterns
	Increases numbers in small landholders dams	• Potential to alter stream flows
	Thought to be a large number of unregistered bores	• Difficult to quantify and regulate groundwater extraction • Aquifer at "high" risk
Kyogle Water Supply Issues	Poor condition of water treatment plant	• Increased OH&S risks • Reduced reliability and performance
	Lack of town water supply security	• Social and economic ramifications eg water restrictions • Potential storage options may have environmental impacts including: altered stream flows; altered catchment ecology and reduced flood impacts. • Potential source replacements may reduce river extraction however may also not be socially acceptable.
	Variable poor raw water quality	• Impacts on water treatment processes
	Water filter backwash to river	• Filter backwash increases pollutant loads in receiving creek and river
Kyogle Sewerage Issues	Sewerage treatment plant capacity and performance	• Higher than ideal hydraulic loads cause short circuits in the treatment process which in turn reduces the receiving water quality • Ageing infrastructure also reduces the effluent quality
	DEC (EPA) Pollution Reduction Program	• Aims to improve water quality and increase effluent reuse • Requires Council's attention
	Contribution STP has on Richmond River during low flows	• Increased recycling of effluent may cause changes to the extraction/effluent release ratio in the Richmond River • Relative nutrient loads on river are increased during low flow periods
	Sewerage reticulation infiltration and storm inflow	• Causes large peaks in flows during storm events, which in turn results in poor effluent quality and potential system surcharges
	On-site sewerage treatment systems	• Potential impact on receiving water quality • Some on-site systems within the town service area with potential water quality and health issues
Kyogle Stormwater Issues	Stormwater system hydraulic bottlenecks	• Potential flood issues in commercial district
	Stormwater quality impacts	• Receiving waters can be adversely impacted by poor stormwater quality • Lack of formal stormwater litter, sedimentation and erosion control measures
	Some stormwater discharges to private property	• May impact land holder

2.5 IWCM Potential Actions

The Concept Study identified a set of potential actions to be considered to address the water management issues including:

- development of a strategic demand management program
- STP upgrade or revised effluent management practices to reduce nutrient and faecal contaminant loads to the environment
- consideration of effluent and stormwater as alternative water sources (recycling and stormwater harvesting)
- development of a data collection and management program for water demands, sewage flows and water quality
- improved surveillance and implementation of audits for on-site systems
- consideration of rainwater tanks to supplement potable water supply for garden watering and toilet flushing
- consideration of alternative water supplies including off-stream storage, purchasing competing licences and supply from Casino
- review of Strategic Business Plans in line with NSW Performance Comparison Reporting requirements
- infiltration and exfiltration studies for sewerage system.

The ultimate viability and appropriateness of these and other options are explored as part of the development of the IWCM Strategy.

3. Baseline Demand Analysis

Baseline demand analysis establishes a robust understanding of how water is used and moves through the water cycle in Kyogle. This is required in order to develop IWCM options, forecast demands and compare the options. This section describes the process taken for development of the baseline historical demands.

3.1 Process

Improved understanding of the way water is used can be gained through assessment of historical water production and consumption data. Historical water demands are climate corrected, that is, the influence of climate is removed. The climate-corrected demand is the demand that would have occurred had average climate conditions occurred during the period in question. Understanding the influence of climate on past usage allows the hidden trends of consumption to be assessed. These trends are assessed through considering key demand drivers such as the population served with town water, residential lot size and water pricing. Also considered in the trend assessment are periods of enforced restrictions. The process taken to consider these factors in the development of water demand forecasts is as follows:

1. Assessment of the influence of climate on historical production records, including historical peak to average day demand factors.
2. Assessment of water consumption (metered accounts) by consumption category.
3. Assessment of unaccounted-for-water (the difference between production and consumption records).
4. Identification of future demand drivers, including on-going conservation measures and recent restrictions.

This baseline demand analysis information is used in Section 4 to develop an end use model for forecasting IWCM options, both now and in the future.

The process for the analysis of demands and the development of forecasts used in the study is outlined in Figure 3-1.

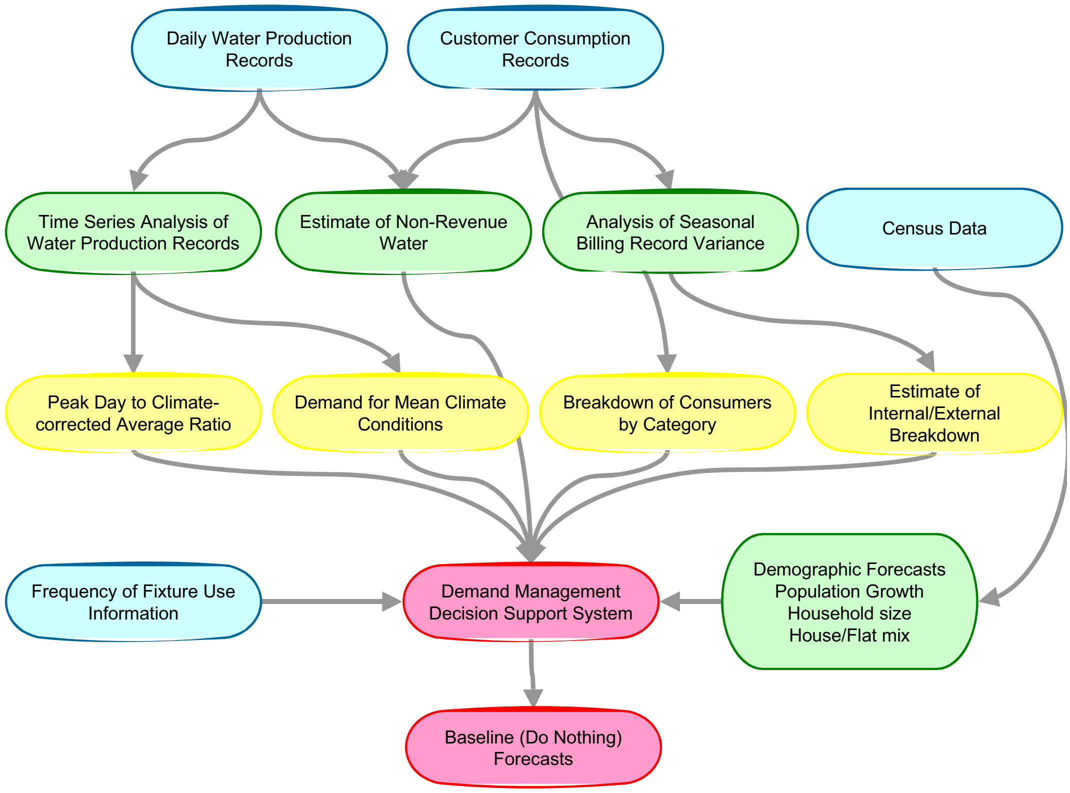


Figure 3-1: Demand Analysis and Forecasting Approach

Annual water balances for the seven catchments have also been prepared to illustrate the movement of water through the water cycle. The water balances are combined with estimates of pollutant loads, based on land use and known point sources, to provide pictures of the impacts of urbanisation. Estimation of the sewage treatment plant flows and loads, as well as on-site wastewater treatment system catchment loads add to the picture.

3.2 Demographics

Population and dwelling trends are required for assessing historical water demands and trends, necessary for the planning of IWCM strategies. Historical demographic information and historical trends are outlined below. The adopted forecasts are described in Section 4.

3.2.1 Historical Population and Previous Forecasts

Australian Bureau of Statistics census data and the *Kyogle Strategy for Closer Rural Settlement and Urban Expansion* (KSC, 2005) have been used to gain an understanding of the trends in population growth, as well household sizes. The estimated residential population[3] (ERP) for Kyogle LGA between 1999 and 2003 and the township's residential population between 1981 and 2001 are plotted on Figure 3-2. Also plotted are the following LGA growth forecasts:

1. Planning NSW (1995).
2. NSW Premiers Department Forecast (1998).

[3] ERP is based on usual residence census counts, with an allowance for net census undercount and the number of residents temporarily overseas at the census date. Adjustments are also made to take into account births, deaths and net migration.

3. DIPNR (2004).

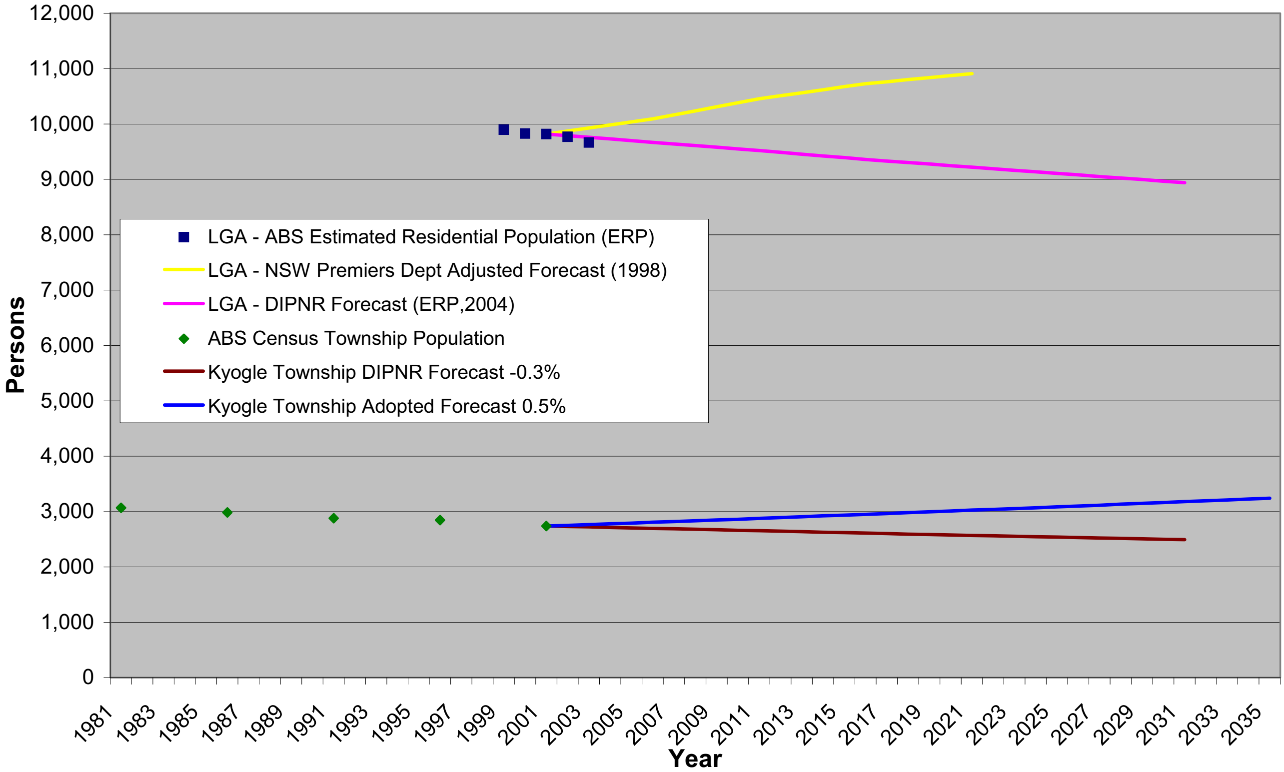


Figure 3-2: Population History and Forecasts

Population throughout the period of records has declined slightly. It is understood that the decline has occurred in both urban and rural areas (KSC, 2005). Population forecasts prior to 2004 have not been realised although there is a general anticipation that growth will occur in Kyogle, especially as the coastal areas become more populated. For the purposes of assessing the IWCM options a modest growth of 0.5% per annum has been assumed, in line with previous growth assumptions for the design of water services (DPWS, 1999). This forecast will be used to test the water supply cost and infrastructure implications of growth.

3.2.2 Resident Population Served with Water and Wastewater Facilities

The population served with reticulated water and wastewater facilities can be different to the population recognised by census collector districts (CCDs). In order to estimate the resident population served the following steps were taken:

1. GIS software (MapInfo) was used to estimate the total number of residential, rural residential and rural lots in each CCD.
2. Each CCD township population was then estimated as the proportion of the number of urban lots to total lots per CCD. Total township population 2,740 (2001 census).
3. Council rates information was used to spatially identify lots served with water and wastewater.
4. The total population served with reticulated water services was estimated as the township urban population, plus the number of rural lots served with water multiplied by the average rural occupancy rate. Total population served with water 2,880 (2001).

5. The total population served with reticulated wastewater services was estimated as the township urban population, less the number of rural lots served with water multiplied by the average rural occupancy rate. Total population served with wastewater 2,575 (2001).
6. An estimate of the ERP served with water and wastewater in 2005 was made assuming a constant proportion between the LGA ERP to water and wastewater populations served.

The net result should be a reasonable estimate of the 2005 population served with water and wastewater in Kyogle (Table 3-1).

Table 3-1: 2005 Populations

Area	2005 ERP
Kyogle Township	2,790
Population served with town water	3,145
Population served with reticulated wastewater	2,810

3.2.3 Household Size

Figure 3-3 plots historical household size for the LGA and Kyogle township. Also shown is the historical persons per account (PPA) served with town water, based on the population served with water estimates and water supply account records. An examination of trends in household size shows that the overall trend has been a negative one and is typical of most communities in Australia.

An asymptotic decrease in household size is forecast (Figure 3-3). The residential persons per account is assumed to remain in line with this trend. This forecast decline in household size will increase the dwelling formation rate above the rate of population growth.

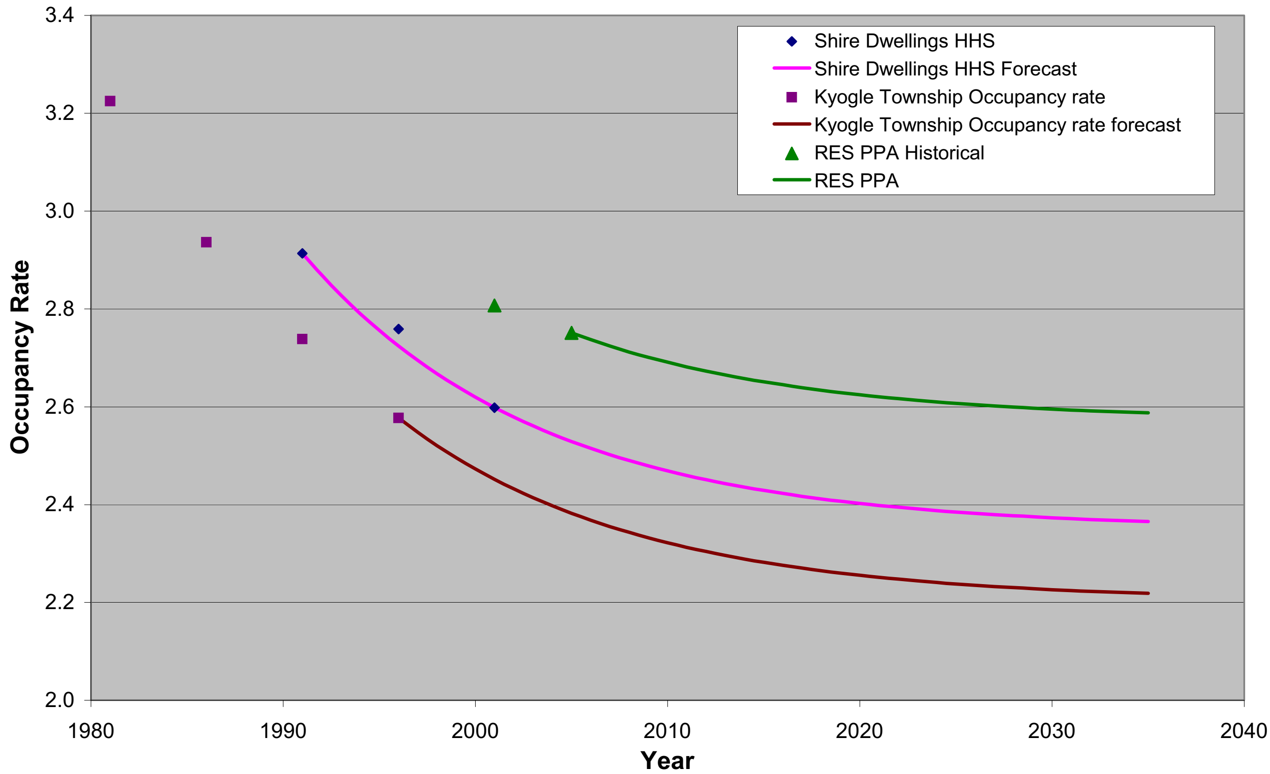


Figure 3-3: Trends in Household Size (HHS) and Persons per Account (PPA)

3.2.4 Dwelling Type Mix

2001 census data for the urban CCDs of Kyogle township, indicate that the vast majority of dwellings are single family residences with only a minor proportion of multi-family dwellings (approximately 4%).

Table 3-2: Urban Dwelling Types

Dwelling Type	Count
Separate Houses	987
Semi-detached	21
Flats	52
Other dwellings	20
Not Stated	33
Unoccupied	84
Total	**1197**

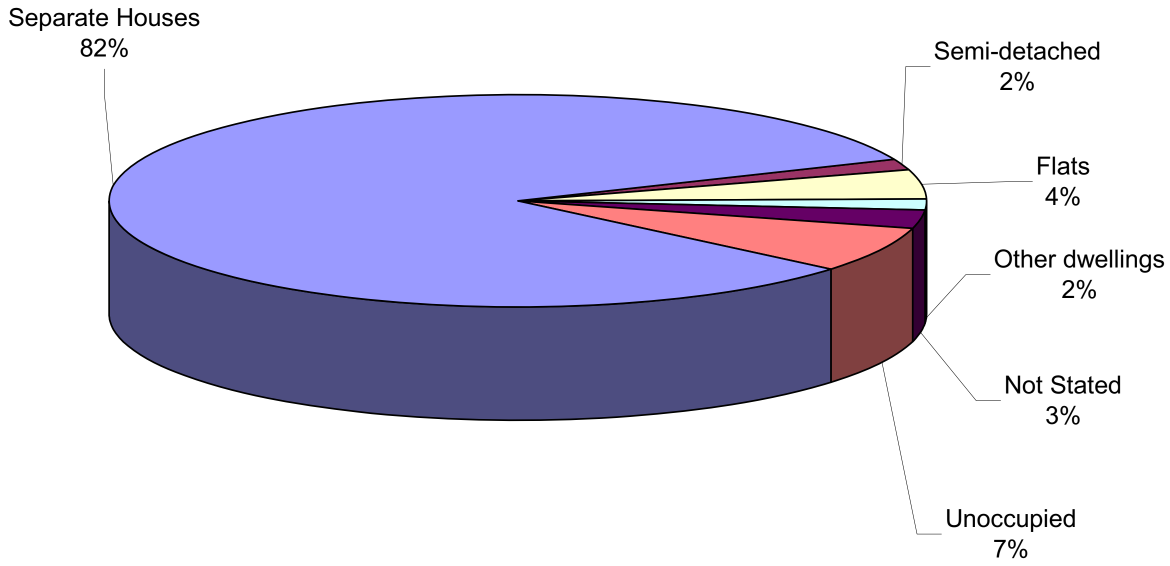


Figure 3-4: Dwelling Type Mix

3.3 Historical Demands

3.3.1 Demand Records

Analysis of the historical use of water has been made using the following metered records:

1. Bulk water supply daily production records (measured on the discharge side of the WTP clearwater tank): January 1967 to June 2005.
2. Consumption records by demand category based on account records: March 1999 to June 2005.
3. Sewage treatment works daily inflows: July 2001 to July 2005.

Council does not operate a non-potable (raw) water supply system.

Recent historical events that are anticipated to significantly impact water usage include:

1. Property metering introduced in mid 1987.
2. Introduction of volumetric water pricing in mid 1996.
3. Serious flooding occurred in February to March 2001 (two declared natural disasters).
4. Kyogle township water restrictions.

Periods and levels of water supply restrictions (post July 1999 to July 2005) are provided in Figure 3-5.

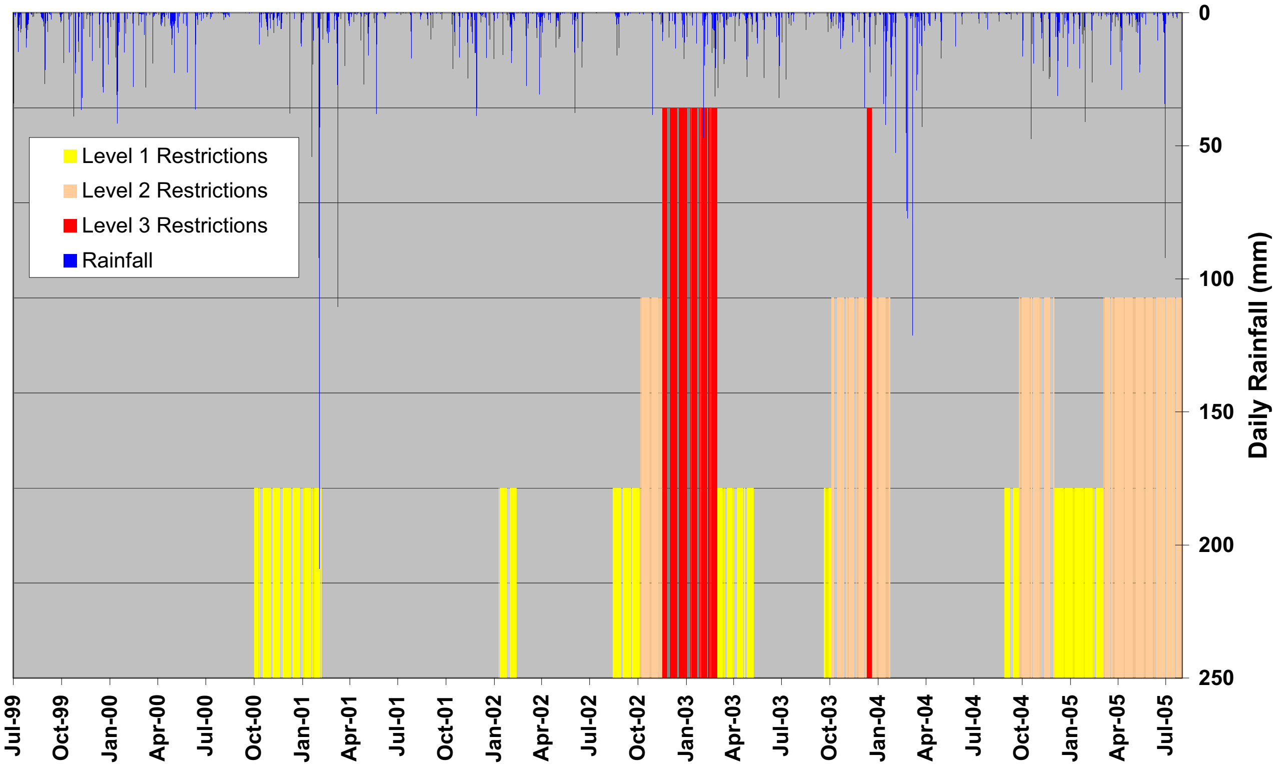


Figure 3-5: Kyogle Water Restrictions

3.3.2 Climate Information

Rainfall, temperature and evaporation are key independent climate parameters typically used in the water tracking model. These parameters are used to derive the soil moisture index, which is typically the most influential independent variable. Climate data has been sourced from the *SILO Data Drill* climate information service (http://www.bom.gov.au/silo). This service uses observed climate data from multiple stations to provide estimates of daily records at any point in Australia. Kyogle township (28 36'S 153 00'E) was selected as the location for the data drill. Whilst the SILO data provides estimates of rainfall and temperature back to 1889, the evaporation data is only available from 1970 onwards. A summary of recent climate parameters is provided in Figure 3-6.

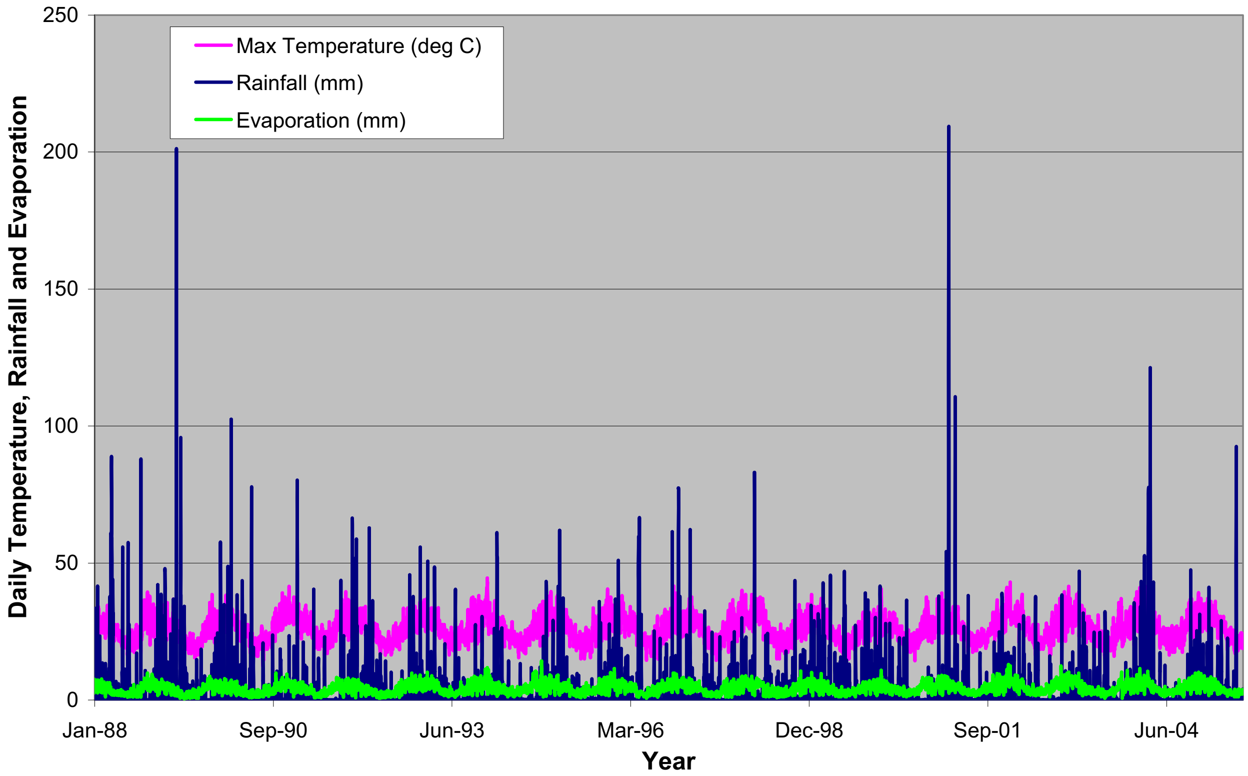


Figure 3-6: Kyogle Rainfall, Temperature and Evaporation

3.3.3 Water Tracking Model

3.3.3.1 Overview

The influence of climate can distort historical demand records leading to an incorrect starting point for projections. With a view to establishing the current climate-corrected demand for Kyogle, a time series model of water production was generated using the DEUS's Water Tracking Software (MEU 2002). This model uses daily production and climate records to assess the influence of climate on demands. This model failed to adequately describe per capita water production. It is thought that issues with the bulk water flow gauge, service reservoir fluctuations and the relative small service area may have influenced this outcome. To overcome this difficulty a monthly climate correction water tracking model has also been prepared. This model is less influenced by daily fluctuations and provides a basis for estimating a climate corrected starting point for demand projections.

The analysis was undertaken using purpose-built multi-variable regression analysis software. The software is a programmed spreadsheet that uses a spreadsheet for the storage of data and visual basic code for the calculations. It provides the user with a detailed understanding of the climate influences on water demands or sewer flows. This particular analysis is of the influence of climate on per capita water production records.

The analysis uses 3 basic steps:

1. Calibration - where the model is calibrated over a short time series to provide a baseline.
2. Hindcasting - where the available climate record is used to project the calibrated model through the full climate record to obtain a statistical understanding of the mean or climate normalised baseline year consumption.
3. Trend Tracking - where the observed demands are compared with those predicted by the baseline-calibrated model and changes in demand relative to the baseline are estimated.

3.3.3.2 Calibration

Historical bulk water production (Section 3.3.1) and climate (Section 3.3.2) data were aggregated in monthly totals. The estimated residential population served with water was calculated assuming linear growth between annual records (Section 3.2.2). The monthly records were then input into the water tracking model.

The calibration of the model was carried out over an eight-year period, between January 1988 to December 1996 (Figure 3-7). This period includes a good range of climatic conditions and is not known to be influenced by mandatory water restrictions.

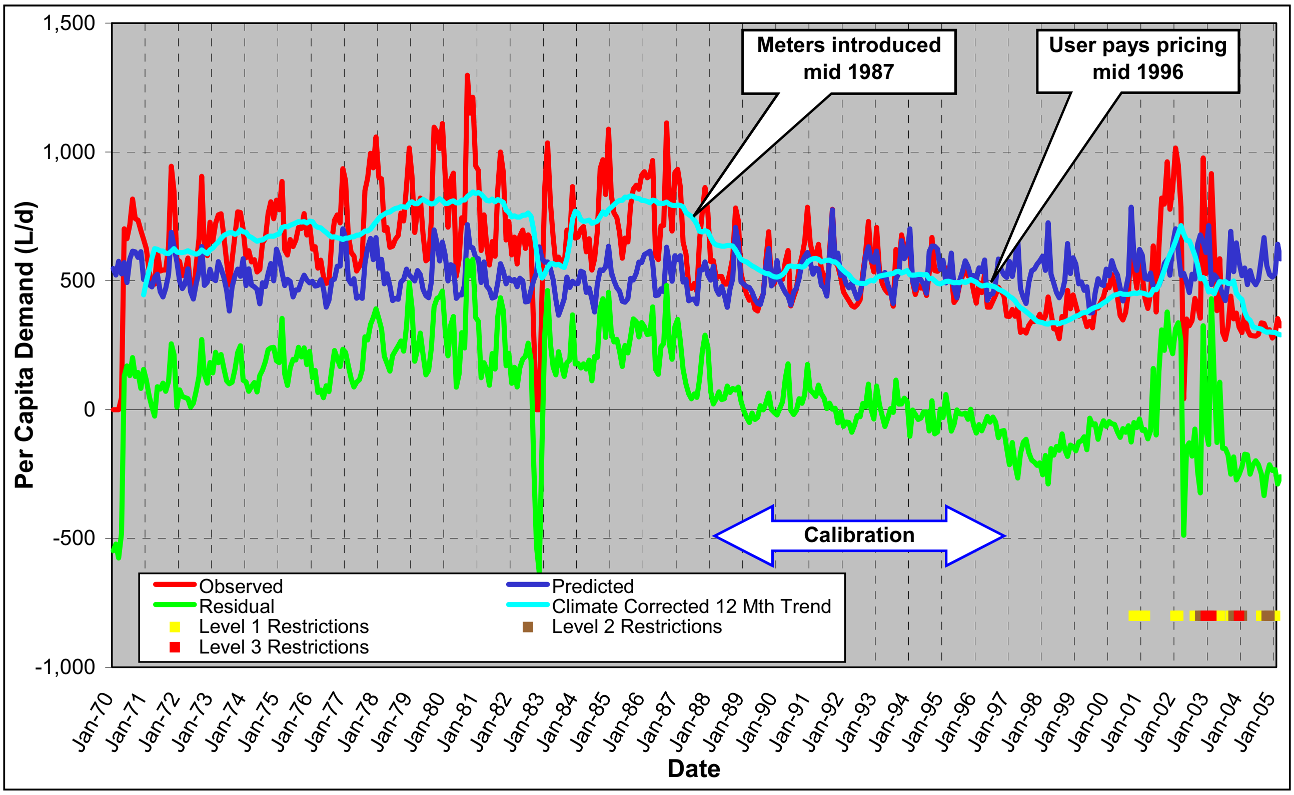


Figure 3-7 Model Calibration – Jan 1988 to Dec 1996

Higher than predicted demands were observed prior to 1988. This is thought to be at least partly due to the introduction of meters (the calibration period includes metering). Sudden changes in the residual demands (observed demand minus predicted demand) indicate areas of suspect historical data, in particular, late 1982 and periods between 2001 and 2003. This combined with restrictions makes it difficult to define recent trends in demands.

Three variables were found to be significant in explaining the monthly water production during the calibration period:

1. A soil moisture index, which combines rainfall and evaporation data to provide an index of soil moisture that models the underlying demand pressure associated with antecedent rainfall and evaporation.
2. Maximum temperature.
3. Rainfall.

Calibration results are tabled below.

Table 3-3: Monthly Regression Model Calibration Results

Statistical Indicator	Result
Calibration period	8 years (Jan 1988 to Dec 1996)
R Squared	0.59
Standard Error of Y Estimate	60.1
F Statistic	49.9
Degrees of Freedom	104
T Statistic – soil moisture index	-6.2
T Statistic – maximum temperature	4.6
T Statistic – rainfall	-2.6

The results indicate that the model is statistically significant. The calibration produced an R squared correlation statistic of 0.59, which is to say that the fitted model could explain 59% of the variations in monthly per capita water production. This is considered to be a reasonable fit for this type of model.

3.3.3.3 Hindcast

While the SILO Data Drill provides estimates of many climate parameters back to 1889, evaporation data is only available from 1970 onwards. For this reason, the model hindcast was conducted over the 30 plus years since 1970 (Figure 3-8).

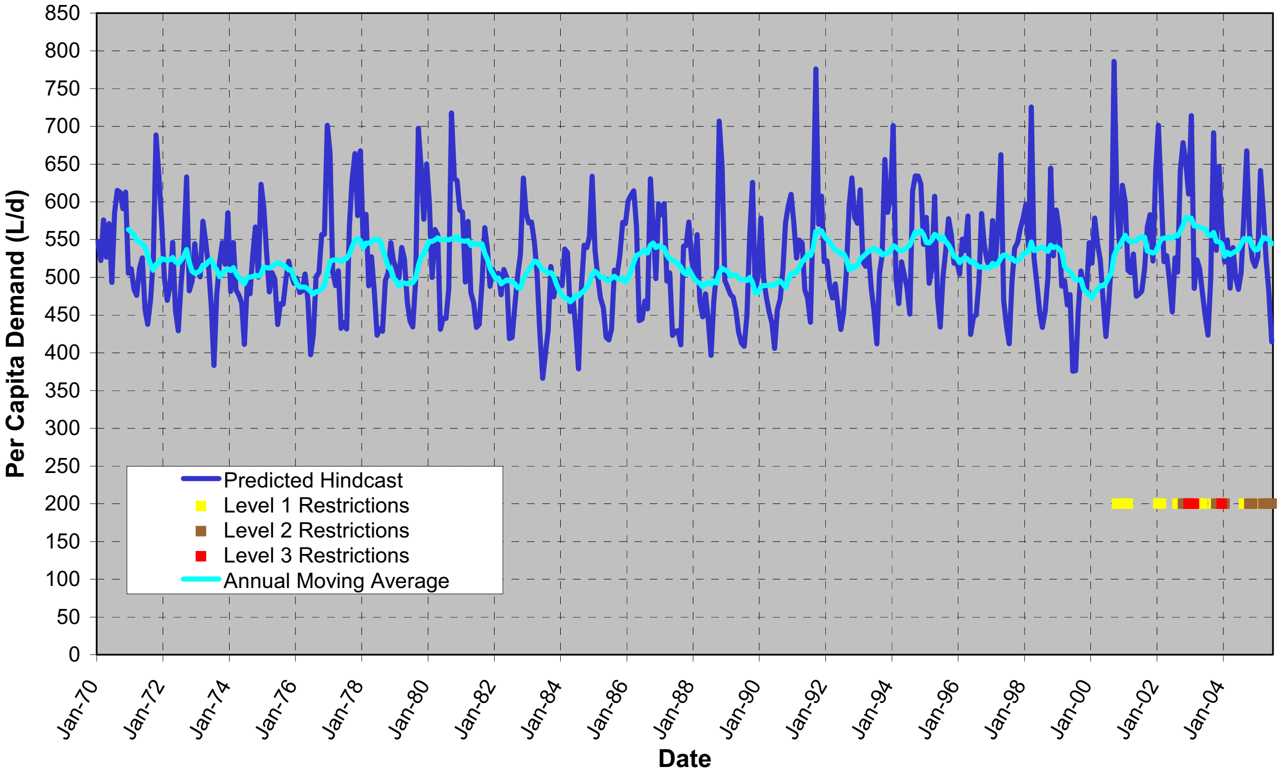


Figure 3-8: Regression Model Hindcast

The hindcast represents the demand that would have occurred in the calibration (baseline) period under the full climate time series. Also shown is the annual trend in predicted monthly production levels. The hindcast demonstrates that annual demands are significantly influenced by climate conditions. With a mean per capita demand of 522 litres per day, the hindcast shows that the hottest\driest months in the climate record will result in a per capita demand of 786 litres per day (50% above average). Alternatively, the coolest/wettest period will result in a per capita demand of 366 litres per day (30% below average).

3.3.3.4 Climate Correction

The climate correction of historical records is shown in Figure 3-9.

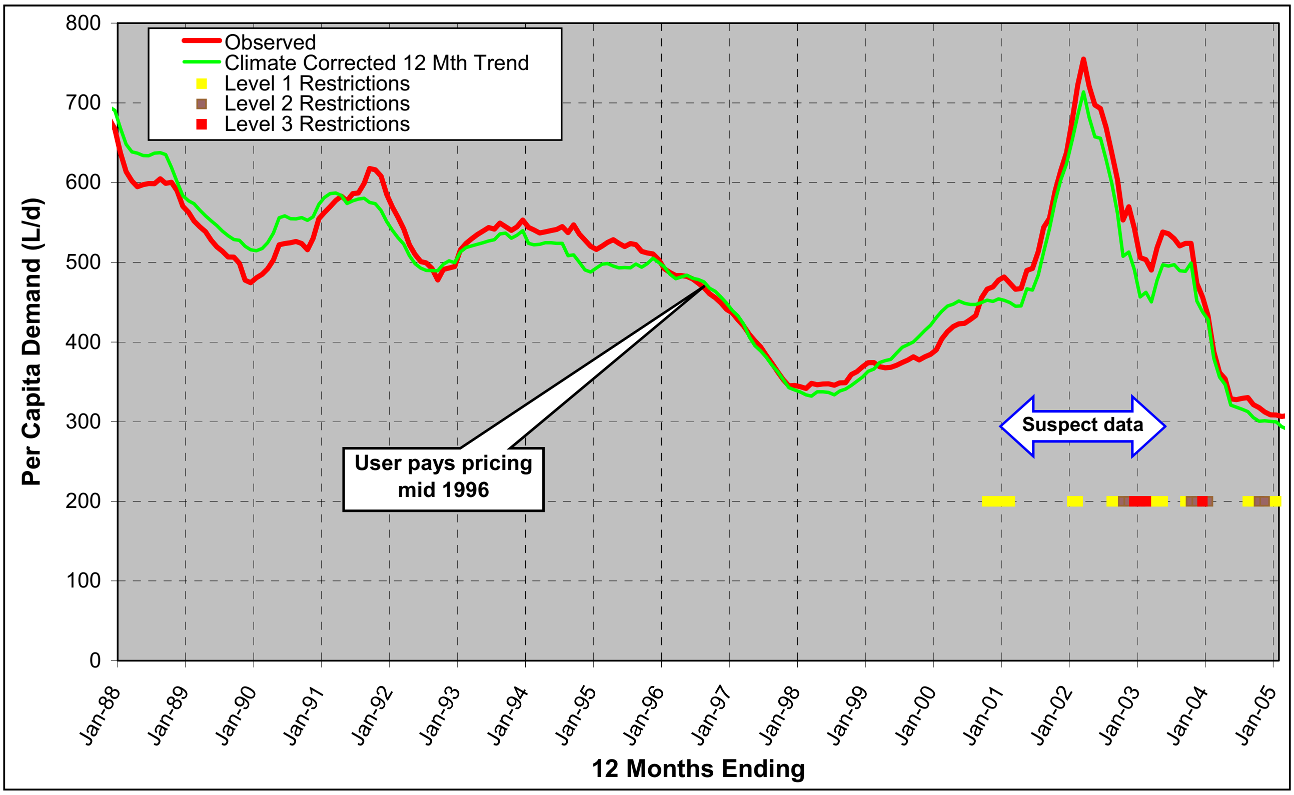


Figure 3-9: Observed and Climate-Corrected Per Capita Water Production

The climate-corrected demand following the introduction of volumetric charges, and prior to known restrictions, ranged between approximately 478 L/person per day and 332 L/person per day. As this range is highly variable and with questionable bulk water production data after 2002 (Section 3.3.6) it is proposed to adopt a typical demand between for the period between mid 1996 and the start of restrictions, of 400 L/person per day. This results in a current climate corrected demand for Kyogle in 2005 of 38 ML/month or 460 ML/annum. For more information on the climate correction process refer to Appendix B.

3.3.4 Estimation of Peak Day to Climate Corrected Average Day Demand Ratio

In the traditional approach to estimating peak demand factors, peak demands are compared with raw demands on an annual basis. There are a number of problems with this approach. Firstly, the arbitrary use of discrete years of data results in large amounts of data being effectively discarded and secondly, the climate influence in any one year can bias the result. Peak demand periods (be they daily or monthly) typically occur once every three to five years. They almost always occur during prolonged periods of hot and dry weather, and may not necessarily occur in a hot or dry year. A relatively minor peak demand period occurring in a cool, wet year will result in a high peak to average ratio. Likewise, a high peak demand occurring in a hot, dry year will result in a low peak to average ratio. Thus it is important to compare peak demands with the climate-corrected demand for a useful comparison.

To assist in estimating the peaking factors for use in Kyogle, a plot of peak to climate corrected daily demand ratios on a 365 day rolling average basis has been produced (Figure 3-10).

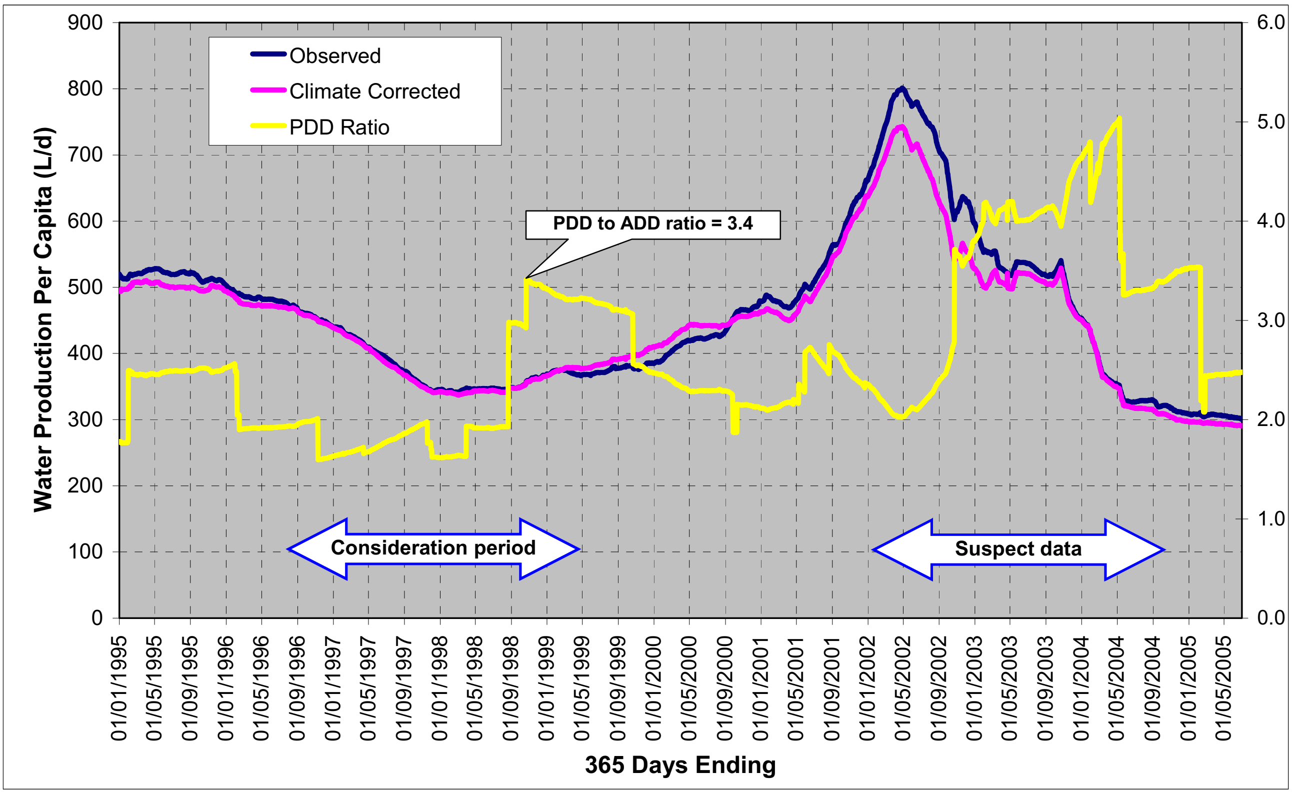


Figure 3-10: Peak and Climate-Corrected Average Day Demands

The daily water tracking model was used for this purpose adopting a calibration period between July 1996 (post user pays pricing) and June 1999 (before beginning of unreliable record and multiple restrictions). The results during this period show that an overall peak to average ratio of 3.4 for maximum day demand would be an appropriate assumption for Kyogle.

3.3.5 Sectoral Demands

To better understand the water usage across the different types of customers connected to Council's water supply system, Council's customer accounts database has been interrogated. Water consumption data between March 1999 to June 2005 were provided for demand assessment. The consumption data is split into six customer categories (sectors):

1. Residential.
2. Commercial.
3. Industrial.
4. Institutional.
5. Rural.
6. Open Space.

The number of customer accounts over the period of consumption record was also provided.

Non-domestic consumption records prior to June 2002 appear to be incomplete (evidenced by account numbers and consumption figures) and have not been further considered in this study. Recent non-domestic records are recorded on a quarterly basis and allow an indication of seasonal demands to be assessed (Figure 3-11).

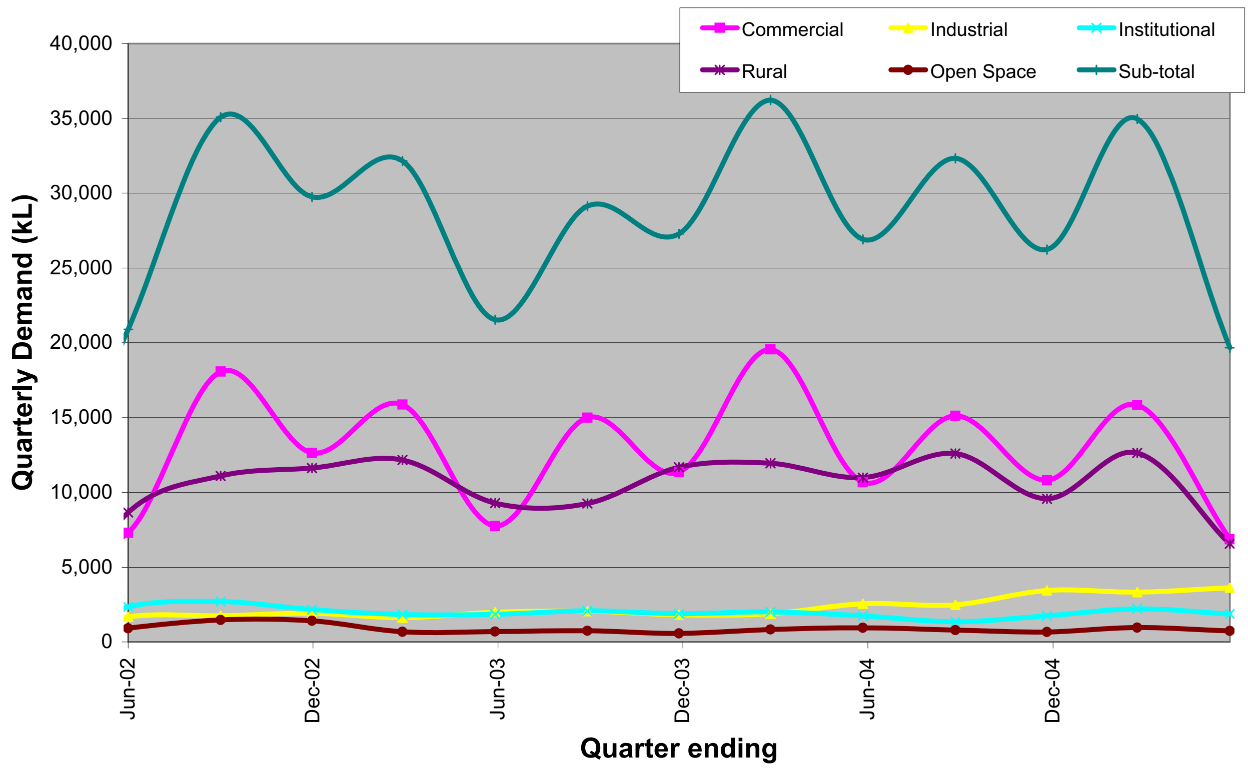


Figure 3-11: Non-domestic Quarterly Consumption

Residential meter readings are recorded biannually and do not allow for assessment of seasonal fluctuations (Figure 3-12).

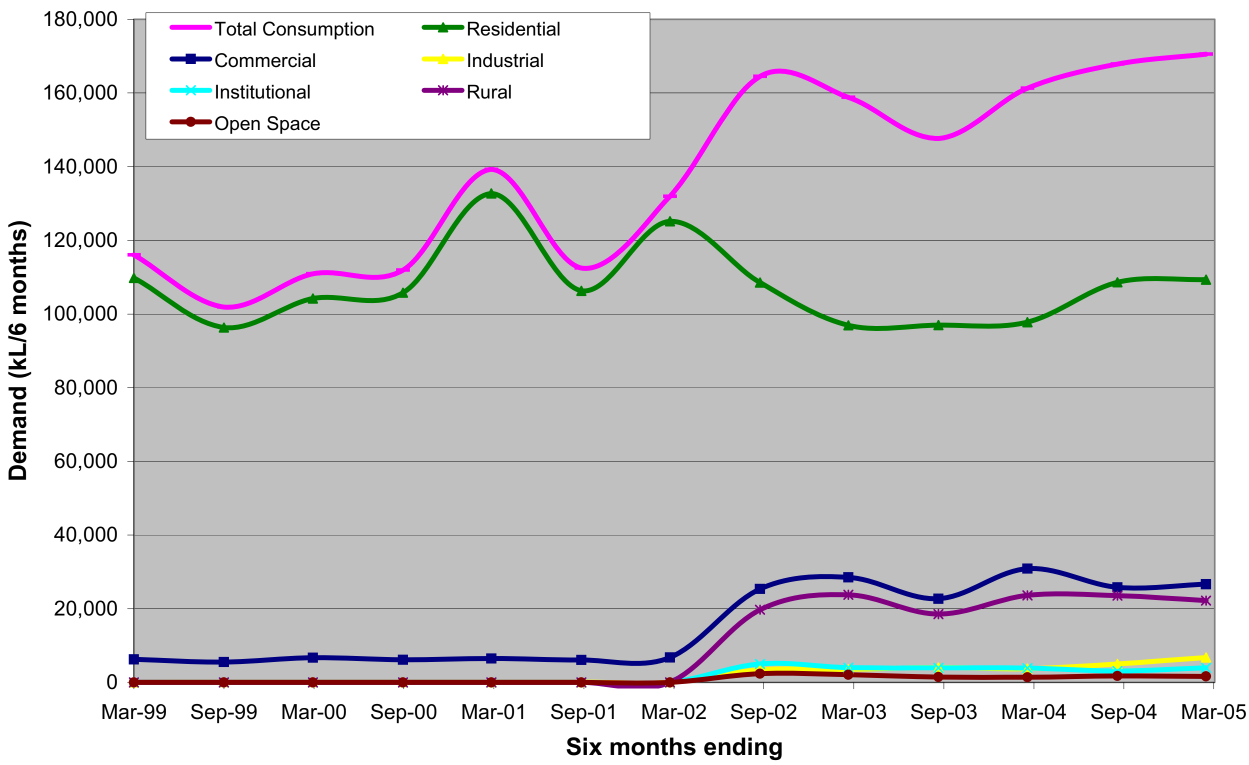


Figure 3-12: Biannual Consumption

Water restrictions are expected to have influenced the available consumption records (Section 3.3.1). However, it is assumed that the relative breakdown in customer demands remains valid for the demand assessment. By summing data from Council's customer database in the years 2003 to 2004, the total breakdown in water consumption is estimated as shown in Figure 3-13. It is observed that total consumption is dominated by the residential sector.

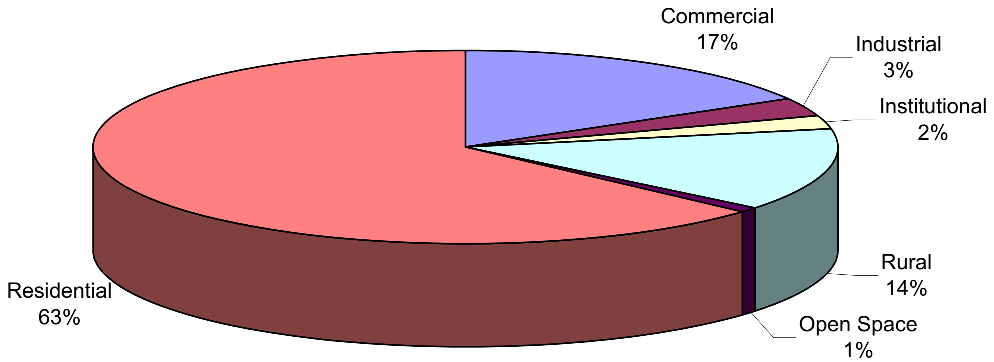


Figure 3-13: Consumption Distribution by Category (annual average 2003 to 2004)

Table 3-4 summarises the 2003 to 2004 average annual consumption rates and account numbers.

Table 3-4: Average Consumption by Sector – 2003 to 2004

Sector	Average Annual Consumption (kL)	Average No. of Accounts	Average Annual Consumption per Account (kL)
Residential	200,090	1,137	176
Commercial	53,056	268	198
Industrial	8,916	14	637
Institutional	7,246	30	242
Rural	43,721	168	261
Open Space	2,968	28	108

As a general comparison, the median average annual residential consumption across NSW in 2003/04 was 215 kL/property (DEUS, 2005).

3.3.6 Major Users

The identification of major uses in the IWCM process helps to better identify opportunities for conservation and recycling. The major town water users are presented in the following table.

Table 3-5: Major Potable Water Users

Rank	03-04 Average consumption (kL)	Use	Description of Premises
1	14,590	Council - Operational	Public Swimming Pool
2	5,702	Industrial	Boral Timber Mill
3	4,324	Institutional	Kyogle High School
4	3,887	Commercial	Kyogle Caravan Park
5	3,772	Rural	Water Carter, Wiangaree Back Road
6	2,736	Industrial	Concrete Batching Plant
7	2,698	Rural	Farm - Grazing, Collins Creek Road
8	2,343	Rural	Dairy, Highfield Road
9	1,783	Insitutional	Kyogle Court Aged Care Home
10	1,740	Rural	Farm, Summerland Way
11	1,720	Rural	Farm, Runnymede Road
12	1,706	Community	Kyogle Showground
13	1,499	Rural	Farm, Collins Creek Road
14	1,477	Insitutional	Kyogle Hospital
15	1,440	Rural	Grazing and feedlot, Summerland Way
16	1,439	Rural	Farm - Grazing, Summerland Way
17	1,354	Commercial	Hotel
18	1,275	Commercial	Bowling Club
19	1,224	Council - Operational	Kyogle Council Depot and Bulk Water Sales
20	1,189	Council - Community	Roxy Car Park and Public Toilets

3.3.7 Estimation of Unaccounted for Water (UFW)

In this study the level of unaccounted-for-water (UFW) is defined as the difference between the bulk water production and total metered consumption. This difference has been estimated using available records (Figure 3-14).

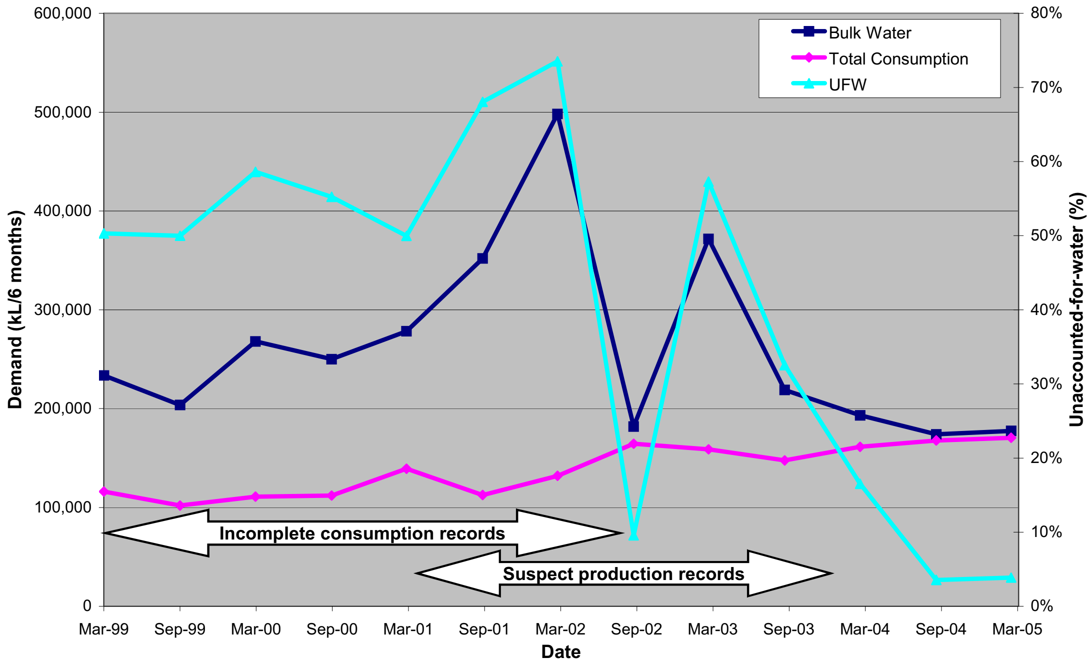


Figure 3-14: Estimates of Unaccounted for Water

The UFW figures indicate significant issues with the metered records. The very high UFW results (up to 75% of the bulk production) prior to June 2002 are likely, at least in part, to be associated with incomplete consumption metering records. The fluctuating bulk production records are also likely, at least in part, to be associated with restrictions, however consumption records do not appear to be significantly influenced by the restrictions. It does appear that in general the level of UFW is decreasing, however it is questionable if the current rate is as low as 4%.

The variations in UFW cannot be explained with the available data, which limits the ability to define a trend in UFW. The variations also indicate that further cross checking of consumption and production records may be warranted.

In general, total UFW can be broken into a number of areas:

- apparent losses – caused by under-reading of customer meters
- unauthorised un-metered consumption – such as water theft
- authorised un-metered consumption
- water treatment backwash volumes
- system losses – leakage.

System leakage was estimated in December 1986 (Public Works, 1987) using a reservoir drop test. At that time it was estimated that total system losses were approximately 49kL per hour (17 to 23 L/connection/hour). The bulk water production meter was also tested at this time and found to be reading high by approximately 14%. However as these tests were conducted nearly 20 years ago the system and meter performance are anticipated to have changed and it remains difficult to estimate system losses without further testing (reservoir drop test or minimum night flow monitoring).

For the purpose of the end use modelling work, it will be assumed that the level of UFW is 15% based on typical figures and in line with on the last two year's biannual average. It will also be assumed that leakage represents 50% of the total UFW. Further investigation into UFW is recommended and could include leakage testing (reservoir drop test and/or minimum flow monitoring) and bulk water meter calibration.

3.3.8 Estimation of Internal and External Use

In developing forecasts using an end use model and considering water conservation and the potential of rainwater and recycled effluent use, it is important to identify which uses are internal and which are external. Internal uses are typically less responsive to conservation measures such as education campaigns and water pricing changes. Also the impact of the use of rainwater or recycled effluent for outdoor use requires an estimation of the proportion of external demands.

One indicator of the level of internal and external use in each consumer category is the seasonal fluctuations in the billing records. Unfortunately, residential records are six monthly, which do not allow for adequate estimation of true seasonal demand fluctuation. For this reason the residential internal/external breakdown in use was estimated by:

1. Adopting typical internal water usage per person (170L/p/d).
2. Multiplying the typical internal usage per person by the 2005 ERP served with water at Kyogle (3,145) to estimate total internal residential usage.
3. Subtracting the estimated internal use from the total residential use to give an estimate of ex-house use.

The non-domestic internal water usage has been estimated based on typical internal usage breakdown. The resulting estimates of internal uses are shown in Table 3-6, which also includes the minimum seasonal demand observed post June 2002 for information.

Table 3-6: Assumed Internal/External Breakdown by Category

Demand Category	Total Consumption	Internal Use	External Use
Residential	63%	75%	25%
Commercial	17%	80% (52%)	20%
Industrial	3%	80% (68%)	20%
Institutional	2%	70% (73%)	30%
Rural	14%	20% (62%)	80%
Open Space	1%	20% (73%)	80%

(52%) – observed minimum seasonal proportion.
The estimate for rural and open space areas, are simply assumptions in the absence of more detailed information. The other estimates are broadly consistent with end use estimates from Australia and North America (MWH 2003, AWARF 2000).

3.3.9 Assumed Current Breakdown in Internal Residential Use

The end use model assumes a detailed breakdown for current residential usage. This breakdown is shown in Figure 3-15. Per capita uses for most end uses were taken from the Perth Domestic Water Use Study (Water Corporation of WA, 2003).

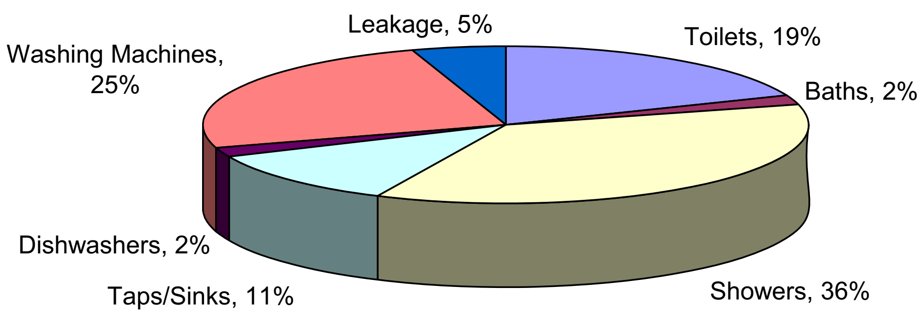


Figure 3-15: Assumed Breakdown in Current Internal Residential Use

3.3.10 Summary of Demand Analysis Outcomes

The historical demand analysis provided the following conclusions:

- the current climate-corrected demand for Kyogle of 460 ML/annum.
- the current peak day to climate-corrected average day ratios for Kyogle is 3.4 (ie current PDD = 4.2 ML/d).

The current breakdown in total water production is outlined in Figure 3-16.

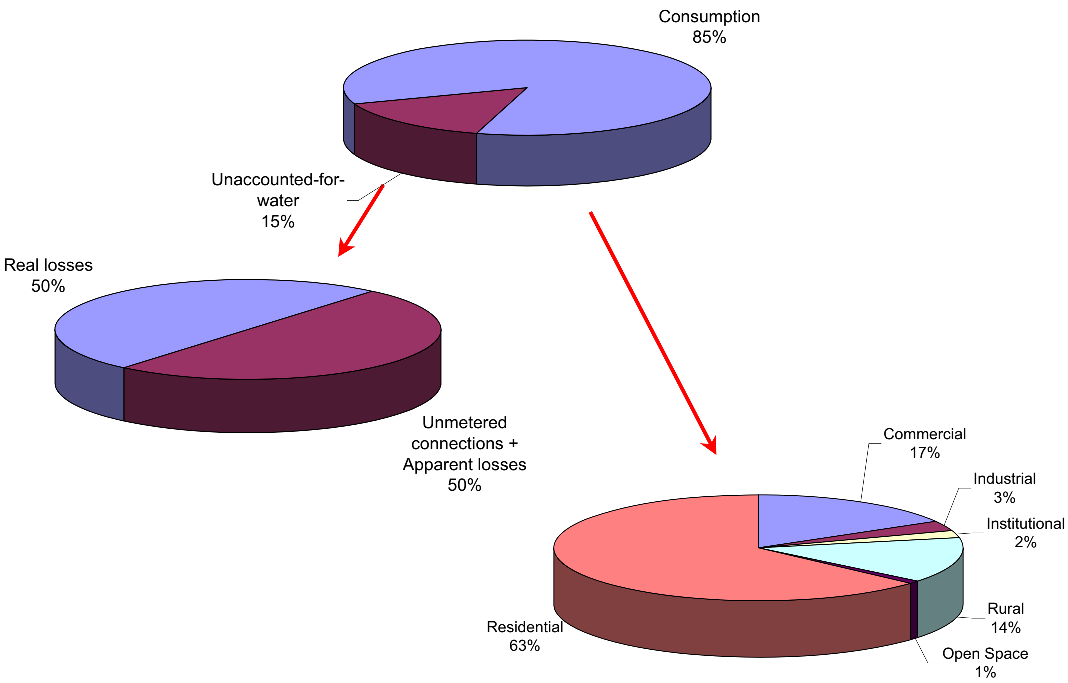


Figure 3-16: Current Breakdown of Total Water Production

3.4 River Water Quality

Stream water quality within the Kyogle LGA was reviewed in the IWCM Concept Study. The Richmond River upstream of Kyogle and Fawcetts Creek were noted to regularly fail (50-100% of the observations) to meet the *ANZECC Water Quality Guidelines* (1992) for drinking water, aquatic ecosystem protection, agricultural irrigation and primary contact recreation.

The following water and nutrient balances provide a picture of the issues that pertain specifically to the urban water cycle associated with Kyogle township in the Upper Richmond River and Fawcetts Creek catchments.

3.4.1 Catchment Water Balance

One of the key drivers for integrated water cycle management is to gain a better understanding of the interaction between water and land use, and their impact on the community and economy, both locally and regionally. Six catchments have been identified for preparation of water balances, four catchments covering the township urban area and two catchments for the upstream catchments of Richmond River and Fawcetts Creek (Figure 3-17):

1. Golf Course Estate.
2. Geneva.
3. Kyogle Central.
4. Kyogle South.
5. Richmond River.
6. Fawcetts Creek.

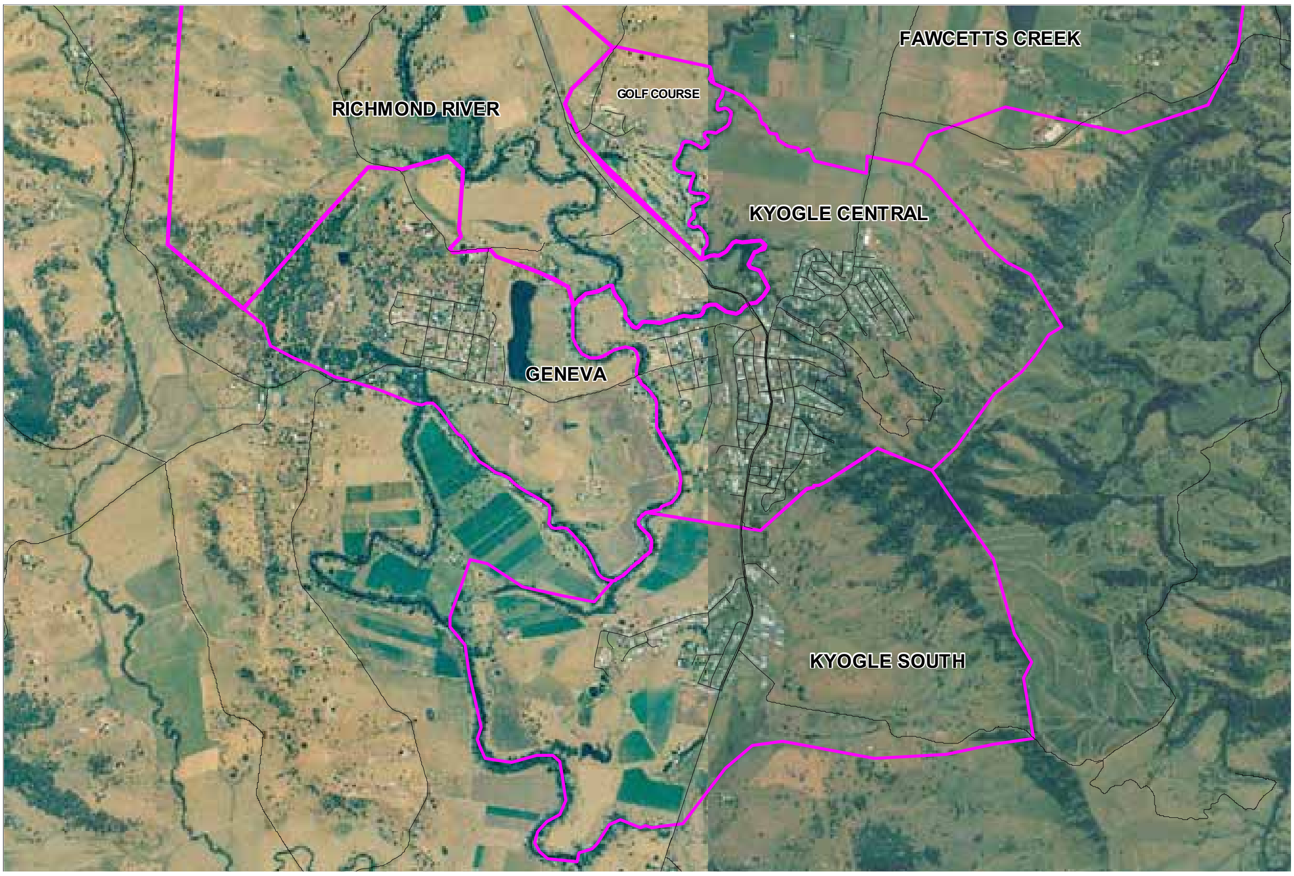


Figure 3-17: Water Balance Catchments

High level annual water balances have been prepared for each of the six catchments for three different development cases (natural, current and future). The water balances assist to understand the movement of water within the Kyogle LGA area with the different stages of development. They are simplified estimates of the annual volume of water movement for each catchment, not intended for design purposes, but to provide a picture of the impact of urbanisation.

The water cycle components considered are:

1. Rainfall – based on historical annual average for the Kyogle area.
2. Surface water inflow – to allow for inflow from any upstream catchments.
3. Water imports – the volume of bulk town water supplied to the catchment, inclusive of unaccounted-for-water.
4. Imported wastewater – the volume of reticulated wastewater transferred to the catchment. Applicable to Kyogle STP in the Kyogle South Catchment.
5. Imported recycled water – the volume of recycled effluent which enters the catchment.
6. Total water consumed - the volume of reticulated and rainwater water consumed within the catchment based on residential population and non-residential population.
7. Exported wastewater - the volume of wastewater transferred to an outside catchment.
8. Effluent surface discharge – the volume of treated wastewater that enters the surface waters within the catchment.
9. Runoff – stream and groundwater flow departing the catchment, including effluent discharged to streams.
10. Lake evaporation – direct evaporation from stored water bodies from within the catchment.
11. Evapotranspiration – evapotranspiration from non-surface runoff water within the catchment.
12. On-site treatment – based on assumed internal water consumption.
13. Town water extractions – the volume of town water piped to outside catchments. Applicable to Richmond River Catchment.
14. Town water supply – the volume of town water consumed within the catchment.
15. Irrigation extraction – the volume of water licenced to be extracted from the catchment.

The following major simplifications have been made in the water balance calculations:

- land usage is assumed to be represented by land zoning
- water storage influences are not assessed
- groundwater movement is assumed to follow surface stream flow between catchments.

For each catchment, three development cases were considered:

1. Natural case – representing a natural catchment without development and associated infrastructure for importing and exporting water.
2. Current case – representing 2004 water import and export volumes, with current land zonings developed.
3. Future case – representing a future development case with 2035 population increase proportioned to areas zoned for urban infill and expansion (refer to Section 4.1.3 for discussion on future urban settlement).

In each case, MUSIC (V3.01) software models were built to estimate annual runoff and loss (evapotranspiration). The annual runoff coefficients determined by MUSIC are primarily influenced by the percentage of impervious area adopted. The key assumptions adopted in the MUSIC models are tabled below (Table 3-7 & Table 3-8).

Table 3-7: Impervious Area

Zone	Residential	Rural Residential	Rural	Commercial	Industrial	Institutional	Open Space	Parks and Forests
	45%	10%	10%	80%	80%	80%	10%	0%

1. Natural development case assumes all areas equivalent to "Parks and Forests".
2. Future residential areas assumed to be rural in the current development case.

Table 3-8: MUSIC Modelling Data

Site	Annual (mm)	Record used
Kyogle 15300 east 2860 south (Daily)	Rainfall 1,196	1940-2004 (daily data)
Brisbane (Monthly)	Evaporation 1,539	MUSIC template

3.4.2 Water Balances

Annual average water demands and wastewater production figures are included in the water balances. A summary of the adopted water balance parameters is tabled below.

Table 3-9: Water Balance Parameters

Category	Annual Runoff Coefficient	Water Consumption (kL/a)[1]	Internal Usage	Comment
Residential	0.53	84/p	75%	town water supply
Rural residential	0.3	84/p	60%	town water supply
Rural with town water	0.30	262/p	20%	town water supply
Rural	0.30	53/p[2]	100%	assumes rainwater tank domestic supply
Commercial	0.76	528/Ha	80%	town supply
Industrial	0.76	2,030/Ha	80%	town supply
Institutional	0.76	540/Ha	70%	
Open Space	0.3	55/Ha	20%	
Lakes	1.00	NA	NA	
Unaccounted-for-water	15%			UFW on town water production
Annual wet weather factor	15%			On average dry weather flow

1. Based on 2003/04 consumption and 2001 population proportions.
2. Based on 85% of typical town water internal usage (144L/p/d).

In the future case, domestic water demands have increased to meet 2035 population requirements assuming per capita demands remain constant. Non-domestic demands have been assumed to increase in line with the population increase for each catchment.

3.4.3 Results

The combined water balance results for all six catchments, representing the Kyogle LGA upstream and including the township is plotted below.

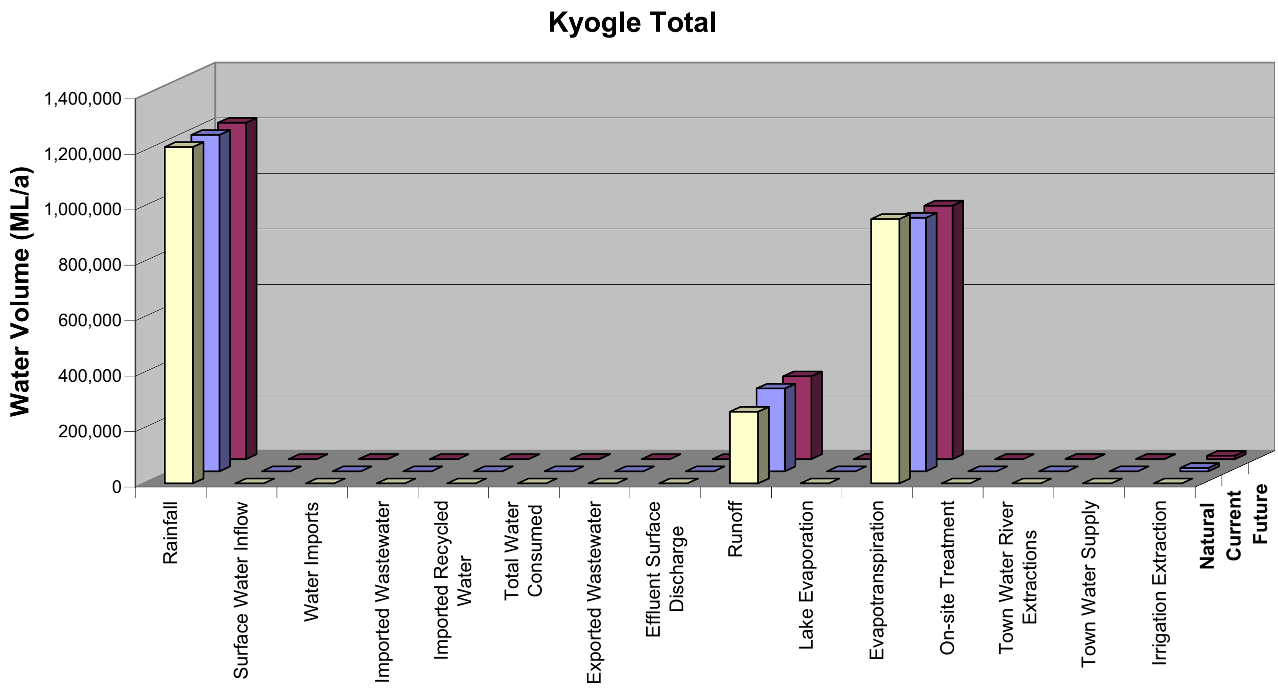


Figure 3-18: Kyogle Upper Richmond Water Balance

Water imports and exports represent the sum of water imported and exported across the six sub catchments included in the study and do not necessarily represent the total movement of water in and out of the study area. Plots of the annual water balances for each catchment are provided in Appendix C.

Annual water volume estimates for the total Kyogle catchments are tabled below.

Table 3-10: Total Kyogle Catchments Annual Volumes

Volume (ML/a)	Natural	Current	Future
Rainfall	1,213,100	1,213,100	1,213,100
Surface Water Inflow	0	0	0
Runoff	259,200	298,300	298,600
Evapotranspiration	953,700	915,000	914,800
Lake Evaporation	162	162	162
Irrigation Extraction	0	12,400	12,400
Total Water Consumed	0	440	520
Town Water Supply	0	400	480
Water Imports	0	370	430
Imported Wastewater	0	210	230
Imported Recycled Water	0	0	0
Exported Wastewater	0	210	230
Effluent Surface Discharge	0	250	310
On-site Treatment	0	110	120

3.5 Impact of Catchment Development on Nutrient Balances

In order to provide an indication of the impact of existing and future land uses in the catchments, an annual average mass balance for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) was estimated for each water balance catchment. The results of this assessment are provided in Figure 3-19, Figure 3-20 and Figure 3-21. An indication of the annual average load in terms of runoff is also provided for each catchment in Figure 3-22, Figure 3-23 and Figure 3-24.

It should be noted that the current nutrient balances have been estimated at the small area level. That is to say they represent typical levels of nutrient *inputs* to natural ecosystems. These should not be confused with catchment nutrient exports, where nutrient inputs are subject to processes such as assimilation, denitrification and phosphorous adsorption before leaving the catchment.

The assessment shows that the existing land uses are likely to have already resulted in a significant increase in pollutant loads over natural conditions. Predicted future growth in the area is moderate, which is reflected in the future pollutant loadings.

The results clearly show that both current urban and rural land uses are likely to be having a significant impact on water quality. Measures to mitigate impacts from these sources are considered as part of the integrated water cycle management strategy.

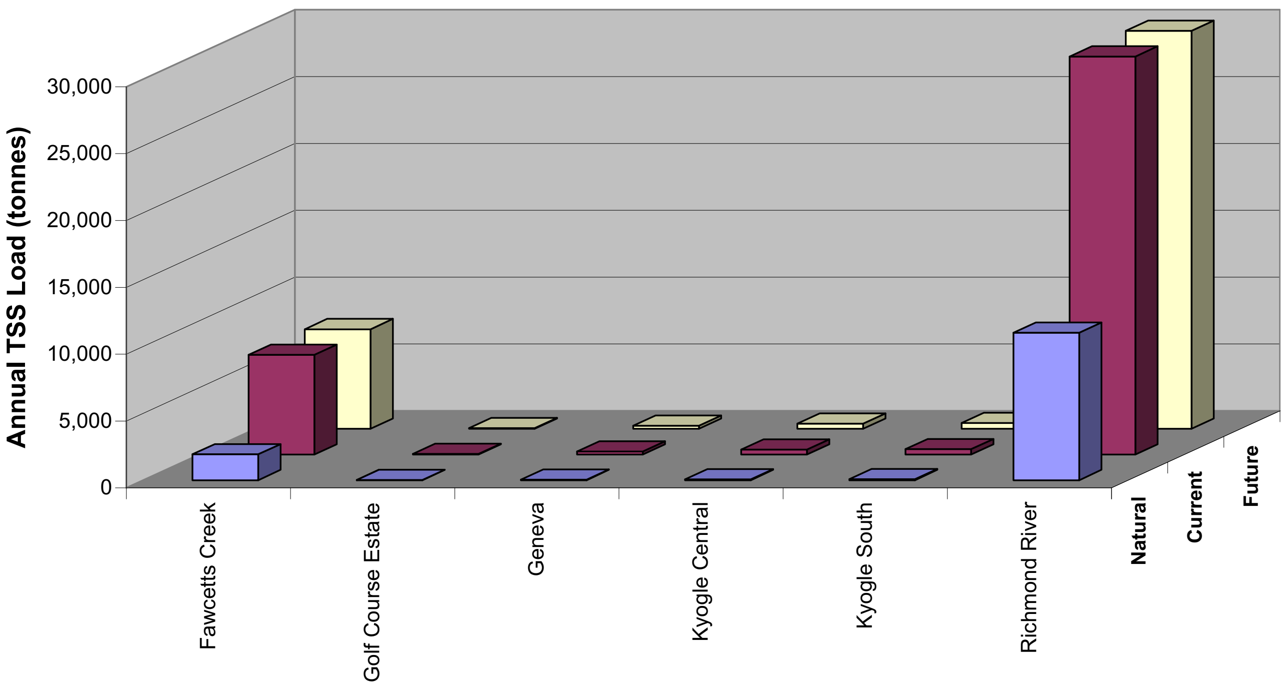


Figure 3-19: Estimated Total Suspended Solids (TSS) Inputs - Kyogle Catchments

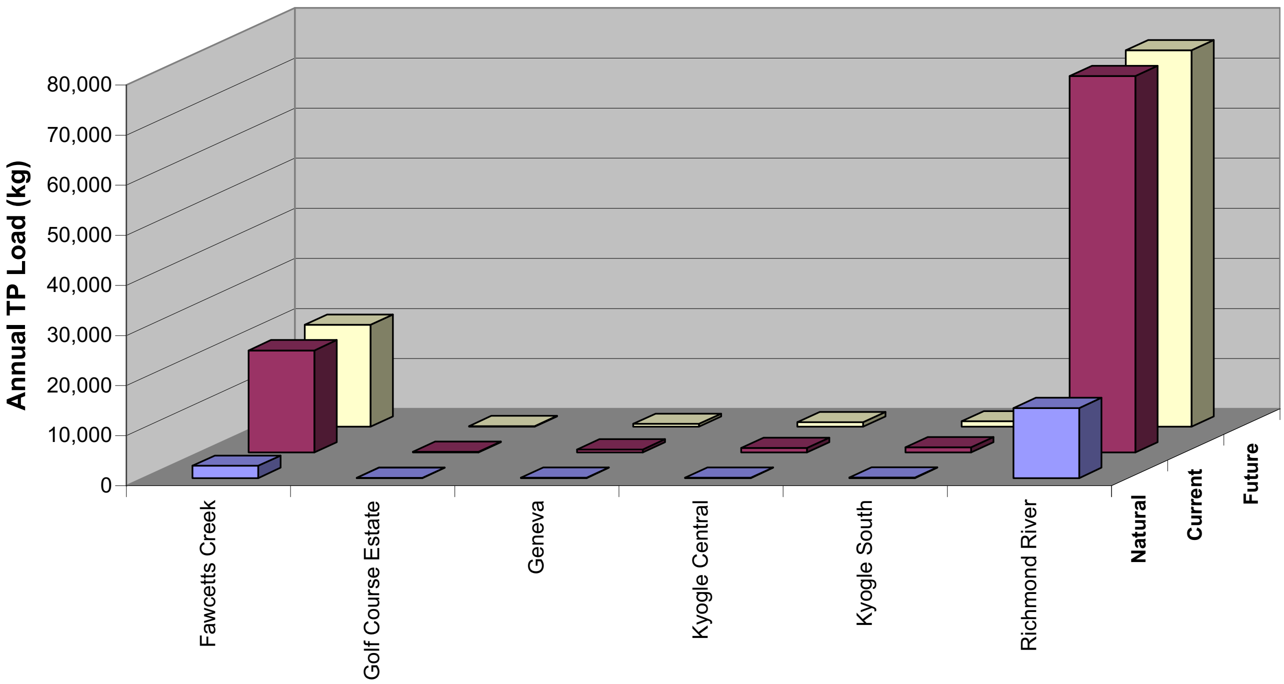


Figure 3-20: Estimated Total Phosphorous (TP) Inputs - Kyogle Catchments

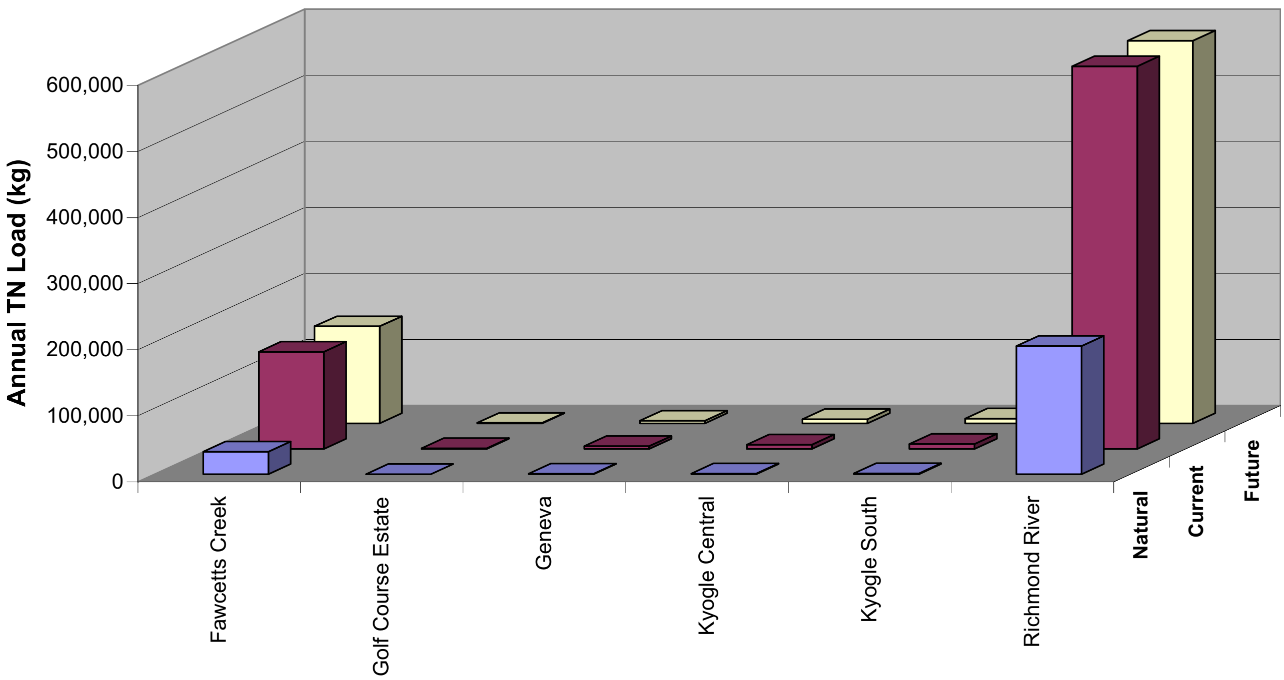


Figure 3-21: Estimated Total Nitrogen (TN) Inputs - Kyogle Catchments

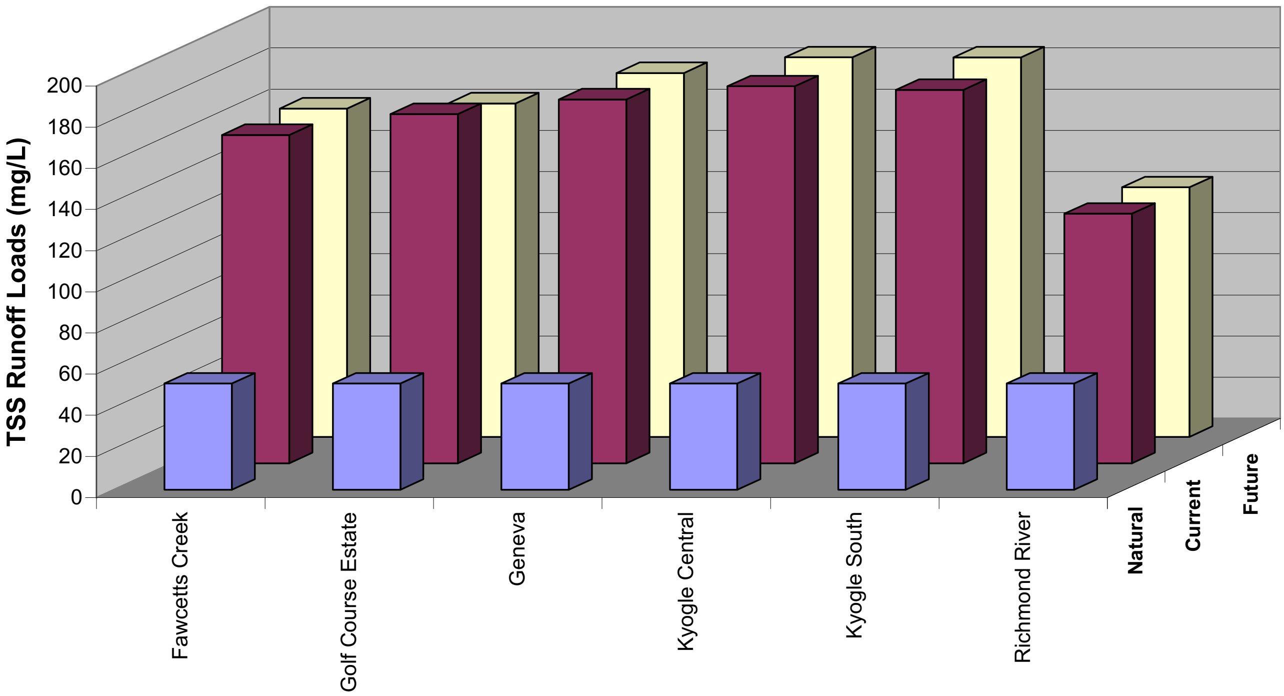


Figure 3-22: Estimated Runoff (TSS) Inputs - Kyogle Catchments

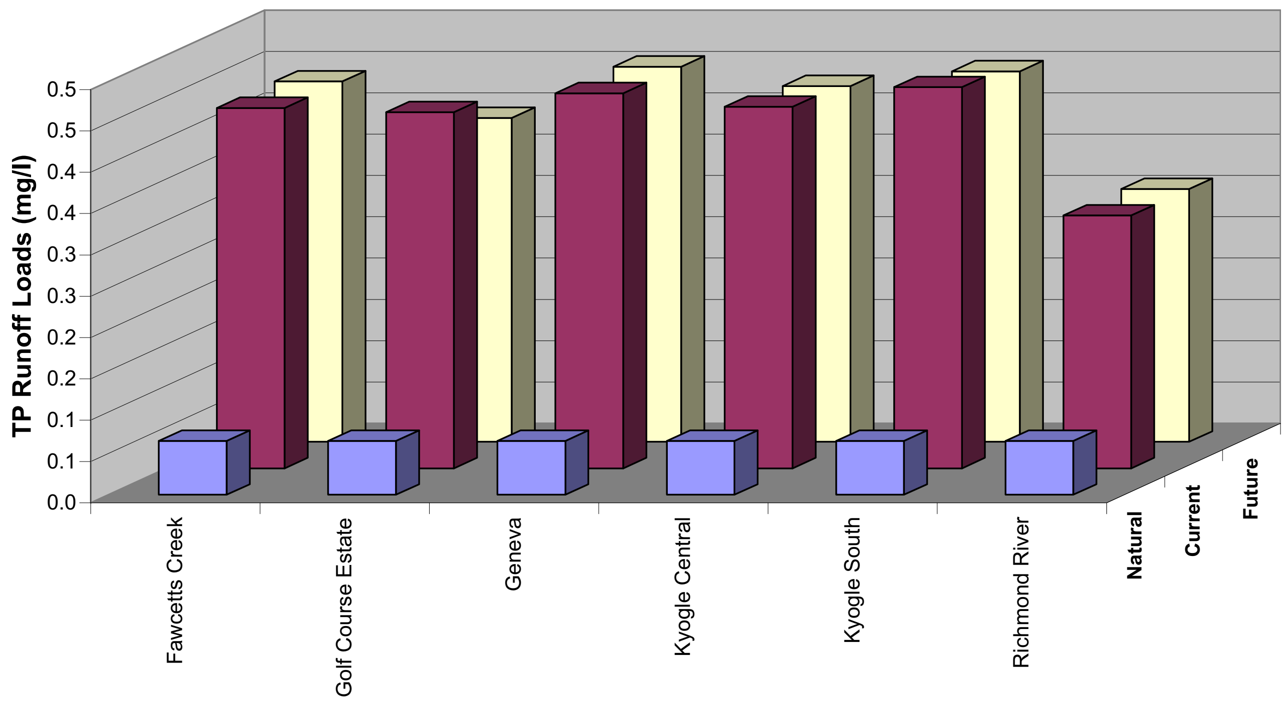


Figure 3-23: Estimated Runoff (TP) Inputs - Kyogle Catchments

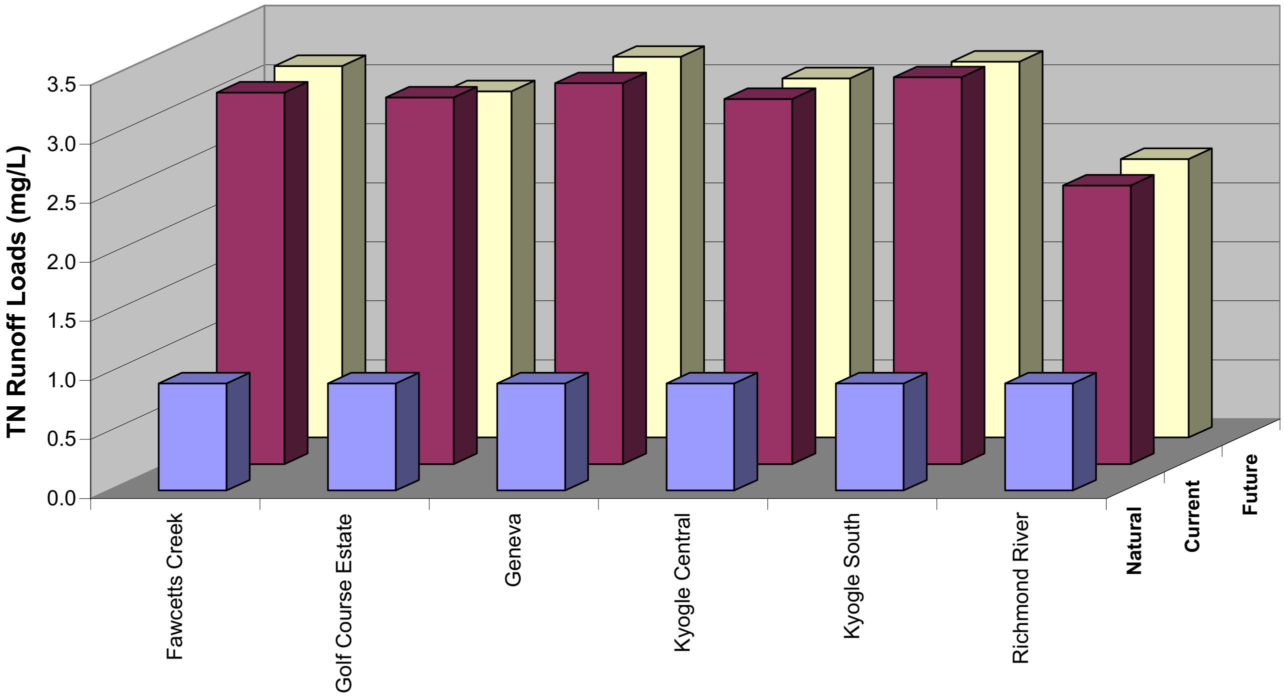


Figure 3-24: Estimated Runoff (TN) Inputs - Kyogle Catchments

3.6 Impact of the Sewage Treatment Plant

The Kyogle STP discharges to the Richmond River downstream of the township (Figure 2-3). The conventional trickling filter treatment plant removes solids, carbonaceous materials and nutrients, however it does not achieve adequate removal to satisfy sensitive water quality requirements. In assessing the current performance of the STP there are two additional factors for consideration at this site:

1. Recent improvements have been made at the STP in an effort to improve the performance of the plant, including chemical phosphorus removal and establishment of artificial wetlands prior to discharge from the site. It is too early yet to determine the impact of the recent works, however it is anticipated that improvements to the quality of the effluent discharging from the site will be made.
2. Effluent flows from the STP site via a drainage channel and a farmer's dam (on private property and known as the Reuse Dam) before discharging to the river. Effluent is partially reused by the farmer and the effluent quality is polished through natural processes in the dam. The licenced effluent discharge point used for monitoring of effluent is located between the STP and the Reuse Dam and does not consider the influence of the dam and farm usage of the effluent.

STP inflows between July 2001 and June 2005 have been assessed using the water-tracking model (Figure 3-25). Correction to the inflow data on days with no readings has been made, by averaging the pre and post readings across these days.

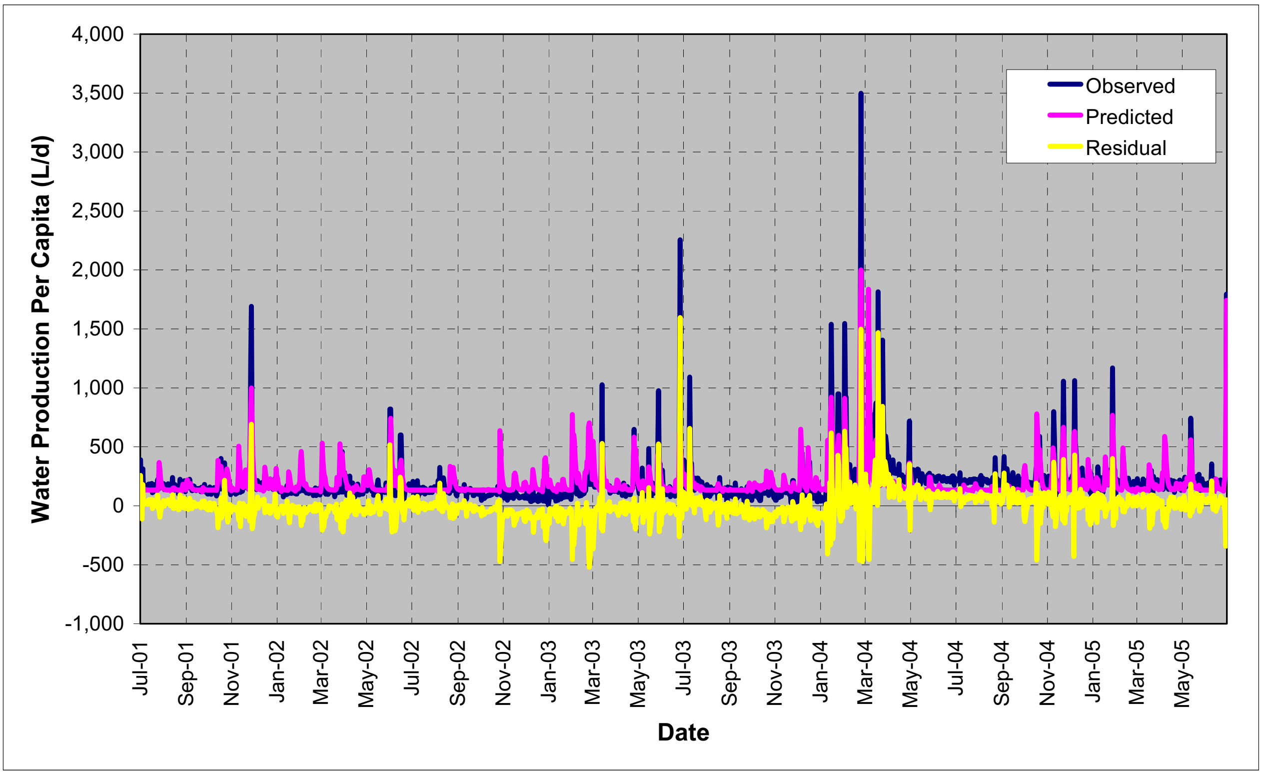


Figure 3-25: Wastewater Tracking

The water-tracking model facilitates recognition of dry and wet periods of record, as well as general trends in flows. The predicted baseline hindcast is plotted in Figure 3-26.

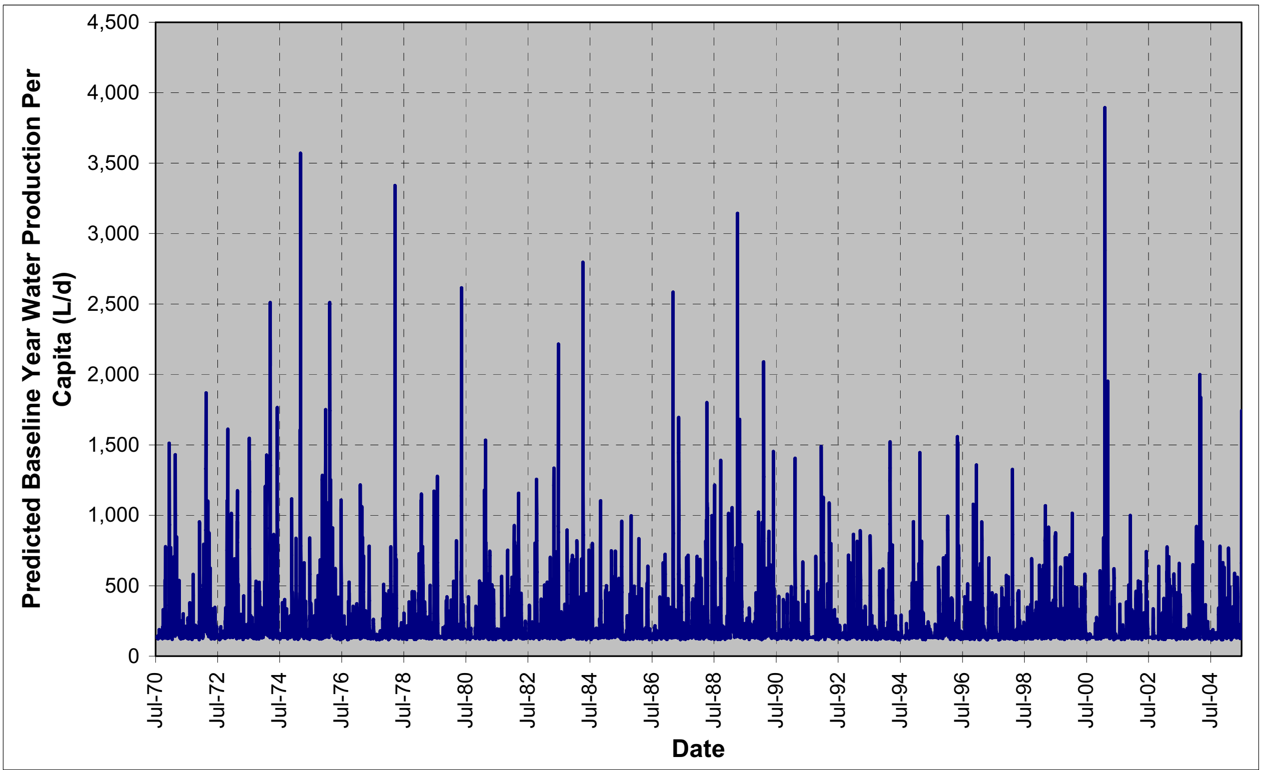


Figure 3-26: Predicted Baseline Production per Capita

The long term average inflow to the STP is 0.5 ML/day. The average annual inflow to the STP over the 2004 and 2005 financial years is 257ML. It is interesting to note that there has been an upward shift in the observed base flow entering the STP since April 2004, possibly associated with calibration/changes at the gauge and/or additional connections to the system Figure 3-27).

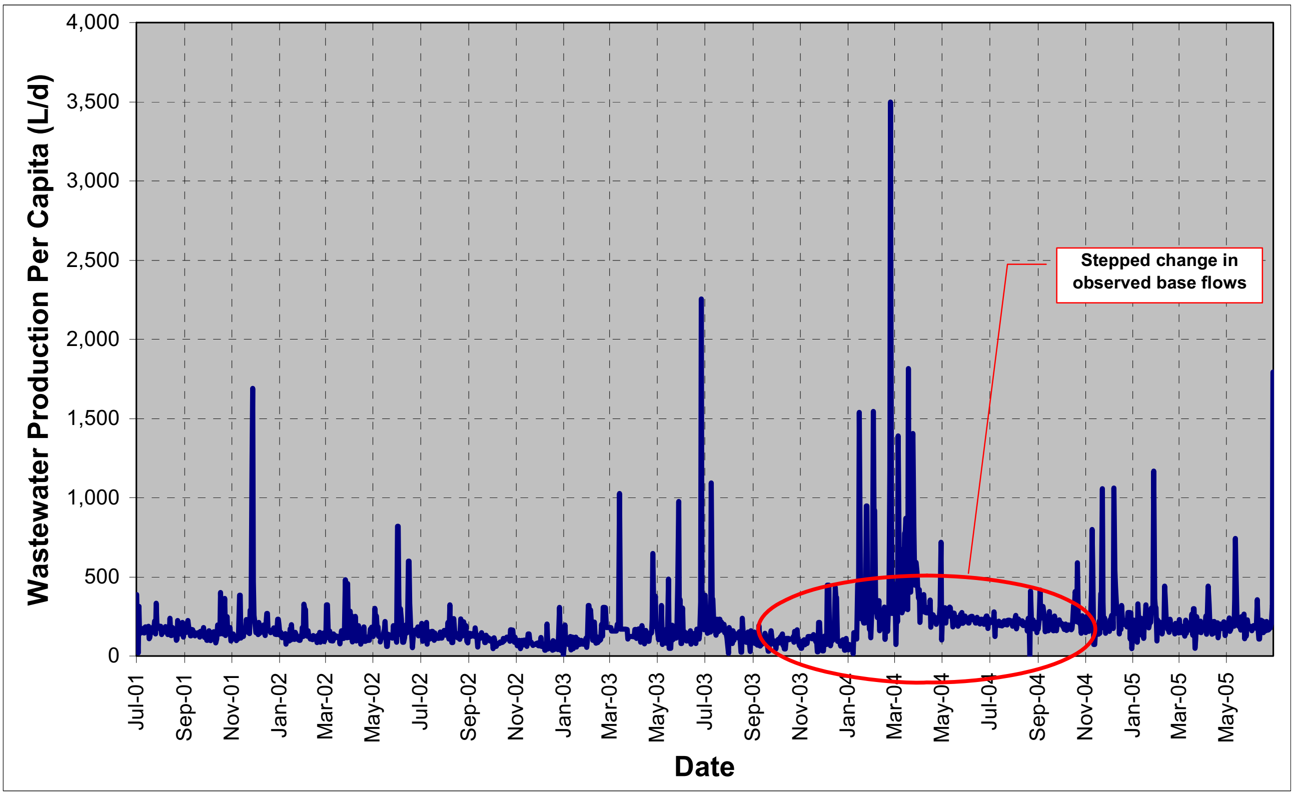


Figure 3-27: Observed STP Daily Inflow

Figure 3-28 illustrates recent STP diurnal inflow patterns and response to wet weather. Approximately 60mm of rainfall occurred between 12 and 14 May 2005. The observed average inflow prior to the rain occurring is approximately 0.7-0.8 ML/d (6 to 11 May 2005). The peak wet weather to average inflow ratio observed on 13 May 2005 is approximately 6.5, indicating a potential inflow and infiltration issue. The lack of tail-out in flows following wet weather events indicates that inflow is significant. Council conducted extensive CCTV inspections and smoke testing in 2003. These inspections revealed that the main sources of inflow were associated with:

- internal cross connections to stormwater
- poorly sealed manholes in stormwater flow paths
- sections of gravity sewer mains which were in extremely poor condition.

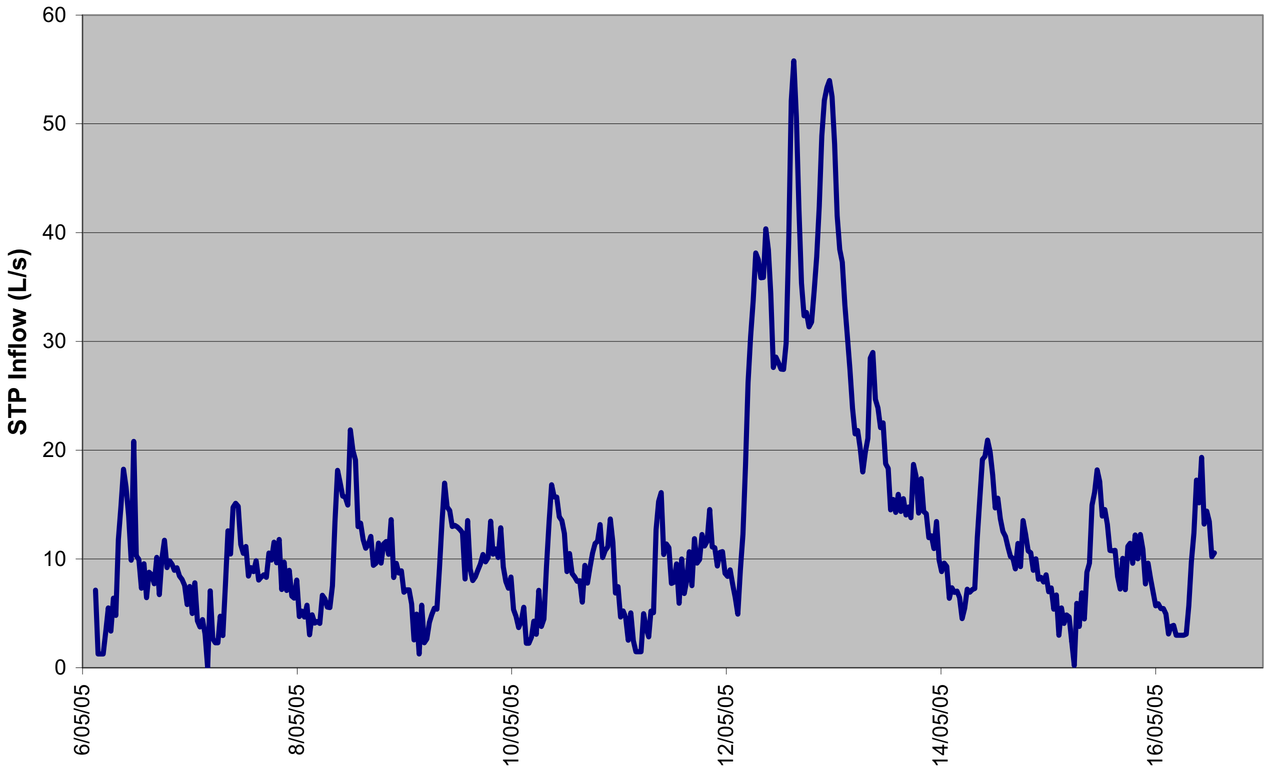


Figure 3-28: Observed STP Inflow (6 May to 16 May 2005)

Typical STP flows and loads are summarised in Table 3-11.

Table 3-11: STP Annual Volumes and Loads

Location	Volume (ML/a)[1]	TSS (mg/L)	TN (mg/L)	TP (mg/L)	TSS (T/a)	TN (T/a)	TP (T/a)
STP Licence Point[2]	257	37.7	9.7	2.5	9.7	2.5	0.6
Reuse Dam[3]	257	25.4	7.4	4.1	6.5	1.9	1.05

1. Based on inflow records.
2. Average readings from Jan 98 to Feb 05
3. Based on 13 Council samples.

On an average annual basis, the STP accounts for approximately 0.05% of the river's annual flow and less than one percent of the estimated total nutrient loads (P and N) which enter the river, as compared to runoff sources above the discharge point (Section 3.5). These estimates do not take into account natural processes which will occur during overland and subsurface flow to the river and within the river itself, such as assimilation and are indicative estimates only.

During low flow periods in the river these proportions may increase significantly. The Concept Study prepared estimates for the contribution of STP nutrient loads as a percentage of the river's annual average nutrient loads for varying flows (Figure 3-29 & Figure 3-30).

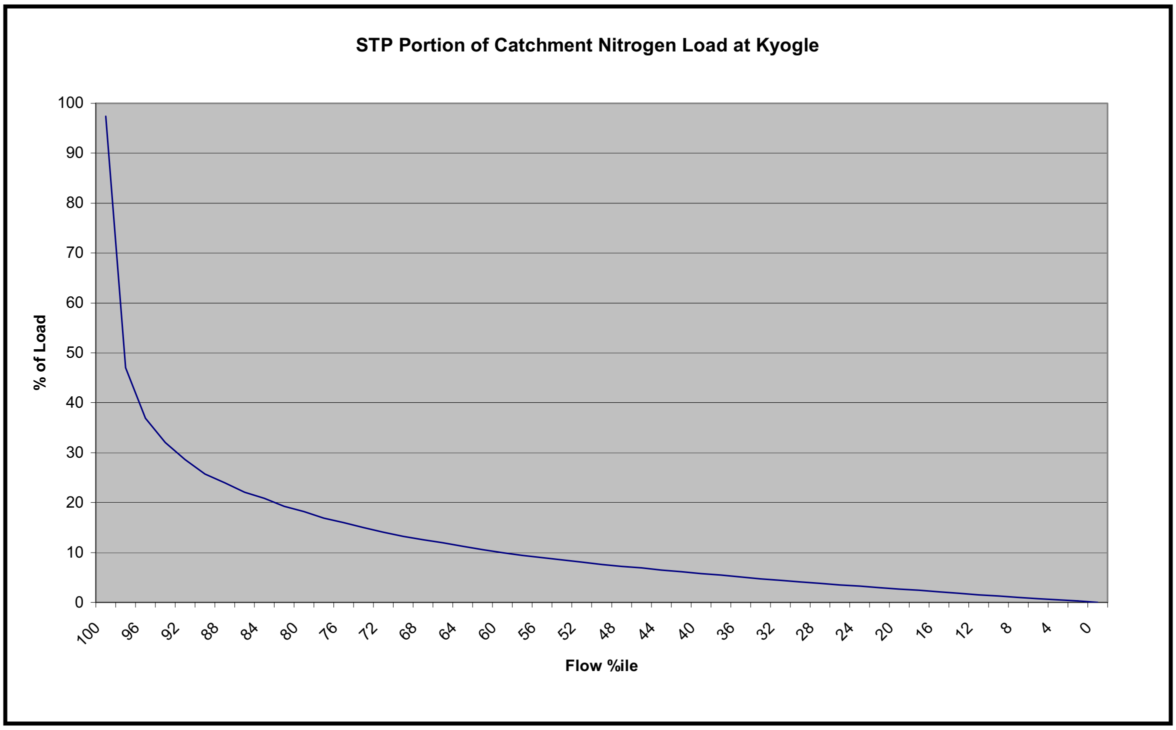


Figure 3-29: TN Effluent Loads

Source: Concept Study
Based on effluent quality at the licence monitoring point.

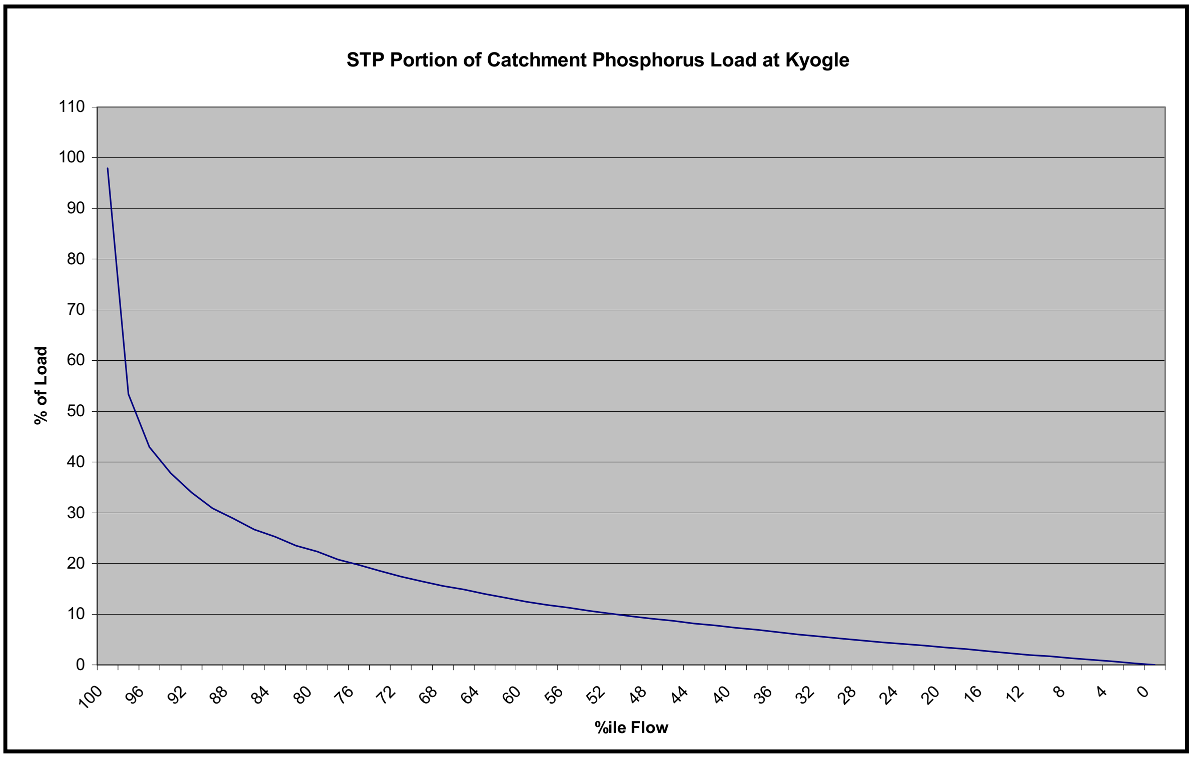


Figure 3-30: TP Effluent Loads

Source: Concept Study
Based on effluent quality at the licence monitoring point.

At river flows less than 76ML/day[4] (80th percentile flow) the STP represents 1% of the river's flow. This shows that the STP has a small but important impact on the river during low flow periods, however comparison of the nutrient loads released from the STP to those present in the river during low flow periods would provide a better assessment of the situation.

Sewage overflows from the sewerage system are reported to be 35 per 100km of sewer main (NSW Performance Report, 2003). The state average is 4 overflows per 100km of main, and as such Kyogle's sewerage system performance is poor in this regard. This may be partly due to reporting of minor events and house service line problems. Sewage overflows are known to occur during wet weather when the sewage is diluted by wet weather inflow and groundwater. Trouble spots in the wastewater system include the Collins Street area, where inflow and infiltration works (relining of sewers) is being undertaken to reduce wet weather impacts. Overflows of this nature are likely to cause short term localised environmental issues and public health risks. The impact of sewage overflow to the river during wet weather is likely to be minor compared to river conditions at the time.

3.7 On-site Wastewater Treatment Systems

Approximately 832 on-site sewerage treatment facilities exist within the Kyogle study area. These range from aerated wastewater treatment systems (AWTS) and septics to very basic pit toilets. A summary of the type and distribution of these systems is provided in Table 3-12 and Figure 3-31.

Table 3-12: Kyogle On-site Wastewater Treatment Systems

Catchment	Type of System						
	Septic Tank	AWTS	Primary Treatment Facility	Composting Toilet	Pan Toilet	Pit Toilet	Other
Fawcetts Creek	175	1	35	6	3	7	1
Geneva	22	1	7	-	-	-	-
Golf Course Estate	4	-	-	-	-	-	-
Kyogle South	13	1	2	-	-	-	-
Kyogle Central	3	-	-	-	-	-	-
Richmond River	417	10	88	16	10	10	-
Total	634	13	132	22	13	17	1

[4] Kyogle IWCM Concept Study

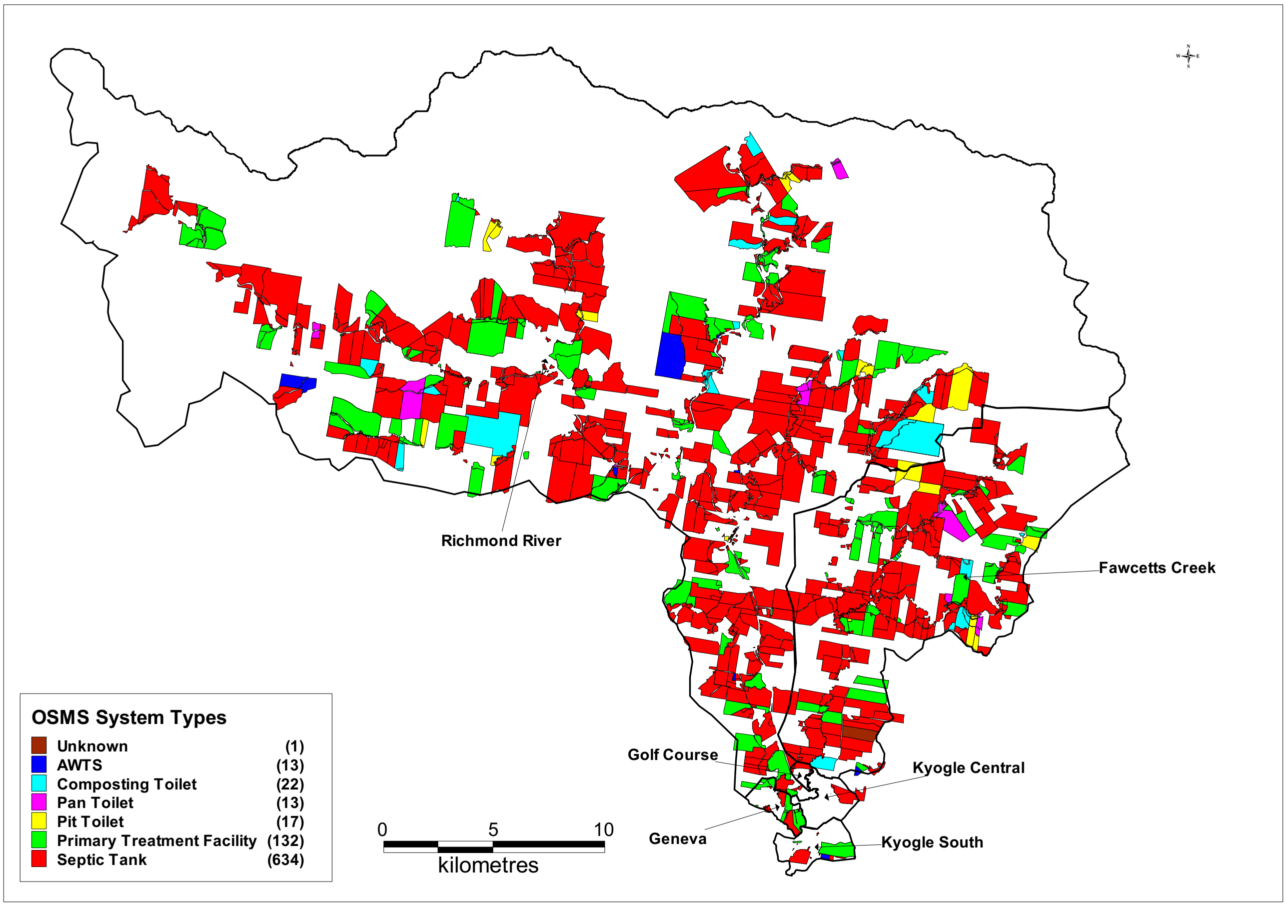


Figure 3-31: Distribution of On-site Wastewater Treatment Systems

Kyogle council has identified risk levels associated with onsite systems in the LGA. The risk levels are influenced by factors such as the type of treatment system, the effluent distribution system and environmental concerns, such as the proximity to a water way and soil type. Table 3-13, shows the risk level posed by the on-site systems present in the Kyogle sub-catchments. It should also be noted that soils within the Kyogle sub-catchment have been identified as having low septic absorption potential (Concept Study p30).

Table 3-13: Risk Level of On-site Wastewater Treatment Systems

Catchment	Risk Level of Systems			
	Low	Medium	High	Unknown
Fawcetts Creek	157	40	18	13
Geneva	17	5	5	3
Golf Course Estate	1	1	2	-
Kyogle South	10	2	3	1
Kyogle Central	3	-	-	-
Richmond River	282	88	131	50
Totals	470	136	159	67

Source: Kyogle Council

Due to the complex nature of nutrient transport from onsite systems, no attempt has been made to empirically determine the impact these systems are having on the nutrient loads or faecal coliform counts in receiving waters. However total environmental input calculations have been carried out for select pollutants leaving the on-site systems.

The methodology utilised to assess the potential impact of on-site wastewater treatment systems on receiving water quality, follows an approach developed by *The Moreton Bay Waterways and Catchments Partnership* for an onsite system audit in the Pine Rivers LGA (MBWCP, 2004). This approach estimated that 10% of septic systems were hydraulically failing.

The results of the mass balance calculations are tabled below.

Table 3-14: On-site Pollutant Loads

Pollutant	Annual Load
Total Nitrogen	12 tonnes
Total Phosphorous	1.5 tonnes
Faecal Coliforms	$8.1*10^{12}$ cfu

The loads are essentially estimates of inputs to the ecosystem. They do not take into account treatment processes which will occur in the biomat within infiltration zones and in the hydraulic pathway leading to the receiving waterway. Also, they do not consider further biological and chemical processes within the catchment and receiving waterways. However, these loads may be compared to the total land runoff nutrient inputs to the catchment. The total nitrogen released from on-site systems represents approximately 1.5% of the total nitrogen entering the catchments waterways. The total phosphorous released from on-site systems also represents approximately 1.5% of the total phosphorous entering the catchments waterways.

The Pine Rivers study estimated that OSS's contribute 2% of the total numbers of faecal coliforms in the catchment, due to the natural treatment and assimilation processes in operation. It is suggested that the contribution of on-site systems on faecal coliform numbers in the receiving waters would be much lower for the Kyogle region due to the lower population density, and higher number of warm blooded animals within the catchment (eg dairy cattle). Interestingly, the study found that surface runoff from greywater irrigation and AWTSs had a greater potential to export nitrogen than surface runoff from the hydraulic failure of septic tanks. This should be considered when assessing the viability of greywater reuse schemes.

It is recognised that localised failure of OSSs may present public health risks and localised environmental damage. As such, it is concluded that the OSS's account for an important, but overall small contribution, to total pollutant loads in the Kyogle LGA.

3.8 Current Water Cycle Management Initiatives

In the development of an IWCM Strategy, it is important that existing water cycle management initiatives are recognised. Some of these initiatives such as water and wastewater treatment systems have been in place for many years and have been effective in providing clean water to drink and protection for the environment. More recent initiatives include water demand, catchment and stormwater management programs.

A summary of existing Council initiatives can be found in Table 3-15 below, and regional, state and national initiatives in Table 3-16 over. The regional, state and national level initiatives provide a context for both the urgency for action and the current direction of water management efforts.

Table 3-15: Current Water Cycle Management Initiatives

Type	Measure	Impact
Local Water Utility Management Plans	Councils are required under the *Local Government Act 1993* to prepare management plans covering their principal activities including water supply, sewerage and urban drainage. Water supply and sewerage business plans are also prepared.	Facilitate effective planning provision of services and inform the State of the Environment reporting.
Development Controls	Identification of flood prone areas and flood levels. Erosion and sediment controls during construction. Individual conditions of consent on significant proposed developments. Guidelines for rainwater tanks.	Assists developers in the planning of new development and building works to minimise risks to the public and property from flooding.
BASIX Implementation	Council is responsible to ensure new development meets the BASIX requirements.	Reduces water and energy demands associated with new development.
Water Treatment	Provision of treated water to the urban community.	Protection of community health
Drinking Water Quality Monitoring	Monitoring of water distribution system water quality and assessment against Australian Drinking Water Quality guidelines. Water quality at the weir pool on the Richmond river is also monitored (refer to Appendix J).	Monitoring of system water quality allows Council to identify water quality issues as they occur and act to ensure that standards are maintained.
Demand management	• Education material - Council Newsletter (monthly) – includes relevant information water services information such as restriction requirements - Information with rates notice and water bills - School classroom presentations - Updated internet site (www.kyogle.nsw.gov.au) • Metered hydrant standpipes (single hydrant at the depot) • Pay for use pricing (single volumetric charge $1.05/kL) • Stormwater presentations to commercial properties.	Reduces water consumption and raises community awareness of the need to save water and the urban water cycle.
Wastewater Management	• Sewerage system operation and maintenance (eg blockage inspections) enhanced by modern electrical equipment and telemetry at pumping stations. • Inflow and infiltration reduction program (relining of troublesome sewers) in place to reduce overflows and improve treatment performance. • Wastewater treatment – effluent from urban sewerage systems is collected and treated at the Kyogle STP. • Best practice wastewater charges.	Protects public health from the risk of uncontrolled wastewater. Reduces water-borne pollutants, nutrients and pathogens entering local waterways.
Wastewater Management	Kyogle Council are working with DEC to meet Pollution Reduction Program at the STP	Will improve the performance of the STP and reduce the impact on the river.
Water Recycling	Indirectly some of the effluent from the STP is reused (irrigation) by an adjacent farmer.	Reduces water-borne pollutants, entering the river and reduces river extractions.

Type	Measure	Impact
On-site wastewater systems	Council's *On site Sewage and Wastewater Management Strategy* provides guidelines and approval requirements for on-site wastewater treatment systems. A compliance officer has been employed to monitor and improve on-site wastewater treatment systems within the LGA.	Reduces risk to public health and the environment from the installation of poorly designed or installed on-site wastewater systems.
Stormwater Management	A stormwater management plan and a flood study have been completed and a program of activities identified and programmed.	Reduces the impact of development on the environment and minimises flooding risks associated with development. Also increases public awareness.
IWCM	Council has initiated the preparation of an IWCM Strategy Study.	Will facilitate effective integrated planning of urban water services.

Table 3-16: Current Regional, State and National Water Cycle Management Initiatives

Level	Initiative	Description
National	Water Reforms	In 1994, the Council of Australian Government agreed to a water reform agenda that addressed: • Cost recovery and pricing • Institutional reform including the streamlining of water legislation • The introduction of allocation and trading • Greater focus on the environment and water quality • Improved public consultation and education. In June 2004, the Commonwealth and five of the seven states (including NSW) agreed to build upon the 1994 reforms by agreeing to the National Water Initiative (NWI). The NWI seeks to bring about: • The expansion of permanent trade in water • An increase the confidence for those investing in the water industry • The utilisation of more sophisticated, transparent and comprehensive water planning processes • A timely resolution of the issue of over-allocated systems • Better and more efficient management of water in urban environments.
National	National Water Efficiency Labelling Scheme	A Water Efficiency Labelling Scheme (WELS) for toilets, washing machines, shower roses, taps, urinals and dishwashers was introduced in 2005. The scheme will become mandatory in 2006 and requires all water using fixtures and appliances in the above categories to display a label indicating the water efficiency rating.
State	Implementation of Water Reforms	In response to the 1994 COAG Water Reform Agenda, NSW has embarked upon a comprehensive suite of water reforms based on an integrated and sustainable approach to natural resource management, including: • Volumetric conversion • Water transfer market • Catchment management boards and water management committees • Updating water legislation • Other matters eg weir review, pricing policy, Healthy Rivers Commission. The blueprint for integrated water cycle management is found within the *Water Management Act 2000* and State Water Management Outcomes Plan.
State	Water Management Act 2000 (WMA)	The WMA requires that in sharing water resources the fundamental health of the State's water systems has first priority. A healthy water system is sought through establishment of Water Sharing Plans. The potential for the use of reclaimed water is recognised and may as a returned flow provide an effluent credit against the water access licence allocation, or through reuse reduce net extraction and potentially allow trading of the unused allocation. An IWCM strategy may be a condition of use to identify opportunities for reuse and conservation.

Level	Initiative	Description
State	State Water Management Outcomes Plan (SWMOP)	Section 6 of the WMA provides for the formation of the SWMOP. Under the SWMOP targets and strategic outcomes can be set in regard to environmental, social and economic considerations. The SWMOP has five year operational targets set for the Water Management Plans and State Government actions. Targets for 2006 include: • Increased adoption of water efficient and WSUD measures to be met in urban areas • High quality return flows credited against local water utility water access licences where environmental criteria met • Country town water consumption to be reduced by >5% per capita (average state wide basis) • Consideration of all practical options for town water reuse • Peak stormwater volumes to be reduced.
State	NSW Water Conservation Strategy	In October 2000 the NSW Water Conservation Strategy was launched to emphasise the need to value water and improve efficiency in the use of water. The Strategy calls for whole-of-government policy on sewage effluent management and recycling, within an integrated water cycle management framework (planning and investment of sewerage, water supply and stormwater services). 19 strategies an 55 actions to promote water conservation are identified, including incentives, research, education, promotion of water efficient devices and water management initiatives.
State	Catchment Management Authorities Act 2003 (CMAA)	Thirteen Catchment Management Authorities (CMAs) have been established across the state to ensure that regional communities have a say in how natural resources are managed in their catchments. The CMAs consist of small skills based bodies drawn from local communities, including local government, indigenous people, landholders, irrigators, environmental groups, industry, DNR and DEC. The CMAs have responsibility for river health and water sharing within defined catchments. The CMAs develop Catchment Action Plans which include natural resource standards and targets and also monitor the operation of the Water Sharing Plans. During the integrated management process the local water utilities should have ongoing contact with the CMAs to discuss changes that may be necessary in order to achieve an integrated system.
State	Environmental Planning and Assessment Amendment Regulation 2004 (EP&A Act)	BASIX is a NSW Government initiative that ensures new homes are designed and built to use less potable water and produce fewer greenhouse gas emissions. Each development application for a residential dwelling must be submitted with a BASIX Certificate. The Water Target is determined by the climate of the dwelling's location, not the type of dwelling. For Kyogle LGA the target is 40% reduction.
Regional	Northern Rivers Catchment Management Authority (NRCMA)	The Northern Rivers Catchment Management Authority (NRCMA) covers the Kyogle LGA. The draft Catchment Action Plan (CAP) has been prepared and a refinement phase involving stakeholder workshops undertaken during April to august 2005. Broader community input is now being sought on the refined CAP, prior to finalisation and gazettal.

The Catchment Action Plan (CAP) is currently at the draft stage. This initiative contains targets for IWCM and protecting and repairing the environment (Table 3-16). The success of these initiatives in meeting the stated goals will depend upon a strong commitment from local government, community groups and the state government.

Table 3-17: Draft Northern Rivers Catchment Action Plan Water Management Targets

CAP Water Management Target	Mechanisms and Activities
W1 - By 2016, rehabilitate and protect the stream health of 60% of stream length	Actions which assist the reduction of bed and bank erosion., rehabilitation of channel structure and the condition and function of riparian zones, for example: • Community education and capacity building • Expert project and scientific advice • River plans for priority areas • Encourage extractive industries to adopt Best Practice • Implement stream bank rehabilitation plans, property vegetation plans, protection and stabilisation structures, fish passages • Protection of riparian vegetation and establishment of regional corridors
W2 – By 2016, all local water utilities to have undertaken integrated planning management for water systems, with 33% implemented.	Target is based on maximising benefits, and reducing negative impacts that can occur with urban water supply and wastewater. It aims at an effective, efficient and productive means of using urban water through appropriate planning. For example: • Maintain and enhance water efficiency education programs • Develop and implement IWCM plans including urban water supply , wastewater management, re-use of effluent and stormwater management.
W3 - By 2016, 80% of LGO's participating in co-ordinated and integrated water quality data collection. Included record keeping, use and community awareness.	Actions aimed at increasing community awareness and understanding of catchments. Human impacts, Community participation and reporting are also targeted. • Catchment education initiatives to affect generational change • Participatory water monitoring and reporting • Legislative changes to prevent water pollution
W4 - By 2016, 95% of aquifers are within identified sustainable yields, with 95% of unregulated waters meeting environmental flow requirements.	Aimed at steps required for sustainable extractions of aquifers and surface waters, coupled with improvements to aquatic habitats. • Development and implementation of macro plans for both aquifers and unregulated surface waters • Water efficiency programs.

For details, refer to the Draft Northern Rivers Catchment Action Plan (Sep 2005)

To assist in the consultation process, a draft Surface Water Sharing Plan Report Card has been prepared outlining the proposed water access rules. Information for the Kyogle area is provided in Appendix D.

4. The Baseline Forecast

This section describes the assessment of future water needs based on the current management approach to water services as described in Sections 2 and 3. The demand forecasts prepared in this section will form the basis for comparison with the integrated water cycle management scenarios developed in Sections 5 and 6. To develop the forecasts, future water demand drivers are assessed in terms of impact on water demands. These impacts are then combined with historical production, consumption and wastewater flow figures and balanced with end use information in the Decision Support System (DSS)[5] model to prepare a baseline water needs forecast.

4.1 Demand Drivers and Trends

Future water supply system demands are typically driven by a variety of factors including:

- demographics
- the propagation of water efficient fixtures and appliances
- household income and lifestyle
- residential lot size
- tourism
- non-residential growth
- climate change.

These factors in relation to Kyogle are discussed below.

4.1.1 Future Population Served with Water and Wastewater

Section 3.2.1 outlined historical population trends at Kyogle and adopted a future population growth of 0.5% per annum for this study. In order to estimate the future estimated residential population (ERP) served with water and wastewater facilities, it has been assumed that the 2001 proportion of population served with water and wastewater to township population remains constant.

The resulting populations served with town water and wastewater facilities are plotted below.

[5] The DSS is a combined end use and least cost planning model. Refer to the user manual (DLWC, 2002) for further details.

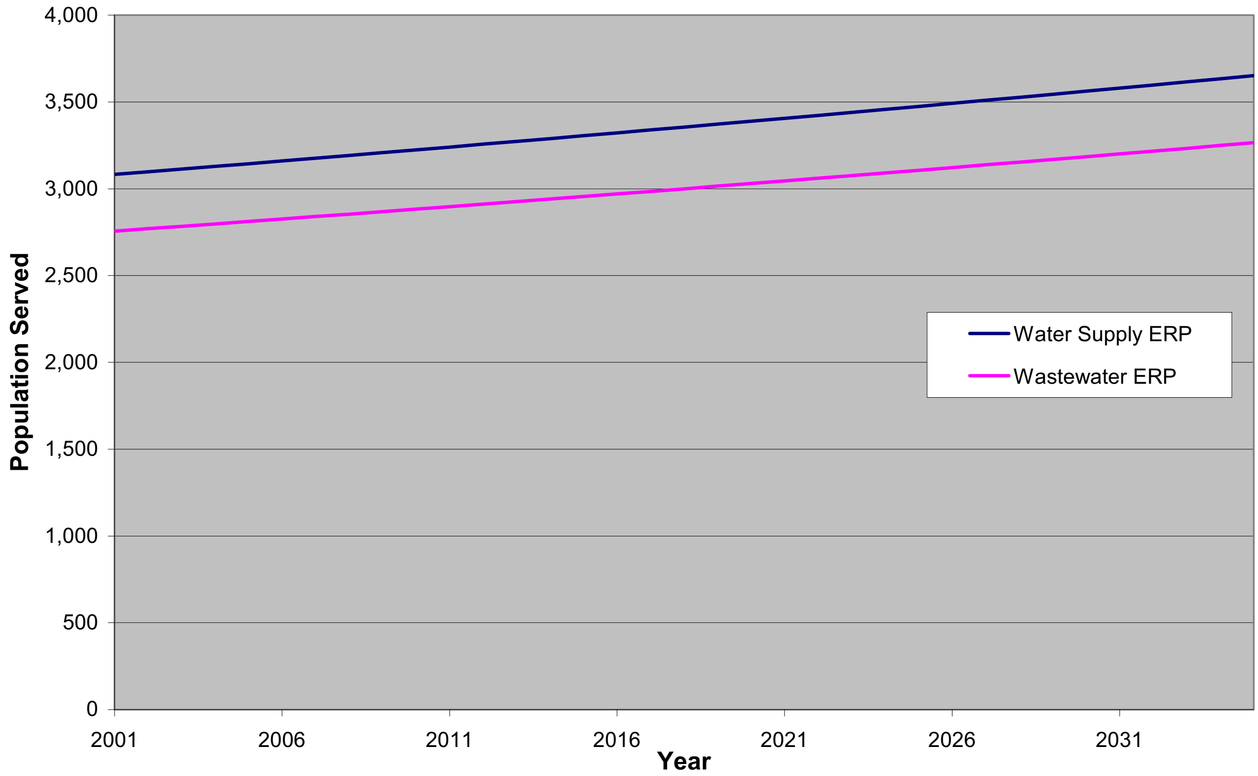


Figure 4-1: Population Served with Water and Wastewater Forecasts

Table 4-1 summarises the population change over the 30 year planning horizon.

Table 4-1: Future Populations

Population (ERP)	2005	2010	2015	2020	2025	2030	2035
Kyogle Township	2,790	2,865	2,935	3,010	3,085	3,165	3,245
Population served with town water	3,145	3,225	3,305	3,390	3,475	3,560	3,650
Population served with reticulated wastewater	2,810	2,880	2,955	3,030	3,105	3,185	3,265

4.1.2 Dwelling Types and Occupancy Rates

For the purpose of preparing demand forecasts, it has been assumed that the proportions of dwelling types in 2001 (Section 3.2.4) will remain constant in the future.

An asymptotic decrease in household size is forecast (Figure 3-3). The residential persons per account is assumed to remain in line with this trend. This forecast decline in household and account sizes (Table 4-2) will increase the dwelling and accounts formation rate above the rate of population growth.

Table 4-2: Future Household and Residential Account Sizes

Residential Persons	2005	2010	2015	2020	2025	2030	2035
Household size (persons per dwelling)	2.38	2.32	2.28	2.26	2.24	2.23	2.22
Account size (persons per account)	2.75	2.69	2.65	2.62	2.61	2.60	2.59

4.1.3 Urbanisation

The Settlement Strategy (KSC, 2005) identifies current urban areas and areas for urban expansion within the LGA. Based on the Settlement Strategy, there are 1,169 developed residential lots and 45 vacant residential lots in Kyogle (including Geneva). There are 95 developed commercial lots and 25 developed industrial lots. Between 1994 and 2003 the average number of dwelling approvals in Kyogle was 4.8 dwellings (includes dual occupancy and flats) per year.

In addition to the current vacant lots and infill areas, the following preferred new areas for future urban growth have been identified:

1. North Kyogle (Homestead) – total 36Ha.
2. Southeast Kyogle (Craig Street) – total 65Ha.
3. Golf Course (rural residential lots) – total 20Ha.

The main areas for future urban development are shown in Figure 4-2.

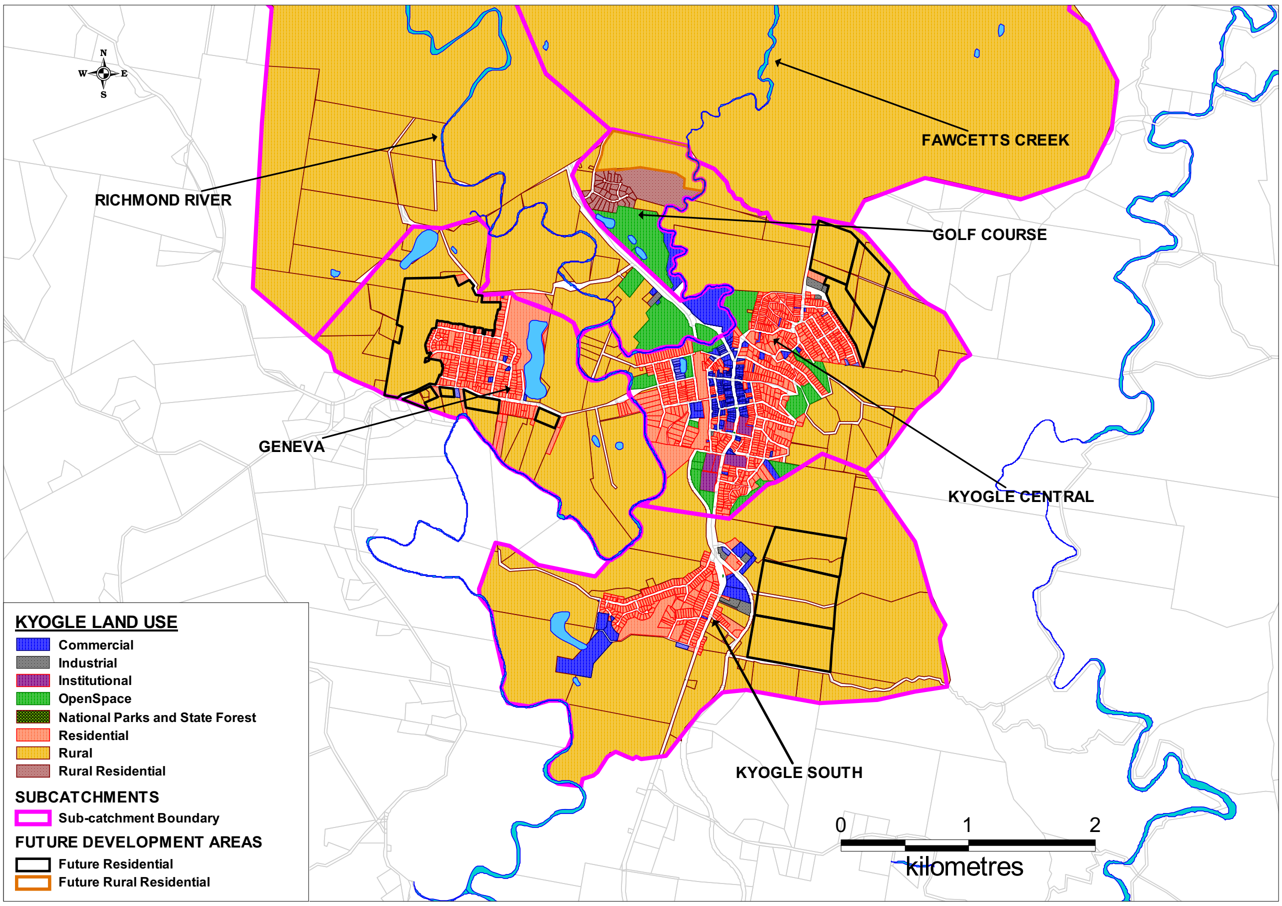


Figure 4-2: Future Urban Areas

In order to provide a ballpark estimate of the ultimate future residential lot numbers, the typical existing lot yield in Kyogle has been estimated at 7.8 residential lots per gross hectare and 3.8 rural residential lots per gross hectare using GIS cadastre information. These yields result in the following potential additional residential lot numbers from vacant, infill and preferred urban growth areas:

1. Potential residential lots – 585 lots.
2. Potential rural residential – 74 lots.

Assuming a future household size of, say, 2.2 persons per dwelling, Kyogle township's potential population based on the abovementioned residential lot numbers is more than 4,000. This indicates that the future identified areas for residential development should adequately provide for the adopted Year 2035 township population of 3,245 (Table 4-1).

For baseline forecasting, it has been assumed that the identified future residential and rural residential settlement areas are to be provided with town water and wastewater facilities. The associated future residential account numbers served with water and wastewater facilities are assumed to be driven by the population and persons per account forecasts.

4.1.4 Residential Lot Size

It is often observed that water demands increase with increasing lot size, due primarily to an associated increase in external water demands.

A coarse analysis of the water usage associated with varying size residential lots has been made on the water system model using GIS software (MapInfo). The distribution of residential lot sizes is plotted in Figure 4-3.

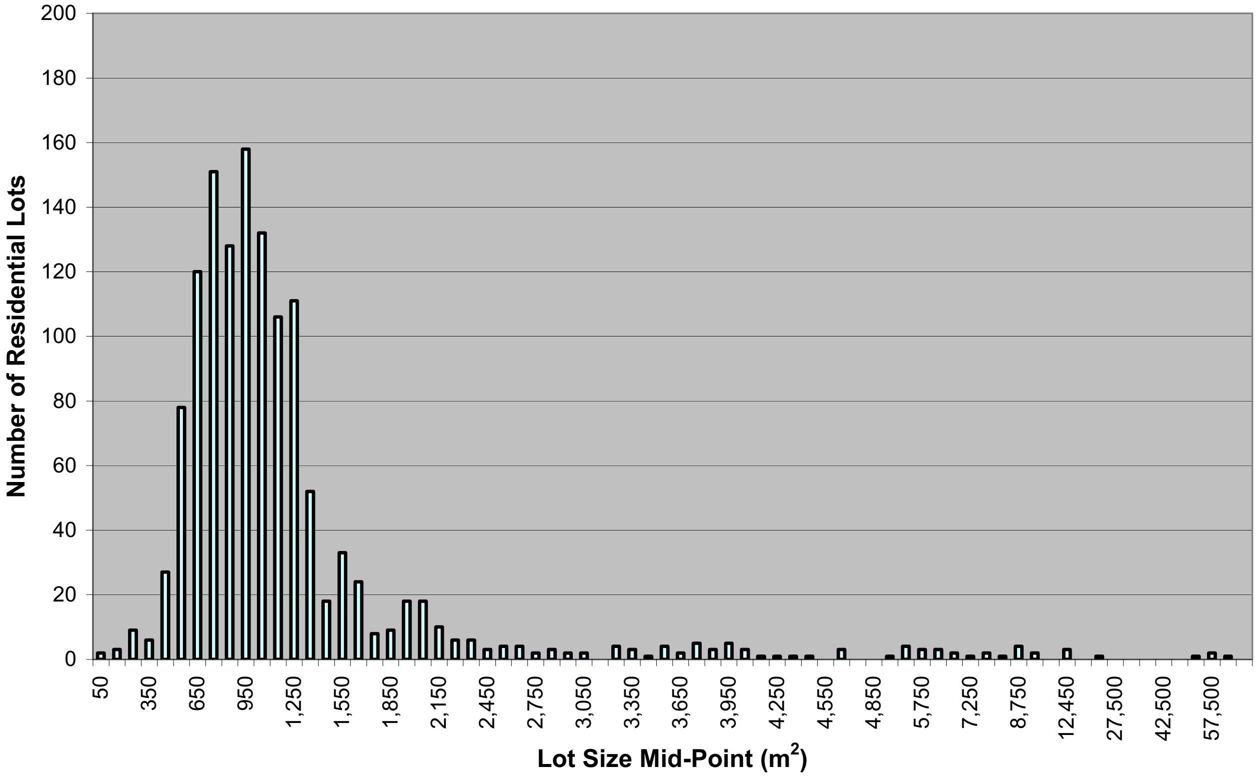


Figure 4-3: Kyogle Residential Lot Size Distribution – Area Served with Water

Typical residential lots vary between 700m² and 1,300m² in size. Township areas representative of typical lot size were selected and average annual consumption for 2004 (kL/a) determined from GIS consumption records (Figure 4-4).

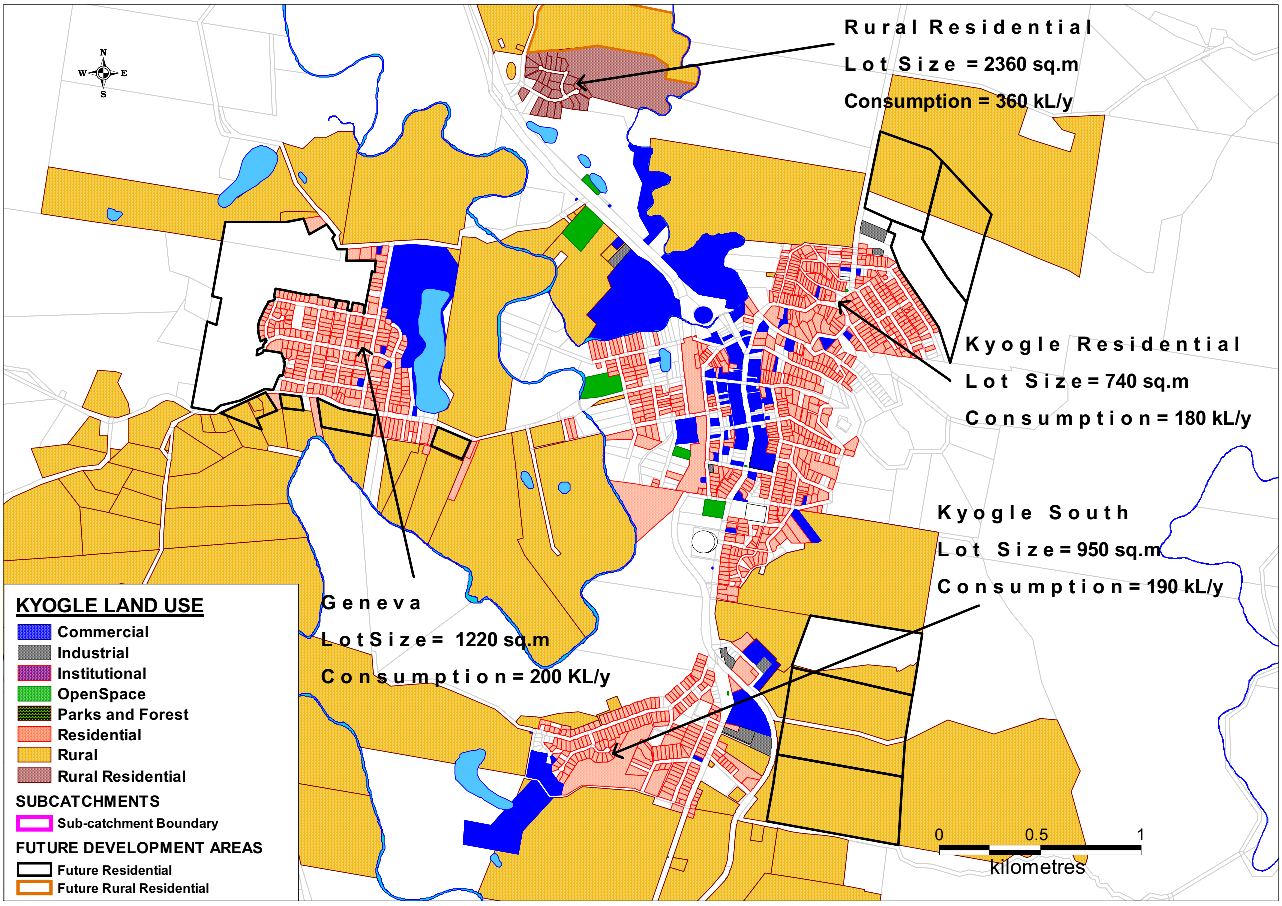


Figure 4-4: Typical Lot Water Consumption

The 2004 consumption figures are comparative only, as restrictions were in place during this period, and the GIS consumption figures provided for the study, require updating. However, based on the typical lot type analysis shown in Figure 4-4, it is observed that water demands appear to increase with increasing lot size. This is particularly the case for the larger rural residential lots. The increase in demands may be associated with larger and newer larger grassed areas and gardens to irrigate and establish, as well as increased wealth and lifestyle expectations.

Should the new release areas follow a trend towards larger residential lot sizes, then there is the potential for an increase in per capita consumption. At this stage, it is assumed that the current proportions of residential lot sizes, including rural residential lots, will remain constant in the future.

4.1.5 The Propagation of Water Efficient Fixtures and Appliances

Appliance ownership figures for dishwashers, washing machines and toilets show that there is a natural tendency for more water efficient fixtures and appliances to increase in popularity (Wilkenfeld 2002). This trend towards increasing appliance efficiency is anticipated to continue into the future and will result in changes in household water use per account.

In addition, the implementation of the new national Water Efficiency Labelling Scheme (WELS), for the mandatory labelling of appliances and the Building Sustainability Index (BASIX) for new developments is anticipated to further increase the market uptake of water efficient fixtures and appliances. Estimate of the impact on usage (prior to WELS and BASIX) are shown in Figure 4-5 to Figure 4-6. WELS and BASIX will further increase the uptake of water efficient fixtures and appliances, particularly showerheads and washing machines.

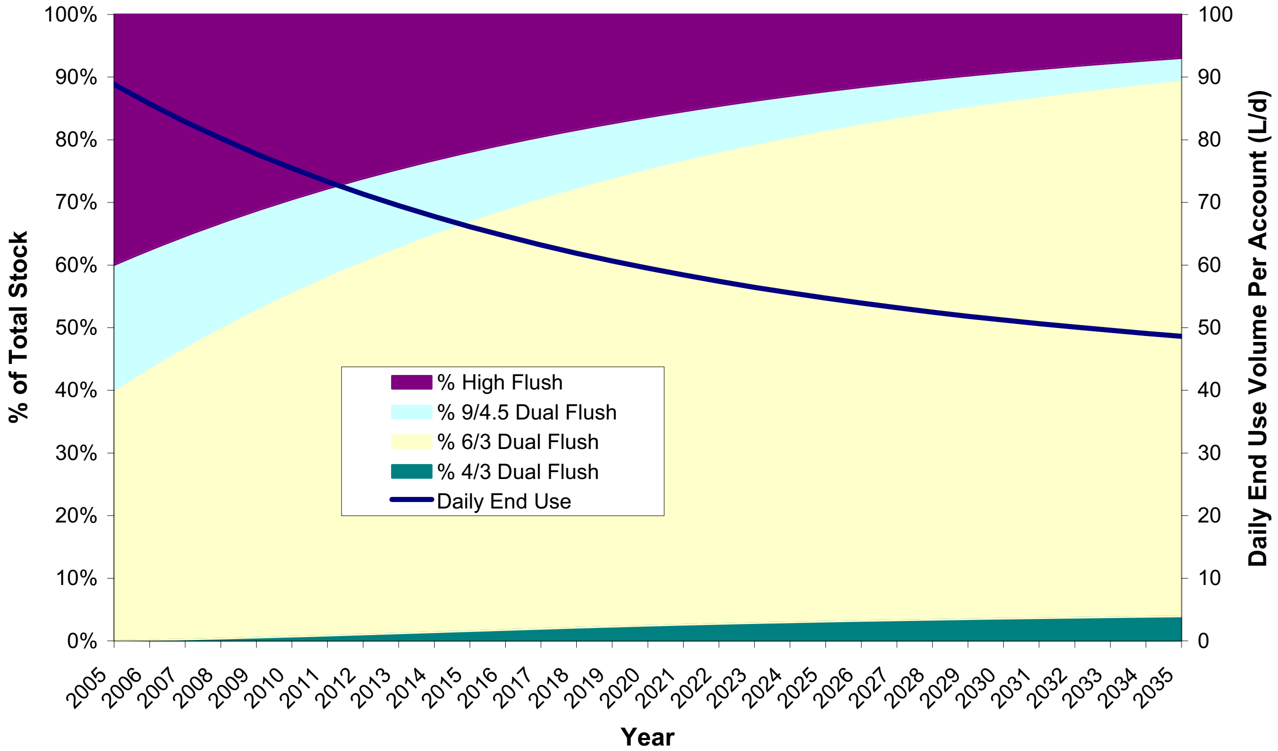


Figure 4-5: Forecast Toilet Installation – Residential

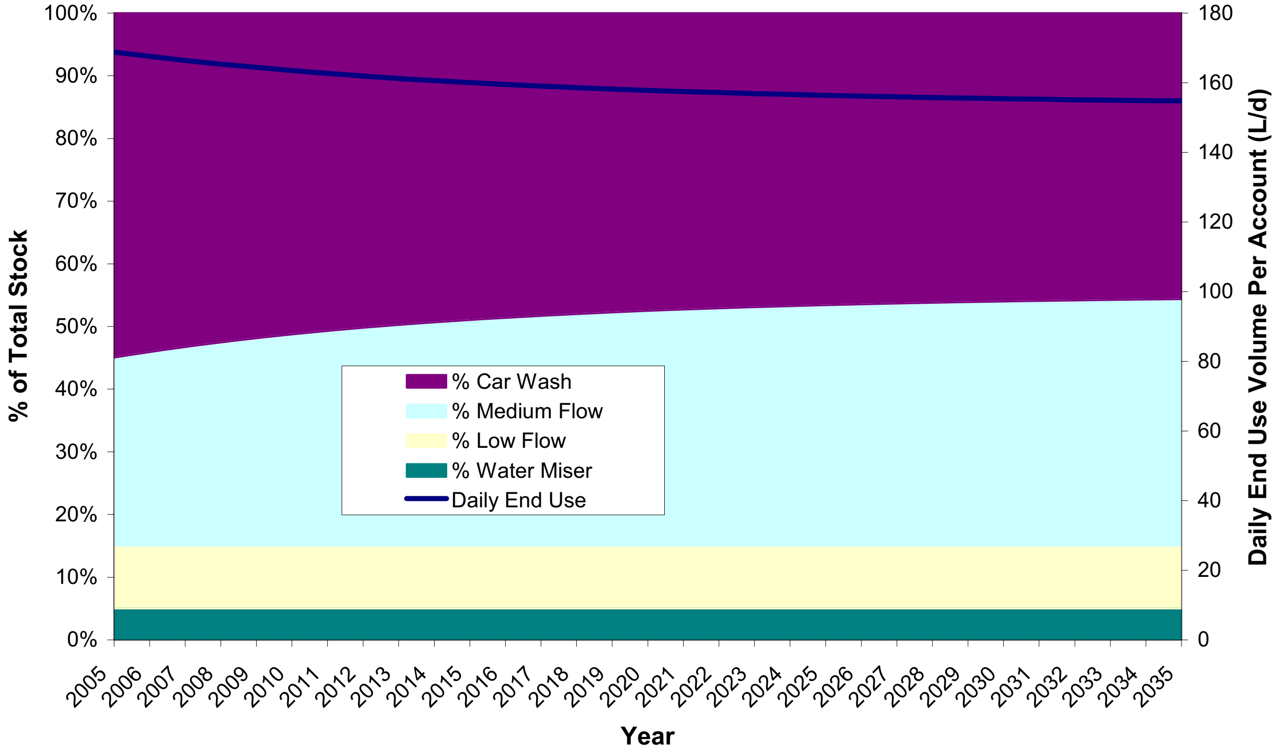


Figure 4-6: Forecast Shower Installation – Residential

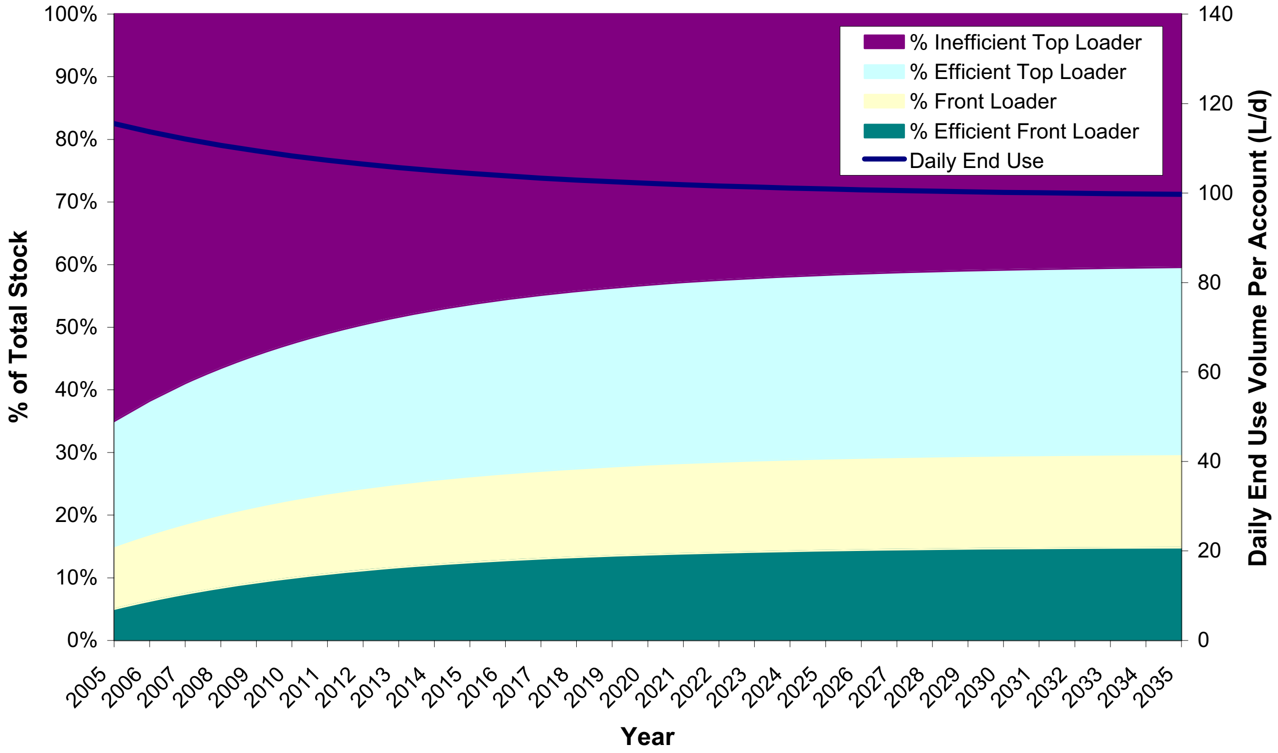


Figure 4-7: Forecast Washing Machine Installation – Residential

As the WELS and BASIX programs are now in place, their influence on demand forecasts will be included in the baseline case. Table 4-3 outlines the assumptions made for these programs.

Table 4-3: WELS and BASIX Water Savings Assumptions

<table>
<tr><th>Option</th><th>Description</th><th>Assumed Market Penetration</th><th>Assumed Water Savings</th></tr>
<tr>
<td>Water Efficiency Labelling Scheme (WELS)</td>
<td>2006 will see the introduction of a mandatory water efficiency labelling scheme for toilets, washing machines, shower roses, taps, urinals and dishwashers.[1]</td>
<td>Assumed to impact on residential customers only

Increase the uptake of efficient washing machines by 5%, low flow showerheads by 15%, and efficient tap fixtures by 5% for new accounts and 1% per year for existing accounts.</td>
<td>Average water use reductions of 20% for taps.

Showerheads and washing machines tabled below:
Showers:
<table>
<tr><th>Name</th><th>Volume per Use (Litres)</th><th>Installation Cost - New Account</th><th>Installation Cost - Replacement Account</th></tr>
<tr><td>Water Miser</td><td>40</td><td>$50</td><td>$50</td></tr>
<tr><td>Low Flow</td><td>49</td><td>$20</td><td>$20</td></tr>
<tr><td>Medium Flow</td><td>70</td><td>$10</td><td>$10</td></tr>
<tr><td>Car Wash</td><td>91</td><td>$10</td><td>$10</td></tr>
</table>
Washing Machines:
<table>
<tr><th>Name</th><th>Volume per Use (Litres)</th><th>Installation Cost - New Account</th><th>Installation Cost - Replacement Account</th></tr>
<tr><td>Efficient Front Loader</td><td>80</td><td>$1,000</td><td>$1,000</td></tr>
<tr><td>Front Loader</td><td>100</td><td>$900</td><td>$900</td></tr>
<tr><td>Efficient Top Loader</td><td>130</td><td>$700</td><td>$700</td></tr>
<tr><td>Inefficient Top Loader</td><td>150</td><td>$600</td><td>$600</td></tr>
</table>
</td>
</tr>
<tr>
<td>Building Sustainability Index (BASIX)</td>
<td>The Building Sustainability Index applies to all new residential development and re-development. Kyogle lies within the 40% target savings area of the State. The savings can be through landscaping, fixtures and alternative water supplies (eg rain and greywater).</td>
<td>Impacts new residential customers. For this study it is assumed that adequate points will be gained through using efficient taps/sinks, efficient showerheads and rainwater tanks.

Taps/sinks Impacts 80% of new residential accounts.

Efficient showerheads (see adjacent market share tables).</td>
<td>Average use reductions of 20% for taps.

Showerhead savings as per WELS.

Showerhead Market Shares:
Code Influenced New Appliance Market Shares
<table>
<tr><th>Year</th><th>Water Miser</th><th>Low Flow</th><th>Medium Flow</th><th>Car Wash</th><th>Total</th></tr>
<tr><td>2005</td><td>5.0%</td><td>10.0%</td><td>40.0%</td><td>45.0%</td><td>100.0%</td></tr>
<tr><td>2006</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2016</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2026</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2036</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2046</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
</table>
Code Influenced Replacement Appliance Market Shares
<table>
<tr><th>Year</th><th>Water Miser</th><th>Low Flow</th><th>Medium Flow</th><th>Car Wash</th><th>Total</th></tr>
<tr><td>2005</td><td>5.0%</td><td>10.0%</td><td>40.0%</td><td>45.0%</td><td>100.0%</td></tr>
<tr><td>2006</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2016</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2026</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2036</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2046</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
</table>
</td>
</tr>
<tr>
<td>BASIX – Rainwater Tanks</td>
<td>BASIX related installation of rainwater tank systems with pump and top-up feed from the potable system.

Roofwater used for general outdoor use, toilet flushing and cold water supply to the washing machine.</td>
<td>90% of all new residential accounts.</td>
<td>70% average reduction in targeted water uses (toilets, washing machines and outdoor).</td>
</tr>
</table>

1. For this study it has been assumed that the WELS scheme will have a negligible impact on toilet sales. This is because the current standard for toilets in Australia is the 6/3 dual flush toilet and that efficiency labelling for toilets is currently almost universal under the voluntary scheme.
2. BASIX overrides other planning provisions which aim to reduce mains-supplied potable water (NSW Govt, 2006).

4.1.6 Household Income/Lifestyle

A number of studies undertaken in Sydney, Melbourne and Perth over the past two decades give clear indications that increasing income can be correlated with increasing water use. In time series analysis models (SMEC 1991, Astley 1992 and Draper 1994) changes in income were linked to per capita and per household consumption. In cross-sectional analysis work, clear income elasticities of demand have been identified as a driver in consumption per household (Montgomery Watson 1995). These results lead to the conclusion that, as real incomes rise, household water usage will also rise.

Lifestyle changes are also expected to influence the way water is used. In particular, it is assumed that discretionary water usage will increase.

Historical average individual annual incomes based on census data for the Kyogle LGA, are plotted in Figure 4-8. In the absence of disposable income data, consumer price index (CPI) correction to household income values (to 2005), are also plotted.[6]

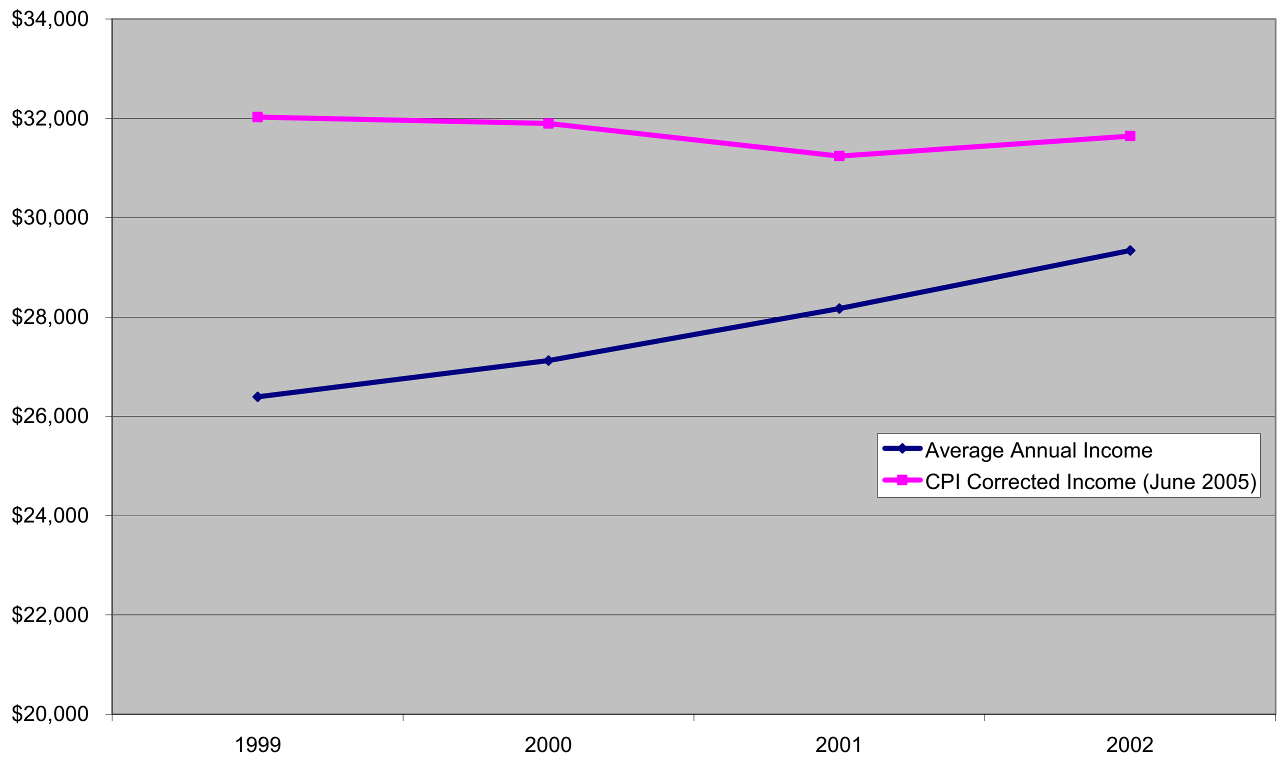


Figure 4-8: Average Individual Annual Income

It is observed that historical average individual annual incomes have been generally increasing. However, when the CPI is considered, relative incomes have generally remained constant. As such, household income is not anticipated to be a strong driver for increasing water demands at this time, however, as there is a general nation wide trend for increasing wealth, it is worth monitoring in the future.

[6] The CPI correction is based on the ABS eight Australian capital city CPI figures, making the results somewhat uncertain for rural areas.

4.1.7 Tourism

Most tourists to Kyogle are anticipated to be day visitors and as such are not expected to generate a significant demand for water. Special community events, such as the annual rodeo may result in short term and temporary increases in water demands and wastewater flows.

4.1.8 Non-residential Growth

Significant non-residential growth has not been identified in previous water supply investigations. In recent times, Council has not received any development applications for significant non-residential developments. Individual applications and system capacity will be considered if and when applications are received. For the purposes of preparing the long term forecasts, it will be assumed that the non-residential demand sectors will increase in line with township population growth.

4.1.9 Climate Change

The prospect of global warming and the associated change in climate has implications for water demands. The current consensus amongst climate scientists is that the climate change associated with the greenhouse effect will be an increase in summer temperatures and a decrease in rainfall. Forecasts for South East Queensland are for a change in rainfall of between –10% and +5% by 2030 and –35% and +10% by 2070. (CSIRO, 2002). Temperatures are also predicted to increase. However, it recognised that it is difficult to quantify long term climate changes and associated influences on water resources and demands. As such, at this stage it is recommended that climate change be recognised as a potential demand driver and considered as a background factor when seeking balanced water management strategies.

4.1.10 Demand Driver Impact Summary

Preliminary assessment of the trends in demand drivers has been made. A summary of the anticipated impacts on water supply demands, including per capita demands is provided in Table 4-4.

Table 4-4: Impact of Demand Drivers

Driver	Expected Change	Demand Impact		
		Residential	Non-Residential	Per capita
Population	Increase	Increase	No change	No change
Non-residential Growth	Increase in line with residential growth	No change	Increase	No change
Household Size	Decrease, results in increased account formation	Increase	No change	No change
Housing Mix	No change	No change	No change	No change
Residential lot size	Not likely to result in a significant impact, unless there is a trend to large lot development approval.	No change	No change	No change
Market share of efficient fixtures and appliances	Increase	Decrease	Decrease	Decrease
Household income	No change	No change	No change	No change
Lifestyle	Increase in discretionary water use (residential baths, dishwashers and external, and non-residential external).	Increase	Increase	Increase
Tourism	Increase – below rate of population growth	No change	No change	No change
Climate change	Increase in temperatures, decrease in rainfall	Potential increase	Potential increase	Potential increase

The DSS model quantifies the impacts of population growth, associated non-residential growth, changing customer account size and water using fixture stock numbers on water demands. Discretionary per capita water usage associated with change in drivers such as household income and lifestyle can be modified in the DSS, if warranted. In this case it has been assumed that the increase in discretionary water usage associated with lifestyle changes will be balanced by the change in the market share of water efficient fixtures and appliances.

There is also a potential increase in per capita demands associated with climate change. However, noting the conservative population growth forecast adopted (higher than historically observed population growth, Section 3.2.1), at this stage, without the introduction of demand management measures, it is assumed that per capita demands will remain constant in the future. It is recommended as improved production, consumption and income data, as well as improved climate change forecasts, become available in the future, that these assumptions be reviewed.

4.2 Wastewater Production Forecasts

Historical wastewater flows and loads were discussed in Section 3.6. Broadly speaking wastewater flows are generated from two sources:

1. Wastewater from potable water usage within a residence or non-domestic building eg showers, toilets, taps/sinks and trade waste.
2. Inflow and infiltration (II) into the sewer system from groundwater via leaky pipes, house-service plumbing and poor pipe connections, rainwater via illegal stormwater connections, and surface runoff via manhole covers.

Release of sewage from the wastewater system can also occur to the environment via exfiltration from sewers in poor condition and overflow or surcharge from constructed overflows and sewer covers.

The DSS estimates average dry weather wastewater flows (ADWF) generated from internal water usage. This allows reductions in wastewater production associated with demand management activities to be estimated. For instance, the reduced wastewater volume associated with improved efficiency fixtures and appliances can be estimated within the DSS.

Estimation of wet weather flow and rainfall derived II, are also included in the DSS through an annual average flow factor and peak daily wet weather factor. These factors are based on historically observed total system ratios and for the baseline wastewater flow forecasts are assumed to remain constant into the future. The DSS contains an II program sheet which allows the benefits of II programs to be estimated.

No significant change to the nature of development connected to the wastewater system is anticipated. With increasing water efficiency, the impact on pollutant loads is considered negligible for the purposes of forecasting.

4.3 Urban Stormwater and Catchment Interaction

Simplified annual water balances and pollutant load estimates (primarily based on MUSIC modelling) for the urban catchments and Upper Richmond River have been prepared (Section 3.4). The baseline forecast estimates have been prepared assuming no significant change in stormwater and catchment management practices in the future.

For the development of IWCM scenarios, it is worth noting that improved stormwater management practices will lead to improved stormwater quality and reduction in stormwater peak flows. Some stormwater management activities, such as water sensitive urban design (WSUD), can influence town water demands. For example, household based landscaping, selection of water tolerant plant species and stormwater harvesting from on-site detention systems can reduce outdoor water usage. Conversely the use of rainwater tanks will reduce peak and average stormwater flows. In these cases, the interaction between the stormwater/catchment systems, town water supply and the wastewater systems may also be estimated.

4.4 DSS Model Development and Preliminary Projections

Baseline town water demands and STP wastewater inflow forecasts have been developed adopting the assumptions discussed in this Sections 4.1 and 4.2 . Peaking ratios on external water usage (residential outdoor and non-residential seasonal) have been adjusted (Table 4-5) in order to model the observed overall peak to average daily demand ratio determined previously as 3.4 (Section 3.3.4).

Table 4-5: Peak to Average Daily Demand Profiles

Adopted Peak Ratio		Resulting Current Peak Period Demands				
Description	**Peak to Average Ratio**	**Consumer Category**	**Units**	**Average Day Water**	**Peak Day Water Demand**	**Peak to Average Ratio**
Residential Outdoor	10.0	Residential	L/d/account	612.2	1,848.0	3.0
Non-Residential Seasonal	10.0	Commercial	L/d/account	779.6	2,112.8	2.7
Customer Leakage	1.0	Industrial	L/d/account	2,078.8	5,633.6	2.7
		Institutional	L/d/account	2,111.8	7,528.6	3.6
		Rural	L/d/account	921.1	6,890.0	7.5
		Open Space	L/d/account	865.0	6,470.2	7.5
		Unmetered	L/d/account	2,925.4	2,925.4	1.0
		Total Consumption	ML/d	1.2	4.1	3.5
		System Losses	ML/d	0.1	0.1	1.0
		Total Production	ML/d	1.3	4.2	3.3

Two forecasts from the DSS are tabled below. Table 4-6 summarises demands and flow forecasts without the influence of BASIX and WELS. As both of these programs are now active and will continue into the future, the baseline forecast has been prepared with BASIX and WELS estimated impacts included (Table 4-7).

Table 4-6: No BASIX/WELS Forecast

No BASIX/WELS Forecast Demand/flow	2005	2010	2015	2020	2025	2030	2035
Per Capita Water Demand (L/c/d)	400	400	400	400	400	400	400
Annual Water Demand (ML/a)	459	471	483	495	508	521	534
Peak Day Water Demand (ML/d)	4.2	4.5	4.8	5.0	5.2	5.4	5.6
STP Annual Inflow (ML/a)	318	317	319	323	328	334	341
STP ADWF (ML/d)	0.8	0.8	0.8	0.8	0.8	0.8	0.8
STP PWWF (ML/d)	9.3	9.7	10.0	10.3	10.6	10.9	11.2

Table 4-7: Baseline Forecast (includes BASIX and WELS)

Baseline Forecast Demand/flow	2005	2010	2015	2020	2025	2030	2035
Per Capita Water Demand (L/c/d)	400	393	387	383	379	377	374
Annual Water Demand (ML/a)	459	462	467	473	481	490	499
Peak Day Water Demand (ML/d)	4.2	4.5	4.7	4.9	5.1	5.3	5.5
STP Annual Inflow (ML/a)	318	313	311	313	316	321	327
STP ADWF (ML/d)	0.8	0.7	0.7	0.7	0.7	0.7	0.8
STP PWWF (ML/d)	9.3	9.7	10.0	10.3	10.6	10.9	11.2

The current average sewage flow generated using the end use model (318ML/a) is higher than the currently observed average inflow (257ML/a, refer to Section 3.6). The differences are likely to be influenced by the following:

1. The current per capita water demand influenced by water restrictions, is around 300L/person per day. The adopted strategy consumption is 400 L/person per day and will result in generation of higher wastewater flows than currently observed.
2. Assumed wastewater flow contributions from un-metered connections (50% of un-metered demands) in the end use model.

It is also interesting to note that there has been a recent increase in the observed base flow entering the STP (refer to Section 3.6)

5. IWCM Scenario Establishment

This section outlines the establishment of the IWCM scenarios and their associated water cycle projections. Each IWCM scenario represents a combination of water supply, wastewater, stormwater and catchment management options in response to the urban water issues identified in Section 2. The options were identified through previous studies, including the Concept Study, the PRG and the Project Team. Each option was discussed and ranked using environmental, social and economic criteria determined by the PRG. The IWCM scenarios were then developed through a combination of PRG preferences and technical assessment. The process of developing the scenarios is set out in the figure below.

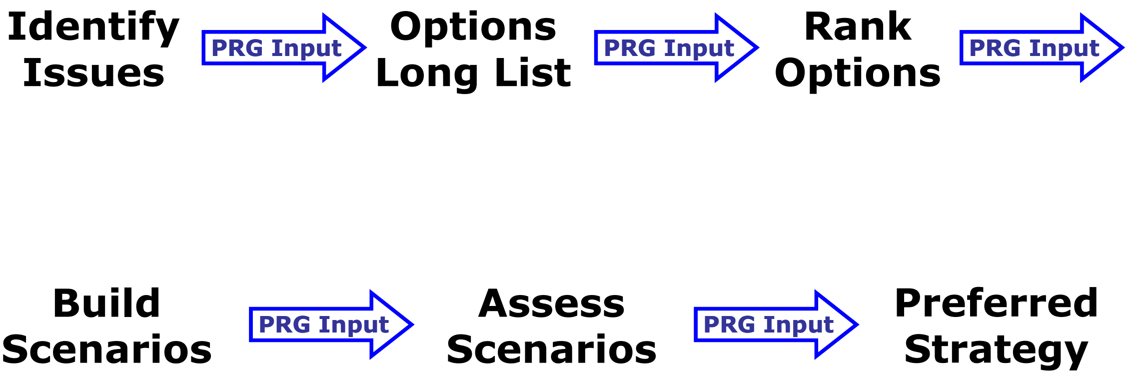


Figure 5-1: Scenario Development Process

Five IWCM scenarios have been built with increasing levels of integration between the urban water services:

1. The Base Case – the case likely to result from the traditional approach of undertaking separate water supply, sewerage and stormwater investigations.
2. Integrated Scenario Level 1 – a low level of integration, targeting new development.
3. Integrated Scenario Level 2 – a medium level of integration, targeting existing development.
4. Integrated Scenario Level 3 – a high level of integration, including targeted recycled effluent use.
5. Integrated Scenario Level 4 – a high level of integration, including recycled effluent use throughout the township.

5.1 IWCM Goals and Assessment Criteria

The IWCM process calls on a triple bottom line (TBL) approach for assessment of potential water management options. In response to this approach, and considering recognised water cycle issues, the PRG developed goals for the Kyogle IWCM Strategy under environmental, social and economic categories (Table 5-1).

Table 5-1: Kyogle IWCM Goals

IWCM Goals	
No.	**Environmental**
1	Improve water quality in the Richmond River
2	Protect environmental low-flows
3	Minimise potable water demand
No.	**Social**
1	Kyogle to be recognised as a responsible water user
2	Community health is maintained and improved
3	A water educated community which is proud of its achievements
4	Affordability of water services
5	Equity throughout the community
6	Reliable and secure services
No.	**Economic**
1	Cost effective water services
2	Provision for and encourage future development

Based on these goals, assessment criteria were developed by the PRG for the purpose of comparing water management options and the IWCM scenarios (refer PRG Workshop 2 Meeting Notes, Appendix A). In all, 41 possible assessment criteria were identified, scored and combined, resulting in eight accepted criteria (Table 5-2).

Table 5-2: Kyogle IWCM Assessment Criteria

Environmental	Social	Economic
• Reduces Pollutants Entering the River • Reduces Extractions from the River • Improves Riparian Zone Health	• Improves Public Awareness • Secures Future Supply • Protects Public Health	• Low Rates and Charges • Low Net Present Value

5.2 Option Short-listing

Catchment, water supply, wastewater and stormwater management issues have been identified at Kyogle (Section 2). There are many different options that can be taken to manage water cycle services in response to these issues. A long list of options was developed through:

- consideration of previous investigations
- ideas relevant to Kyogle from the PRG and Project Team
- recent initiatives within Australia.

In all, more than 130 water management ideas were discussed during the PRG workshops (refer to Appendix A). These options included water conservation approaches (such as water efficient appliances, retrofit and rebate programs, enhanced community education, water pricing and regulations), source substitution initiatives (such as rainwater, greywater and recycled effluent), and water infrastructure based approaches (such as leakage reduction, inflow and infiltration reduction, improved wastewater treatment). Many of the ideas contained similar elements and as such were able to be combined for initial comparison. Options were also grouped under new development, existing development, non-urban areas (catchment areas) and supply side management headings to facilitate consideration of the different application of each option.

In all, 65 options were initially ranked using a multi-criteria analysis tool as shown in Table 5-3 The multi-criteria assessment tool allowed comparison of each of the options against the IWCM criteria. Scoring was carried out during PRG Workshop 3 (Appendix A). Each PRG member ranked options against the IWCM criteria. Scores ranged between -3 (representing an extremely poor outcome for the criteria assessed) and +3 (representing an excellent outcome for the criteria assessed). A score of zero represented essentially no impact. All scores were tallied and averaged for assessment of the options. Standard deviation of scores, to indicate variability across the PRG, were also estimated.

Initially, equal weightings were applied across the assessment criteria. To check the sensitivity of results to each of the environmental, social and economic assessment categories, double weightings were applied (Appendix A).The multi-criteria comparison process enabled:

1. Preliminary consideration of the advantages and disadvantages of each option, through scoring and associated discussion.
2. Ranking of options using the IWCM criteria and testing sensitivity to environmental, social and economic weightings.
3. Demonstration of the PRG's preferences for the types of water management options to be considered further.

Table 5-3: Long List TBL Assessment

Kyogle Integrated Water Cycle Management Strategy
TBL Option Multi-criteria Analysis

MWH

IWCM Option	Overall Rank			
	Equal Weight	Environmental	Social	Economic
New Development				
Mandatory use of rainwater tanks for new development	3	4	4	2
On-site greywater recycling	8	5	10	11
Community IWCM education (promotion/guidelines)	10	16	8	14
Adopt higher BASIX standards	13	26	15	13
Efficiency controls on showerheads and tapware	14	31	18	9
Landscaping/native planting controls	23	34	28	15
Gross pollutant traps	25	13	26	25
Smart sewers (low inflow and infiltration)	26	33	39	18
Water Sensitive Urban Design DCPs	28	28	32	24
Stormwater harvesting	30	18	35	30
Recycled water use through a "third pipe" system	32	17	33	38
Self sufficient new rural development	36	40	36	31
Traditional detention basins	40	36	46	34
Sewer mining	41	41	50	33
Enhanced erosion controls during and after construction	43	47	47	36
Stormwater treatment ponds/wetlands	48	43	43	52
On-site detention	62	60	62	63
Existing Development				
Retrofit of on-site greywater recycling	2	2	3	6
Community IWCM education (promotion/guidelines)	4	7	2	8
Stormwater harvesting	5	3	5	12
Rainwater tank rebate	6	8	9	5
Rainwater tank retrofit program	7	10	6	4
Residential retrofit of showers and tap flow regulators	8	11	7	3
Shared equipment and access funding sources for IWCM	11	22	13	7
Stormwater treatment ponds/wetlands	12	6	12	19
High water user audits	15	32	16	10
Active system leak detection and repair	16	27	23	17
Dual flush toilet retrofit	17	30	24	16
Retrofit of Water Sensitive Urban Design to key areas	20	15	25	21
Retrofit of recycled water system to all areas	22	9	20	35
Reuse effluent at STW (nursery, adj land)	27	21	34	27
Retrofit of recycled water system to key users	29	23	29	28
Washing machine rebate	31	39	31	20
Upgrade of sewage treatment works to allow river discharge	33	14	27	45
Combined STW upgrade and reuse at STW	35	24	30	43
Enhanced conservation signal in water pricing	36	38	22	41
Infiltration and inflow reduction program	39	44	41	32
Litter/organics to stormwater reduction (bins, street clean, bags)	44	48	44	42
Gross pollutant traps	45	37	48	51
Rehabilitation of existing watercourses	46	46	45	48
Community rainwater tanks for general use	50	55	49	39
Septage treatment at STW	54	50	51	57
Improved monitoring of water cycle facilities (incl. on-site & gw))	56	59	54	53
Improved trade waste management	57	58	57	55
Sewer mining	58	56	58	60
Detention basins with low flow release	59	54	60	59
Flood mitigation works in key areas	65	64	66	64
Non-Urban Areas				
Community education/enhanced land care programs	1	1	1	1
Implement macro water sharing plan	17	20	14	21
Improved monitoring of farming practices	19	19	17	23
Protect and rehabilitate riparian zones	21	12	21	26
Increase storage capacity within catchment	24	25	11	29
Establishment of buffer zones alongside significant streams	42	42	42	39
Improve on-site systems	47	49	40	49
Purchase competing licences	51	52	53	44
Return of recycled effluent to point of extraction	52	51	55	47
Revegetation for dryland salinity	53	57	52	49
Erosion and weed controls	55	53	56	56
Improved management of contaminated and landfill sites	60	61	61	54
Remove disused weirs	61	62	59	62
Regulate "horse and house" farm licensing	63	63	63	61
Supply-side Management				
Off stream storage and new/upgrade WTP	34	29	19	46
Transfer of water from Casino, decommission WTP	38	35	37	37
Toonumbah Dam augmented supply and new/upgrade WTP	49	45	38	58
Dam Upper Richmond, regulate flow and new/upgrade WTP	64	65	64	66
Increase capacity of existing weir and new/upgrade WTP	66	66	65	65

Top Ten Option
Bottom Ten Option

Overall, the PRG considered there to be opportunities for a wide range of water cycle management options in Kyogle and as such this wide range of options was carried forward for further assessment.

5.3 Preliminary Option Assessment

Assessment of water cycle management options requires consideration of the application of each individual option. For most water management options this includes assumptions regarding:

1. Extent - the area or number of customers impacted by the activity.
2. Efficiency - the water savings or gains associated with the activity.
3. Cost – including initial setup and on-going costs, to both the customer and water utility.

Further, it is recognised that many of the options are interrelated and when combined their benefits and costs require their interaction to be considered. For instance, the individual water savings associated with education and rebate programs targeting the same end uses cannot be simply added together. Likewise, effluent reuse approaches require consideration not only of water savings but also catchment advantages and disadvantages.

The DSS is the main tool used to assess town water savings and associated costs of IWCM options, both on an individual basis, and when combined within an integrated scenario. The DSS allows development of forecast water demands and wastewater flows, considering each options' impact on end water uses. To assess the impact of IWCM options on urban runoff and pollutant loads, the catchment based approaches used for the baseline assessment in Sections 3.4 and 3.5 are adopted.

5.3.1 Water Savings and Costs

Town water savings assumptions used in the DSS for comparison of the individual options and the five scenarios are presented in the following table. The options considered primarily target external water usage where there is generally the greatest opportunity for potable water savings. Where information is available from existing conservation efforts, these have been used. Where information is not available, reasonable assumptions have been made on the basis of the number of customers affected and the estimated volume of water used in the targeted end use/s. Additional information on source substitution approaches is provided in Appendix E.

Table 5-4: Water Savings and Costs Assumed for each IWCM Option

<table>
<tr><th>Option</th><th>Description</th><th>Assumed Market Penetration</th><th>Assumed Water Savings</th><th>Assumed implementation costs</th></tr>
<tr><td rowspan="2">Water Efficiency Labelling Scheme (WELS)</td><td rowspan="2">2005 will see the introduction of a mandatory water efficiency labelling scheme for toilets, washing machines, shower roses, taps, urinals and dishwashers.[1]</td><td rowspan="2">Assumed to impact on residential customers only.

Increase the uptake of efficient washing machines by 5%, low flow showerheads by 15%, and efficient tap fixtures by 5% for new accounts and 1% per year for existing accounts.</td><td>Average use reduction of 20% for taps.

Showerheads and washing machines tabled below:</td><td>Cost to utility of $500 per year for enhancement of WELS promotional materials and $3,000 setup.

Additional purchase cost to customer of $20 per tap kit.

Showerheads and washing machines tabled below:</td></tr>
<tr><td colspan="2">Showers:
<table>
<tr><th>Name</th><th>Volume per Use (Litres)</th><th>Installation Cost - New Account</th><th>Installation Cost - Replacement Account</th></tr>
<tr><td>Water Miser</td><td>40</td><td>$50</td><td>$50</td></tr>
<tr><td>Low Flow</td><td>49</td><td>$20</td><td>$20</td></tr>
<tr><td>Medium Flow</td><td>70</td><td>$10</td><td>$10</td></tr>
<tr><td>Car Wash</td><td>91</td><td>$10</td><td>$10</td></tr>
</table>
Washing machines:
<table>
<tr><th>Name</th><th>Volume per Use (Litres)</th><th>Installation Cost - New Account</th><th>Installation Cost - Replacement Account</th></tr>
<tr><td>Efficient Front Loader</td><td>80</td><td>$1,000</td><td>$1,000</td></tr>
<tr><td>Front Loader</td><td>100</td><td>$900</td><td>$900</td></tr>
<tr><td>Efficient Top Loader</td><td>130</td><td>$700</td><td>$700</td></tr>
<tr><td>Inefficient Top Loader</td><td>150</td><td>$600</td><td>$600</td></tr>
</table></td></tr>
<tr><td>Building Sustainability Index (BASIX)</td><td>The Building Sustainability Index applies to all new residential development and re-development. Kyogle lies within the 40% target savings area of the State. The savings can be gained through landscaping, fixtures and alternative water supplies (eg rain and greywater).</td><td>Impacts new residential customers. For this study it is assumed that adequate points will be gained through using efficient taps/sinks, efficient showerheads and rainwater tanks.</td><td>Refer to BASIX – Fixtures and BASIX – Rainwater Tanks options below.</td><td>Cost to utility of $5,000 for setup and $1,000 per year for administration.</td></tr>
<tr><td rowspan="2">BASIX – Fixtures</td><td rowspan="2">BASIX related low flow taps and showerheads.</td><td rowspan="2">Taps/sinks impact 80% of new residential accounts.

Efficient showerheads market share change as per adjacent market share tables.</td><td>Average use reductions of 20% for taps.

Showerhead savings as per WELS.</td><td>Additional purchase cost to customer of $20 per tap kit.

Showerhead costs as per WELS.</td></tr>
<tr><td colspan="2">Showerhead Market Shares:
<u>Code Influenced New Appliance Market Shares</u>
<table>
<tr><th>Year</th><th>Water Miser</th><th>Low Flow</th><th>Medium Flow</th><th>Car Wash</th><th>Total</th></tr>
<tr><td>2005</td><td>5.0%</td><td>10.0%</td><td>40.0%</td><td>45.0%</td><td>100.0%</td></tr>
<tr><td>2006</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2016</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2026</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2036</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
<tr><td>2046</td><td>10.0%</td><td>80.0%</td><td>5.0%</td><td>5.0%</td><td>100.0%</td></tr>
</table>
<u>Code Influenced Replacement Appliance Market Shares</u>
<table>
<tr><th>Year</th><th>Water Miser</th><th>Low Flow</th><th>Medium Flow</th><th>Car Wash</th><th>Total</th></tr>
<tr><td>2005</td><td>5.0%</td><td>10.0%</td><td>40.0%</td><td>45.0%</td><td>100.0%</td></tr>
<tr><td>2006</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2016</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2026</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2036</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
<tr><td>2046</td><td>5.0%</td><td>25.0%</td><td>35.0%</td><td>35.0%</td><td>100.0%</td></tr>
</table></td></tr>
</table>

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
BASIX – Rainwater Tanks	BASIX related installation of rainwater tank systems with pump and top-up feed from the potable system. Roofwater used for general outdoor use, toilet flushing and cold water supply to the washing machine.	90% of all new residential accounts.	70% average reduction in targeted water uses (toilets, washing machines and outdoor).	$3,000 cost for a 5,000 L tank and associated installation, $500 per pump and $20 per year pumping costs. Costs to customers based on annual repayments on capital outlay over 10 year pump life and 40 year tank/ plumbing life at 7% pa interest rate. $1,000 per year admin. cost to the Council.
Mandatory use of rainwater tanks on all new development	Mandatory installation of rainwater tank systems (as per BASIX – Rainwater tanks)	100% of all new residential accounts.	As per *BASIX – Rainwater tanks*.	Cost to utility of $2,000 for setup and $1,000 per year for administration. As per *BASIX – Rainwater tanks*.
Rainwater Tank retrofit Program	Council will offer to retrofit rainwater tanks to properties at a subsidised cost. Installation requirements as per *BASIX – Rainwater tanks*.	20% of customers over the planning period (4 years) will accept the offer.	70% average reduction in targeted water uses. Only half of customers will hook up to the toilet and washing machine.	Cost to utility of $5,000 for setup and $3,000 per year for administration. Rainwater tank system costs as per *BASIX – Rainwater tanks*. 20% costs borne by Council.
Community IWCM Education	Council would provide materials, training and technical assistance to implement a comprehensive ongoing community education program focussing on IWCM promotion and guidelines.	50% of residential, commercial, industrial, institutional and parks customers will take note of the program.	1 to 5% reduction in all uses except outdoor use which achieves a 10% reduction for participating customers.	$20,000 cost to setup the program including producing promotional material and advertising. $30,000 cost per year to utility to carry out the program including part time education officer, competitions, town promotions & school visits.
On-site greywater recycling - diversion	Installation of greywater diversion systems with subsurface irrigation as a result of education program.	Impacts 5% of new and existing residential development between 2006 and 2015.	10% reduction in targeted outdoor water uses.	Setup costs covered in *Community IWCM Education*. Additional $1,000 per year for inspections. $500 for simple valve to pump out system and $30/y on-going costs.
On-site greywater recycling – new development	Installation of greywater treatment, storage and plumbing through promotion at time of development.	Impacts 35% of new development.	Targeted water usage reductions: Toilets - 90% Washing machine–50% Outdoor – 20% .	Cost to utility of $2,000 for setup and additional $1,000 per year for administration. $10,500 for new home installation and $300/year on-going costs.

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
On-site greywater recycling – new and existing development	Installation of greywater treatment, storage and plumbing through promotion and retrofit at time of development and major renovations.	Impacts 35% of new development and 18% of existing development over the full planning period.	As above.	Utility, on-going and new home installation costs as above. 20% capital costs borne by Council. $12,500 for installation at new home (assume Queenslander style).
Self sufficient new rural development.	No further new rural development connections to the town water and wastewater systems.	100% new rural development.	100% saving in targeted rural water usage.	$500/y on-going utility administration cost.
Enhanced conservation signal in water pricing	Council will introduce an inclining block tariff for all users. Price in the higher block will be approximately 70% more that in the lower block. An increase in revenue will be offset by a reduction in the fixed charge.	Targeted at residential and rural external water use. All customers will respond to the price signal.	Price elasticity of –0.2 for outdoor and –0.05 for indoor.	$5,000 cost to utility to establish the program.
Residential retrofit	During an audit or upon request, an approved plumber retrofits the shower and toilet in an existing residential housing. The retrofit kit is assumed to contain a low-flow shower head, a dual flush toilet cistern, a tap flow restrictor, tap washers to fix leaky taps, and a pamphlet on how to conserve water and read meters to detect leaks.	Targeting existing residential customers and carried out over three years 2006 to 2008. 5% of participants in the program are free-riders. Market figures tabled below.	Toilet and showerhead water savings tabled below.	Toilet and showerhead utility and customer costs tabled below.

Toilets

Type	% of Accounts by Year 2006	2007	2008	Cost Per Unit	Cost to Utility	Cost to Customer
Convert High Flush to 9/4.5 Dual Flush	1.0%	1.0%	1.0%	$120	$62	$58
Convert High Flush to 6/3 Dual Flush	1.0%	2.0%	1.0%	$350	$182	$168
Convert High Flush to 4/3 Dual Flush	1.0%	1.0%	1.0%	$350	$182	$168
Convert 9/4.5 Dual Flush to 6/3 Dual Flush	2.0%	2.0%	2.0%	$350	$182	$168
Convert 9/4.5 Dual Flush to 4/3 Dual Flush	1.0%	1.0%	1.0%	$350	$182	$168
Convert 6/3 Dual Flush to 4/3 Dual Flush	1.0%	1.0%	1.0%	$350	$182	$168

Showers

Type	% of Accounts by Year 2006	2007	2008	Cost Per Unit	Cost to Utility	Cost to Customer
Convert Car Wash to Medium Flow	1.0%	1.0%	1.0%	$350	$182	$168
Convert Car Wash to Low Flow	1.0%	1.0%	1.0%	$120	$62	$58
Convert Car Wash to Water Miser	1.0%	1.0%	1.0%	$350	$182	$168
Convert Medium Flow to Low Flow	1.0%	1.0%	1.0%	$120	$62	$58
Convert Medium Flow to Water Miser	1.0%	1.0%	1.0%	$350	$182	$168
Convert Low Flow to Water Miser	0.0%	0.0%	0.0%	$350	$182	$168

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
Commercial toilet retrofit	During an audit or upon request, an approved plumber retrofits the toilet cisterns in an existing commercial building.	Targeting existing residential customers and carried out over three years 2006 to 2008. 5% of participants in the program are free-riders. Market penetration as tabled for *Residential retrofit* (toilets).	Toilet water savings as tabled for the *Residential retrofit* (toilets).	Toilet utility and customer costs as table*d for the Residential retrofit* (toilets).
Residential washing machine rebate	Council to provide a $300 washing machine rebate to customers for water efficient washing machines.	Targeting existing residential customers and carried out over three years 2006 to 2008. 5% of participants in the program are free-riders. Market figures tabled below.	Washing machine water savings tabled below.	Washing machine utility and customer costs tabled below.

Washing machines:

Type	% of Accounts by Year 2006	2007	2008	Cost to Utility	Cost to Customer
Convert Inefficient Top Loader to Efficient Top Loader	0.0%	0.0%	0.0%	$300	$500
Convert Inefficient Top Loader to Front Loader	1.0%	1.0%	1.0%	$300	$500
Convert Inefficient Top Loader to Efficient Front Loader	1.0%	1.0%	1.0%	$300	$500
Convert Efficient Top Loader to Front Loader	0.0%	0.0%	0.0%	$300	$500
Convert Efficient Top Loader to Efficient Front Loader	0.0%	0.0%	0.0%	$300	$500
Convert Front Loader to Efficient Front Loader	0.0%	0.0%	0.0%	$300	$500

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
High water users audit	Top users (commercial, industrial and rural) are offered a free audit which includes indoor water conservation measures and development of an irrigation schedule, where applicable. Indoor water savings are realised through low-flow showerheads and taps, toilet water-displacement devices, and leak repair.	Council will conduct an audit of the top 50% of non residential properties across Kyogle over a single year program in 2007.	15% savings in targeted water uses. Diminishing leak reduction savings assumed after 3 years.	$5,000 for Council to setup the program and $10,000 to implement the program.
Install meters on un-metered customer connections	Council continues to install meters on un-metered properties.	50% of assumed un-metered properties.	Assumed to result in a 20% water savings.	$1,000/y administration cost. $300 cost to customer and $15 additional on-going cost

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
Active system leak detection and repair	Council to facilitate a program of identifying water leaks through establishment of 5 district metering areas (DMA) across the supply system.	Leakage assumed to be half of all NRW. Leak detection and repair assumed to be carried out over 10% of 35km of pipe each year.	Reduces leakage by 25% in targeted areas. Loss reduction assumed for 3 years.	$20,000 program establishment cost. $25,000 for establishment of each DMA. $3,000 ongoing administration costs. $300/km detection cost $500/km repair costs
Inflow and Infiltration reduction program	Council to continue with a program to reline and renew sewers with high rain derived inflow and infiltration (II) and associated house services. Smart sewers (low II systems) are assumed for all new wastewater systems.	Target worst 3 kilometres of sewer system (20% each year for 5 years), which is assumed to represent 50% of preventable II.	Assumed to reduce II by 40%.	Program already established. $5,000/year administration costs $300/m repair and renew costs. 5% costs to customers representing illegal connections and plumbing repairs.
Water sensitive urban design (WSUD) development control plans (DCPs)	WSUD DCPs established for new residential developments. It is assumed that DCPs developed at other LGAs will be adapted for Kyogle. The DCP is assumed to reduce outdoor water usage through landscaping, plant selection and on-site stormwater harvesting.	80% of all new residential development.	10% saving in outdoor water usage.	Cost to utility of $2,000 for setup and additional $1,000 per year for administration. $500 additional cost to each customer.
Retrofit of WSUD approaches to key areas	Council to identify opportunities to apply WSUD principles in parks and open space areas to reduce water demands. Opportunities include appropriate landscaping and stormwater harvesting.	Target 10% of existing parks and open spaces over three years (2006 to 2008).	Target 20% average demand and 5% peak demand water savings.	$10,000 establishment costs. $2,000/y additional implementation costs.
Targeted recycled effluent (RE) use	Recycled effluent provided to targeted areas within the township through a "third pipe system". RE to be used for toilet flushing, washing machines, outdoor uses and irrigation.	All new residential customers within the Craig St new residential area, representing 40% of new residential lots. 5% of existing residential customers and 20% of existing rural, commercial, industrial and parks customers over two years (2007 to 2008).	100% reduction in targeted end uses, with the exception of 50% in commercial toilets. Half of the participating existing residential customers include toilet and washing machine reuse.	Establishment, additional treatment and transfer costs, $4M capital costs plus additional $72k per year O&M.[2] Additional customer costs for dual reticulation: *Residential* - $1k (new) and $3k (existing) per account. All *non-residential external* - $0.5k (new) and $1k (existing) per account. *Commercial toilets* - $0.5k (new) and $1k (existing) per account.

Option	Description	Assumed Market Penetration	Assumed Water Savings	Assumed implementation costs
Full township RE use	Recycled effluent would be provided to the township through a "third pipe system". RE to be used for toilet flushing, washing machines, outdoor uses and irrigation.	90% of all new residential customers. 90% of existing residential, rural, commercial, industrial and parks customers over three years (2007 to 2009).	100% reduction in targeted end uses, with the exception of 50% in existing customer toilets and washing machines. Half of the participating existing residential customers include toilet and washing machine reuse.	Establishment, additional treatment and transfer costs, \$9M capital costs plus additional \$72k per year O&M. [2] Additional customer costs for dual reticulation: *Residential* - \$1k (new) and \$4k (existing) per account. All *non-residential external* - \$0.5k (new) and \$1k (existing) per account. *Commercial toilets* - \$0.5k (new) and \$1k (existing) per account.

Notes:
1. For this study it has been assumed that the WELS scheme will have a negligible impact on toilet sales. This is because the current standard for toilets in Australia is the 6/3 dual flush toilet and that efficiency labelling for toilets is currently almost universal under the voluntary scheme.
2. BASIX currently overrides other planning provisions (such as DCPs) which aim to reduce consumption of mains-supplied potable water (NSW Govt., 2006). As such, some the tabled options, such as mandatory rainwater tanks in new developments, may require legislative change to be implemented.
3. For further details on cost estimation refer to Section 6.3.
4. Costs are refined in the development of the preferred scenario, refer to Section 7.2.1.

Reasonable estimates of what it would take to make the approach work have been adopted. As such, the savings become targets based on the full implementation and market penetration assumed. Particularly in the cases where customers are required to spend additional money, rigorous promotion and or/rebates are proposed. Scenario 4 assumes provision of a recycled water system (third pipe) to the entire township. As far as we are aware such a comprehensive system has not been previously achieved for existing development. As such, this scenario represents an extended target for a maximum integrated water management case.

The estimated annual average water savings and indicative annualised costs per kilolitre of water savings for each option are tabled below in order of water savings.

Table 5-5: Individual Option Savings and Costs

Measure Name	Customer Annualised Cost ($/kL)	Utility Annualised Cost ($/kL)	Community Annualised Cost ($/kL)	Average Water Savings (ML/a)
Dual reticulation - Full Recycled Water	$1.66	$3.65	$5.31	176.2
Rainwater for Existing Development	$2.46	$0.71	$3.17	33.4
Dual reticulation - Targeted Recycled Water	$0.78	$11.62	$12.40	29.2
BASIX High level with Rainwater tanks	$1.59	$0.05	$1.64	23.2
Mandatory Rainwater for New and Infill Development	$2.12	$0.06	$2.18	19.2
Enhanced Conservation Signal in Water Pricing	$0.00	$0.02	$0.02	13.7
High Water User Audit Program	variable	$0.09	variable	10.1
Greywater Recycling - New Development and Retrofit	$11.48	$2.13	$13.60	8.5
Self Sufficient New Rural Development	NA	$0.07	NA	7.6
Community IWCM Education	variable	$4.50	variable	6.9
WELS total Program Impact	$0.53	$0.11	$0.64	6.2
Greywater Recycling - New Development Only	$12.87	$0.30	$13.17	3.7
Installing Meters on Unmetered Properties	$0.17	$0.03	$0.20	2.1
Residential Shower Retrofit	$0.41	$0.41	$0.82	2.0
System Water Loss Reduction	$0.00	$8.75	$8.75	1.9
Water Sensitive Urban Design for New Residential Development	$0.00	$4.21	$4.21	1.2
Residential Toilet Retrofit	$1.68	$1.82	$3.51	0.5
Greywater Recycling Promotion	$8.40	$1.42	$9.83	0.4
Commercial Toilet Retrofit	$0.61	$0.66	$1.27	0.3
Residential Washing Machine Rebate	$0.00	$8.27	$8.27	0.1
Water Sensitive Urban Design for Key Existing Development	variable	$15.95	variable	0.1

Notes:
1. Stand alone savings cannot be summed together to estimate total scenario savings, as interactions between measures must be considered.
2. Customer annualised costs are exclusive of any rates impact.
3. Community costs are a combination of customer and utility annualised costs.

Table 5-5 indicates that the greatest water savings are estimated through source substitution methods. Of the conservation approaches, water pricing achieves the highest water savings. Retrofit and rebate programs have generally not achieved substantial water savings. This is partly because WELS and BASIX influence appliance and fixture stocks.

5.3.2 Urban Pollutant Reduction and Catchment Activities

Catchment management and improved wastewater treatment options assumed benefits are provided below.

Table 5-6: Urban Pollutant Reduction and Catchment Management Activity Savings and Costs

Option	Description	Benefits	Costs
IWCM Education	The IWCM education material would include promotion of all IWCM initiatives.	Expected to enhance and sustain other IWCM initiatives.	Refer to Table 5-4.
WSUD	Urban catchment flow control and sediment based treatment practices such as grass swales, buffer strips, cascades and infiltration techniques. Enacted through development controls for new development. Limited stormwater harvesting and management opportunities assumed within existing development areas. Refer also to Appendix E.	For town water savings refer to Table 5-4. Best practice pollutant reduction savings assumed (VSC 1999): • 80% retention of urban suspended solids • 45% retention of urban total phosphorus and nitrogen • 5-10% reduction in annual runoff. • Peak discharge maintained at pre-development levels.	Refer to Table 5-4.
Improved wastewater treatment	Improved wastewater treatment is assumed through upgrade of the current secondary level treatment facilities. The level of upgrade is dependent on the final use of the treated effluent. Three options are considered: 1. Land disposal of all dry weather flow (secondary treatment). 2. Restricted reuse of all dry weather flow (secondary treatment + disinfection). 3. Unrestricted non-potable reuse up to 3 times ADWF (tertiary treatment + disinfection & residual).	All options will reduce pollutant loads to the river compared to current practice. Tertiary treated effluent is also recognised as a return flow to the river.	*Secondary treatment*: $0.9M + add. $10k/y. *Secondary treatment + disinfection*: $1.0M + add. $15k/y. *Tertiary treatment + disinfection & residual*: $2.4M + add. $72k/y. Refer also to Table 5-4 and Appendix F.
Inflow and infiltration reduction program	Reduced wet weather inflow and infiltration through relining and renewal of existing sewers. Adoption of smart sewers in new development areas.	For wastewater flow reductions refer to Table 5-4. Also expected to reduce frequency and volume of sewage overflows.	Refer to Table 5-4.

Option	Description	Benefits	Costs
On-site Wastewater Systems	The small number of remaining township residential properties with on-site wastewater connected to the sewer with private grinder pumps or similar.	All residential properties connected to the sewer system. Reduces public health risks.	Customer costs approximately $3k per property and $50/y O&M.
Catchment management initiatives	A wide range of initiatives primarily aimed at reducing river extractions and pollutants entering the river. Initiatives include: • protection and rehabilitation of riparian zones • implementation of the water sharing plan • improved farming practices • erosion and weed controls • improved on-site wastewater systems • improved management of contaminated land and landfill sites.	Should reduce pollutants entering the river and managed extraction from the river. For the purposes of this study (which seeks an urban water cycle management strategy) the benefits are recognised, but not quantified.	Costs are highly variable depending on the range and extent of activities undertaken. Allowances have been made for supporting CMA funded activities ($10k/year for 5 years) and other activities ($20k/year for 5 years).
Stormwater management – flood mitigation - system upgrade	The Stormwater Management Plan (DAA, 2002) and Flood Management Study (WBM, 2004) identified and budgeted works are assumed. Includes, minor flow bypass, floodway outlet, lagoon and wetland, property acquisition, piping of open drains and gross pollutant traps.	Reduced flooding near the commercial area and stormwater litter reduction.	*Flood mitigation*: $2.2M + $1k/y *System upgrade*: $1.7k + $8k/y

Notes:
1. Costs are refined in the development of the preferred scenario, refer to Section 7.2.1.

Catchment activities identified as having potential for CMA assistance (refer to Appendix A) include:

1. Community IWCM education (promotion/guidelines).
2. Shared equipment and access funding sources for IWCM.
3. Rehabilitation of existing watercourses.
4. Community education/enhanced land care programs.
5. Erosion and weed controls.
6. Establishment of buffer zones alongside significant streams.
7. Removal of disused weirs.
8. Protection and rehabilitation of riparian zones.

5.4 Scenario Description

The IWCM process recognises that a combination of water cycle management initiatives is required to achieve project goals. By bundling options into discrete scenarios, different visions for future water management are created.

When deciding on which options to include in scenarios, one of the key considerations is if there is an obviously better measure available. For example, both rainwater and greywater reuse options require storage of water and modifications to plumbing. Greywater however, will require significant treatment before it can be used. This treatment will involve more energy use and will be considerably more maintenance intensive than the use of rainwater. Thus, it may be more appropriate to consider rainwater use. This will not mean that individual customers cannot pursue greywater recycling options, however for widespread installations facilitated by Council, rainwater harvesting options are considered more appropriate for inclusion in scenarios.

Five IWCM scenarios have been prepared through bundling together complimentary water cycle management options. The scenarios represent increasing levels of integration between the urban water services:

1. The Base Case – the case likely to result from the traditional approach of undertaking separate water supply, sewerage and stormwater investigations.
2. Integrated Scenario Level 1 – a low level of integration, targeting new development.
3. Integrated Scenario Level 2 – a medium level of integration, targeting existing development.
4. Integrated Scenario Level 3 – a high level of integration, including targeted recycled effluent use.
5. Integrated Scenario Level 4 – a high level of integration, including recycled effluent use throughout the township.

The scenarios were developed considering Kyogle's IWCM goals, the interaction of the identified water management options and the PRG's preferences. The PRG formed two sets of bundled options (refer to Appendix A) based on a concept of preliminary targets (Figure 5-2).

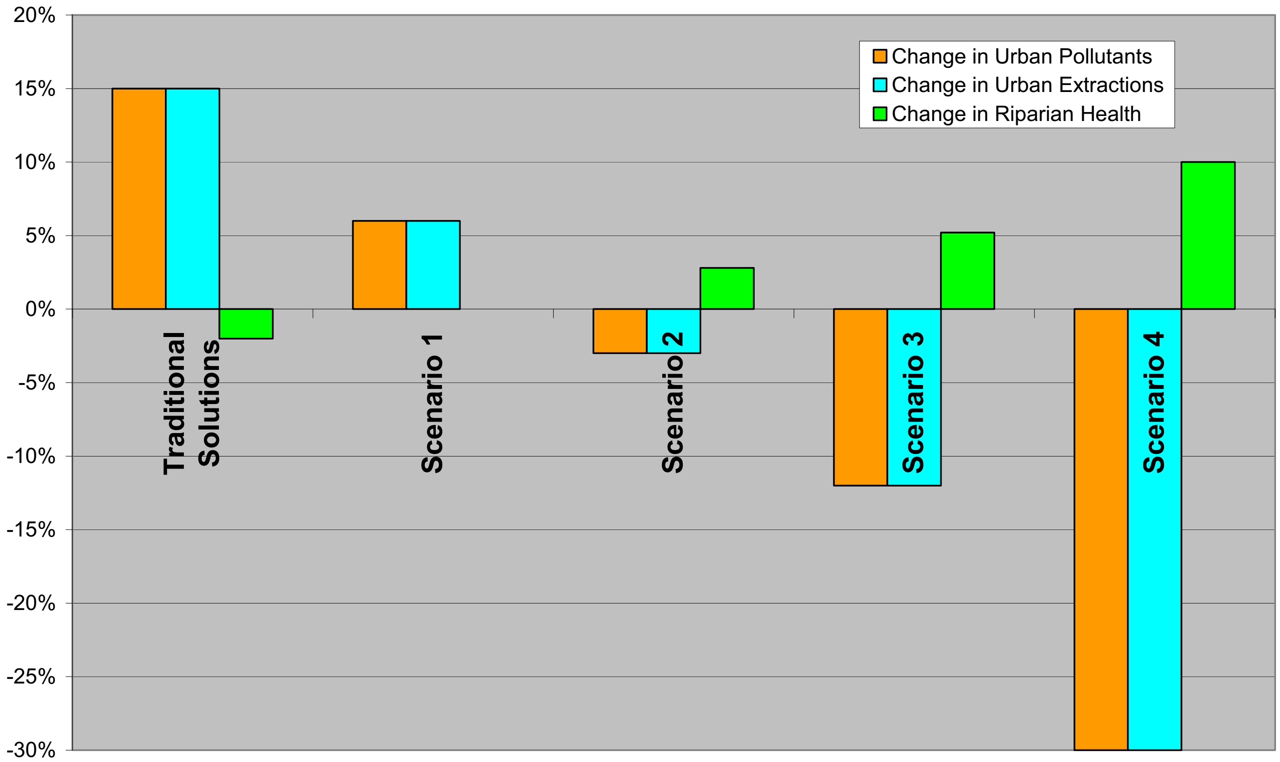


Figure 5-2: Preliminary Scenario Targets

The adopted combinations of options in each of the scenarios are roughly based on a balance between the PRG's two sets of bundling preferences (Table 5-7). Many of the initiatives are common to subsequent scenarios once introduced.

Table 5-7: Adopted IWCM Scenarios

Scenario	Base Case Traditional Approach	Scenario 1 Target New Development	Scenario 2 Target All Development	Scenario 3 Targeted Recycled Water	Scenario 4 Full Recycled Water
Water Source					
Off stream storage and new/upgrade WTP	√	√	√	√	√
Sewage Treatment					
Secondary (land purchase)	√	√			
Secondary + nutrient removal + disinfection			√		
Tertiary + disinfection (+ residual)				√	√
Inflow and infiltration reduction		√	√	√	√
Recycled Water					
100% Non-food crop irrigation at STP	√	√			
Dry weather non-contact irrigation/wetlands			√		
Targeted RE use and discharge				√	
Full RE use and discharge					√
Greywater					
Greywater (diversion)		√	√	√	
Greywater (new development)			√	√	
Greywater retrofit (residential development)				√	
Rainwater					
BASIX tanks (new development)	√				
Mandatory tanks (new development)		√	√	√	
Retrofit/rebate tanks (existing development)			√	√	
Stormwater					
Stormwater current initiatives	√	√	√	√	√
WSUD (new development)		√	√	√	√
WSUD (new and key existing development)			√	√	√
Conservation					
Current initiatives (incl. BASIX)	√	√	√	√	√
Improved community education		√	√	√	√
Fixture retrofits and rebates			√	√	√
Inclining block tariff			√	√	√
Leakage reduction, audits and metering		√	√	√	√
Self-sufficient new rural		√	√	√	√
Catchment					
Catchment current initiatives	√	√	√	√	√
CMA supported activities		√	√	√	√
Other catchment activities			√	√	√

The *Base Case* represents a traditional approach to water management through separately managing urban water services. It includes off-stream storage and a new WTP for town water supply. This supply side approach is common to all scenarios, with off-stream storage, WTP capacity and system capacity requirements reduced with increased town water savings in the other scenarios. Wastewater management consists of secondary treatment and dry weather non-food crop irrigation at the STP. BASIX and WELS are included in all scenarios.

Scenario 1 targets new development through rainwater tanks and WSUD on all new development (development control plan). No new rural urban water services are allowed. Improved community IWCM education is introduced, along with water supply system improvements (leakage reduction, audits and metering). Wastewater management consists of secondary treatment and dry weather non-food crop irrigation at the STP. An enhanced II reduction program is also adopted. CMA supported catchment management activities are included.

Scenario 2 targets existing development through an efficient appliances retrofit and rebates schemes, a rainwater tank rebate, WSUD at key existing development areas and an inclining block water tariff aimed at reducing high water usage. Greywater installation is introduced to new developments (along with rainwater tanks). Wastewater management consists of secondary treatment with constructed wetlands and disinfection to allow dry weather non-contact irrigation at the STP. Other (non CMA funded) catchment management activities are included.

Scenario 3 allows for a targeted recycled effluent system via a third pipe system. The targeted system extends from the STP along the main street to the golf course and southwards through the industrial area to rural lands. It allows connection for most of the commercial area along with targeted parks, industry, rural areas and a new residential area. Rainwater and greywater source substitution is assumed in other areas. Wastewater management consists of dry weather tertiary treatment and disinfection, with non-potable reuse via third pipe. The targeted recycled effluent system is presented in the following figure.

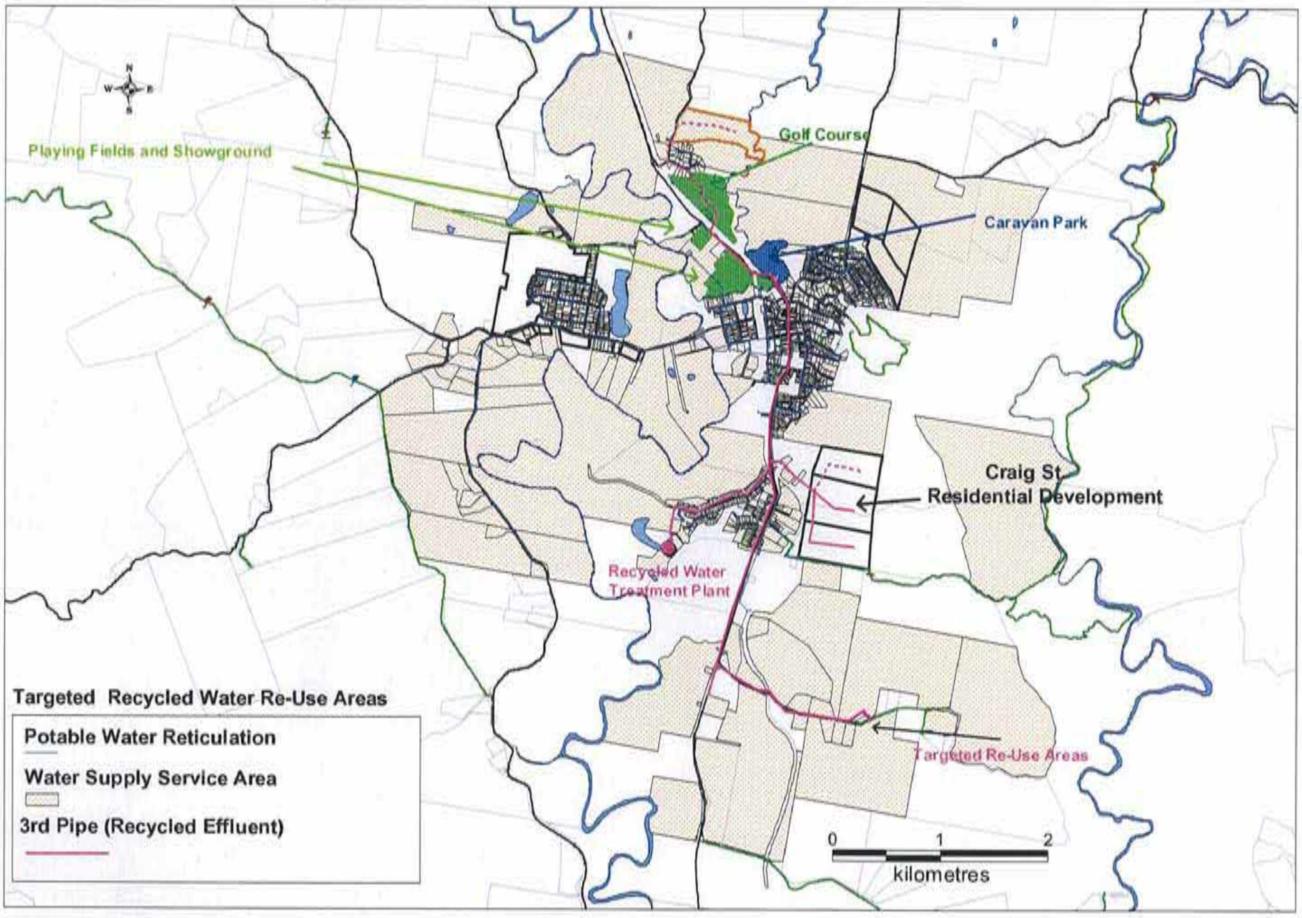


Figure 5-3: Targeted Recycled Effluent System Layout

Scenario 4 provides recycled effluent to the entire town. Other forms of source substitution are not required. Wastewater management consists of dry weather tertiary treatment and disinfection, with non-potable reuse via a third pipe system covering the existing town water supply area.

5.5 Scenario Projections

Town water demands and wastewater flow projections for each scenario have been prepared in the DSS model based on the assumptions outlined in Sections 5.3 and 5.4 above. The projections cover the 30 year planning horizon. The *Do Nothing* case is included to demonstrate potential benefits beyond historical practice. The Do Nothing case excludes BASIX and water efficiency labelling, and assumes the current sewage treatment processes in place. It is not an option considered for implementation.

5.5.1 Town Water Demands

Per capita potable water demands provide an indication of town water savings for each scenario and are plotted below.

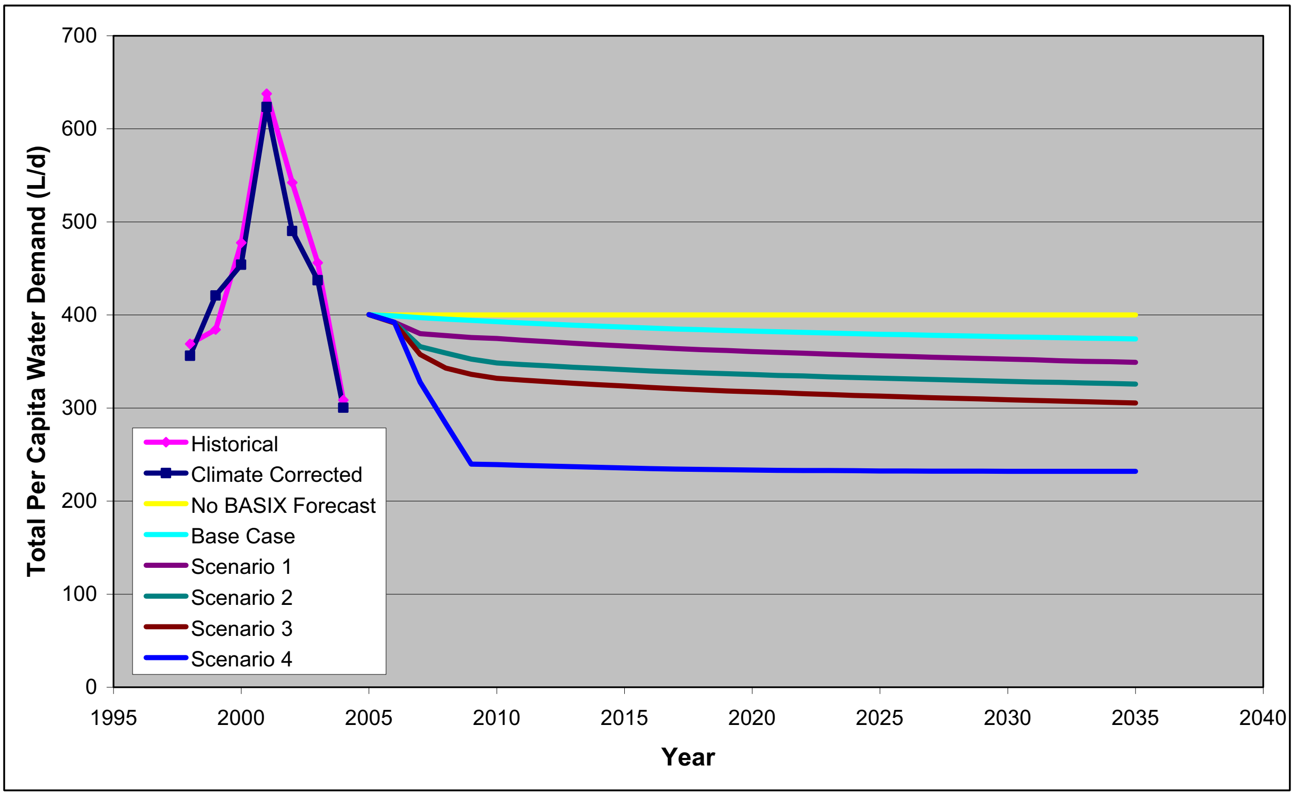


Figure 5-4: Per Capita Water Demands

Associated peak and average town water demand projections are tabled over.

Table 5-8: Annual Potable Water Demands

Annual Potable Water Demands (ML/a)							
Scenario	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Base Case	459	462	467	473	481	490	499
Scenario 1	459	441	442	446	452	458	465
Scenario 2	459	410	412	416	421	427	434
Scenario 3	459	391	390	393	397	402	407
Scenario 4	459	282	284	289	295	302	309

Table 5-9: Peak Day Potable Water Demands

Peak Day Potable Water Demands (ML/d)							
Scenario	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Base Case	4.2	4.5	4.7	5.0	5.2	5.4	5.5
Scenario 1	4.2	4.2	4.4	4.6	4.7	4.9	5.0
Scenario 2	4.2	3.9	4.1	4.2	4.4	4.5	4.6
Scenario 3	4.2	3.5	3.7	3.8	3.9	4.0	4.1
Scenario 4	4.2	1.2	1.3	1.3	1.4	1.5	1.5

The demand forecasts indicate increasing potable water savings with increasing levels of integration. The highest savings are associated with the recycled effluent approaches in Scenarios 3 and 4. Scenario 2 is forecast to maintain similar average demands to the current demands over the 30 year period. Peak day demands increase beyond current levels in all scenarios, except where recycled effluent is introduced (Scenarios 3 and 4).

5.5.2 Wastewater and Recycled Effluent Flows

Forecast annual wastewater flows to the STP are plotted below (Figure 5-5).

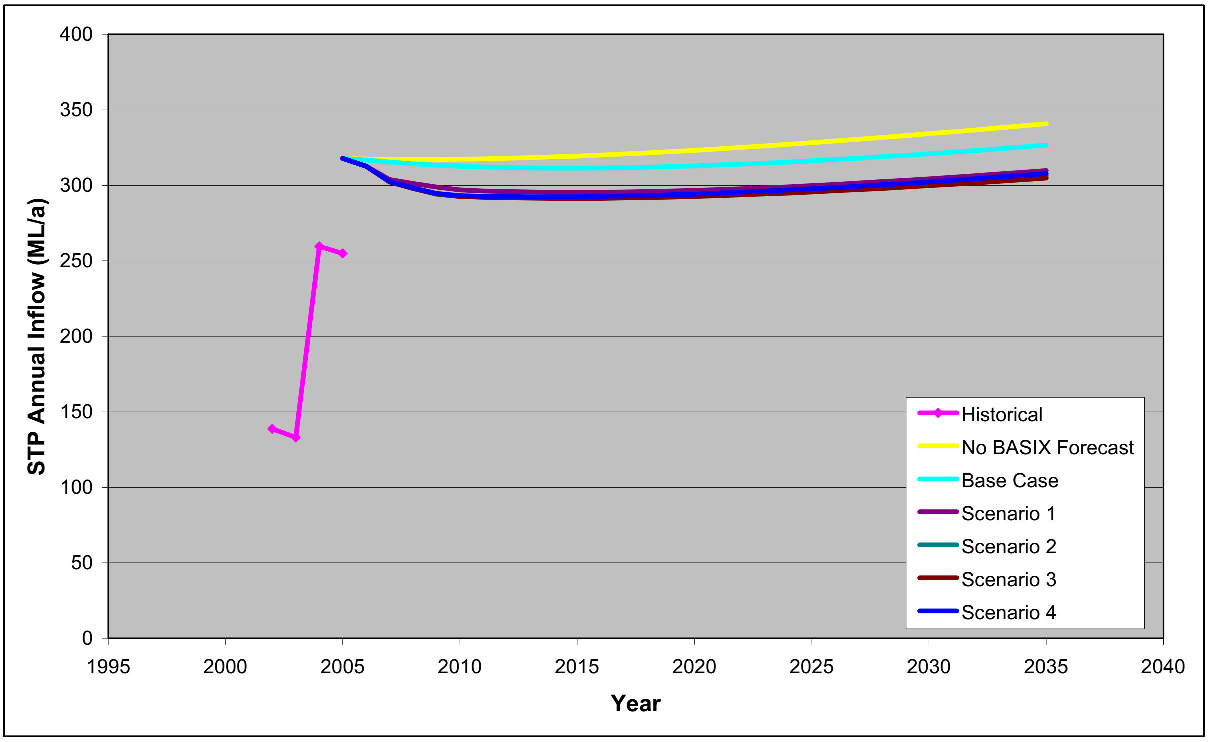


Figure 5-5: STP Annual Inflow

The associated dry and wet weather flows, as well as recycled effluent annual flows are tabled below.

Table 5-10: STP Average Dry Weather Inflow

STP ADWF Inflow (ML/d)							
Scenario	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Base Case	0.76	0.74	0.73	0.73	0.74	0.75	0.76
Scenario 1	0.76	0.72	0.71	0.71	0.71	0.72	0.73
Scenario 2	0.76	0.70	0.70	0.70	0.70	0.71	0.73
Scenario 3	0.76	0.70	0.70	0.70	0.70	0.71	0.72
Scenario 4	0.76	0.71	0.70	0.70	0.71	0.72	0.73

Table 5-11: STP Peak Wet Weather Flow

STP Peak Wet Weather Inflow (ML/d)							
Scenario	2005	2010	2015	2020	2025	2030	2035
Base Case	9.3	9.7	10.0	10.3	10.6	10.9	11.2
Scenario 1	9.3	8.1	8.3	8.6	8.8	9.1	9.3
Scenario 2	9.3	8.1	8.3	8.6	8.8	9.1	9.3
Scenario 3	9.3	8.1	8.3	8.6	8.8	9.1	9.3
Scenario 4	9.3	8.1	8.3	8.6	8.8	9.1	9.3

Table 5-12: Annual Recycled Effluent Demands

Annual Recycled Water Demands (ML/a)							
Scenario	2005	2010	2015	2020	2025	2030	2035
Base Case	0	0	0	0	0	0	0
Scenario 1	0	0	0	0	0	0	0
Scenario 2	0	0	0	0	0	0	0
Scenario 3	0	23	25	27	29	30	32
Scenario 4	0	169	173	176	180	183	186

There are only minor differences between the scenarios in the average and peak wastewater flow forecasts. Inflow and infiltration initiatives introduced in Scenario 1 provide the greatest impact in reducing peak wet weather flows.

The forecast recycled water demands represent target demands assuming customer acceptance and take-up as outlined in Table 5-4. The town water demand breakdown, along with generated wastewater is summarised below (Figure 5-6).

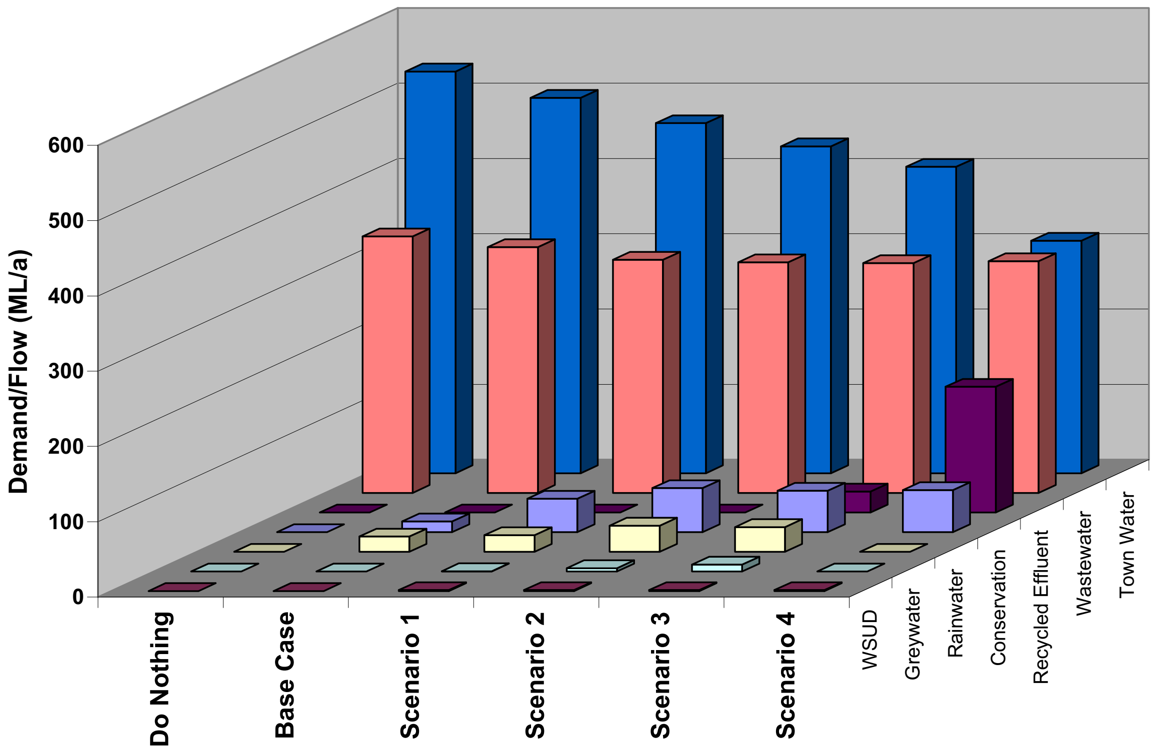


Figure 5-6: Urban Water Supply and Wastewater Forecast by Scenario

5.5.3 Urban Catchment Water Balances

Annual water balances for the combined urban catchments (Golf Course, Kyogle Central, Kyogle South and Geneva – refer to Section 3.4.1) have been prepared for each scenario (Figure 5-7) using the same approach outlined in Section 3.4.1. The water balances illustrate the impacts of integrated management on the bulk movement of water within the urban catchments.

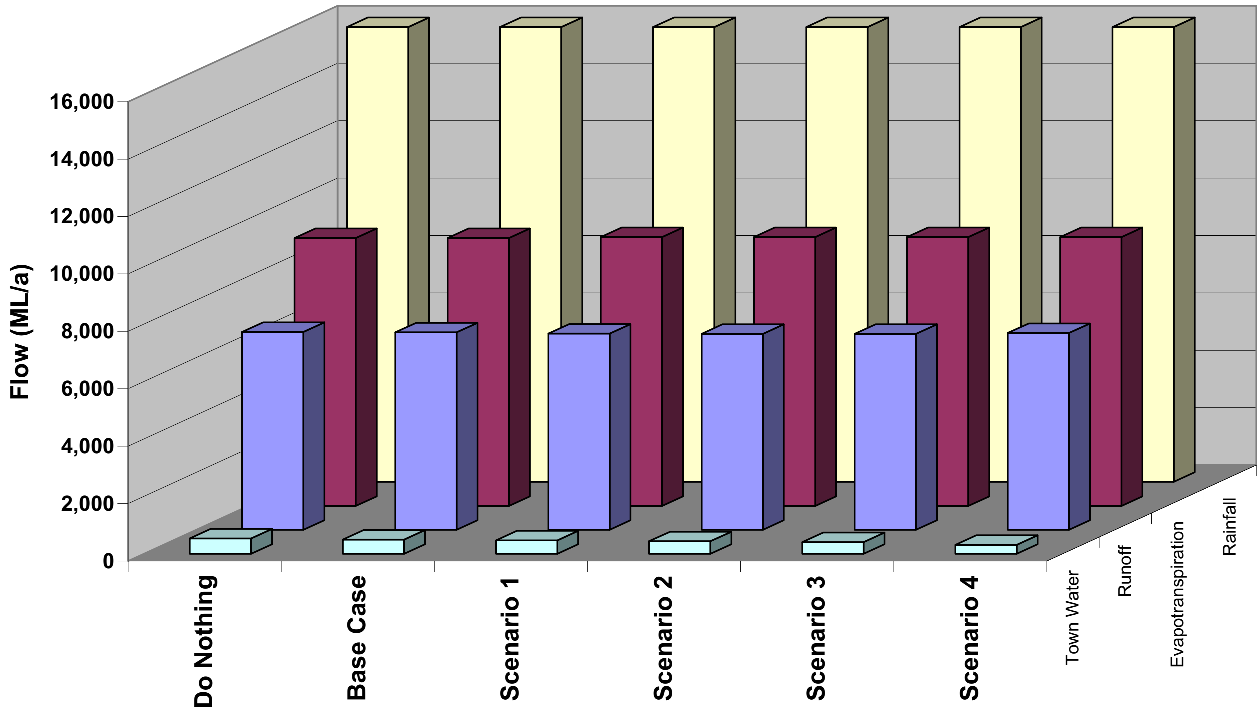


Figure 5-7: Urban Catchment Water Balance Forecast by Scenario

The integrated scenarios have only a minor influence on urban catchment runoff and evapotranspiration.

5.5.4 Urban Pollutant Loads

Urban pollutant reductions are anticipated through a combination of improved wastewater treatment and WSUD. Annual pollutant loads from Kyogle's *urban* area have been estimated by combining runoff (based on land usage, same process used in Section 3.5) and treated wastewater loads. The treated wastewater loads are based on dry weather flow performance (Appendix F) and it is assumed that pollutant loads released to the environment during wet weather are minor. It is also assumed that land application treatment systems (Base Case, Scenario 1 and Scenario 2) remove all nutrients and suspended solids prior to river discharge.

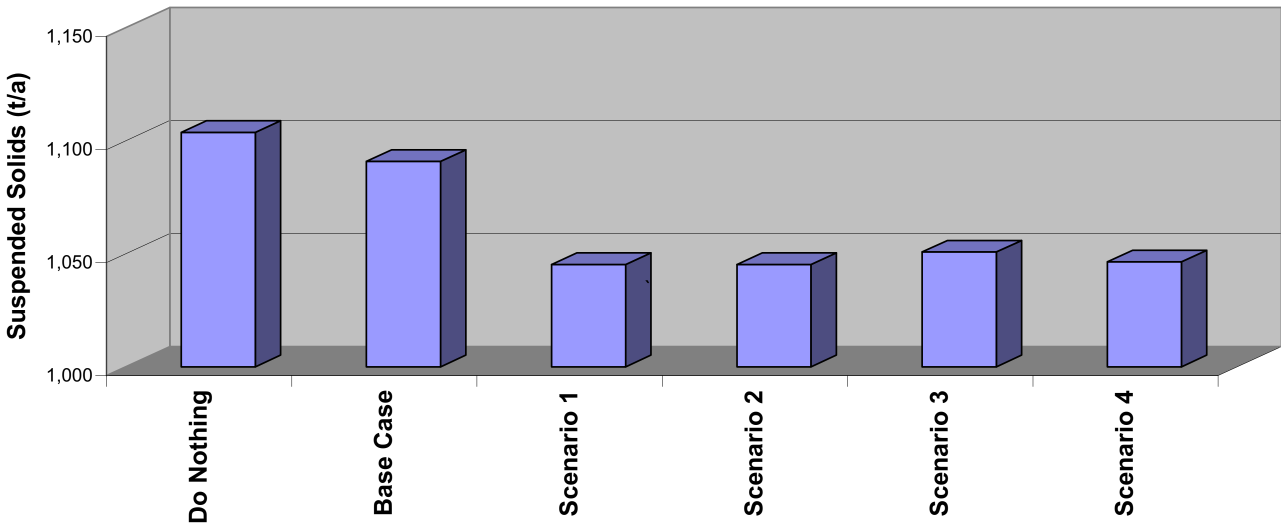


Figure 5-8: Urban Pollutant Loads – Suspended Solids

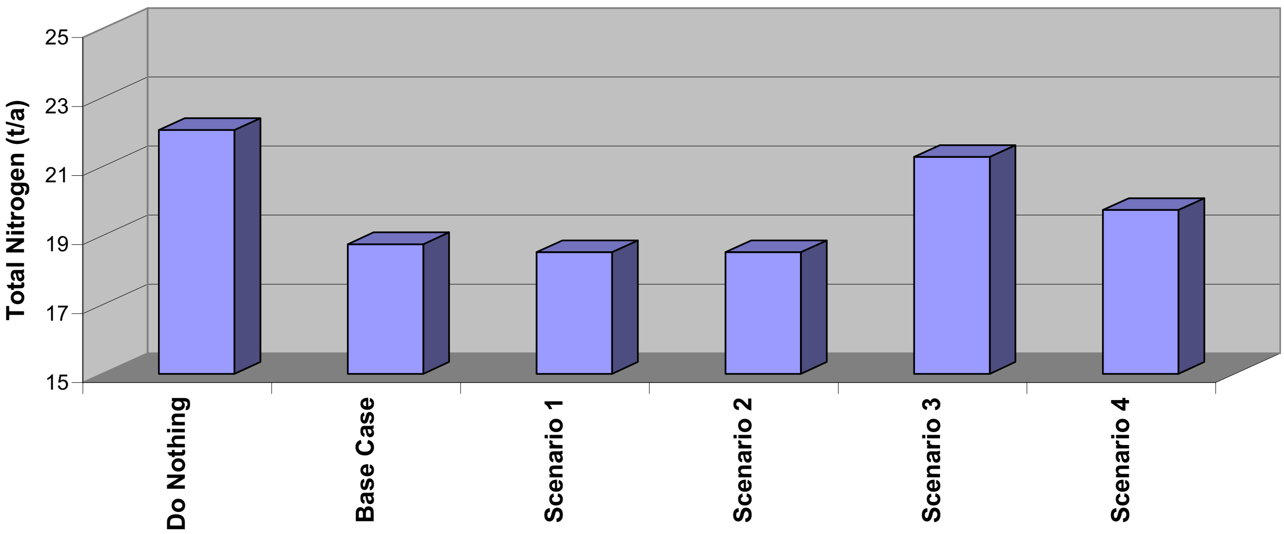


Figure 5-9: Urban Pollutant Loads – Total Nitrogen

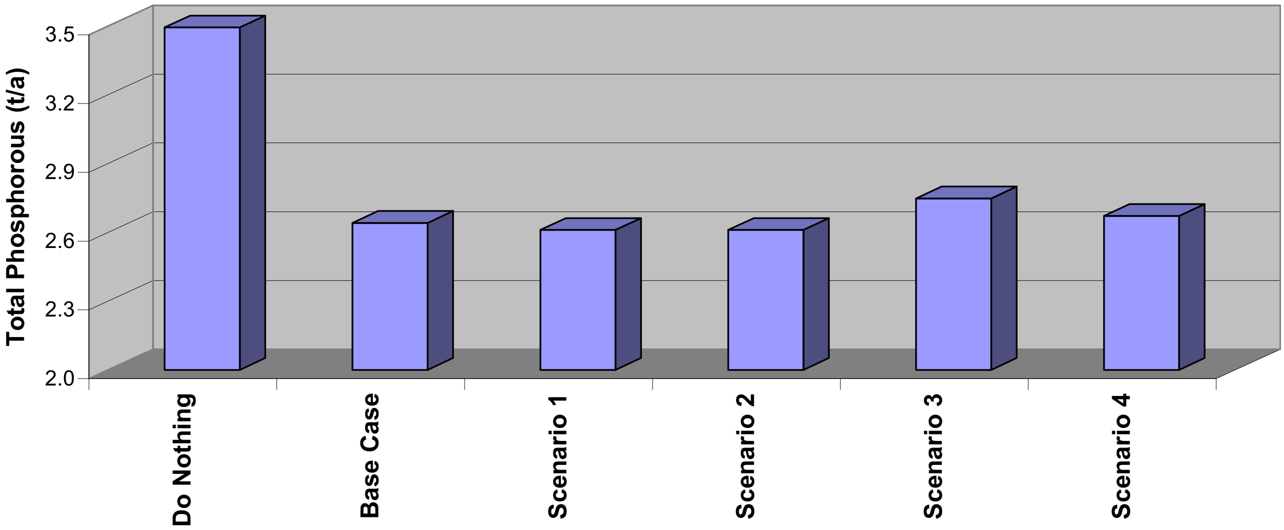


Figure 5-10: Urban Pollutant Loads – Total Phosphorus

The projections developed in this section of the report are used to develop the key urban water services infrastructure requirements and costs associated with scenario approaches.

6. IWCM Scenario Infrastructure

Urban water service volumetric and load projections for each of the five IWCM scenarios have been prepared. This section outlines the associated major infrastructure requirements and costs. Economic analysis of each scenario is also undertaken, including the estimated impact to household rates. This information is developed to assist selection of a preferred IWCM strategy.

6.1 Modelling Assessment

In the assessment of the costs and impacts of integrated water cycle management measures, there is a need for the use of a modelling framework to handle the complexity of the interactions between catchment hydrology, demographic trends, water demands, demand management and source substitution. The methodology adopted in this project utilises:

1. The demand management DSS for the development of forecasts and estimates of end use for each scenario (Section 5.5).
2. The use of the daily water tracking models to give a detailed understanding of the climate factors influencing daily water demands and wastewater flows (Section 3.3.3).
3. The use of the "fuzzy logic" rainwater harvesting simulation model to provide an understanding of the expected impact of rainwater harvesting systems on demands from the coolest wettest day of the year to the hottest and driest (Appendix G).
4. The use of the WATHNET stochastic simulation package for the simulation of the daily operation of the system. WATHNET simulates the impact of scenarios on supply reliability, and also provides information on the storage required for wastewater recycling systems (Appendix G).

The four models allow the use of detailed simulations in a short time-frame. Changes in water use brought about by the natural propagation of water efficient fixtures and appliances, demand management programs and changes in the type of housing are automatically considered in the assessment of rainwater tanks in the fuzzy logic model. Changes in indoor and outdoor use brought about by demand management and source substitution initiatives are automatically considered when considering the reliability of surface water supply systems.

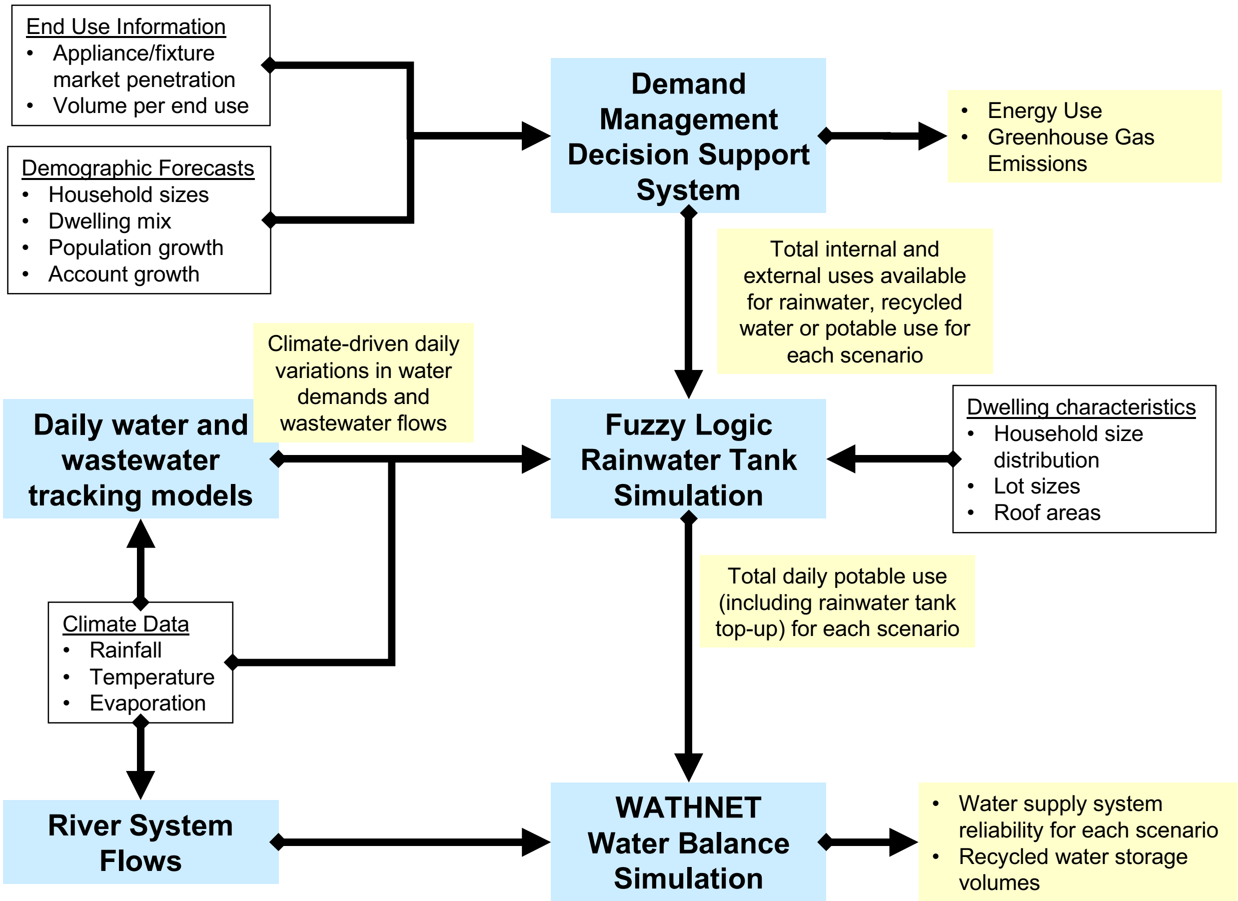


Figure 6-1: Modelling Framework

6.2 Water Resources

Securing future water supply for Kyogle is likely to be a considerable challenge. In recent years low flows in the Richmond River have resulted in water restrictions and demonstrated the sensitivity of the existing supply arrangements. Even with significant conservation efforts, demand can still be expected to grow in the future (Integrated Scenario 1). Securing a more reliable supply, through development of water resources and/or source substitution is anticipated.

6.2.1 Supply-side Management

The forecast IWCM scenario Year 2035 average day and peak day demands vary between 0.8 to 1.4ML/d, and 1.5 to 5.5ML/d, respectively, depending on the level of conservation effort and source substitution targeted. There are a number of supply side options, which have been identified in previous studies and during PRG stakeholder workshops, which have been considered to find a future balance between supply and demand. These town water supply options are outlined below.

Table 6-1: Water Supply-side Options

Option	Description	Comments
Off-stream storage and new WTP[1]	Water drawn from Richmond River weir, stored off-stream (approximately 0.5km from the weir). New WTP.	Location of storage to be confirmed. Size of storage subject to assessment and water sharing rules.
Iron Pot Creek Transfer[1]	Supplement supply with transfer from Toonumbar Dam.	Unreliable supply, quality issues and difficult construction.
Casino transfer (approx 30km)	Buy treated water from Richmond Valley Council via a new transfer system (30km), and decommission the existing WTP.	Dependent on cooperation with RVC. May also be opportunity to link in with ROUS scheme.
Groundwater[2]	Local bores to supplement supply.	Aquifer already stressed.
New dam on the Richmond River	Regulate the river with a dam in the upper reaches.	Very high economic and environmental cost. Likely to be socially and politically unacceptable.

1. DPWS 1999.
2. DPWS 1999 and Appendix H.

Based on discussions with Council and the PRG, transfer from Iron Pot Creek is an unlikely to provide reliable supply as demonstrated through the recent drought. In addition, the water source suffers occasional poor water quality (algal blooms), requires construction of a pipeline through rocky terrain and is currently utilised by farmers, who have expressed concerns that the resource is inadequate to also supply the township.

On-stream storage, assuming a suitable dam and storage site could be identified, is unlikely to be environmentally and economically justifiable, socially acceptable, and is not supported by current state government policy.

6.2.1.1 Groundwater

In additional to previous water supply studies, a desktop review for the potential of groundwater resources to contribute to the supply of Kyogle's town supply has been made (Appendix H). The study identified that there is potential for groundwater resources within the Kyogle township area, particularly in granite formations, and is likely to be of reasonable water quality. However, review of existing boreholes showed that it is unlikely that the yields normally required for town water supply can be obtained from aquifers in the area. Also, any development of groundwater resources would require assessment of the impact on existing groundwater uses to be considered. As such, groundwater is not considered likely to provide a major town water supply source. However, groundwater is proposed to play an important role during drought management as a backup supply (Kyogle Council, 2005c) and has the potential to be used to supplement minor demands through small-scale or multi-borehole abstractions for specific local uses, such as sports-field watering, as part of an integrated scheme.

6.2.1.2 Supply-side Approach

Indicative costing and NPV analysis suggests there is little long term cost difference between the off-stream storage with a new WTP supply option and the transfer from Casino option[7].

[7] 500ML off-stream storage & new WTP (DPWS, 1999) - 30y @ 7% NPV = \$13.8M. Casino transfer via 250mm DICL main and \$0.80/kL - 30y @ 7% NPV = \$13.0M.

The off-stream storage location and site conditions may significantly impact the cost of this option. A new WTP or WTP upgrade is anticipated to provide adequate water quality (Appendix F). Existing raw water pumps may be utilised to transfer water between the storage and the WTP.

To transfer supply from Casino is subject to a satisfactory agreement being reached between the two councils, including an agreed water price. The transfer route would likely follow the existing road corridor between Casino and Kyogle. Kyogle Council anticipates few problems with this route and it could also allow for supply to outlying areas of Casino. Further, a transfer scheme between Kyogle and Casino may also provide the opportunity for supply to be linked to the ROUS water supply scheme (serves the Lismore area) in the future.

The choice of supply option is not clear cut and requires detailed consideration of the environmental, social and financial costs and benefits of each option. In order to initially compare the IWCM scenarios, a common town water supply side approach has been adopted following discussions with Council, namely, continued supply from the Richmond River with off-stream storage and new water treatment facilities.

6.2.2 Supply Reliability and Security

The current water supply secure yield has been assessed previously (DPWS, 1999). At the time, allocation of river water was decided cooperatively between Kyogle Council, Casino Council and local irrigators. Town supply licence conditions did not include an allowance for environmental flows. However, for safe yield assessment, it was assumed that minimum environmental flow condition would be the 80th percentile flow (ie the flow that is equalled or exceeded 80% of the time) when storage is greater than 50 percent full and the 95th percentile flow when the storage is less than 50% full. Based on available data at the time, these flows were 71 ML/day (80%ile) and 28 ML/day (95%ile). It was also noted that more stringent environmental flow conditions could be imposed (DPWS, 1999).

Currently, a macro water plan is being developed for the north coast area by state government departments. The water sharing rules will allocate water for the environmental needs of the water source and direct how water is to be shared among different water uses. As part of this process, basic landholder water rights and water extraction requirements will be assessed. It is anticipated that environmental flow requirements and extraction limits will be set. Existing town water supply licences require assessment where an upgrade in water infrastructure is required. In these cases, town water utilities will need to meet conditions specified in the macro water plans (DNR, 2005). At this stage, the water sharing and environmental flow conditions are to be confirmed and draft surface water sharing report cards have been prepared to assist in the current consultation process for development of the macro water plan (Appendix D).

Each of the IWCM scenarios impose different town water demands on the river. In one sense, the reliability of the IWCM scenarios increases with increasing diversity of source substitution approaches, however, all scenarios are still dependent on river supply to some degree. A common approach and level of reliability has been adopted to compare the scenarios. The key assumptions include:

1. Township volumetric entitlement remains the same as current ie 564ML/a.
2. River intake flowrate kept the same as current capacity ie 68L/s.
3. Water supply headworks are sized to provide:
   - an annual reliability of 95 percent (ie restrictions on supply should not last for more than 5 percent of the time)
   - the probability that storage level decreases to 5 percent in any day should not exceed 0.005%.
4. Restrictions are enforced so that:

- 20% demand restrictions apply when the storage falls to the 50% level
- 30% demand restrictions apply when the storage falls to the 25% level
- 50% demand restrictions apply when the storage falls to the 12% level.

5. In line with previous studies, high flow licence environmental flow conditions are based on the 80 and 95 percentile IQQM flows[8], 57.5ML/d and 17.7ML/d, respectively.

Two additional cases for Scenario 2 demands have also been tested:

1. Draft Kyogle Area Report Card Rules - cease to pump at 15ML/d and no pumping for 24 hours when the Richmond river gauge at Kyogle reads above the 80th percentile after reading below 15ML/d the previous day.
2. Reduced supply reliability – off-stream storage sized to provide an annual reliability of 75 percent.

These assumptions, combined with historical climate data, form the basis for the WATHNET water balance modelling. One thousand 50 year replicates of climate, streamflow and synthetic demands were developed to assess reliability needs. On this basis, the key supply component that changes in each scenario is the size of the off-stream storage. Figure 6-2 outlines the approximate relationship estimated through modelling between town water supply demands (Year 2035) and off-stream storage volume.

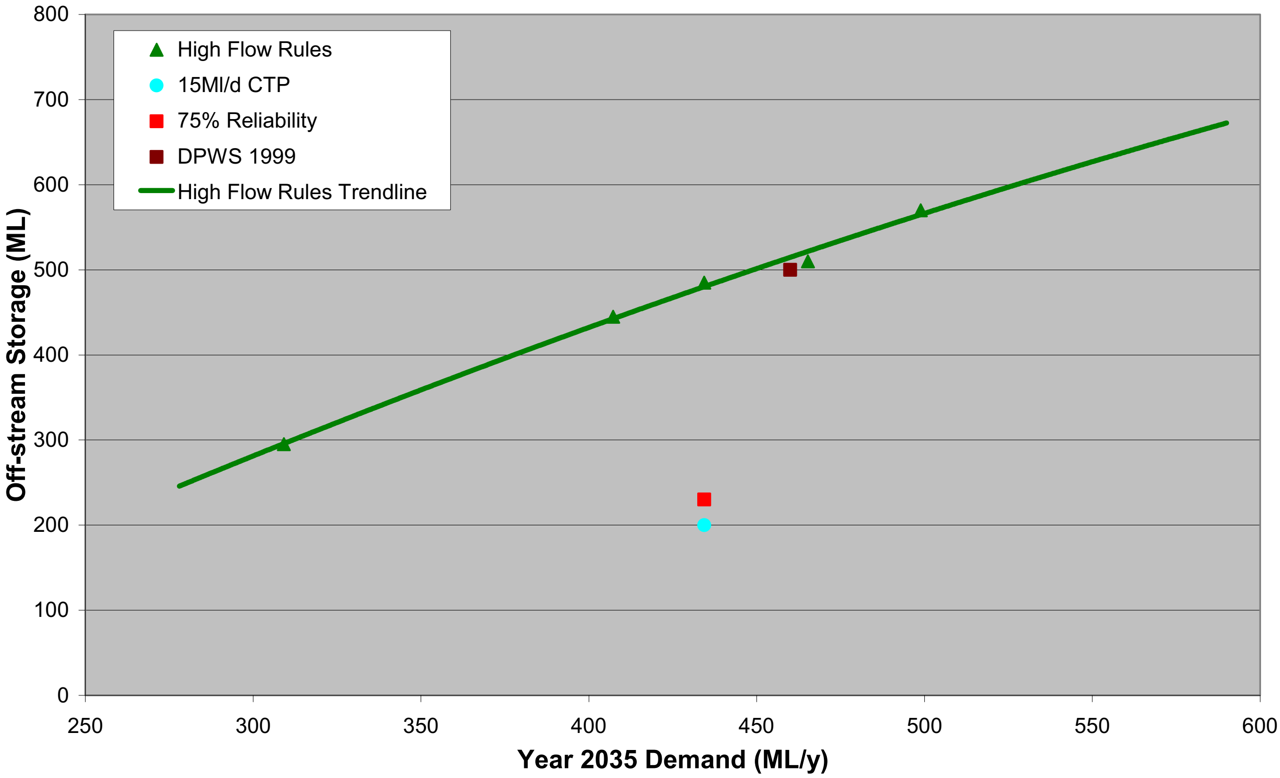


Figure 6-2: Assumed Reliability – Storage Volume and Demand Relationship

It should be noted, that significant assumptions have been made to assess the reliability requirements for town water supply and that the upcoming water sharing plan may make these assumptions redundant. It is

[8] IQQM synthetic daily streamflow data between 1892 and 2001, at the town water supply extraction point. Data provided by DNR for the IWCM study.

recommended that the reliability assessment be reviewed following agreement on water sharing requirements. For further information refer to Appendix G.

6.3 Water Infrastructure

In assessing the costs and benefits of each scenario, it is important to understand the infrastructure required for water cycle management in each case. The assessment considers potable, recycled and wastewater system requirements. Major stormwater infrastructure needs are also recognised, based on previous studies in this area.

In order to compare the scenarios, a simplified assessment has been made for the treatment, storage and transfer requirements. Only major infrastructure items are considered and general engineering practice guidelines are used for the sizing and selection of components. Generally, there are reductions in potable water supply infrastructure with increasing levels of water conservation and source substitution. Also, financial gains can be made through delaying potable water supply infrastructure implementation.

All costs are order of cost estimates only, intended to allow comparison of the scenarios. Unless otherwise stated, cost rates are sourced from the *NSW Reference Rates Manual*, (MEU, 2003). Generally, *reference rates* have been adopted which include an allowance above *contract rates* for survey, investigation, design and project management (generally 15 to 20%) and contingency (generally 10%). Other general costing and sizing assumptions include:

1. Pipe material selection: DICL pressure mains and uPVC sewer mains.
2. For all reticulation, rising and trunk main costs, it is assumed that excavation is in OTR and pipelines are laid at minimum depth.
3. Head losses in pressure mains assumed to be 5m/km.
4. No additional allowance has been made for firefighting requirements in the sizing of the potable or and recycled systems.
5. All costs are utility costs, unless otherwise stated.

6.3.1 Water Supply

The key water supply components considered for comparison between the scenarios are:

1. Water treatment plant – to treat raw water to drinking water quality requirements.
2. Off-stream storage – to store raw water for reliability of supply.
3. Service reservoirs – to store and regulate potable water for distribution to customers
4. Raw water transfer system – pipes and pumps to transfer raw water between the river off-take, the off-stream storage and the WTP.
5. Potable water transfer – pipes and pumps to transfer treated water between the WTP and service reservoirs.
6. Reticulation extension – to service new areas.

Unless otherwise noted, service storages have been sized based on peak day demands and transfer infrastructure based supply of a single peak day demand over 22 hours. Distribution reticulation works are assumed to be incorporated in programmed renewal works and common to all scenarios.

6.3.1.1 Water Treatment Plant

The existing WTP is currently programmed for upgrade, however for the initial scenario comparison, a new WTP is assumed. The new WTP is sized to provide 2035 peak day demand requirements. Its description and costs are provided in Appendix F. Based on discussions with Council, the new WTP is planned to be constructed in 2010, in all scenarios, to delay capital expenditure. In the interim period there is risk associated with performance of the existing WTP and supply capacity to meet peak demands. Restrictions could be used to mitigate supply capacity issues, should it arise.

6.3.1.2 Off-stream Storage

The off-stream storage has been sized based on reliability requirements (Section 6.2.2). The current estimates of the required storage volume for each scenario are provided in Table 6-2. It is anticipated that the storage size will be further refined, following finalisation of water sharing plan rules.

Table 6-2: Off-stream Storage Capacity

Scenario	Storage Volume (ML)
Base Case	570
Scenario 1	510
Scenario 2	485
Scenario 3	445
Scenario 4	295

1. Initial costing and scenario comparison based on storage sizes within 2-13% of tabled values.

There is an immediate need for the off-stream storage. In all scenarios the off-stream storage is assumed to be constructed in 2008, to allow time for approvals, design and tendering processes.

The order of cost estimate for the off-stream storage has been built up from base assumptions:

1. Engineered cut and fill lagoon (turkey nest) type structure with simple inlet and outlet arrangements.
2. Storage is located within 0.5 kilometres of the weir on a flat site with no flooding or environmental issues.
3. 3.5 metre effective depth with 0.25 metre dead storage and 0.75 metre freeboard (for wave action), 1:3 and 4 metre wide walls.
4. Cut and fill earthworks $8/m^3. Local clay liner $4/m^2. Drought tolerant grass facing $8/m^2. Roadway $40/m^2. Fencing $10/m. Land purchase and easements $20k/Ha. Inlet and outlet works $20k.
5. In-direct costs (including design, management and contingency) 35% of direct costs.

The cut and fill storage type is based on previous investigation recommendations (DPWS 1999). Further investigation is recommended to identify a suitable location for the off-stream storage, including consideration of land and pipeline easement acquisition, as well as any opportunities to utilise natural drainage basins for the storage.

6.3.1.3 Service Reservoirs

The Kyogle township water supply distribution system effectively acts as a single reservoir zone. As such, the total service reservoir storage volume (currently 4.84ML) has been adopted for assessing storage requirements. In order to meet peak day demand requirements the size and timing of additional storage is provided in Table 6-3.

Table 6-3: Service Reservoir Augmentation

Scenario	Additional storage (ML)	Year
Base case	1.0	2020
Scenario 1	1.0	2030
Scenario 2	Not required	
Scenario 3	Not required	
Scenario 4	Not required	

It is assumed that the new service reservoir will be located within the grounds of the existing Hill Street Reservoir property, constructed in steel, with an allowance for power installation and access road construction.

6.3.1.4 Raw Water Transfer

It is proposed to continue to use the existing raw water pumping station and rising main which has capacity to meet 2035 peak day demands in all scenarios. A new 500 metre long gravity/rising main is required to transfer water between the raw water pumping station and the off-stream storage. This main will have sufficient capacity to meet projected 2035 peak day demands and be constructed in conjunction with the off-stream storage.

6.3.1.5 Potable Water Transfer

The existing clear water pumping station at the WTP has a capacity of 4.6 ML/d (3.3ML/d standby). It is assumed the WPS will be upgraded to meet peak day demand requirements (over 22 hours) as required in each scenario (not required in Scenarios 3 and 4). The existing rising main and trunk mains are assumed to be in good condition and of adequate hydraulic capacity (all less than 1m/s at PDD over 22 hours).

6.3.1.6 Reticulation Extension

Reticulation lead-in mains and distribution mains are required to serve the future village residential development areas of Homestead, Craig Street, Geneva and the Golf Course areas in all scenarios. Approximately 5 kilometres of 100/150mm mains and one kilometre of 200mm main are estimated to be required. It has been assumed that the lead-in mains be constructed between 2006 and 2007, and the distribution mains progressively installed between 2007 and 2035.

6.3.1.7 On-going Costs

Kyogle township's current water supply on-going costs are listed in Table 6-4.

Table 6-4: Township Water Supply Current On-going Costs

Item	Annual cost	Comments
Operation and maintenance	$196k/y	general, equipment, testing & sampling
Administration	$140k/y	includes insurance
Energy	$32k/y	
Chemicals	$11k/y	
Total	$379k/y	

On-going costs have been split into fixed (O&M and administration) and variable (chemicals and energy) components, for net present value assessment. The DSS automatically estimates variable costs for each year according to annual potable demands. Future on-going costs include the following changes to current on-going costs, where appropriate for the scenario:

1. Off-stream storage – additional $30k/year.
2. New WTP (refer to Appendix F) – additional $78.5k/year (fixed) + additional $112k/ML (variable).
3. New equipment – reduction $20k/year.

The currently programmed water supply renewal works are included in each scenario ($250k/y for entire LGA).

6.3.2 Wastewater

The key wastewater components considered for comparison between the scenarios are:

1. Sewage treatment plant – to treat sewage to a suitable level for each scenario's applications.
2. Transfer system – pipes and pumps to transfer collected wastewater to the STP.
3. Reticulation extension – to service new areas.

Distribution reticulation works are assumed to be incorporated in programmed renewal works and common to all scenarios.

6.3.2.1 Sewage Treatment Plant

In all scenarios, the STP is planned to be upgraded in 2007. Treatment processes are based on effluent application requirements and scenario objectives (Table 6-5). It is sized to meet dry weather flow requirements. Process descriptions and costs are provided in Appendix F.

Table 6-5: STP Process Upgrade

Scenario	Process Description
Base Case	Secondary level treatment. Purchase land and agricultural (non-food crop) reuse.
Scenario 1	Secondary level treatment. Purchase land and agricultural (non-food crop) reuse.
Scenario 2	Secondary level treatment, hydroponic wetland nutrient removal and disinfection.
Scenario 3	Tertiary level treatment, disinfection and residual for third pipe distribution to key township areas.
Scenario 4	Tertiary level treatment, disinfection and residual for third pipe distribution to key township areas.

6.3.2.2 Transfer System

All existing SPSs and rising mains are assumed to be in good condition and to have sufficient capacity to meet future flow requirements (refer to Table 5-11). II program works are covered in Section 5.3.2. This applies to all scenarios.

6.3.2.3 Reticulation Extension and On-site Replacement

Reticulation collection mains are required to serve the future residential development areas of Homestead, Craig Street, Geneva and the Golf Course areas in all scenarios. Approximately 5 kilometres of 150mm sewer mains and one kilometre of 225mm carrier main are estimated to be required. It has been assumed that the carriers will be constructed between 2006 and 2007, and the sewer reticulation mains progressively installed between 2007 and 2035.

There are currently several unconnected on-site wastewater treatment systems located in the urban area of Kyogle. It is assumed that Council will facilitate sewer connections at these properties. It is assumed that 10 properties will install a grinder pump/pot arrangement at $3,000 per property (borne by the householder) between 2007 and 2009. An allowance of $5,000 per year between 2007 and 2009 to administer the installation has been made in all scenarios. These assumptions have been made to allow for comparison of the scenarios. Council will investigate further options for each of the on-site sewage management systems within the existing sewered areas. Various options for funding will also be investigated in consultation with each of the affected properties.

6.3.2.4 On-going Costs

Kyogle township's current wastewater on-going costs are listed in Table 6-6.

Table 6-6: Township Wastewater On-going Costs

Item	Annual cost	Comments
Operation and maintenance	$185k/y	general, equipment, testing & sampling
Administration	$110k/y	includes insurance
Energy	$7k/y	
Chemicals	$18k/y	
Total	$320k/y	

On-going costs have been split into fixed (O&M and administration) and variable (chemicals and energy) components, for net present value assessment. The DSS automatically estimates variable costs for each year according to annual wastewater flows. Future on-going costs include the following changes to current on-going costs, where appropriate for the scenario:

1. Base case and Scenario 1 Treatment (refer to Appendix F) – additional $10k/year.
2. Scenario 2 Treatment (refer to Appendix F) – additional $15k/year.
3. Scenario 3 and 4 Treatment (refer to Appendix F) – additional $72k/year.
4. Private grinder pump O&M (householder cost) - $50/property/year.

The currently programmed water supply renewal works are included in each scenario ($160k/y for entire LGA).

6.3.3 Stormwater

Stormwater improvements are as currently proposed by Council and include:

1. Flood mitigation works.
2. System works – general upgrade and quality improvement works.

Previous stormwater investigations include the *Kyogle Council Urban Stormwater Management Strategy* (DAA, 2002) and the *Kyogle Flood Study* (WBM 2004).

6.3.3.1 Flood Mitigation

Flood mitigation works include a minor flow bypass, floodway upgrades and purchase of property in the floodway. Works are programmed to be completed in 2008 and are common to all scenarios.

6.3.3.2 System Works

System works includes installation of gross pollutant traps, lagoon/wetland improvements, pipe and drain improvements. Works are programmed to be implemented in 2007 and are common to all scenarios.

6.3.3.3 On-going Costs

Kyogle township's current stormwater on-going costs are listed in Table 6-7.

Table 6-7: Township Stormwater On-going Costs

Item	Annual cost	Comments
Operation and maintenance	$15k/y[1]	Limit of available funds (General funds)
Administration	$5k/y	includes insurance
Total	$20k/y	

1. Limit available in General Funds Budget.

Future on-going costs include the following changes to current on-going costs, where appropriate for the scenario:

1. Flood mitigation works – additional $1k/year.
2. System works – additional $8k/year.

The currently programmed stormwater renewal works are included in each scenario for comparison ($25k/y for entire LGA).[9]

6.3.4 Recycled Effluent

Wastewater treatment provisions are covered in Appendix F. Should uncovered recycled effluent storage be adopted, then additional treatment facilities to remove algae (such as a dissolved air flotation plant) and re-chlorinate the recycled effluent are likely to be required. Brief description of the recycled effluent systems is provided in Section 5.3.2. Recycled effluent approaches also include significant community costs (refer to Table 5-4).

6.3.4.1 Storage, Transfer and Reticulation

It is assumed that all recycled effluent system infrastructure will be constructed between 2007 and 2008. A peaking factor of 4.5 (PDD:ADD) has been used to calculate peak day recycled water demands from annual demands. Peak day demands have been used to size the recycled effluent service reservoir and transfer

[9] Renewal costs have been reviewed to include asset depreciation as part of the development of the preferred scenario, refer to Section 7.2.1.

infrastructure. Bulk storage of treated effluent is also required to provide a reliable supply. These have been sized at 8ML and 40ML for Scenarios 3 and 4, respectively. For information on sizing of the bulk storages refer to Appendix G.

Targeted Recycled Effluent Scheme (Scenario 3)

The bulk storage lagoon is assumed to be located at the STP. The storage has been costed based on $20k/ML.

It is estimated that a recycled effluent reservoir with a capacity of 0.5ML will be required for peak day demands. It is assumed to be located at the north eastern corner of the Craig Street residential development at the same level as the existing Hill Street Reservoir. This reservoir will meet forecast demand of targeted recycled water customers such as those at Craig Street. A 2.1 kilometre 100mm diameter rising main and 11kW pumping station are assumed to transfer recycled effluent from the STP to the service reservoir and meet a forecast peak day demand in 2035 of 5L/s. Approximately seven km of 100mm diameter third pipe main is estimated to provide recycled water to targeted customers.

Full Town Reuse (Scenario 4)

The bulk storage lagoon is assumed to be located at the STP. The storage has been costed based on $15k/ML.

It is estimated that a recycled effluent reservoir with a capacity of 2.2ML will be required for peak day demands. It is assumed to be located adjacent to the existing Hill Street Reservoir. As A 3.2 kilometre 200mm diameter rising main and 75kW pumping station are assumed to transfer recycled effluent from the STP to the service reservoir and meet a forecast peak day demand in 2035 of 27L/s. It is assumed that the ‘third pipe’ system (combination 100/150mm) required to distribute recycled water to the entire Kyogle township will be similar in length to the current potable water reticulation (35km) plus an extra 5 kilometres of main to service new residential developments.

6.3.4.2 On-going Costs

There are currently no recycled effluent system on-going costs. The on-going costs associated with the new recycled effluent schemes are:

1. Trunk and reticulation O&M – $6.8k/year and $41.3k/year for Scenarios 3 and 4, respectively.
2. Reservoir O&M - $2k/year.
3. Pumping station O&M - $5k/year.

On-going treatment costs are covered under Section 6.3.2. Community on-going costs are identified in Table 5-4.

6.3.5 Scenario Infrastructure Summary

Summaries of the major infrastructure and on-going costs for each scenario are tabled below. Off-stream storage capacities tabled are the costed capacities and are subject to change (refer to Section 6.2.2).

Table 6-8: Base Case Infrastructure Summary

Infrastructure	Capacity	Implementation Year	Cost Estimate ($'000)
Water			
Water treatment plant	5.5ML/d	2010	5,622
Off-stream storage	570ML	2008	3,918
Service reservoir	1.0ML	2020	445
Raw water transfer	5.5ML/d	2008	92
Potable water transfer	5.5ML/d	2007	150
Reticulation extension	Max hour demands	2007-35	628
Wastewater			
Sewage treatment plant	All dry weather flow	2007	890
Transfer system	Wet weather flow	NA	0
Reticulation extension	Wet weather flow	2007-35	657
Stormwater			
Flood mitigation	Variable	2008	2,200
System works	Variable	2007	2
Recycled effluent			
Storage, transfer and reticulation	NA	NA	NA

Table 6-9: Base Case On-going Utility Costs Summary

Component	On-going costs ($'000/y)[1]	
	Current	Future[2]
Water	379	526
Wastewater	319	330
Stormwater	20	29
Recycled effluent	NA	NA

1. Includes proportion of administration costs and excludes renewals.
2. O&M costs vary according to usage.

Table 6-10: Scenario 1 Infrastructure Summary

Infrastructure	Capacity	Implementation Year	Cost Estimate ($'000)
Water			
Water treatment plant	5.0ML/d	2010	5,345
Off-stream storage	510ML	2008	3,753
Service reservoir	1.0ML	2030	445
Raw water transfer	5.0ML/d	2008	92
Potable water transfer	5.0ML/d	2015	150
Reticulation extension	Max hour demands	2007-35	628
Wastewater			
Sewage treatment plant	All dry weather flow	2007	890
Transfer system	Wet weather flow	NA	0
Reticulation extension	Wet weather flow	2007-35	657
Stormwater			
Flood mitigation	Variable	2008	2,200
System works	Variable	2007	2
Recycled effluent			
Storage, transfer and reticulation	NA	NA	NA

Table 6-11: Scenario 1 On-going Utility Costs Summary

Component	On-going costs ($'000/y)[1]	
	Current	Future[2]
Water	379	519
Wastewater	319	329
Stormwater	20	29
Recycled effluent	NA	NA

Table 6-12: Scenario 2 Infrastructure Summary

Infrastructure	Capacity	Implementation Year	Cost Estimate ($'000)
Water			
Water treatment plant	4.6ML/d	2010	5,152
Off-stream storage	485ML	2008	3,364
Service reservoir	NA	NA	0
Raw water transfer	4.6ML/d	2008	92
Potable water transfer	4.6ML/d	2025	150
Reticulation extension	Max hour demands	2007-35	628
Wastewater			
Sewage treatment plant	All dry weather flow	2007	970
Transfer system	Wet weather flow	NA	0
Reticulation extension	Wet weather flow	2007-35	657
Stormwater			
Flood mitigation	Variable	2008	2,200
System works	Variable	2007	2
Recycled effluent			
Storage, transfer and reticulation	NA	NA	NA

Table 6-13: Scenario 2 On-going Utility Costs Summary

Component	On-going costs ($'000/y)[1]	
	Current	Future[2]
Water	379	503
Wastewater	319	334
Stormwater	20	29
Recycled effluent	NA	NA

1. Includes proportion of administration costs and excludes renewals.
2. O&M costs vary according to usage.

Table 6-14: Scenario 3 Infrastructure Summary

Infrastructure	Capacity	Implementation Year	Cost Estimate ($'000)
Water			
Water treatment plant	4.1ML/d	2010	4,880
Off-stream storage	445ML	2008	3,194
Service reservoir	NA	NA	0
Raw water transfer	4.1ML/d	2008	92
Potable water transfer	NA	NA	0
Reticulation extension	Max hour demands	2007-35	628
Wastewater			
Sewage treatment plant	All dry weather flow	2007	2,400
Transfer system	Wet weather flow	NA	0
Reticulation extension	Wet weather flow	2007-35	657
Stormwater			
Flood mitigation	Variable	2008	2,200
System works	Variable	2007	2
Recycled effluent			
Storage, transfer and reticulation	PDD = 0.4Ml/d	2007-08	1,450

Table 6-15: Scenario 3 On-going Utility Costs Summary

Component	On-going costs ($'000/y)[1]	
	Current	Future[2]
Water	379	497
Wastewater	319	391
Stormwater	20	29
Recycled effluent	0	14

1. Includes proportion of administration costs and excludes renewals.
2. O&M costs vary according to usage.

Table 6-16: Scenario 4 Infrastructure Summary

Infrastructure	Capacity	Implementation Year	Cost Estimate ($'000)
Water			
Water treatment plant	1.5ML/d	2010	3,513
Off-stream storage	295ML	2008	2,728
Service reservoir	NA	NA	0
Raw water transfer	1.5ML/d	2008	92
Potable water transfer	NA	NA	0
Reticulation extension	Max hour demands	2007-35	628
Wastewater			
Sewage treatment plant	All dry weather flow	2007	2,400
Transfer system	Wet weather flow	NA	0
Reticulation extension	Wet weather flow	2007-35	657
Stormwater			
Flood mitigation	Variable	2008	2,200
System works	Variable	2007	2
Recycled effluent			
Storage, transfer and reticulation	PDD = 2.3Ml/d	2007-08	6,550

Table 6-17: Scenario 4 On-going Utility Costs Summary

Component	On-going costs ($'000/y)[1]	
	Current	Future[2]
Water	379	477
Wastewater	319	391
Stormwater	20	29
Recycled effluent	0	48

1. Includes proportion of administration costs and excludes renewals.
2. O&M costs vary according to usage.

6.4 Economic Implications

The economic implications of each scenario are investigated to allow comparison of the scenarios. Financial modelling is used to estimate the impact of each scenario on the typical annual residential bill. This assists to define the financial impact on residents and through the modelling process outline the forecast investment and loans required by Council. Financial modelling has been carried out using the Queensland Department of Natural Resources and Mines' Financial Model. This model is purpose built for small to medium sized utilities to develop appropriate financial strategies.

30 year financial plans have been developed for each scenario. The preferred scenario's financial plans are further developed based on refined costing information and assumptions (refer to Section 7.2.1). Infrastructure and non-structural capital and on-going cost estimate assumptions for each scenario are documented in Sections 5.3 and 6.3. These cost estimates have been adopted along with additional information provided for Council in order to develop the rate impact model. Subsidy impacts have been considered in the modelling. Details of the financial modelling are provided in Appendix I.

6.4.1 Financing of Activities

Council rates provide the main source of funds for water, wastewater and stormwater activities. Currently water and sewerage have individual funds, whilst stormwater is covered under the general fund. Where planned expenditure exceeds available cash reserves then loans are assumed.

In addition to recovering costs through Council rates, NSW country water utilities have access to various government schemes to assist in the provision of water services. The *Country Towns Water Supply & Sewerage Program* provides technical and financial assistance to deliver affordable and well managed water supply and sewerage services in country town urban areas. Under the program, approved activities generally receive subsidy up to 50 percent of the associated costs.

Kyogle Council has made application to the *Federal Natural Disaster Mitigation Programme (2005-06)* for flood mitigation works funding. The application is still subject to approval, however Council anticipates federal government contribution of $975,000 and state government contribution of $930,000 (total of $1,905,000 of the $2.4M flood mitigation cost estimate).

The CMA can also provide funds for certain catchment activities related to the water cycle (refer to Section 5.3.2).

IWCM activities which may potentially receive subsidised funding are summarised below (Table 6-18). All subsidies are subject to individual assessment and approval.

Table 6-18: Potential Water Management Subsidies

Funding Source	Activity	Assumed Subsidy
Country Towns Water Supply & Sewerage Program	Kyogle Water supply upgrade works (incl. off-stream storage, new WTP, new transfer works). Other village water supply upgrade works (Bonalbo and UMMWWS). IWCM Study. Sewage treatment plant upgrade.	50%
Federal Natural Disaster Mitigation Programme	Flood mitigation works.	$1.905M
Northern Rivers Catchment Management Authority	Assumed to include IWCM/catchment education programs, riparian zone rehabilitation and controls (refer to Section 5.3.2).	100%

6.4.2 Financial Modelling Assumptions

Financial models have been established for the water and wastewater funds, as well as the stormwater portion of the general fund. Costs outside of IWCM activities are included in the financial modelling to allow rates impact assessment (Table 6-19). These costs are common to all scenarios.[10]

[10] Renewal costs have been reviewed to include asset depreciation as part of the development of the preferred scenario, refer to Section 7.2.1.

Table 6-19: Other Costs

Activity	Cost ($'000)
Water	
Kyogle IWCM Part 2	75
Bonalbo WTP construction	1100
Bonalbo Alternate Water Sources	278
Bonalbo PS 1 Upgrade Peacock Creek source 2006/07	70
UMMWWS WTP Construction	725
UMMWWS Off-stream Storage 2010/11	300
Water capital renewals	250/y
Other Village Water O&M	171.2/y
Wastewater	
Woodenbong STP augmentation	45
Wastewater capital renewals	160/y
Other Village Wastewater O&M	145/y
Stormwater	
Stormwater - Other (All Villages)	45/y
Stormwater capital renewals	25/y

UMMWWS – Urbenville Muli Muli Woodenbong Water Supply System.

Key financial assumptions are tabled below.

Table 6-20: Financial Assumptions

Item	Adopted Information		
Baseline data	Audited 2003/04 & 2004/05 financial statements for the water and sewerage funds. Stormwater fund based on marginal cost basis.		
Population growth rates	As per IWCM study.		
Financial rates	Loans interest rate: 7% per annum. 2005 Dollars.		
Capital works program, renewals, and additional operation, maintenance and administration costs	IWCM 30 year financial plans, refer to Appendix I.		
Capital works funding priority	1. Accumulated cash reserves. 2. Borrowings. 3. Rate increases. Stormwater assumes combination of subsidy and debt funding.		
Level of subsidy	As advised by Council. No subsidy is available for renewal works. Subsidy assumptions shown on the financial plans (Appendix I).		
Reticulation extensions	All extensions funded by developers.		
Rates increase	In any one year will not exceed CPI + 12%.		
Substitute sources	Included in the Water Fund		
	Water fund	Sewerage fund	Stormwater fund
Number of connections	1,893	1,578	1,578
Developer charges	$3,500 per ET from 2006/07 onwards		
2005/06 typical residential annual rates	$452	$490	NA
Cross-subsidy	Not applied.		

6.4.3 Scenario Financial Summary

The key outcomes of the financial modelling are tabled below (Table 6-21 and Table 6-22). Customer costs (exclusive of Council's costs) are derived from the costs assumed in Table 5-4 and Table 5-6. Subsidy assumptions in the *Council (subsidised)* case are described in Section 6.4.1. *Peak annual household rates* refers to the highest annual rates modelled over the 30 year planning horizon. All figures are 2005 dollars. It should be noted that these estimates are order of cost, developed for comparison purposes.

Table 6-21: Scenario Net Present Value Estimates

Scenario	Net Present Value Costs*		
	Customer**	Council (subsidised)	Council
Base case	$1,569	$16,864	$21,113
Scenario 1	$1,833	$18,054	$22,137
Scenario 2	$3,320	$17,812	$21,702
Scenario 3	$4,156	$20,412	$24,761
Scenario 4	$5,542	$23,895	$27,566

*30 year, 7% discount rate. ** Excludes rates impact.

Table 6-22: Scenario Rates Impact (assumes subsidies available)

Scenario	Peak Annual Household Rates			
	Water	Wastewater	Stormwater*	Total Increase
2005/06 rates	$452	$490	NA	NA
Base case	$699	$477	$60	$294
Scenario 1	$747	$512	$63	$380
Scenario 2	$699	$512	$68	$337
Scenario 3	$753	$584	$68	$463
Scenario 4	$935	$584	$68	$645

* increase above equivalent current stormwater rates

The following conclusions are drawn from the financial modelling comparison of scenarios:

1. Significant investment is required by the community and Council in all scenarios. This reflects the current status of water assets and the major works required for water supply, wastewater treatment upgrade and flood mitigation works.
2. Generally, the scenarios with the highest levels of integration are the most expensive. This is particularly the case for costs borne directly by the community.
3. Council capital expenditure and associated loans drive rates increases.
4. Typical residential household rates are estimated to increase by at least $300 per year to ensure the currently adopted levels of service. This assumes that subsidies are available for key works.

7. IWCM Preferred Scenario

Through consultation with the PRG, five IWCM scenarios have been developed. The scenarios include a traditional solution (Base Case) and four integrated approaches (Scenarios 1 to 4) incorporating increasing levels of conservation and source substitution. For each scenario, water supply, wastewater flows and urban runoff projections have been estimated. Major infrastructure requirements and associated costs have also been developed. This section of the report outlines how this information has been used to compare the IWCM scenarios and select a preferred IWCM scenario for implementation. Refinements to the preferred scenario are also discussed.

7.1 Scenario Comparison

The IWCM scenarios were compared based on the consideration of environmental, social and economic (TBL) assessment criteria developed for this study (Section 5.1).

To assist balance the sometimes conflicting considerations, a multi-criteria analysis decision tool has been used to compare the scenarios. As a group, the PRG discussed and scored each scenario against the TBL criteria. The scores for some criteria, such as the reduction in water extractions and low net present value, were directly quantifiable using information developed during this study. Other scores, such as the social assessment criteria were made based on the consensus of the PRG. Contentious scores were also tested to determine impact on the overall ranking of the scenarios. Further testing of each of the TBL categories was also made to check sensitivity of the resulting scenario ranks.

7.1.1 Environmental Perspective

Estimates of water supply demands, wastewater flows, urban runoff and urban pollutant loads for each scenario have been made (Section 5.5).

Environmental Assessment Criteria
➢ reduces extractions from the Richmond River

Savings on the annual amount of water extracted from the river for town supply are anticipated through a combination of conservation activities, such as education, pricing and water efficient fixtures, as well as source substitution, such as rainwater, greywater and recycled effluent. Comparison the town water savings for each scenario are presented below (Figure 7-1).

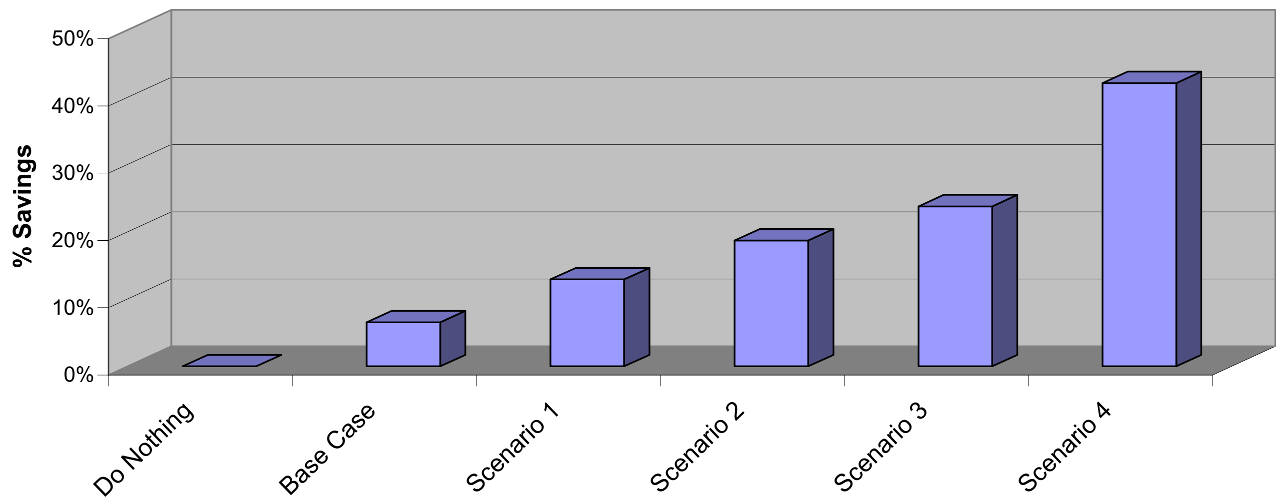


Figure 7-1: Town Water Extraction Savings

As the level of integration increases across the scenarios, increased water savings are made.

Environmental Assessment Criteria

- reduces pollutants entering the Richmond River

Reduction in pollutant loads emanating from the urban areas is also possible through improved wastewater treatment, improved source control and management of urban runoff. Suspended solids, total nitrogen and total phosphorus load estimates were developed. As phosphorus loads are often a sensitive factor in influencing river health, comparison of the total phosphorus reductions for each scenario are presented below (Figure 7-2).

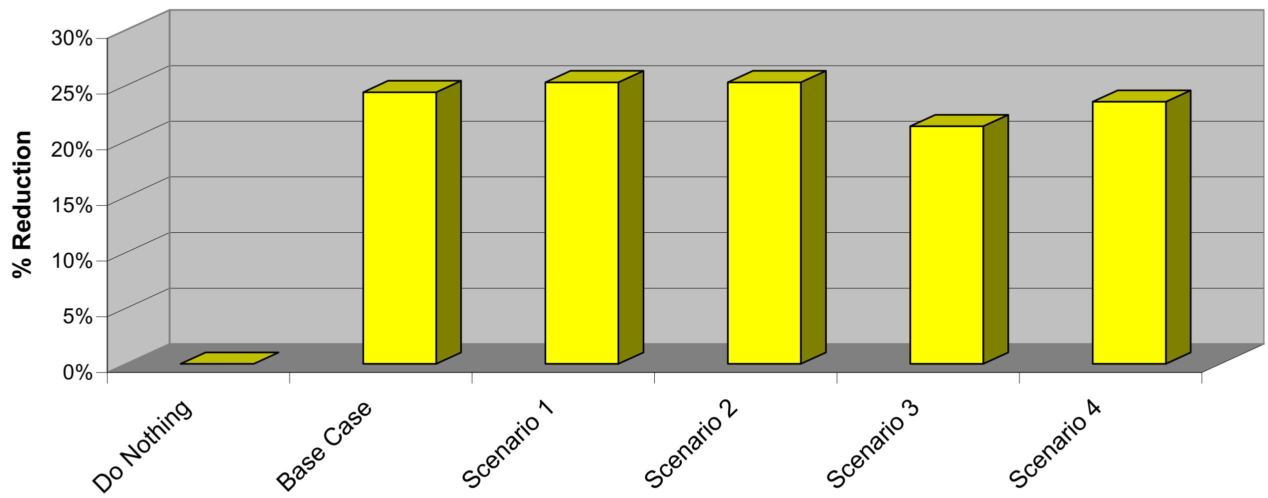


Figure 7-2: Urban Catchment Pollutant Reduction (based on TP)

All scenarios are expected to beneficially reduce urban pollutant loads. Each scenario includes wastewater treatment facilities improvements to improve the quality of dry weather effluent. WSUD is anticipated to reduce urban runoff pollutants from new developments (Scenario's 1 to 4) and key existing development (Scenarios 2 to 4).

Environmental Assessment Criteria
- improves riparian zone health

To provide an indication of the potential benefit associated with urban influences on the river, a surrogate indicator based on the combined water extraction saving and pollutant reduction (TP) is presented (Figure 7-3).

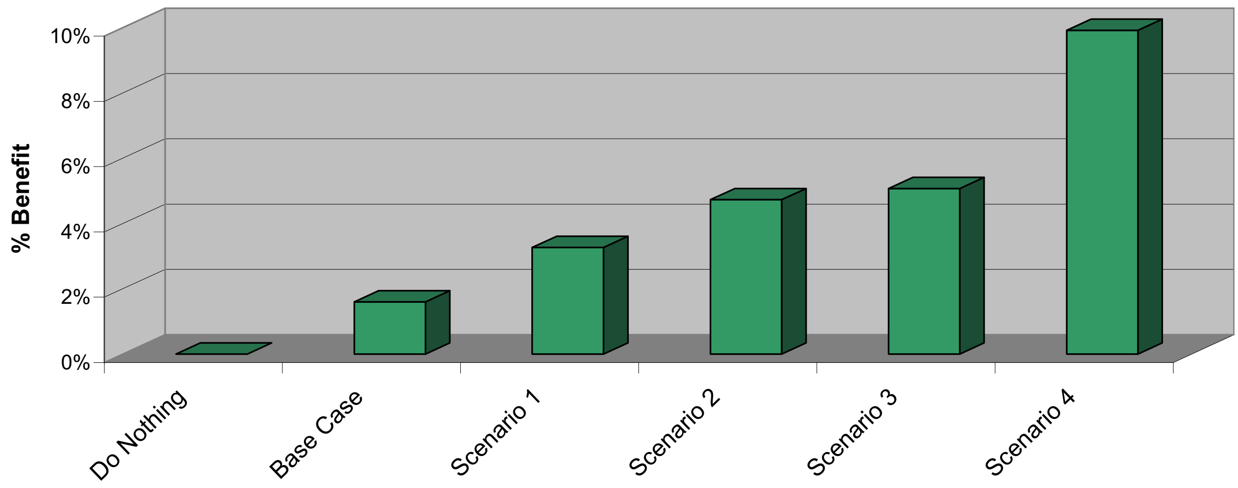


Figure 7-3: Urban Area Benefit to Stream Health (surrogate indicator)

It is expected that the combination of reduced extractions and reduced pollutant loads will improve river health. The value of this indicator is based on the assumption that river health has been compromised by a combination of river extractions and pollutant loads added to the river from urban sources. As natural processes are complex and as non-urban influences have a bearing, it is recognised that this indicator may not adequately describe the impact of each scenario on river health. However, it provides a way of helping to quantify impacts for comparison for the urban contribution to river health.

7.1.2 Social Perspective

Social Assessment Criteria
- improves public awareness
- secures future supply
- protects public health

It is difficult to quantify the social assessment criteria and a qualitative approach for social comparison has been adopted. The consensus of the PRG has been used to score the relative ability of each scenario to meet the social assessment criteria (Figure 7-4).

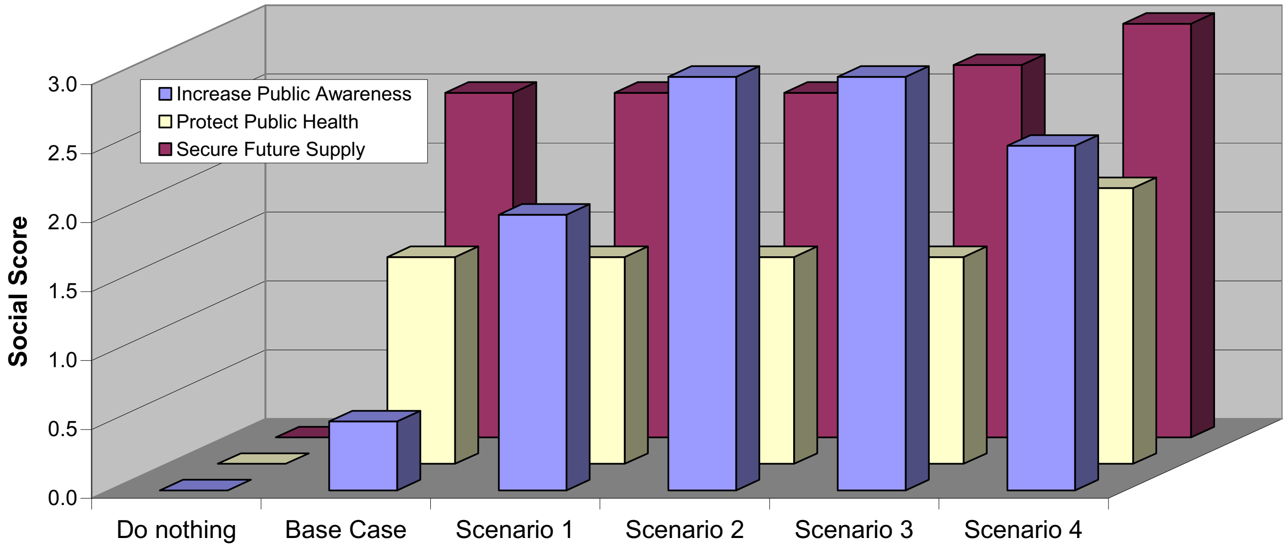


Figure 7-4: PRG Determined Social Scores

Scenarios were scored between -3 and +3 as per the scoring system described in Section 5.2. The PRG considered that each scenario would result in positive social outcomes and adopted a score of +3 for the scenario with the perceived best outcome. Other scenario scores were made relative to the highest scored scenario.

Some of factors and issues discussed by the PRG through scoring the social criteria included:

1. Public awareness and understanding of IWCM activities will improve with conservation activities such as BASIX and provision of information by Council (common to all scenarios), improved community education (Scenarios 1 to 4), and increasing variety and levels of source substitution.
2. Security of future supply will improve through consideration of future water demands (all scenarios), a common approach to sizing headworks infrastructure, be it off-stream storage or transfer (all scenarios), and increased use of recycled effluent (Scenarios 3 & 4).
3. Public health will be equally protected by each scenario in terms of the risk of disease outbreak, providing public health and engineering standards are observed. The use of advanced wastewater treatment processes was considered to better protect the public when in contact with river water (Scenarios 3 & 4).

7.1.3 Economic Perspective

Estimates of community (customer) costs, utility (Council) costs and the associated impact to typical residential rates for each scenario have been made (Section 6.4.3).

Economic Assessment Criteria
- low rates and charges
- low net present value

Figure 7-5 compares the percentage increase in the cost indicators for each scenario against the Base Case. It should be noted that even the Base Case requires significant water infrastructure investment in order to meet community expectations and Council's objectives for service standards.

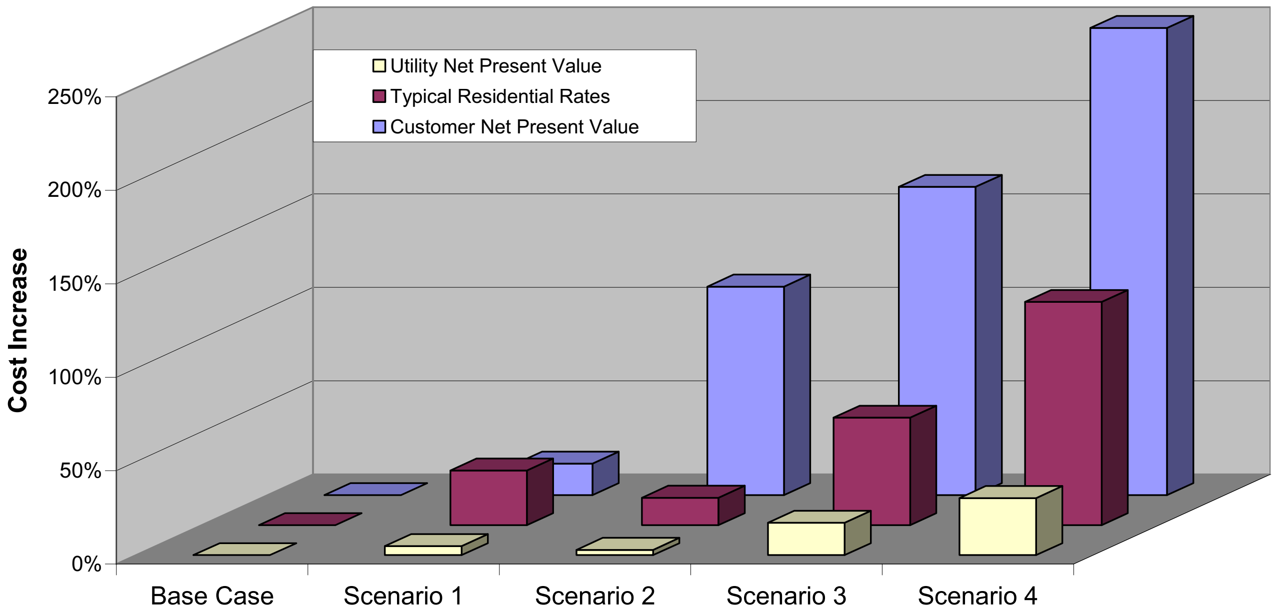


Figure 7-5: Cost Increase Comparison

As the level of integration increases across the scenarios, generally increased expenditure is required. Source substitution approaches also have the potential to significantly increase community costs.

7.1.4 Other Factors

Other factors discussed by the PRG which were not directly measured but influenced the overall perception of each scenario to meet IWCM objectives included:

1. Community acceptance of source substitution approaches, particularly recycled effluent approaches. Rainwater and greywater approaches are known to the community. Recycled effluent through a third pipe system requires a new level of community involvement. Community feedback should be sought if source substitution approaches are to be adopted.
2. Affordability of each option, recognising that each scenario involves significant rates increases. Further work is required to refine supply side costs and if need be a reduced level of service will be considered to reduce cost impacts.
3. DEC's preferred hierarchy for reuse projects:
    i. Replace potable water supply demands with recycled effluent.
    ii. Implement industrial reuse opportunities.
    iii. Implement beneficial agricultural/open space reuse opportunities which substitute river extractions.
    iv. Implement agricultural/open space reuse opportunities (do not substitute river extractions).
    v. Environmental regeneration projects.

7.1.5 Scenario Ranking

Scenario scores for IWCM assessment criteria were agreed by the PRG and input to the multi-criteria assessment tool to rank scenarios. The scores and rank of each scenario for equal weighting placed on the criteria are shown in Table 7-1.

Table 7-1: Scenario Ranking – Equal Criteria Weighting

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

Scenario	Environmental			1	Social			1	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.6	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	0.9	2
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.0	1
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	0.7	4
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	0.8	3

Scenario 2 scored the highest[11].

A check of the scenario rankings sensitivity to the three TBL criteria categories was also made (Table 7-2).

[11] Estimates of typical rates and utility net present values were improved subsequent to the preferred scenario selection workshop. The relative differences in costs are minor and favour the economic ranking of Scenario 2.

Table 7-2: Scenario Ranking Sensitivity

Scenario	Ranking			
	Equal Weighting	High Environmental Weighting	High Social Weighting	High Economic Weighting
Do Nothing	6	6	6	5
Base Case	5	5	5	3
Scenario 1	2	3	4	2
Scenario 2	1	2	1	1
Scenario 3	4	4	3	4
Scenario 4	3	1	2	6

Scenario 2 remained the highest ranked scenario for increased social and economic weightings. For the increased environmental weighting, Scenario 2 was ranked second behind Scenario 4.

An additional check was made by the PRG to recognise that Scenario 3 has high environmental value in terms of return to river flows, particularly during dry weather. To test this benefit on the scenario rankings, the environmental score was increased. With this change, Scenario 2 remained the highest ranked scenario for equal criteria weighting and was again ranked second behind Scenario 4 for the increased environmental criteria weighting.

Based on the multi-criteria analysis and workshop discussions the PRG selected Scenario 2 as the preferred scenario for implementation.

7.2 The Preferred Scenario

Scenario 2 is an integrated approach to urban water management which targets all development for an 18% reduction in future water usage. It incorporates many aspects of best practice water services management. As for the other scenarios considered, the main constraint to its successful implementation remains the water supply side management investment in infrastructure required.

7.2.1 Refinements

Review of Scenario 2's capital and recurrent costs has been made in line with Council's advice. Cost changes have been made to assess the financial impacts of alternative water supply approaches, recognise the cost savings which could be achieved through a combined program of demand management activities and recognise Council's planned levels of expenditure. A major change to stormwater renewals was made to better reflect likely asset depreciation requirements. Cost refinements are tabled below (Table 7-3).

Table 7-3: Preferred Scenario Cost Refinements

Activity	Capital Cost	Recurrent Cost
Active system leak detection	$20k	$3k/y
Installation of meters on un-metered connections	NA	$1k/y for 4 years
High user water audits	$2k	NA

Activity	Capital Cost	Recurrent Cost
BASIX/WELS	NA	NA
Rainwater tank rebate	$1k*	$3k/y for 15 years*
On-site greywater recycling - diversion	$1k	NA
On-site greywater recycling - treatment (new development)	$4k	NA
WSUD DCPs	$2k	NA
Inflow and infiltration program	NA	Delayed to 2007 $179-181k/y for 4 years
STP treatment process upgrade	$1,500k	No change
STP septage treatment	$250k	$3k/y
Retrofit of WSUD to key areas	$125k	$2k/y
Stormwater capital renewals	NA	$126k/y

* Administration costs only.

The refinement of Scenario 2 also included three cases for typical rates impacts analysis along with subsidy impact assessment:

1. Case 1 – Off-stream storage reservoir (485ML) based on high environmental flow licence requirements (80 percentile flow at 57.5ML/d and 95 percentile flow at 17.7ML/d).
2. Case 2 – Supply through transfer of water from Casino.
3. Case 3 – Low cost option including sizing of the off-stream storage reservoir (200ML) based on the draft macro water plan cease to pump flow at 15ML/d (Appendix G) and refurbishment works to the existing water treatment plant. The refurbishment works include:
   - suitable backwash treatment and/or recycling
   - replacement of clear water pumps and associated electrical equipment
   - concrete remedial works and tank lining
   - improved process control and monitoring
   - possible automation of some processes
   - any other improvements which may be identified during concept development.

Typical rate impacts for each Scenario 2 case are tabled below.

Table 7-4: Preferred Scenario Peak Typical Residential Rates Estimates ($/y)

Case	Water	Sewer	Stormwater[1]	Total Increase
2005/06 rates	452	490	NA	0
Case 1 (subsidised)	682	473	129	342
Case 1 (no subsidies)	1,043	505	211	817
Case 2 (subsidised)	708	473	129	368
Case 2 (no subsidies)	1,175	505	211	949
Case 3 (subsidised)	546	473	129	206
Case 3 (no subsidies)	707	505	211	481

1. Increase in stormwater rates.
2. ADOPTED CASE – total increase in typical residential rates of $238/y.

All cases include relatively high capital costs early in the planning horizon resulting in the need for loans and increases to water rates at a time when it may not be apparent that there is an impending cash flow problem.

Case 3 is the cheapest option, however it is considered to be a high risk option in terms of meeting desired levels of service, as it is subject to confirmation of water sharing rules and the ability of the existing treatment plant to meet future capacity requirements. Case 2 is the most expensive option and is considered to have medium level risks associated with achieving agreement of supply terms to ensure long term reliability with an external supplier and at a reasonable cost. Case 1 is considered a relatively low risk supply approach, however it is not the cheapest approach.

Should the assumed subsidies not be available, then further increases to typical residential water, sewer and stormwater rates are anticipated. Case 1 and 2 water rates and stormwater rates are particularly sensitive to the availability of subsidies.

With these refinements in mind, a community display and workshop was held on 23 February 2006, to present the PRG's preferred IWCM scenario to the broader community for comment (Appendix A). Although poorly attended the attendees at the workshop generally recognised that improvements to water, sewerage and stormwater infrastructure are required. There were concerns raised regarding:

- consideration of the social impacts of the scenarios, including ensuring jobs are kept in Kyogle
- future privatisation of water services
- the quality and cost of supply from Casino.

During this community workshop, Council representatives advised that further investigation into the supply side cases is required, including further community input. Council also explained that every avenue for external funding will be investigated, increases in water and sewerage charges are anticipated for preferred levels of service, and indicated that dedicated stormwater funding needs to be obtained if the proposed stormwater improvements are to occur. It was on this basis that the IWCM Strategy Plan Draft Report was prepared for comment.

In March 2006, Council distributed 4,400 community surveys seeking community feedback on Council's provision of water services and the proposed options for improvement with associated increases in rates (Appendix K). In all 160 replies were received by the end of June 2006, representing the best understanding of community views available to Council. Based on the responses, Cases 1 and 2 were generally not supported by the community because of the relatively high costs and a perceived lack of independence associated with the Casino transfer scheme.

Recognising that the community did not generally support the proposed costs associated with Cases 1 and 2, and the associated financial risks to Council with these cases, the low cost water supply approach remained the only viable option (Appendix K).

It was recommended in Council's 2006/07 Management Plan that the IWCM Scenario 2 Case 3 (low cost water supply approach) be adopted and budget allocations have been made accordingly. The 2006/07 Management Plan now includes budget provisions, revenue policies and pricing strategies as recommended by the IWCM Strategy Plan for delivery of water services from 2006/07 and beyond.

7.2.2 IWCM Strategy

Key features of Kyogle's IWCM Strategy are outlined below:

- Water supply from the Richmond River with a new off-stream storage (200ML), refurbished water treatment plant, new transfer facilities and a new service reservoir.
- Wastewater treatment facilities upgraded to allow restricted reuse at the treatment works. The treatment improvements will include a hydroponic wetland within the existing Council land and a septage receival and treatment facility. The sewer inflow and infiltration reduction and rehabilitation program will continue. The several remaining urban properties with on-site wastewater treatment systems will be connected to the sewer.
- Stormwater flood mitigation works and activities will be implemented. Drainage improvements and additional stormwater quality improvement devices are included. Water sensitive urban design development control plans will be developed to reduce outdoor water usage and stormwater runoff impacts from new developments. Local stormwater harvesting opportunities are included.
- On-going renewal of the water, wastewater and stormwater systems.
- Catchment management activities in line with CMA initiatives, including, the water sharing plan, improved on-site systems and riparian rehabilitation.
- Source substitution (potential for outdoor, toilet flushing and clothes washing uses) through mandatory use of rainwater tanks on new development, a rainwater tank retrofit program (subsidised cost) and promotion of greywater reuse systems.
- Conservation of water usage through community education (special events, brochures, schools, competitions), water supply system leak detection and repair, high water user audits, inclining block tariff, residential retrofit of dual flush toilets, low flow taps and showerheads, commercial toilet retrofit (on request), residential washing machine rebate, and no new rural town water and wastewater connections.

The 30 year financial plan for the Strategy is presented in Table 7-5.

Table 7-5: Kyogle IWCM Strategy 30 Year Plan

Project	Type	Subsidy (%)	1 2006	2 2007	3 2008	4 2009	5 2010	6 2011	7 2012	8 2013	9 2014	10 2015	11 2016	12 2017	13 2018	14 2019	15 2020	16 2021	17 2022	18 2023	19 2024	20 2025	21 2026	22 2027	23 2028	24 2029	25 2030	26 2031	27 2032	28 2033	29 2034	30 2035
Water Supply																																
Off stream storage (200ML)	Capital	50%			2,000																											
Off stream storage	On-going				20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Raw water transfer system*	Capital	50%			92																											
Upgrade/Remedial Works to existing WTP*	Capital	50%					900																									
Potable water transfer system*	Capital																					150										
Service reservoir*	Capital																435															
Reticulation extension*	Capital		65	82	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Demand Management																																
Conservation activities	Capital		41	17	15																											
Conservation activities	On-going		4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Community IWCM education (promotion/guidelines)	Capital	100%	50																													
Community IWCM education (promotion/guidelines)	On-going	100%	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Substitute sources	Capital		4	2																												
Substitute sources	On-going		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3															
Wastewater																																
2^0 treatment + nutrient removal + disinfection - hydroponic wetland*	Capital			1,500																												
Reticulation extension*	Capital		79	96	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Infiltration and inflow reduction program	On-going			179	180	180	181																									
Septage treatment at STW	Capital			250																												
Septage treatment at STW	On-going		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Stormwater																																
SMP Flood mitigation	Capital	88%			2,200																											
SMP Flood mitigation	On-going				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SMP Upgrade and quality	Capital			2																												
SMP Upgrade and quality	On-going			8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Water sensitive urban design DCPs	Capital		2																													
Retrofit of water sensitive urban design to key areas	Capital		25	25	25	25	25																									
Retrofit of water sensitive urban design to key areas	On-going			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Catchment																																
CMA supported catchment activities	Capital		10	10	10	10	10																									
Other catchment activities	Capital		20	20	20	20	20																									
Kyogle Water Supply O&M	On-going		379	378	434	480	479	478	478	478	478	479	479	479	479	479	479	479	480	480	480	480	481	481	481	481	482	482	482	482	483	483
Kyogle Wastewater O&M	On-going		319	334	333	333	333	333	333	333	332	332	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	334	334
Water - Other																																
Kyogle IWCM Part 2	Capital	50%	75																													
Bonalbo WTP construction	Capital	50%	1,100																													
Bonalbo Alternate Water Sources	Capital	50%	278																													
Bonalbo PS 1 Upgrade Peacock Creek source 2006/07	Capital	50%	70																													
UMMWWS WTP Construction	Capital	50%	725																													
UMMWWS Off-stream Storage 2010/11	Capital	50%						300																								
Water capital renewals	Renewals		250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
Other Village Water O&M	On-going		183	183	183	183	183	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171	171
Wastewater - Other																																
Woodenbong STP augmentation	Capital		45																													
Wastewater capital renewals	Renewals		160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
Other Village Wastewater O&M	On-going		145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145
Stormwater - Other																																
Stormwater - Other (All Villages)	On-going		45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Stormwater capital renewals	Renewals		126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126

* On-going costs included in *Kyogle Water Supply O&M* or *Kyogle Wastewater O&M*; UMMWWS - Urbenville Muli Muli Woodenbong Water Supply System

7.2.3 IWCM Strategy Implementation Risks

The IWCM Strategy Plan requires integrated implementation to be successful. The elements of the Strategy are interdependent, require significant infrastructure investment within the next few years and early implementation of water conservation measures to achieve the targeted outcomes. Failure to implement a portion of the strategy will require the recommendations to be re-assessed. For example, a decision not to proceed with the source substitution activities will require additional water supply capacity in order to compensate for the source substitution savings. However, the integrated approach to the delivery of urban water services is expected to result in improved water cycle outcomes, including improved sustainability.

In addition to the implementation risks associated with integrated water management approaches, there are three key areas for further consideration:

1. The proposed water supply improvements have been adopted primarily because other supply options are considered too expensive. The low cost water supply approach is dependent on acquisition of a site for the off-stream storage and confirmation of the draft water sharing plan cease to pump rules. It is understood that potential sites have been identified and are likely to prove suitable. The cease to pump rules effectively determine the size of the off-stream storage required for acceptable supply reliability. Should the rules become more stringent then a larger storage is required to maintain the same level of reliability.
2. The adopted low cost water supply approach is dependent on the existing WTP being refurbished to an adequate state to provide safe and adequate treatment of stored river water for drinking purposes, and capability to meet future peak demands (in combination with the supply system). At this stage, the peak capacity of the refurbished WTP has not been finalised and is dependent on specialised assessment. Council considers it likely that on-going restrictions will be required (a change to desired levels of service) to control demands and allowance has been made for an additional town water service reservoir (2ML) in the Year 2020 to provide for peak demands. It is proposed that the concept design of the off-stream storage and WTP consider the WTP's future capacity to meet peak demand periods (particularly over several high demand days), operational protocols for management of stored water quality and process requirements to treat the impounded river water. Operational strategies to facilitate management of demands at short notice and associated contingency plans are likely to be required.
3. Sewage treatment process upgrade. To avoid any STP licensing issues, continuing development of the treatment process design, in consultation with the DEC, is proposed.

8. Addressing the Issues

The Kyogle IWCM Strategy Plan responds to the issues raised in the IWCM Concept Study and by stakeholders during the project. The Strategy compliments regional programs, in particular, the CAP. A summary of how these issues are to be addressed is set out in the following table.

Table 8-1: Addressing the Issues

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
Catchment	Agricultural extractions: • during low flow periods, river extractions can exceed the total river flows • fluctuations in agricultural demand may impact on the preferred water cycle management strategy • impacts downstream users, including town water supply.	The Strategy supports the Northern Rivers Catchment Management Authority's (NRCMA) Catchment Action Plan (CAP) which includes initiatives for: • stream rehabilitation and protection • community education • legislative change to prevent water pollution • development of water sharing plans. Future town water extractions and water supply infrastructure based on macro water plan requirements (refer to *Lack of Town Water Supply Security* below).
	Poor river water quality: • reduces the usability of the river water • algal blooms (potential health issues) • impacts on town water supply • reduces ecological diversity of river system.	The Strategy supports the CAP (see *Agricultural Extractions* above). The Strategy also includes: • improved sewage treatment • inflow and infiltration reduction • WSUD in new development and at key existing developments • improved community education.
	Dryland salinity in upper catchment areas: • reduces downstream water quality • decreases productivity of land • reduces ecological diversity.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Soil erosion: • reduces downstream water quality • decreases productivity of land.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	River bank erosion: • reduces river water quality • reduces ecological diversity of river bank and river system.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Deforestation and monodiversity: • reduces river water quality • reduces ecological diversity	The Strategy supports the CAP (see *Agricultural Extractions* above).

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
	Climate change and greenhouse gases: • may impact availability of water resources • potentially exacerbates issues such as soil erosion and dry land salinity. • potentially impacts stormwater quantity and quality.	The Strategy supports the CAP (see *Agricultural Extractions* above). The Strategy also includes: • increased water storage • diversified water sources (rainwater, greywater & stormwater) • reduced energy consumption through improved equipment efficiencies • demand management which is expected to allow Kyogle to cater for future growth without increasing average water consumption • WSUD practices and rainwater tanks for reduced peak flow and pollutant runoff • improved quantity and quality monitoring.
	Ecological health of water ways: • threatened species may potentially be impacted by activities in the catchment • changes to Kyogle's water cycle infrastructure (eg the weir) could impact on the rivers environmental flows and fish migration patterns.	The Strategy supports the CAP (see *Agricultural Extractions* above). Environmental flows are to be maintained in accordance with the Surface Water Sharing Plan.
	Increased numbers in small landholders dams: • potential to alter stream flows.	The Strategy supports the CAP (see *Agricultural Extractions* above).
	Thought to be a large number of unregistered bores: • difficult to quantify and regulate groundwater extraction • aquifer at "high" risk.	The Strategy supports the CAP (see *Agricultural Extractions* above). The DNR continues to regulate groundwater extractions. Additional information for IWCM Strategy is anticipated at the 5 year review. The Strategy does not rely on aquifer water sources directly (bores maybe used during drought periods).
Kyogle Water Supply Issues	Poor condition of water treatment plant: • increased OH&S risks • reduced reliability and performance	The WTP is to be refurbished.
	Lack of town water supply security: • social and economic ramifications eg water restrictions • potential storage options may have environmental impacts including: altered stream flows; altered catchment ecology and reduced flood impacts • potential source replacements may reduce river extraction however may also not be socially acceptable.	The Strategy addresses future supply security through: • demand management program including conservation and source substitution • diversification of water sources (rainwater, greywater & stormwater) • provision of off-stream storage with river extractions in accordance with the Surface Water Sharing Plan The Strategy was developed through a consultative process with key stakeholders and community.
	Variable poor raw water quality: • impacts on water treatment processes.	Provision of the off-stream storage will change raw water quality characteristics. The WTP and off-stream storage concept design will consider operational protocols for management of the stored raw water quality. The WTP will be refurbished to enable delivery of treated water to drinking water standards.
	Water filter backwash to river: • filter backwash increases pollutant loads in receiving creek and river.	The WTP refurbishment will include suitable filter backwash treatment and/or recycling.

Addressing the Issues		
Context	**Issue**	**IWCM Strategy Response**
Kyogle Sewerage Issues	Sewerage treatment plant capacity and performance: • higher than ideal hydraulic loads cause short circuits in the treatment process which in turn reduces the receiving water quality • ageing infrastructure also reduces the effluent quality.	The Strategy includes improvement of sewage treatment processes and infrastructure.
	DEC(EPA) Pollution Reduction Program: • aims to improve water quality and increase effluent reuse • requires Council's attention.	The Strategy includes improvement of sewage treatment processes and infrastructure to meet sensitive water quality standards. The Council will continue to liaise with DEC to develop the concept design.
	Contribution STP has on Richmond River during low flows: • increased recycling of effluent may cause changes to the extraction/effluent release ratio in the Richmond River • relative nutrient loads on river are increased during low flow periods.	The Strategy includes improvement of sewage treatment processes and infrastructure. All low sewage flow will receive improved treatment. Council controlled reuse.
	Sewerage reticulation infiltration and storm inflow: • causes large peaks in flows during storm events, which in turn results in poor effluent quality and potential system surcharges.	Inflow and infiltration rehabilitation works will continue. Adoption of *smart sewers* in new development areas. Future sewage dry weather flows are anticipated to decrease through indoor conservation efforts and greywater reuse.
	On-site sewerage treatment systems: • potential impact on receiving water quality • some on-site systems within the town service area with potential water quality and health issues.	Connection of urban on-site systems to the wastewater reticulation system. Continued implementation of the *On-site Sewage and Wastewater Management Strategy* (2000). Provision of septage receival and treatment facilities at the STP.
Kyogle Stormwater Issues	Stormwater system hydraulic bottlenecks: • potential flood issues in commercial district.	The Strategy includes flood mitigation works and provision for long term stormwater system operation and maintenance,
	Stormwater quality impacts: • receiving waters can be adversely impacted by poor stormwater quality • lack of formal stormwater litter, sedimentation and erosion control measures.	WSUD in new and key development areas, community education and the provision of improved stormwater system infrastructure (including gross pollutant traps and kerb and guttering) are anticipated to improve stormwater runoff quality.
	Some stormwater discharges to private property: • may impact land holder.	Council to address on a case by case basis.

9. The Next Steps

The adopted IWCM Strategy provides the framework for sustainable management of Kyogle's urban water services into the future. The next steps in implementation of the IWCM Strategy will include:

1. Budgeting, funding allocation, subsidy and grant approvals (already initiated through the 2006/07 Management Plan and subsidy requests).
2. IWCM activity development and approvals.
3. Design and documentation.
4. Procurement and operational arrangements.
5. Construction and commissioning.
6. System management, operation and monitoring.

Implementation of the Strategy requires on-going support by Council, the community and relevant government agencies. Implementation of the Strategy is an on-going process involving review every five years. At the first five year review all the villages served by the Council are anticipated to be amalgamated into the Strategy. A monitoring and review program will enable assessment of Strategy in its ability to achieve Kyogle's IWCM goals, allow identification of new issues and refinement of the Strategy to ensure best management. It will also allow key assumptions made during the development of the Strategy to be updated.

The detailed actions required to implement the Strategy Plan are described in this document and summarised in Table 9-1. Together, Kyogle Council and the community now have the task of successfully implementing the Strategy.

Table 9-1: Kyogle IWCM Strategy Action Plan

Kyogle IWCM Strategy Action Plan		
Description	**Further Actions**	**Timetable**
Water Source		
Off stream storage and upgrade WTP (low cost option requiring restricted demand)	Further development of this concept required to determine site for off-stream storage and allow for design and construction works.	Investigation works to commence in July 2006 with funds allocated in the 2008/2009 financial year for construction works.
	Water Treatment Plant backwash water discharge to be addressed as a matter of priority. Treatment concept to be developed to allow for construction.	Investigation works to commence in July 2006 with funds allocated in the 2006/2007 financial year for construction works.
	Drought Management Plan to be reviewed particularly with respect to triggers for imposing of water restrictions. Level 1 Water Restrictions are expected to be permanently imposed.	Drought Management Plan to be reviewed after completion of off-stream storage concept development. May also need to review again following assessment of the WTP refurbishment and peak capacity.
	Investigation of existing Water Treatment Plant to assess the possible peak capacity of the plant and identify works required for refurbishment and improvements.	Investigation works to commence in December 2006 with funds allocated in the 2010/2011 financial year for construction works.
Sewage Treatment		
Secondary + nutrient removal + disinfection	Concept to be developed to detailed design stage to allow construction as soon as possible. Council to liaise closely with the DEC to develop concept to the point where detailed design can commence. Project Specific Reference Group to be formed.	Concept development to commence July 2006 with funds allocated in the 2006/2007 financial year for construction works. Project Specific Reference Group to be formed in July 2006 with the first workshop on August 31, 2006.
Inflow and infiltration reduction	Ongoing program of rehabilitation works and internal plumbing repairs based on detailed CCTV and smoke testing results.	Funds allocated on an annual basis commencing 2004/05. Budget allocations removed from the 2006/2007 and 2007/2008 financial years due to lack of state government subsidy for the upgrade works at the Kyogle STP, program to recommence in 2008/2009.
On-site systems	Connection of remaining township residential properties to the sewer system.	2007 to 2009.

Kyogle IWCM Strategy Action Plan		
Description	Further Actions	Timetable
Recycled Water		
Dry weather non-contact irrigation/wetlands	Included as part of the "Sewage Treatment - Secondary + nutrient removal + disinfection" component above.	
Greywater		
Greywater (diversion)	Review of NSW Health guidelines and Council policies to be undertaken to determine system standards and approvals process.	Consultation with Council's Planning Department to commence July 2006.
Greywater (new development)	Development Control Plan and/or conditions of development consent to be reviewed to cover greywater systems on new development.	Consultation with Council's Planning Department to commence July 2006.
Rainwater		
Mandatory tanks (new development)	Development Control Plan and/or conditions of development consent to be reviewed to require rainwater tanks as well as compliance with BASIX.	Consultation with Councils Planning Department to commence July 2006.
Retrofit/rebate tanks (existing development)	Detailed rebate program to be established.	Rebate program development to commence July 2006 with funds allocated in the 2006/2007 financial year towards rebate payments.
Stormwater		
Stormwater current initiatives	Stormwater revenue stream to be established to help fund both current and proposed initiatives.	New Stormwater and Flood Mitigation charge of $25 per developed property in each of the villages implemented in the 2006/2007 Management Plan.
WSUD (new development)	Development Control Plan and/or conditions of development to be reviewed to ensure Water Sensitive Urban Design principles are followed for new developments and redevelopments.	Consultation with Council's Planning Department to commence July 2006.
WSUD (new and key existing development)	As above, and investigation works required in each village to identify key stormwater improvement projects and formulate a program of works.	Council to engage a consultant by December 2006.
	Council to review revenue stream to source funding levels required to provide desired levels of service.	Options to be reviewed during 2006/2007 to enable increased charges to be imposed in the 2007/2008 financial year.

Kyogle IWCM Strategy Action Plan		
Description	Further Actions	Timetable
Conservation		
Current initiatives (incl. BASIX)	Continue current conservation activities.	2006/2007 and ongoing.
Improved community education	Community education program to be developed in conjunction with rebate program, and to incorporate items such as greywater recycling and water sensitive urban design.	Program and associated information to be developed as part of the implementation of the rebate program in 2006/2007.
Fixture retrofits and rebates	Detailed rebate program to be established. Including plumbing contracts, marketing materials, quality assurance and reporting procedures.	Rebate program development to commence July 2006 with funds allocated in the 2006/2007 financial year towards rebate payments.
Inclining block tariff	On-going revenue modelling to set adjustments to fixed and variable charges. Revenue Policy to be amended to reflect new water consumption charges.	New charges adopted in the 2006/2007 Management Plan. New charges to be implemented in the first billing period of the 2006/2007 financial year.
Leakage reduction, audits and metering	Identification and metering of un-metered connections.	2006/2007 and ongoing.
	Active participation in the Water Directorate's state-wide Water Loss Program.	2007/2008.
	Audits of high water users on a voluntary basis	2006/2007 and ongoing.
Self-sufficient new rural development	Development Control Plan and/or conditions of development to be reviewed to ensure all new rural development is self sufficient in water and sewerage services.	Consultation with Councils Planning Department to commence July 2006.
	Development Control Plan and/or conditions of development to be reviewed to ensure Water Sensitive Urban Design principles are followed for new developments and redevelopments.	Consultation with Councils Planning Department to commence July 2006.
Monitoring and Review		
Water Quality Monitoring	Continuation of current water quality monitoring program (refer to Appendix J).	2006/2007 and ongoing.
	Development and implementation of revised water quality monitoring program for the Kyogle STP augmentation works.	To be developed as part of the pre-construction activities associated with the Kyogle STP augmentation.

Kyogle IWCM Strategy Action Plan		
Description	**Further Actions**	**Timetable**
	Involvement in regionally co-ordinated water quality monitoring programs such as the NRCMA Northern Rivers Ecosystem Health Monitoring program and NSW health programs such as pesticide monitoring programs.	2006/2007 and ongoing.
Water Quantity Metering	Continuation of current monitoring program including sectoral consumption records.	2006/2007 and ongoing.
	Installation of backwash metering at the WTP.	2006/2007
	Maintenance and regular calibration of all existing meters, flow measuring devices and telemetry data recording.	2006/2007 and ongoing.
Integrated Water Cycle Management	Review of the Kyogle IWCM Strategy.	2011/2012
	Consolidation of other village IWCM strategies and long term strategies to allow one IWCM strategy to cover all serviced villages.	2011/2012
Administration	Review of water billing system data to better reflect water and sewerage customer categories	2006/2007
	Review of Developer Contributions for Water, Sewer and Stormwater and Flood Mitigation.	To commence in August 2006 with a view to revised charges being adopted for the 2007/2008 financial year.
	Review of current Water Supply and Sewerage Services Strategic Business Plans to reflect IWCM Strategy outcomes and revision of levels of service.	To commence in August 2006 with a view to revised charges being adopted for the 2007/2008 financial year.

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Appendices

Appendix A – Community Consultation

Kyogle Council
Integrated Water Cycle Management Strategy

Community Consultation Report

July 2006

Prepared for MWH Australia Pty Limited

Que Sera Consulting Pty Limited
ABN 2608 6952 605

Kyogle Integrated Water Cycle Management Strategy
Community Consultation Report

Introduction

This report outlines the community consultation process undertaken for the development of the Kyogle Integrated Water Cycle Management Strategy.

In 2005, Kyogle Council and the Department of Energy, Utilities and Sustainability implemented a new best practice approach to water utility strategic planning known as Integrated Water Cycle Management (IWCM).

On 31 August 2005, Kyogle Council held the first of six stakeholder and community workshops to provide input and feedback on the options being considered for the development of an IWCM Strategy.

Community involvement is seen as an essential part of the success of the IWCM. A Project Reference Group (PRG) was established from invited representatives of government agencies, community and business groups. Five PRG workshops were held during the six months it took to develop the IWCM strategy, and were timed to fit in with findings from technical investigations.

Workshop Schedule

The following workshops were held:

- PRG Workshop 1 – Study Objectives and Process, Concept Study findings - 31 August 2005
- PRG Workshop 2 – Develop long list of options and assessment criteria for decision making – 14 September 2005
- PRG Workshop 3 – Develop short list of options for further assessment – 28 September 2005
- PRG Workshop 4 – Options assessment – 12 October 2005
- PRG Workshop 5 – Preferred scenario – 30 November 2005
- Community Display and Workshop – Information and feedback – 23 February 2006.

Figure 1 outlines the consultation program, which ran in parallel to the technical studies.

Figure 1: Consultation Program

Project Reference Group

The role of the PRG was to represent their constituents during workshop deliberations, while providing input and feedback on scenarios. The PRG assisted in:

- Identifying urban water cycle related issues
- Identifying potential measures to address the issues
- Assessing the potential measures and forming strategic options (scenarios)
- Identifying the preferred scenario.

Table 1: Members of the Project Reference Group

Member	Organisation
Graham Kennett	Kyogle Council – Water and Sewerage
Frank Winter	Kyogle Council – Emergency and Flood Management
Scott Turner	Kyogle Council – Planning and Community Services
Ernie Bennett	Kyogle Council – Councilor (Mayor)
Peter Lewis	Kyogle Council - Councilor
David Liska	Kyogle Council - Councilor
Patsy Nagas	Kyogle Council - Councilor
Jeff Marriott	Kyogle Council - Councilor
Bryan Hannigan	Kyogle Council - Councilor
Jim McNeill	Kyogle Council - Councilor
Ian Kirkpatrick	Kyogle Council - Councilor
Lindsay Passfield	Kyogle Council - Councilor
Adam Joyner	MWH - Consultant
Russell Beatty	MWH - Consultant
Susan Love	Que Sera Consulting - facilitator
Chris Hennessy	Department of Energy Utilities and Sustainability
Rob Siebert	Department of Commerce
Jeremy Black	Department of Natural Resources
Graeme Budd	Department of Environment and Conservation
Brett Nudd	Department of Environment and Conservation
Jennie Fenton	Northern Rivers Catchment Management Authority
Stephen Channells	Department of Lands
Geoff Sullivan	North Coast Public Health Unit
Richard Swinton	Department of Primary Industries
Patrick Dwyer	Department of Primary Industries Fisheries
Ray Medhurst	Richmond Valley Council
Mark Hesse	Richmond Valley Council
Russell Bonney	NSW Farmers Association
Phillip Gresham	Kyogle Chamber of Commerce
Ron Randell	Gugin Gudduba Local Aboriginal Land Council
Malcolm Wallace	Turkey Nest Tourism Group
Bob Jarman	Kyogle Land Care
Les Hellyar	Richmond River Water Users Association
Graham Gordon	Upper Richmond River Water Users Association
Ron Martin	Kyogle Community Economic Development Committee
Ian Warren	Byron Shire Council (observer)
Patrick Pahlow	Department of Planning

Note: not all members of the PRG were able to attend all five workshops. Workshop notes were sent to all members of the PRG.

Processes

Council engaged MWH Australia Pty Limited as consultants to assist in the development of the IWCM strategy. Each PRG workshop was three hours and was held in the Kyogle Council Chambers. Workshops were independently facilitated by Susan Love from Que Sera Consulting Pty Limited. At the start of Workshop 1, the objectives of the PRG and the Terms of Reference for the PRG were outlined and agreed.

The PRG workshops worked towards the development of a recommended IWCM Strategy (Figure 2).

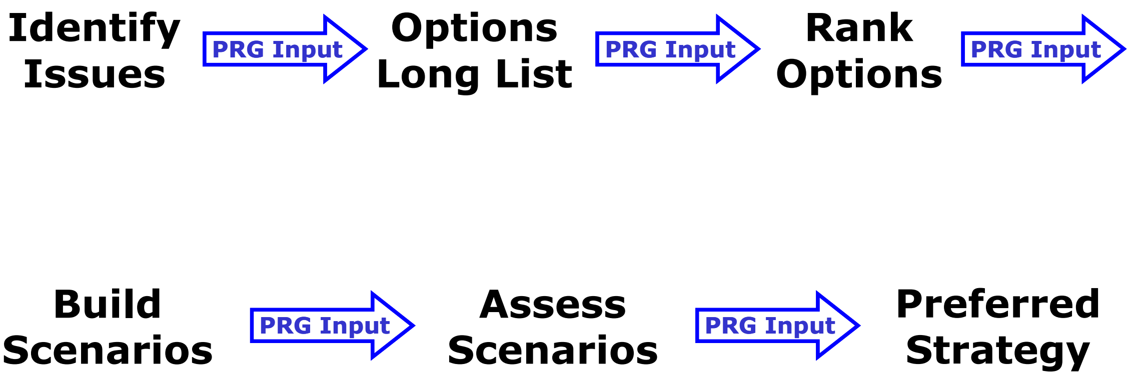

Figure 2: Strategy Development

An outline of the objectives, process and outcomes of each PRG workshop are listed below. Details of each workshop are provided in the attached workshop notes.

PRG Workshop 1 – IWCM Issues

The first workshop agreed on the Terms of Reference. An understanding of the IWCM concept and process, as well as the roles and responsibilities of PRG members was presented and agreed. The PRG identified additional IWCM issues not included in the Concept Study.

PRG Workshop 2 – IWCM Options and Assessment Criteria

The second workshop involved an introduction to the option screening process. The PRG broke into 4 groups to develop and agree a long list of IWCM options. The groups again broke into 4 groups to discuss and list the assessment criteria for social, economic and environment. When the lists were developed each PRG member was given 9 stickers to allocate criteria from all 4 lists.

PRG Workshop 3 – Options Ranking

The third workshop involved 2 groups from the PRG scoring on a double sided A3 sheet. Thirty three options were scored by each group. Following the scoring process, several comments on the scoring process were made.

PRG Workshop 4 – Scenario Building

During Workshop 4, Jennie Fenton, Northern Rivers Catchment Management Authority (NRCMA) presented to the PRG on the NRCMA's role and funding arrangements. The PRG bundled the IWCM options into scenarios. The group reviewed the triple bottom line screening criteria for the fine screening. The PRG broke into 2 groups. The base case represents Council's planned water management activities. The process of allocating options selected at workshop 3 to the categories of base case, scenario 1 to 4 was explained. Potential scenario targets were discussed.

After bundling of options was completed, both groups briefly outlined their scenarios. There was some discussion on the process from here. Options would be massaged into scenarios. A dollar value would be attributed to each scenario.

PRG Workshop 5 – Preferred Scenario

In workshop 5, the final PRG workshop, the whole group scored the scenarios via an electronic presentation. Following discussion, Scenario 2 was preferred. Council outlined their broader community involvement strategy. The PRG agreed to the proposed strategy. Council thanked the PRG for their valuable efforts on the development of the Kyogle IWCM Strategy preferred scenario.

Community Display and Workshop

Kyogle Council was very keen to broaden consultation to the wider community following the selection of the preferred scenario. In December 2005, information on the IWCM, the role of the PRG, and notification of a community workshop to be held in February 2006 was sent out to the Kyogle community. The opportunity to present the preferred scenario to the community for consideration and comment was part of Council's strategy for meaningful community involvement. Council wanted to test the IWCM preferred strategy with those people who would be paying for it.

All members of the Kyogle community were invited to attend a drop-in display and workshop at the Kyogle Hall on Thursday 23 February 2006. Some ten people attended from the community. Maps, diagrams, workshop findings, other relevant documents were on display. A questionnaire booklet was available for written comments. Questionnaire comments are attached.

The community workshop was designed to present the IWCM process, deliberations of the PRG, and the preferred scenario in an informal way. A question and answer session was an essential part of the workshop, to allow open discussion on issues of concern and interest to the community.

The workshop was attended by representatives from Kyogle Council, Department of Energy, Utilities and Sustainability, MWH and the independent facilitator. The format for the workshop was as follows:

- Agenda and introductions
- The Kyogle IWSM strategy – catchment, water supply, sewerage, stormwater issues
- What the IWCM strategy looks like – what is it?
- Concept study and the PRG
- The IWCM program and development
- The potential options and ranking
- The scenarios – benefits, costs and ranking
- The PRG preferred scenario
- The community involvement process
- Completing the IWCM process
- Questions and answers.

Community presentation slides related to scenario costs and description of the preferred scenario are attached.

Community feedback from the workshop included:

- Consideration of climate change
- Ensuring jobs are kept in Kyogle
- Social impact of scenarios
- Concerns regarding the taste and quality of water from Casino
- Preference for local management of the water supply
- Privatisation of water supply
- Management of water used on farms
- Timeframe and cost.

During the presentation, Council made it clear that further community views would be sought in relation to the option for water supply for a new treatment plant and storage or supply transferred from Casino. Those attending the workshop were encouraged to discuss the issues with family and friends. Council advised that the preferred strategy would be re-visited every five years to ensure its effectiveness and to take advantage of the latest data on such things as climate change.

Attachments

1. PRG Workshop 1 Notes
2. PRG Workshop 2 Notes
3. PRG Workshop 3 Notes
4. PRG Workshop 4 Notes
5. PRG Workshop 5 Notes
6. Community Workshop Presentation – Preferred Scenario Costs and Description
7. Community Questionnaire Responses

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Meeting Notes

Kyogle Integrated Water Cycle Management Strategy
Project Reference Group Workshop 1

Venue: Kyogle Council Chambers
Time: 2:00pm – 5:00pm 31 August 2005

Client Name: Kyogle Council

Project Name: Kyogle Integrated Water Cycle Management Strategy   MWH Project No: A0150600

Facilitator: Susan Love

Attendees	Organisation	Initials
Graham Kennett	Kyogle Council	GK
Frank Winter	Kyogle Council	FW
Ernie Bennett	Mayor Kyogle Council	EB
Ian Kirkpatrick	Councillor Kyogle Council	IK
Lindsay Passfield	Councillor Kyogle Council	LP
Adam Joyner	MWH	AJ
Russell Beatty	MWH	AB
Chris Hennessy	DEUS	CH
Jeremy Black	DNR	JB
Graeme Budd	DEC	GB
Geoff Sullivan	North Coast Public Health Unit	GS
Richard Swinton	DPI	RS
Ray Medhurst	Richmond Valley Council	RM
Phillip Gresham	Kyogle Chamaber of Commerce	PG
Bob Jarman	Kyogle Land Care	BJ
Les Hellyar	Richmond River Water Users Association	LH
Graham Gordon	Upper Richmond River Water Users Assoc	GG
Ron Martin	Kyogle Community Economic Dev. Committee	RM
Ian Warren	Byron Shire Council (observer)	IW
Mark Hesse	Richmond Valley Council	MH
Patrick Pahlow	Department of Planning	PP

Apologies	Organisation
Scott Turner	Kyogle Council
Peter Lewis	Councillor Kyogle Council
David Liska	Councillor Kyogle Council
Patsy Nagas	Councillor Kyogle Council
Bryan Hannigan	Councillor Kyogle Council
Jeff Marriott	Councillor Kyogle council
Jim O'Neill	Councillor Kyogle Council
Rob Siebert	DOC
Jennie Fenton	NRCMA
Patrick Dwyer	DPI Fisheries
Malcolm Wallace	Turkey Nest Tourism Group

Circulate To:

Above

Item		Action
1.0	Welcome and Introductions	
1.1	*Welcome*	
	GK provided the welcome. Each participant introduced.	
1.2	*Introductions*	
1.3	*Agenda and Terms of reference*	
	Agenda and terms of reference discussed and accepted. Agreed actions list to be included.	AJ
2.0	Workshop Objectives	
2.1	*Establish the PRG*	
2.2	*Provide understanding of the IWCM concept and process*	
2.3	*Provide understanding of the PRG roles and responsibilities*	
2.4	*Identify PRG IWCM issues*	
	Workshop objectives discussed and accepted.	
3.0	What is Integrated Water Cycle Management?	
3.1	*The IWCM Approach*	
3.2	*Why IWCM is Important*	
	RB presented the IWCM approach. Presentation handed out at meeting.	
4.0	Kyogle Integrated Water Cycle Management Study	
4.1	*The Study – objectives, study area and activities*	
4.2	*Existing system and issues*	
	AJ and GK presented on the Kyogle IWCM. Program, context and issues discussed. Presentation handed out at meeting.	
	Questions discussed included (note – full list of issues provided under 5.3):	
	big changes experienced in recent years by the diary industry; high water use in farm forestry; study may want to consider drop test and WWTP inflows; wet weather flows assumed due to illegal connections, but mostly from ingress of stormwater (rehabilitation work being done); biosolids disposed of on site; flood mitigation - opportunities for integration; floodways – may reinstate old drainage paths – properties being resumed; look at number of rain tanks and desire for retrofitting; and, irrigators at Upper Richmond River have little extraction (2 weeks?) over the past 4 years.	
5.0	PRG Role and Establishment	
5.1	*PRG Project Inputs and Program*	
	Program discussed. Total 5 workshops.	
5.2	*PRG Members*	
	Representatives attending Workshop 1 agreed to be members of the PRG. Input is required, but can be provided out of workshop sessions if necessary. It was noted that	

some members of the PRG are attending in their own time and are not being paid.

The PRG will write to NRCMA requesting a representative to attend workshops. GK

PRG contact list to be updated and sent to PRG members. AJ, GK

5.3 PRG IWCM Discussion on Issues

The following issues and discussion were recorded:

- Recent changes in irrigation use:
  - the closure of irrigated dairy farms may have reduced irrigation use
  - with increasing beef prices, irrigation may have increased again
  - there has been little irrigation in the last four years due to water shortages in any case.
- Raising the weir could increase storage from 20 to say 50 ML:
  - DPI Fisheries may be concerned about weirs
  - Fisheries letter dated 29/8/05 tabled at workshop, includes the following areas of concern: threatened species; weirs and barriers to fish migration; and, environmental flows.
- A breakdown of water usage was requested. AJ, GK
- Drivers of runoff in the Upper Richmond River catchment:
  - small holdings increase numbers of dams on creeks and gullies and reduce water runoff to streams
  - some of these dams not used and may increase low flows through seepage
  - the Richmond River is stressed and the STP discharge is important as a return flow.
- Has the issue of dam in upper reaches been considered?
- What are perceptions from downstream Councils eg Richmond Valley?
  - downstream users want no less flow and quality of water.
- Need to seriously consider using water from Casino as spare capacity is available.
- Opportunity to utilise Toonanbah Dam:
  - only 15km from Kyogle
  - Council has already looked at this option – terrain is difficult – may require some tunnelling, water quality is not good particularly during dry periods and questionable reliability during dry periods.
- Perspective on the town water supply – peak demand is the equivalent of the volume of the local swimming pool. The average dry weather flow from the sewage treatment plant would take – four days to fill the same pool.
- River only stressed at low flows – even in a dry year it has some good flows. Could be an option to build a dam/s for irrigators and then allow Council to have full access to the river in low flow times. PRG
- Discussion on urban water demands:

- does the demand fluctuate? not much at present
- Level 1 restrictions actually may initially increase water use
- 600,000 L per day in > Level 1 restrictions. Note: before meters – nearly twice as much use as now – volumetric charges has been increased at the expense of the fixed charge – this hurt Council's revenue in 2002
- there is awareness of stormwater issues – shopkeepers no longer washing down footpaths daily. The community needs to be commended for saving water.

- IQQM flow information is available for use in the study from DNR.
- Climate change issues:
  - potentially higher temperatures, lower rainfall and more severe wet and drought cycles
  - it is important that the IWCM strategy consider climate change
  - the Study will make a statement on the potential impacts of climate change
  - in any case, the Study will be revisited by Council every 5 years.
- Potential for recycled water use:
  - an analysis of water use is required that identifies the minimum standard of water that can be used for different uses throughout the town
  - consideration will be given to a recycled water main that could be substituted for a number of existing potable uses throughout the town
  - DEC wants to encourage potable replacement re-use as far as possible and not simply land disposal
  - storage of the recycled water will be a key issue – needed during dry times when sewerage system flow is at it's lowest.

All PRG members agreed to consider any additional issues over the next few days and send them to AJ at adam.w.joyner@au.mwhglobal.com — PRG

6.0 Next Workshop

Workshops need to be held to suit the technical requirements of the project.

The following dates were agreed and noted:

- Workshop 2: Wednesday 14 September 05
- Workshop 3: Wednesday 28 September 05
- Workshop 4: Wednesday 12 October 05.

PRG

There will be approximately 4 weeks break between Workshop 4 and the final workshop. These dates will be confirmed. Workshops will commence at 12 noon and be 3 hours maximum.
Lunch will be supplied.
Note – next workshop to be held on 14 September 05, 12 noon to 3pm.
Please RSVP to GK at graham.kennett@kyogle.nsw.gov.au — PRG

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Meeting Notes

Kyogle Integrated Water Cycle Management Strategy
Project Reference Group Workshop 2

Venue: Kyogle Council Chambers
Time: 12 noon – 3:00pm 14 September 2005

Client Name: Kyogle Council

Project Name: Kyogle Integrated Water Cycle Management Strategy MWH Project No: A0150600

Facilitator: Susan Love

Attendees	Organisation	Initials
Graham Kennett	Kyogle Council	GK
Frank Winter	Kyogle Council	FW
Ernie Bennett	Mayor Kyogle Council	EB
Ian Kirkpatrick	Councillor Kyogle Council	IK
Lindsay Passfield	Councillor Kyogle Council	LP
Adam Joyner	MWH	AJ
Chris Hennessy	DEUS	CH
Brett Nudd (replacing Graeme Budd)	DEC	BN
Richard Swinton	DPI	RS
Bob Jarman	Kyogle Land Care	BJ
Graham Gordon	Upper Richmond River Water Users Assoc	GG
Ron Martin	Kyogle Community Economic Dev. Committee	RM
Ian Warren	Byron Shire Council (observer)	IW
Mark Hesse	Richmond Valley Council	MH
Russell Bonney	NSW Farmers Association	RBo

Apologies	Organisation
Refer to attendance sheet	

Circulate To:	
All PRG members	

Item	Action

1.0 Introduction

1.1 Welcome

CH provided the welcome, outlining the IWCM history and process.

1.2 Introductions

Russell Bonney representing NSW Farmers Assoc welcomed to the PRG.

1.3 Apologies

Noted. GK reported that he has written to JF of NRCMA seeking a representative to attend workshops. The facilitator noted that JF has written to the PRG stating that NRCMA is unable to attend workshops but wants to receive all workshop information.

1.4 Agenda and Previous or shop notes

Agenda was outlined. Previous workshop notes accepted with the following changes:

- 5.3 dot point 10 – second sentence to now read – Could be an option to build dam s for irrigators … etc
- 5.3 dot point 11 – third topic to now read – 600,000 litres per day in … etc.

2.0 Workshop Objectives

2.1 Introduction to the option screening process

2.2 Develop and agree on the long list of IWCM options

2.3 Agree on the option assessment criteria

Workshop objectives discussed and accepted.

3.0 The long list screening process

3.1 T assessment

AJ reiterated the Kyogle IWCM Strategy aim. The option assessment process was explained and discussed.

3.2 The screening tool

The screening tool to be used in Workshop 3 was introduced and discussed.

3.3 ac ground information

A summary of the issues identified in the Concept Study and in PRG Workshop 1 was discussed. GK noted that there is a need to look at impact from on-site systems, in particular treatment of septage at the STP. It was noted that GB has sent in comments on the summary of issues presented in Workshop 2 Briefing Paper. Agreed a balance of TBL aspects be achieved. RS said that a macro water sharing plan for the Richmond River was being prepared and CMA updates available on website.

4.0 The long list of options

4.1 Current yogle ater use

Due to time constraints this item was deferred to PRG Workshop 3.

4.2 Some available IWCM options

Refer to PRG Workshop 2 Briefing Notes.

4.3 PRG IWCM options

The process to identify the PRG's options was discussed. The PRG broke into 4 groups and "brainstormed" ideas to address the IWCM issues. These options were presented during a working lunch by each of the 4 groups. Each group's ideas are tabled below.

Group 1 - Ideas

No.	New development
1	Plan for increased usage/encouragement
2	Water recycling - for parks & gardens
3	Promote competitive advantage of water supply in Kyogle
4	Rain water tanks eg. subsidies/penalties
5	Innovative storage methods eg. gutters, swimming pools
6	Dual reticulation for supply of recycled water
7	Reuse stormwater - irrigation of parks through detaining peak flows
8	Erosion/sediment control during and after construction
No.	**Existing development**
1	Water recycling
2	Rain water tanks
3	Higher water pricing
4	Collect, treat, use storm water runoff - detain on-site,specifically industrial sites
5	Increase capacity of existing weir
6	Sealing roads near waterways to reduce sediment runoff
7	Greywater recycling
8	Water audits/investigation of high users (industrial users) - assess effluent recycling potential
No.	**Non-urban areas**
1	More storage capacity (new economic development)
2	Better usage of current facilities eg. Toonumbar
3	Upgrade STP technology
4	Encourage composting toilets
5	Improve existing on-site sewerage
6	Protecting and rehabilitate riparian areas
7	Regulate "horse & house farms" licensing
8	Regulate land use eg. fertiliser, pesticide, intensive ag. runoff, land use eg forestry vs pasture
9	Water harvesting from streams - become a recreational resource
10	Put QLD hat on - utilise water resources in upper catchments

Group 2 - Ideas	
No.	**New development**
1	Establish guidelines for future development re. erosion/water runoff etc
2	Encourage reuse in new development areas
3	Encourage new development to use measures to conserve use
4	Water tanks on all new developments
5	New rural/residential (small acreage) should be self sufficient
No.	**Existing development**
1	Implement innovative reuse/water saving program for existing public projects
2	Access community water grants
3	Incentives to conserve water use
4	Water tanks for general use
5	Stormwater filtration, or some cleaning, for re-use
6	Implement innovative reuse/water saving program for new urban projects
7	Implement education program
8	Engage an official to liaise with all stakeholders
No.	**Non-urban areas**
1	Continuation of river bank rehabilitation with support from Council (source funding)
2	Composting toilets as an alternative to septic
3	Investigate the impact on the ground water table or the increasing number of bores
4	Establish dams to supplement water supply drawn from river
5	Establish environmental levy to assist with cost involved in programs
6	As in existing development

Group 3 - Ideas	
No.	**New development**
1	WSUD DCPs - BASIX compliance, including rainwater tanks
2	Greywater re-use
3	Water-hardy plantings
4	Rainwater for toilets
5	Effluent re-use at STW or to replace existing demand extraction
6	Off-stream storage for Kyogle water supply and new treatment plant
7	Industrial development controls and allowance for further demands
8	Limiting stormwater runoff from new areas
9	Hook up to Casino Water Supply (transfer supply)
No.	**Existing development**
1	Retrofit and rebate programs (tanks, etc)
2	Greywater re-use
3	Stormwater inflow elimination program
4	Water-hardy plantings
5	Stormwater detention and re-use
6	Stormwater sediment controls including GPT's
7	Flood mitigation in "The Flat"
8	Sealing of steeper sections of gravel shoulders and sealing roads in rural areas
9	Grassing gravel shoulders & sealing gravel roads in town
10	Stormwater retardation of flows entering the river
11	Sewage effluent be used to provide nursery for riparian/revegetating plantings
12	SEA type projects
13	Control of industrial wastes
14	More rubbish bins in town areas to limit rubbish
15	Banning of plastic bags
16	Improved riparian areas in village to allow public access
No.	**Non-urban areas**
1	Environmental weed control
2	Treatment of septage at STW
3	Erosion/seed control from agricultural areas such as plantations
4	Removal/treatment of contaminated sites with potential impact on water quality (eg. dips)
5	Dam Upper Richmond & regulate stream
6	Remove disused weirs in catchment
7	Limit access of stock to rivers & streams by providing off stream watering points
8	Identification & management of chemical run-off from farming areas, including a monitoring program

Group 4 - Ideas	
No.	**New development**
1	"BASIX" - consider adopt higher standard than required
2	Low water gardens
3	Smaller blocks & gardens
4	Urban reuse/dual supply/3rd pipe
5	Sewer mining
6	Tanks
7	Swimming pools as storage
8	Stormwater harvesting
9	Internal recycling (showers)
10	"WSUDS" - attract low water use industry
11	Community use - high water
12	Education covenant
13	Holistic approach
14	Set up Kyogle as an example to NSW
No.	**Existing development**
1	Education - competitions
2	Retrofitting - $ incentives / disincentives (conditional on benefits achieved) for rainwater tanks, dual water supp
3	Fees staged upwards to discourage high water use - inclining block tariffs
4	Stormwater/dual water supply
6	Replace existing water use with recycled water, where possible
7	Sewer mining
8	Street sweeping to reduce pollutants entering stormwater eg Grafton Study
9	Encourage rental people to be water efficient
10	Renew sewer mains
11	Renew water mains - leakage programs - system monitoring - pressure reduction
No.	**Non-urban areas**
1	Education - efficiencies
2	More high flow storage
3	Erosion control - water quality - landuse management - riparian management
4	Macro water sharing plan implementation role?
5	Kyogle sponsoring upstream irrigation/water use competition

During the presentations of the IWCM ideas the following additional comments were made:

- Any incentive program for rainwater tanks needs to be effective. Talk to tank suppliers.
- "Horse and house" reasonable water use guidelines have been developed.
- Consider high water use by community – look at options for small developments such as communal swimming pool.
- Use competitions and education – use existing models.
- Clean up street litter at source, don't wait until it gets to the GPT.
- Monitoring farm chemicals leaving farms allows farmers to "self regulate" as chemicals are expensive.
- Consider water sharing by farmers – negotiate regulations.
- Resolve issue of who is responsible for riparian areas – fencing etc.
- Utilise the opportunities at Kyogle (including at head of catchment).

Note: PRG to provide any comments on long list of options to GK before next workshop. PRG

5.0 Assessment criteria

5.1 Possible assessment criteria

Refer to PRG Workshop 2 Briefing Notes.

5.2 PRG agreed assessment criteria

After discussion, the following list of IWCM goals was developed by the PRG to steer the assessment process:

IWCM Goals	
No.	**Environmental**
1	Improve water quality in the Richmond River
2	Protect environmental low-flows
3	Minimise potable water demand
No.	**Social**
1	Kyogle to be recognised as a responsible water user
2	Community health is maintained and improved
3	A water educated community which is proud of its achievements
4	Affordability of water services
5	Equity throughout the community
6	Reliable and secure services
No.	**Economic**
1	Cost effective water services
2	Provision for and encourage future development

Members broke into the same 4 groups as for the options brainstorming, to discuss and list assessment criteria for the screening tool. When lists were developed, each member was given 9 stickers to allocate criteria developed on all 4 lists. The outcome is tabled below (ranked).

Ranked Assessment Criteria		
No.	**Environmental**	**Score**
1	Reduce pollutant load from STP to river	7
2	Reduce pollutant load from stormwater to river and catchment	4
3	Water use/head	4
4	Minimise pollutants (rural/urban/industrial)	3
5	Minimise extraction (potable and irrigation)	2
6	Achieve water standards/achieve riparian standards of health	2
7	Low flow levels monitored/improved	2
8	Discharges to environment meet water quality standards/guideline	2
9	Reduce stormwater nutrient/ pollutant discharges to the river	2
10	Improved and co-ordinated water quality information available	2
11	Water sampling results (effluent - WWTP)	2
12	Improve the health of waterways	1
13	Reduce demand on river during low flow periods (by building dam	1
14	DIPNR Records - meter data: inflow/outflow & time/event	1
	Sub-total	35
No.	**Social**	**Score**
1	Improve water efficiency	5
2	Improve public awareness	4
3	Reduce periods and levels of restrictions	4
4	Level of community involvement in education activities	4
5	Protect public health	3
6	Achieve daily daily use figures against benchmarks	3
7	Service interruptions minimised or reduced	2
8	Water sampling results	2
9	Community acceptance of water service costs	1
10	Improved community awareness and education	1
11	Particular groups not disadvantaged or overly advantaged	1
12	Reportable/notifiable diseases	1
13	Community reaction to IWCM - overall/sub-groups	1
14	Educate community in water-saving practices in dry times	0
15	Water service costs comply with IPART guidelines	0
16	Imposing of restrictions that are not too frequent	0
	Sub-total	32
No.	**Economic**	**Score**
1	Impact on rates/charges	7
2	Availability of water for future development	7
3	Adequate and affordable water resource	4
4	Well managed infrastructure - efficient water delivery	4
5	Minimise life-cycle costing	4
6	Minimise cost to user	3
7	Capital investment required	3
8	Affordable developer charging can be implemented	3
9	Penalise and reward on usage rates	2
10	Allows compliance with regional and state pricing requirements	0
11	Operational/maintenance costs	0
	Sub-total	37
	Total	104

6.0 Next Workshop

The next workshop to score the IWCM options will be held on Wednesday 28 September 05 between 12 noon and 3pm. PRG

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Meeting Notes

Kyogle Integrated Water Cycle Management Strategy
Project Reference Group Workshop 3

Venue: Kyogle Council Chambers
Time: 12 noon – 3:00pm 2 September 2005

Client Name: Kyogle Council

Project Name: Kyogle Integrated Water Cycle Management Strategy   MWH Project No: A0150600

Facilitator: Susan Love

Attendees	Organisation	Initials
Brett Nudd	Department of Environment and Conservation	BN
Chris Hennessy	Department of Energy Utilities and Sustainability	CH
Ernie Bennett	Kyogle Council -Councillor (Mayor)	EB
Frank Winter	Kyogle Council - Emergency and Flood Management	FW
Gordon Bebb	Toonumbar Water Users Association	GB
Graham Kennett	Kyogle Council - Water and Sewerage Engineer	GK
Ian Kirkpatrick	Kyogle Council –Councillor	IK
Ian Warren	Byron Shire Council	IW
Jim O'Neill	Kyogle Council –Councillor	JO
Lindsay Passfield	Kyogle Council –Councillor	LP
Patrick Dwyer	Department of Primary Industries, Fisheries	PD
Richard Swinton	Department of Primary Industries	RS
Rob Siebert	Department of Commerce	RoS
Russell Bonney	NSW Farmers Association	Rbo
Sharri Murphy	Department of Environment and Conservation	SM
Susan Love	Que Sera - Consultation Facilitator	SL
Adam Joyner	MWH - Consultant	AJ

Apologies
See attendance sheet

Circulate To:
All PRG members

Item	Action
1.0 Introduction	
The following members were welcomed – Cr Jim O'Neill (Kyogle), Rob Siebert (DOC), Sharri Murphy (DEC), Gordon Bebb (Toonumbar Water Users Assoc) and Patrick Dwyer (DPI Fisheries).	
1.1 Apologies	
Noted.	
1.2 Agenda and previous or shop notes	

Agenda was outlined. Previous workshop notes accepted with the following changes:

- Page 5, Non-urban areas, point 4 – to now read (eg. *Dips*)
- Page 7, point 2 – to now read …reasonable *ater* use guidelines…

RS expressed sympathy to Council and the community regarding the recent fire in Kyogle.

2.0 Workshop Objective

2.1 Develop the short list of IWCM options for scenario development.

Workshop objective discussed and accepted.

3.0 ackground information

3.1 IWCM option assessment process reminder

AJ reiterated the Kyogle IWCM option assessment process and identified that the PRG were at the "screen measures" stage.

3.2 IWCM options outine and assessment criteria

A town water usage chart was provided for background information, based on 2003-04 annual consumption and typical water use breakdown. It was noted that unaccounted-for-water was not included in chart. Water efficiency, source substitution and WSUD approaches were discussed. RS noted that automatic flush urinals may be the least effective mechanism. Water efficiency devices dependent on community involvement/education and management.

AJ explained that some 130 ideas are listed from Workshop 2 and the Concept Study. All have been considered, and some like ideas are grouped together (eg education) to produce 65 IWCM options for scoring. The 8 TBL assessment criteria were developed based on the highest scored criteria from Workshop 2. Average scores will be compared for rankings and therefore independent of the number of individual assessment criteria under each of the three TBL groups (environmental, social & economic). Weighting of the three TBL criteria groupings can be done later as a sensitivity check. RS expressed the fear that PRG members will use different criteria to score options based on expertise, leading to an average score. GK noted that everyone brings different expertise to the table, not just an engineering focus. All agreed there would be a balance between scores. CH encouraged all members to be bold with their scoring.

4.0 Options ranking

4.1 o to use the screening tool

AJ handed out a double-sided A3 sheet for the scoring process and the scoring process was described. Some discussion followed and some terms were explained. The PRG went though the first two options as a group.

4.2 Scoring of options

The PRG broke into 2 groups, with one group scoring the grey shaded options and the other the white options (some 33 options for each group). Some PRG members chose to score all options on the double-sided sheet.

After all scoring was completed, the following comments on the scoring process were made:

- Process is open to interpretation – scoring on individual's impressions based on experience. Note: process is coarse-screening and a step towards the development of a strategy of combined IWCM options.

- Council agreed that they wanted Kyogle to grow.
- Reminder that there is limited time for the IWCM process.
- The PRG was encouraged to bring up any big issues during process.
- Cost implications of options may be significant. Note – scenarios are to be costed (including ongoing costs) as part of the IWCM Strategy process.
- DEC prefer the replacement of potable water use (in contrast to land disposal of treated effluent).
- This is a transparent process with the outcome put on the table for community comment.

AJ congratulated the PRG on their scoring efforts. All scores will be to input into a spreadsheet and results reported at the next workshop.

5.0 Next Workshop

The next workshop will be held on Wednesday 12 October 2005 (12 noon to 3pm). Workshop 5 tentatively set for Wednesday 16 November 2005, TBC. PRG

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Meeting Notes
Kyogle Integrated Water Cycle Management Strategy
Project Reference Group Workshop 4

Venue: Kyogle Council Chambers
Time: 12 noon – 3:00pm 12 October 2005

Client Name: Kyogle Council

Project Name: Kyogle Integrated Water Cycle Management Strategy MWH Project No: A0150600

Facilitator: Susan Love

Attendees	Organisation	Initials
Brett Nudd	Department of Environment and Conservation	BN
Ernie Bennett	Kyogle Council -Councillor (Mayor)	EB
Graham Kennett	Kyogle Council - Water and Sewerage Engineer	GK
Ian Kirkpatrick	Kyogle Council –Councillor	IK
Ian Warren	Byron Shire Council	IW
Patrick Dwyer	Department of Primary Industries, Fisheries	PD
Richard Swinton	Department of Primary Industries	RW
Rob Siebert	Department of Commerce	RoS
Jennie Fenton	NRCMA	JeF
Bob Jarman	Kyogle Land Care	BJ
Mark Hesse	Richmond Valley Council	MH
James Flockton	Richmond Valley Council	JF
Susan Love	Que Sera - Consultation Facilitator	SL
Adam Joyner	MWH - Consultant	AJ

Apologies
See attendance sheet

Circulate To:
All PRG members

Item	Action

1.0 Introduction

The following members were welcomed – James Flockton (RVC), and Jennie Fenton (NRCMA).

1.1 Apologies

Noted.

1.2 Agenda and previous or shop notes

PRG agreed to include JF in agenda after Item 2. Previous workshop notes were accepted. GK outlined a small change to TBL Ranking Sheet distributed to members. Change noted.

2.0 Workshop Objective

2.1 undle the IWCM options into scenarios.

2.2 Revie the T screening criteria for fine screening.

Workshop objectives discussed and accepted.

3.0 NRCMA Presentation

JF outlined the role and funding arrangements for the NRCMA. The following points were made:

- The NRCMA has developed a draft Strategic Plan – 10 years, and a Draft Catchment Action Plan for natural resource management. Implementation Plans have commenced for first 2 years.
- NRCMA works in partnership with local government and community (Land Care, Aboriginal groups, Coast Care etc), and fosters community capacity building.
- Funding comes from several quarters and amounts to approx. $6M per year. Some funding is going to priority programs (before the Strategic Plan is approved).
- NRCMA will only consider funding for engineering solutions if outcomes cannot be obtained another way. NRCMA will support funding for water supply catchments and give priority to them.
- The NRCMA Board can assist with lobbying relevant Government departments and Ministers to assist IWCM strategies.

Several questions from the group covered possible assistance with funding for more expensive strategies within the IWCM; consideration by NRCMA for funding of education strategy for Kyogle; advice on other forms of funding for tree planting etc.

Contact details for NRCMA (for the Kyogle area):

Peter Boyd (Area based coordinator) phone 6672 5608; Kerry Francis (Regional facilitator) phone 6627 0114.

4.0 Workshop 3 ranking

AJ discussed where the group was in the option assessment process – build scenarios.

AJ asked for any questions regarding the ranking sheet based on selection from Workshop 3. GK clarified that the "Combined STW upgrade and reuse at STW" option should be "Combined STW upgrade and reuse". Discussion centred on the use of a base case; costing scenarios; possible Council liability issues associated with reuse.

5.0 undling of IWCM options

AJ outlined the process. PRG broke into 2 groups. The base case is what Council was planning to do. AJ explained the process of allocating options selected at workshop 3 to the categories of base case, scenario 1 to 4. Potential scenario targets were discussed. Base case was reviewed by GK.

After bundling of options was completed, both groups briefly outlined their scenarios. There was some discussion on the process from here. AJ said that the options would be massaged into scenarios. A dollar value would be attributed to each scenario. AJ congratulated the PRG on their efforts during the bundling process. Results of the bundling exercise are tabled below.

6.0 Next Workshop

The final workshop 5 will be held on Wednesday 16 November 2005 (12 noon to 3pm). PRG

Kyogle Integrated Water Cycle Management Strategy
PRG Workshop 4 - Scenario Bundling

OPTION	Overall Rank	GROUP 1[5]					GROUP 2				
		Base case	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Base case	Scenario 1	Scenario 2	Scenario 3	Scenario 4
New Development											
Mandatory use of rainwater tanks for new development	3										
On-site greywater recycling[1]	8							Divert	Store/tmt	Store/tmt	Store/tmt
Community IWCM education (promotion/guidelines)	10							CMA	CMA	CMA	CMA
Adopt higher BASIX standards	13										
Efficiency controls on showerheads and tapware	14										
Landscaping/native planting controls	23										
Gross pollutant traps	25										
Smart sewers (low inflow and infiltration)	26										
Water Sensitive Urban Design DCPs[2]	28										
Stormwater harvesting	30										
Recycled water use through a "third pipe" system	32										
Self sufficient new rural development	36										
Traditional detention basins	40										
Sewer mining	41										
Enhanced erosion controls during and after construction	43										
Stormwater treatment ponds/wetlands	48										
On-site detention	62										
BASIX[3]											
Existing Development											
Retrofit of on-site greywater recycling	2										
Community IWCM education (promotion/guidelines)	4							CMA	CMA	CMA	CMA
Stormwater harvesting	5										Scenario 5
Rainwater tank rebate	6										
Rainwater tank retrofit program	7										
Residential retrofit of showers and tap flow regulators	8								Increase	Increase	Increase
Shared equipment and access funding sources for IWCM	11							CMA	CMA	CMA	CMA
Stormwater treatment ponds/wetlands	12										
High water user audits	15										
Active system leak detection and repair	16										
Dual flush toilet retrofit	17								Increase	Increase	Increase
Retrofit of Water Sensitive Urban Design to key areas	20										
Retrofit of recycled water system to all areas	22										
Reuse effluent at STW (nursery, adj land)	27										
Retrofit of recycled water system to key users	29										
Washing machine rebate	31										
Upgrade of sewage treatment works to allow river discharge	33										
Combined STW upgrade and reuse	35							Disinfect	Disinfect	Tertiary	Tertiary
Enhanced conservation signal in water pricing	36										
Infiltration and inflow reduction program	39										
Litter/organics to stormwater reduction (bins, street clean, bags)	44										
Gross pollutant traps	45										
Rehabilitation of existing watercourses	46							CMA	CMA	CMA	CMA
Community rainwater tanks for general use[4]	50										
Septage treatment at STW	54										
Improved monitoring of water cycle facilities (incl. on-site & gw))	56										
Improved trade waste management	57										
Sewer mining	58										
Detention basins with low flow release	59										
Flood mitigation works in key areas	65										
Installing meters on unmetered connections[3]											
Non-Urban Areas											
Community education/enhanced land care programs	1						CMA	CMA	CMA	CMA	CMA
Implement macro water sharing plan	17										
Improved monitoring of farming practices	19										
Protect and rehabilitate riparian zones	21							CMA	CMA	CMA	CMA
Increase storage capacity within catchment	24										
Establishment of buffer zones alongside significant streams	42							CMA	CMA	CMA	CMA
Improve on-site systems	47										
Purchase competing licences	51										
Return of recycled effluent to point of extraction	52										
Revegetation for dryland salinity	53										
Erosion and weed controls	55						CMA	CMA	CMA	CMA	CMA
Improved management of contaminated and landfill sites	60										
Remove disused weirs	61							CMA	CMA	CMA	CMA
Regulate "horse and house" farm licensing	63										
Supply-side Management											
Off stream storage and new/upgrade WTP	34										
Transfer of water from Casino, decommission WTP	38										
Toonumbah Dam augmented supply and new/upgrade WTP	49										
Dam Upper Richmond, regulate flow and new/upgrade WTP	64										
Increase capacity of existing weir and new/upgrade WTP	66										

[1] Question raised on feasibility.		Selected
[2] WSUD DCP being developed by group of councils.	CMA	Potential CMA assistance
[3] Option identified during workshop 4.		Not an issue
[4] Water needs to be effectively used.		Not feasible
[5] Did not get to cross check compatability of options.		

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Meeting Notes

Kyogle Integrated Water Cycle Management Strategy
Project Reference Group Workshop 5

Venue: Kyogle Council Chambers
Time: 12 noon – 3:00pm 30 November 2005

Client Name: Kyogle Council

Project Name: Kyogle Integrated Water Cycle Management Strategy   MWH Project No: A0150600

Facilitator: Susan Love

Attendees	Organisation	Initials
Graeme Budd	Department of Environment and Conservation	GB
Shari Murphy	Department of Environment and Conservation	SM
Ernie Bennett	Kyogle Council -Councillor (Mayor)	EB
Frank Winter	Kyogle Council – Emergency and Flood Management	FW
Graham Kennett	Kyogle Council - Water and Sewerage Engineer	GK
Scott Turner	Kyogle Council – Planning and Community Services	ST
Ian Kirkpatrick	Kyogle Council –Councillor	IK
Lindsay Passfield	Kyogle Council - Councillor	LP
Chris Hennessy	Department of Energy Utilities and Sustainability	CH
Richard Swinton	Department of Primary Industries	RW
Rob Siebert	Department of Commerce	RoS
Russell Bonney	NSW Farmers Association	RB
Bob Jarman	Kyogle Land Care	BJ
Mark Hesse	Richmond Valley Council	MH
James Flockton	Richmond Valley Council	JF
Jeanine Murray	Department of Natural Resources	JM
Susan Love	Que Sera - Consultation Facilitator	SL
Adam Joyner	MWH - Consultant	AJ

Apologies
See attendance sheet

Circulate To:
All PRG members

Item	Action
1.0 Introduction	
The following members were welcomed – Scott Turner (Kyogle Council), and Jeanine Murray (DNR).	
1.1 Apologies	
Noted.	
1.2 Agenda and previous or shop notes	
Previous workshop notes were accepted.	

2.0 Workshop Objective

2.1 Identify the PRG s preferred scenario.

2.2 Discuss the broader community communications strategy.

Workshop objectives discussed and accepted.

3.0 Scenario Triple ottom ine Outcomes

AJ outlined the background information and assumptions made to undertake the study (refer to workshop presentation and briefing notes). The following points were made:

- GK stated that the path Council will take for the future water supply side approach is not a given, especially noting the high costs and rate impacts for future supply. The IWCM scenarios are currently based on continued supply from the Richmond River with offstream storage and improved treatment facilities. Further consultation will be required with Richmond Valley Council regarding the possible connection to Casino's water supply, with transfer to Kyogle. Consideration of the regional ROUS Water supply system is also a factor. Comparisons will be discussed with wider community consultation.
- Off-stream storage volumes are based on major assumptions, including environmental flow requirements which at this stage will not be available early next year.

IWCM scenario descriptions and outcomes

AJ described the five scenarios, including the base case. The following points were made:

- GB noted that excess treated effluent is returned to the river in Scenarios 3 and 4.
- GK noted that the assumed funding subsidy was 50% (Country Towns Water Program).
- High costs are associated with the recycled water scenarios (Scenarios 3 and 4), due to third pipe reticulation, retrofitting plumbing and high treatment process requirements.

AJ outlined scenario benefits and costs (refer to workshop presentation and briefing notes).

4.0 Preferred scenario

AJ explained multi-criteria analysis scoring tool to assist discussion and selection of the preferred scenario. The whole group scored the scenarios via electronic presentation. Base environmental and economic scores were based on numerical estimates of benefits and costs associated with each scenario. Social base scores were determined by the PRG. Sensitivity of environmental, social and economic weightings were tested. Increased value to Scenario 3 (for return flows) was also tested. Results of the scoring are appended to these notes. The following points were made:

- GB stated that the do nothing option will not satisfy the community who are aware of the PRG process and will have high expectations.
- GK explained that Council will continue all its current community education programs eg. BASIX
- Issues of community acceptance for source substitution approaches, especially recycled effluent were discussed.
- Community affordability for all scenarios was discussed. GK stated that Council

can defer building infrastructure for 7-10 years and continue water restrictions, or community can pay for works now.

Following discussion, the PRG agreed Scenario 2 was preferred.

5.0 Communication strategy

GK outlined Council's preferred approach for the communication strategy, including:

- Consultation on the scenarios (including preferred) to be open to the whole community.
- Open display in the Kyogle Hall in the afternoon, followed by a workshop in the evening.
- A panel would take general questions from the community.
- Information on the scenarios and consultation process to be made available to community before display and workshop (February 2006 date indicated).
- The consultation process has been explained in the Council Newsletter December 2005.

The PRG made the following points:

- A 6 week display period for scenarios could be considered and written comments taken.
- A survey could be developed.
- An education process is required. The display and workshop will assist in educating the community.
- Members of the PRG will be invited to take part in the display and workshop.

6.0 Completing the IWCM Process

AJ noted that this was the final PRG workshop. He stated that after the communication phase, a final report will be produced. He thanked the PRG for their deliberation on scoring the scenarios and their contributions to the workshops.

LP thanked AJ and the facilitator.

GK congratulated the PRG and thanked them on behalf of Council. He explained that the IWCM process was a new concept and that he was very happy with its roll out for Kyogle Council. He noted that Kyogle was a small council and the outcomes were admirable.

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			1	Social			1	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.6	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	0.9	2
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.0	1
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	0.7	4
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	0.8	3

Figure 1: E ual Weightings

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			2	Social			1	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.8	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	1.1	3
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.2	2
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	1.0	4
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	1.3	1

Figure 2: Environmental Weighting

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			1	Social			2	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.9	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	1.1	4
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.3	1
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	1.1	3
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	1.2	2

Figure 3: Social Weightings

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			1	Social			1	Economic			2	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.3	3
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	0.4	2
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	0.4	1
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	0.0	4
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	-0.1	6

Figure 4: Economic Weightings

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			1	Social			2	Economic			1.5	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.7	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	0.9	2
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.0	1
Integrated Scenario 3	2.5	1.7	1.5	1.9	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	0.8	3
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	0.8	4

Figure 5: Environmental:Social:Economic 1:2:1.5 Weightings

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			1	Social			1	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.6	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	0.9	2
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.0	1
Integrated Scenario 3	2.5	2.0	2.0	2.2	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	0.8	3
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	0.8	4

Figure 6: Sc3 Return Flow with E ual Weightings

Kyogle Integrated Water Cycle Management Strategy
Multi-criteria Analysis Scoring Sheet

MWH

Scenario	Environmental			2	Social			1	Economic			1	Total Weighted Score	Overall rank
	Reduces Pollutants Entering the River	Reduces Extractions from the River	Improves Riparian Zone Health	Total Environmental Score	Improves Public Awareness	Secures Future Supply	Protects Public Health	Total Social Score	Community NPV	Low Rates and Charges	Low NPV	Total Economic Score		
Individual Criteria Weighting:	1	1	1		1	1	1		1	1	1			
Scenarios														
Do Nothing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6
Baseline Scenario	2.9	0.5	0.5	1.3	0.5	2.5	1.5	1.5	-0.8	-1.7	0.0	-0.8	0.8	5
Integrated Scenario 1	3.0	0.9	1.0	1.6	2.0	2.5	1.5	2.0	-1.0	-1.8	-0.4	-1.1	1.1	4
Integrated Scenario 2	3.0	1.3	1.4	1.9	3.0	2.5	1.5	2.3	-1.8	-1.8	-0.3	-1.3	1.2	2
Integrated Scenario 3	2.5	2.0	2.0	2.2	3.0	2.7	1.5	2.4	-2.2	-2.3	-1.8	-2.1	1.2	3
Integrated Scenario 4	2.8	3.0	3.0	2.9	2.5	3.0	2.0	2.5	-3.0	-3.0	-3.0	-3.0	1.3	1

Figure : Sc3 Return Flow with Environmental Weighting

Kyogle Integrated Water Cycle Management Strategy Community Workshop

23 February 2006

Scenario costs

- Significant increase in Council's water related costs.
- Water costs include substitute sources.

Scenario	Net Present Value Costs*		
	Community**	Council (subsidised)	Council
Base case	$1,569	$16,864	$21,113
Scenario 1	$1,833	$18,054	$22,137
Scenario 2	$3,320	$17,812	$21,702
Scenario 3	$4,156	$20,412	$24,761
Scenario 4	$5,542	$23,895	$27,566

*30 year, 7% discount rate. ** Excludes rates impact.

Scenario	Peak Annual Household Rates			
	Water	Wastewater	Stormwater*	Total Increase
2005/06 rates	$452	$490	NA	NA
Base case	$699	$477	$60	$294
Scenario 1	$747	$512	$63	$380
Scenario 2	$658	$512	$68	$296
Scenario 3	$753	$584	$68	$463
Scenario 4	$935	$584	$68	$645

* increase above equivalent current stormwater rates

PRG preferred scenario

PRG IWCM Strategy recommendation: Scenario 2

- an integrated approach targeting an 18% reduction in future water usage.
- incorporates many aspects of best practice water services management

Key features include:

- **Water supply** from the Richmond River with an off-stream storage, new water treatment plant and transfer facilities. On-going renewals.
- **Wastewater** treatment facilities upgraded to allow restricted reuse at the treatment works. Sewer inflow and infiltration reduction program, as well as on-going renewals.
- **Stormwater** flood mitigation works and activities. Water sensitive urban design development control plans to reduce outdoor water usage and stormwater impacts from new developments. Local stormwater harvesting opportunities. On-going system renewal.
- **Catchment** management activities in line with CMA initiatives, including: water sharing plan, improved on-site systems and riparian rehabilitation.

Preferred scenario

Source substitution (potential for outdoor, toilet flushing and clothes washing uses)
- mandatory use of rainwater tanks on new residential development
- rainwater tank retrofit program (subsidised cost)
- promotion of greywater reuse systems

Conservation
- community education (special events, brochures, schools, competitions)
- water supply system leak detection and repair
- high water user audits
- inclining block tariff
- residential retrofit of dual flush toilet, low flow taps & showerhead, and commercial toilet retrofit (on request)
- residential washing machine rebate
- no new rural town water and wastewater connections

Further refinements
- alternative supply from Casino
- update the strategy in line with water sharing plan requirements

Community involvement

- **Your comments and opinions are valuable to the development of the IWCM strategy.**
- **This workshop provides the opportunity for comments and feedback through:**
  - questions and answers
  - written comments – refer to the comments book.
- **We would like to know:**
  - what aspects of the preferred strategy you
    - support
    - don't support
    - could live with.
  - are there aspects of the process which could be improved?

Kyogle Council

Kyogle Integrated Water Cycle Management Strategy

Community Workshop – February 23, 2006

Community Feedback and Questionnaire

All comments made in this book are to be considered in the finalisation of the Kyogle Integrated Water Cycle Management Strategy. All comments, be they positive or negative, will be given equal consideration. All feedback from the community is considered valuable and your contribution and interest are appreciated by Council.

PLEASE USE ONE PAGE PER PERSON

Name: (optional) Graham Kennett
Address: (optional) 9 Norlodge St
Geneva

Contact Phone: 66320228

Questionnaire:

	Strongly Agree	No Strong Opinion	Strongly Disagree
Are you satisfied with the process of consultation that Council has undertaken for its urban water services?	✓		
Do you think that the current charges for water and sewerage are reasonable and justifiable?	✓		
Would you support the imposition of an additional charge to support storm water and catchment based improvements?	✓		
Would you support the connection of Kyogle to the Casino Water Supply?		✓	
Are you happy with the level of state and federal government assistance for the outcomes of the strategy?			✓
Are you satisfied with the current level of service from each of the urban water services;			
Water supply		✓	
Sewerage system		✓	
Storm water and flood mitigation			✓

General Comments:

PLEASE USE ONE PAGE PER PERSON

Name: (optional) Tom CADET
Address: (optional) 146 Summerland Way
Kyogle

Contact Phone: 0266321896

Questionnaire:

	Strongly Agree	No Strong Opinion	Strongly Disagree
Are you satisfied with the process of consultation that Council has undertaken for its urban water services?		✓	
Do you think that the current charges for water and sewerage are reasonable and justifiable?			
Would you support the imposition of an additional charge to support storm water and catchment based improvements?			✓
Would you support the connection of Kyogle to the Casino Water Supply?			✓
Are you happy with the level of state and federal government assistance for the outcomes of the strategy?			✓
Are you satisfied with the current level of service from each of the urban water services;			
Water supply	✓		
Sewerage system	✓		
Storm water and flood mitigation			✓

General Comments:

I feel that the Council's priorities need to be shifted to providing basic services - Spending millions on big ticket items like the main street upgrade is wrong when many street in the town are nearly third world condition - (narrow) poor pavement with numerous patches, no stormwater drainage to speak of)

The upgrade of sewerage and Water treatment is overdue and was ~~[illegible]~~ supposed to be planned more than 30 years ago when I came to the town to work for the Council.

PLEASE USE ONE PAGE PER PERSON

Name: (optional) Tom & Betty Fitzgerald.
Address: (optional) 1 James St
Kyogle

Contact Phone: 02 66 321796

Questionnaire:

	Strongly Agree	No Strong Opinion	Strongly Disagree
Are you satisfied with the process of consultation that Council has undertaken for its urban water services?			
Do you think that the current charges for water and sewerage are reasonable and justifiable?	✓		
Would you support the imposition of an additional charge to support storm water and catchment based improvements?	✓		
Would you support the connection of Kyogle to the Casino Water Supply?			✓
Are you happy with the level of state and federal government assistance for the outcomes of the strategy?			✓
Are you satisfied with the current level of service from each of the urban water services;			
Water supply	✓		
Sewerage system	✓		
Storm water and flood mitigation	✓		

General Comments: I feel that Council should seek funds to upgrade the Water Treatment Plant & Sewerage System - Strongly disagree with sending water to Casino & reverse. I believe Water & Sewerage is more important than the remodel of the main Street.

PLEASE USE ONE PAGE PER PERSON

Name: (optional) Mark Doolan

Address: (optional) 2 Fisher Street Kyogle

Contact Phone: 66322303

Questionnaire:

	Strongly Agree	No Strong Opinion	Strongly Disagree
Are you satisfied with the process of consultation that Council has undertaken for its urban water services?		✓	
Do you think that the current charges for water and sewerage are reasonable and justifiable?	✓		
Would you support the imposition of an additional charge to support storm water and catchment based improvements?	✓		
Would you support the connection of Kyogle to the Casino Water Supply?			✓
Are you happy with the level of state and federal government assistance for the outcomes of the strategy?			✓
Are you satisfied with the current level of service from each of the urban water services;			
Water supply	✓		
Sewerage system	✓		
Storm water and flood mitigation			✓

General Comments:

Appendix B – Outline of the Climate Correction Approach

Introduction

The time series analysis of water production records is used to remove the influence of climate and water restrictions from the bulk water production records and provide a climate-corrected starting point for unrestricted demands. The analysis involves three steps:

1. Model calibration – to determine the influence of climate and other key factors on demand;
2. Model hindcasting – to provide a statistical basis for the starting point for unrestricted, climate-normalised demand; and
3. Climate correction.

Outline of Multi Variable Regression Analysis Approach

The time series analysis of water production data was undertaken using a multi-variable regression analysis approach. Calibration of the regression model is undertaken using a monthly time series of per capita water production as the dependent variable. The explanatory (independent) variables include:

- Soil moisture index;
- Mean maximum daily temperature; and,
- Mean daily rainfall.

The regression equation for the included variables takes the form:

$$D_t = B_0 + B_1 \times f_1(v_1) + B_2 \times f_2(v_2) + ... + B_n \times f_n(v_n)$$

Where: D_t = per capita water production in month t;
v_1 to v_n = independent variables for month t;

$$f_n(v_n) = v_n \text{ if linear or}$$

$$f_n(v_n) = \tan^{-1}\left(\left(v_n - \frac{(v_U + v_L)}{2}\right) \times \left(\frac{\pi}{v_U - v_L}\right)\right) \text{if non - linear}$$

Where v = Upper shape constant
v = Lower shape constant.

The model searches for the optimal combination of the upper and lower shape constants and soil moisture index parameters to maximise the significance of the independent variable as measured by the t statistic.

The transformation function used in this case is particularly suited to situations where there is potential for attenuation in the variable response at high and low values of the variable. This is particularly true in the analysis of climatic effects on water demands.

The function can assume a variety of shapes and can closely approximate the linear curve or assume the form of a “step” function at any point in the variable range if required.

The curve fitting approaches used here have been found to be useful in a number of other applications such as the cross-sectional analysis of the factors influencing water demands and time series models for filling in missing climate records.

Analysis showed that three variables were able to demonstrate statistical significance in explaining demand:

1. Mean soil moisture index;
2. Mean maximum daily temperature; and,
3. Mean daily rainfall.

The Soil Moisture Index

The model uses a simple soil moisture simulator to represent the antecedent climate effects on demand. This particular soil moisture store model has been found to generate a high correlation with water demand in many separate applications.

The soil moisture index is generated using daily rainfall and evaporation data. The calibration of the index involves changing three items:

- The rainfall multiplier;
- The evaporation power; and
- The evaporation multiplier.

The three parameters are set within the regression model along with transformation shape constants. The soil moisture index is calculated using the following equation:

$$SMI_t = SMI_{t-1} + M_R \times R_t - M_E \times E_t^P \times \frac{SMI_{t-1}}{100}$$

$$SMI_t = 0 \quad \text{if } S_t < 0$$

$$SMI_t = 100 \quad \text{if } S_t > 100$$

$$SMI_t = S_t \quad otherwise$$

Where SMI_t = Soil moisture index at time t
M_R = Rainfall multiplier
R_t = Rainfall at time t
M_E = Evaporation multiplier
E_t = Evaporation at time t
P = Evaporation power.

The evaporation power used has resulted in the departure of the model from traditional soil moisture models, and where the evaporation power departs significantly from unity, the soil moisture index is unlikely to model soil moisture.

The need for the use of an evaporation power is significant, with its inclusion in the soil moisture index formula resulting in a departure from traditional soil moisture models. The reason for this phenomenon will need further investigation, however it is suspected that it is the result of rapid drying of surface soil layers, or some type of behavioural phenomenon, such as irrigation decisions being based on perceptions of, rather than actual, soil moisture.

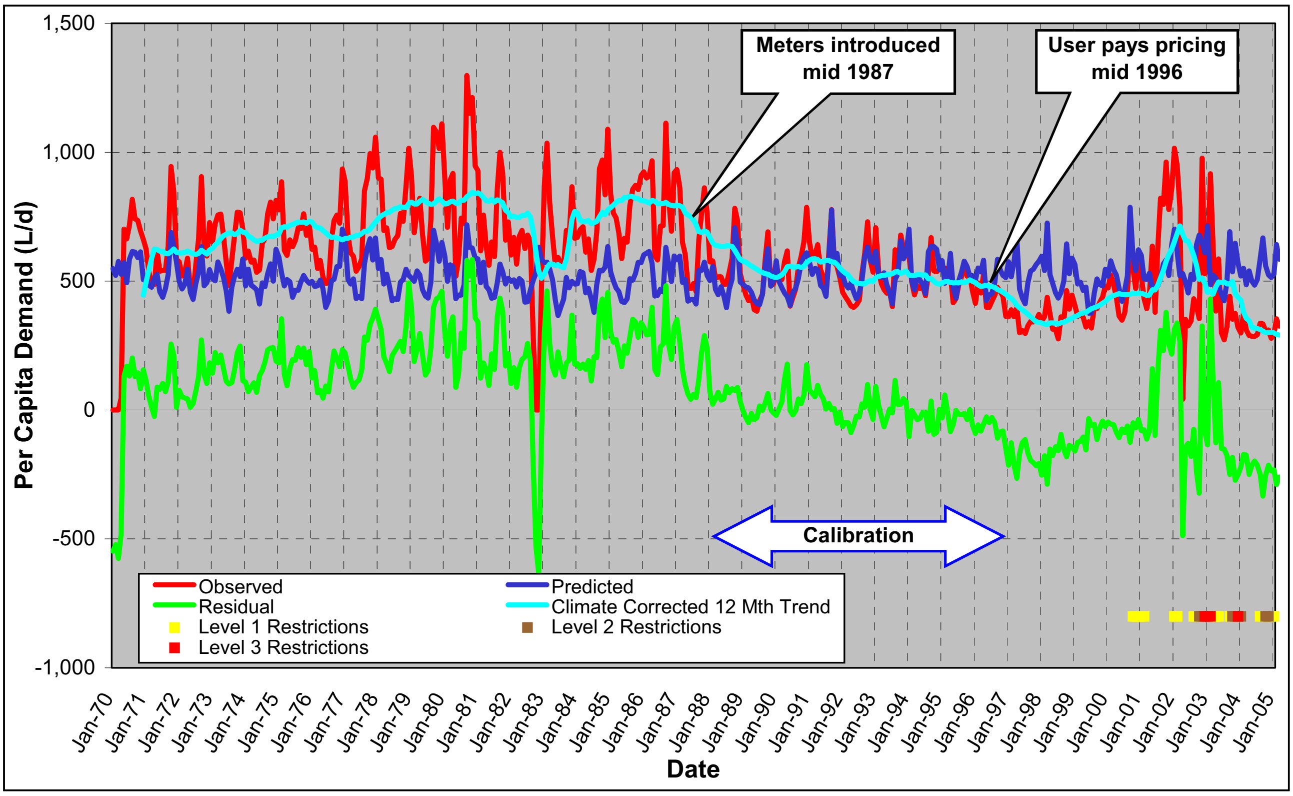


Figure 1: Calibration and Climate Correction of emands

Climate ata

Climate data was sourced from the SILO climate data service, which provided interpolated daily estimates of temperature, rainfall and evaporation for each supply area.

Model Hindcasting

The model hindcast is a key part of the climate-correction methodology. It provides a statistical basis for estimating the current climate-normalised starting point for demands and the impact of each level of water restrictions. The hindcast is limited to data from 1970 onwards due to the unavailability of evaporation data before that date. The use of a longer time series to understand the influence of climate is important because by looking at a short time series, the influence of climate will bias the estimation of the mean consumption. For example, if we are looking at the last five years of data, that period could well have been cooler and wetter or hotter and drier than the long-term average. Thus the estimate of the mean behaviour will be lower or higher than the true mean. The impact of water restrictions will also have a biased result. The analysis showed that the impact of restrictions increased with increasing temperature. If the period of water restrictions was in the coolest or warmest months of the year, assessing the impact on that basis will result in a low or high estimate of the impact of the water restrictions.

The climate correction is carried out in a number of steps:

1. The regression equation is then used to estimate the demand that would have occurred in the months since July 1970 to June 2005 (full years of data are required to be used to avoid a biased result;
2. The mean per capita demand for the 36 year period is then calculated; and

3. The mean per capita demand is then multiplied by the estimate of the current population to give the climate-corrected stating point to each supply area.

Climate Correction

The monthly water tracking model typically predicts daily water demand using transformed soil moisture, temperature and rainfall data.

$$P_t = \alpha + \beta_1 SMI_t + \beta_2 T_t + \beta_2 R_t + \varepsilon_t$$
$$\widehat{P}_t = \alpha + \beta_1 SMI_t + \beta_2 T_t + \beta_2 R_t$$

The climate correction is based on the assumption that changes in demand are identical for both fixed and seasonal demand. The climate correction aggregates demand from the previous 12 months using the following equation:

$$P_{12}' = P_{12} + \left(\widehat{P}_F - \hat{P}_{12}\right) \times \frac{P_{12}}{\hat{P}_{12}}$$

Where: P_{12}' = the climate corrected per capita water production for the 12 month period

P_{12} = the observed per capita water production for the 12 month period

$\widehat{P}_F$ = average predicted water production over the full period

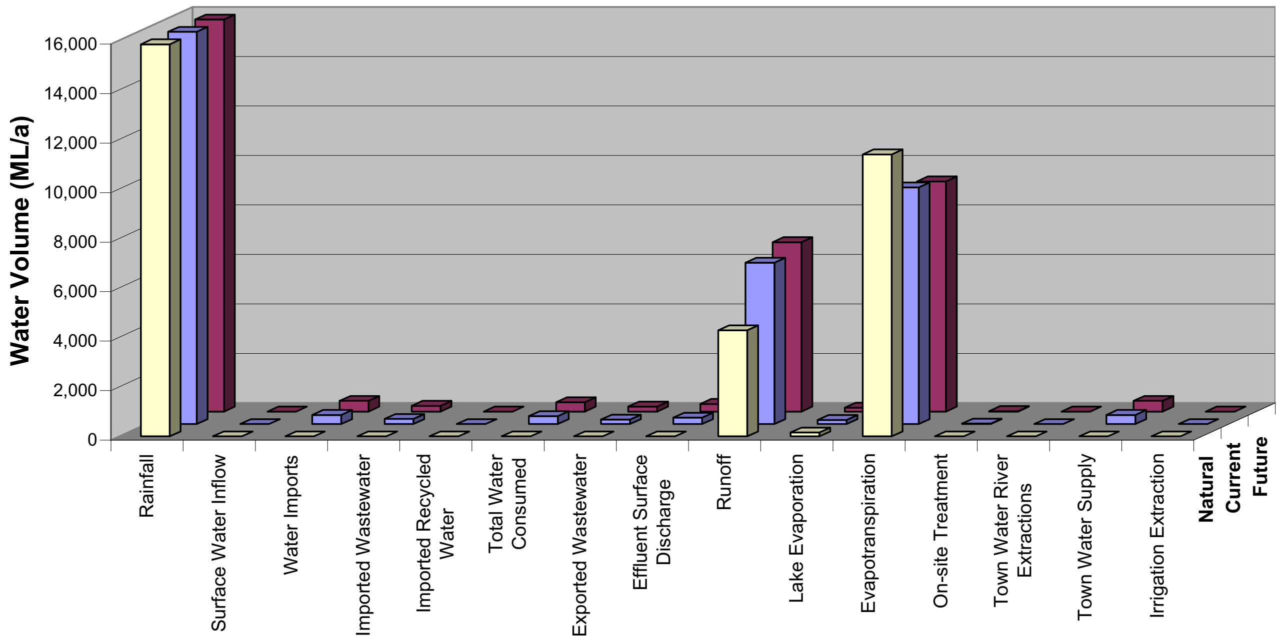
$\hat{P}_{12}$ = average of the predicted water production for the 12 month period

$\widehat{P}_F - \hat{P}_{12}$ is the climate correction that would apply if there had been no change in the demand regime since the calibration period, that is the difference in demand from the long term average over the 12 months in question.

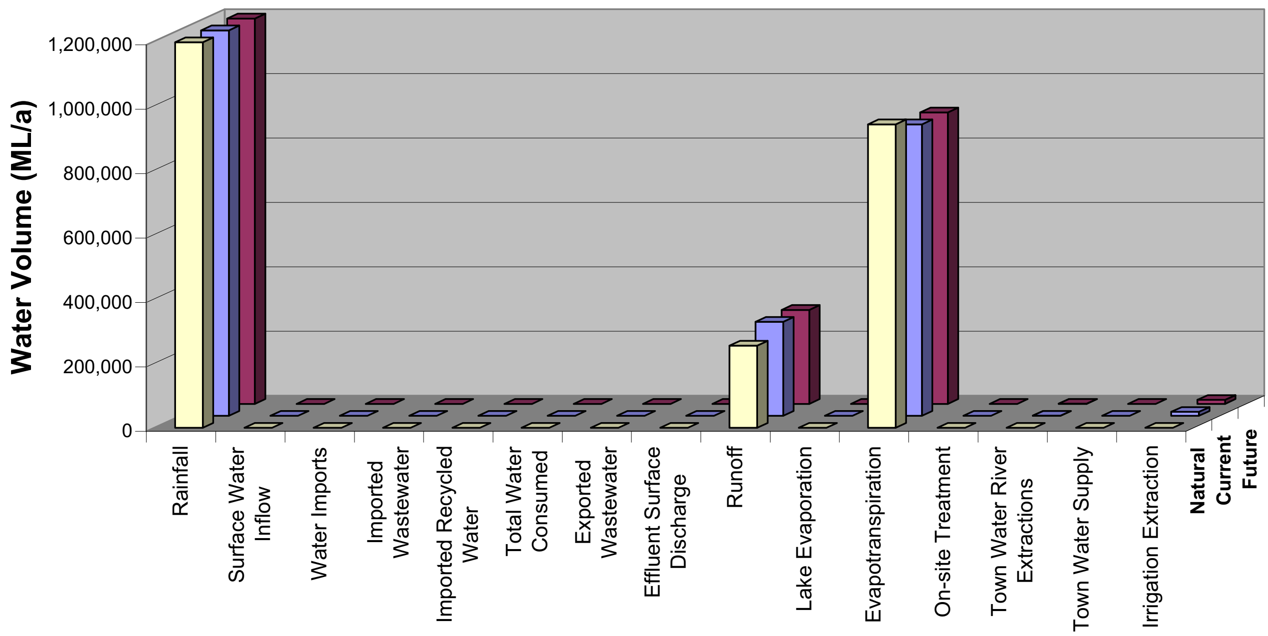
$\frac{P_{12}}{\hat{P}_{12}}$ is effectively a factor that describes the proportional deviation of the observed demand from that predicted in the calibration period. Thus if the demand is predicted demand is 10% less that that observed, then the model implies that the demand has increased by 10% and thus the climate correction must also be increased by 10%.

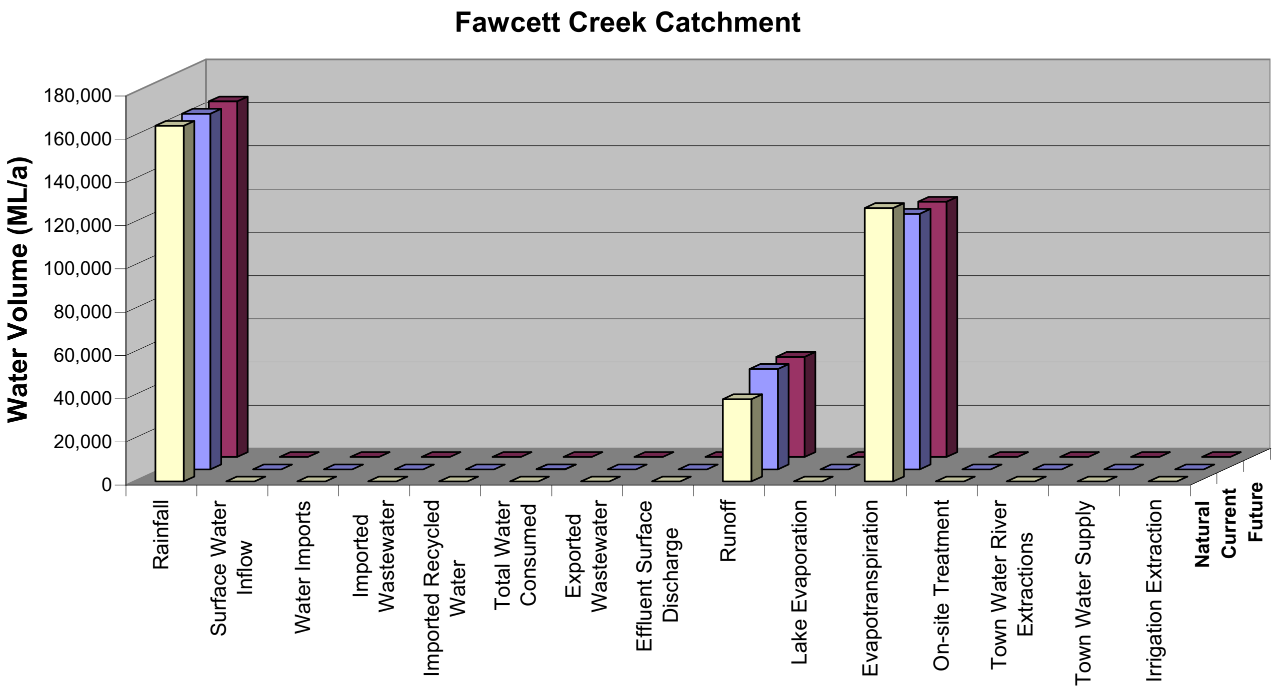
Appendix C – Water Balances

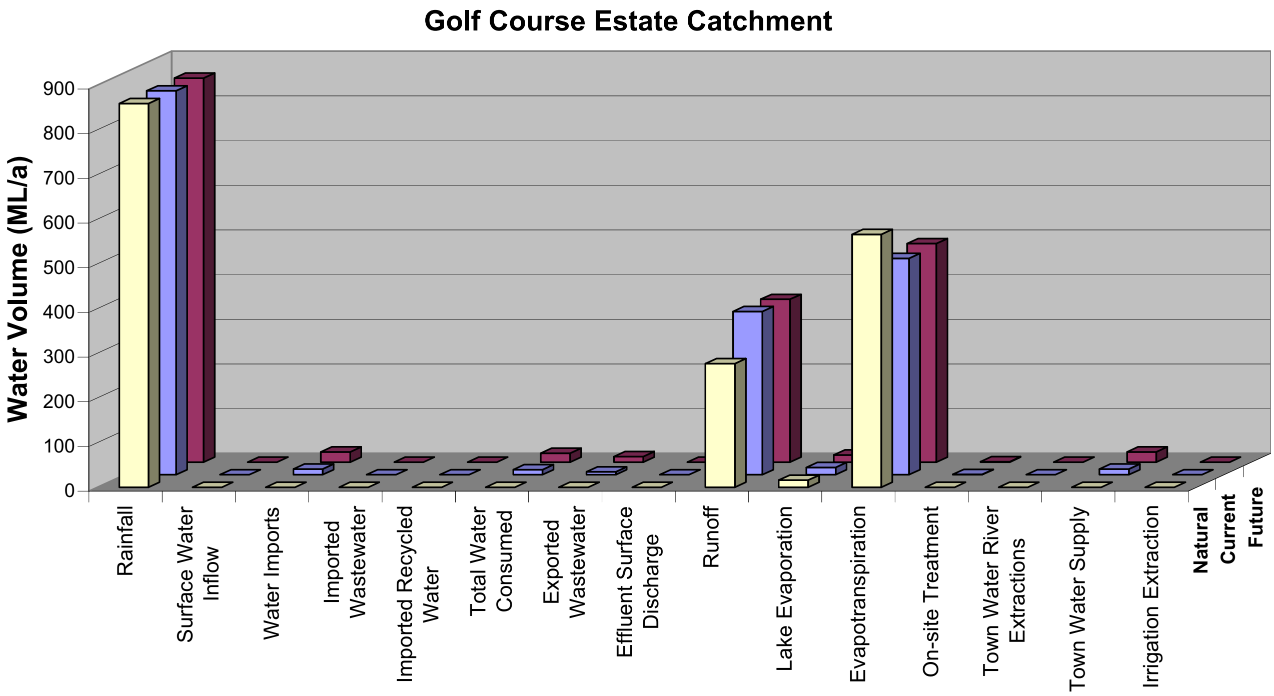
Urban Catchments

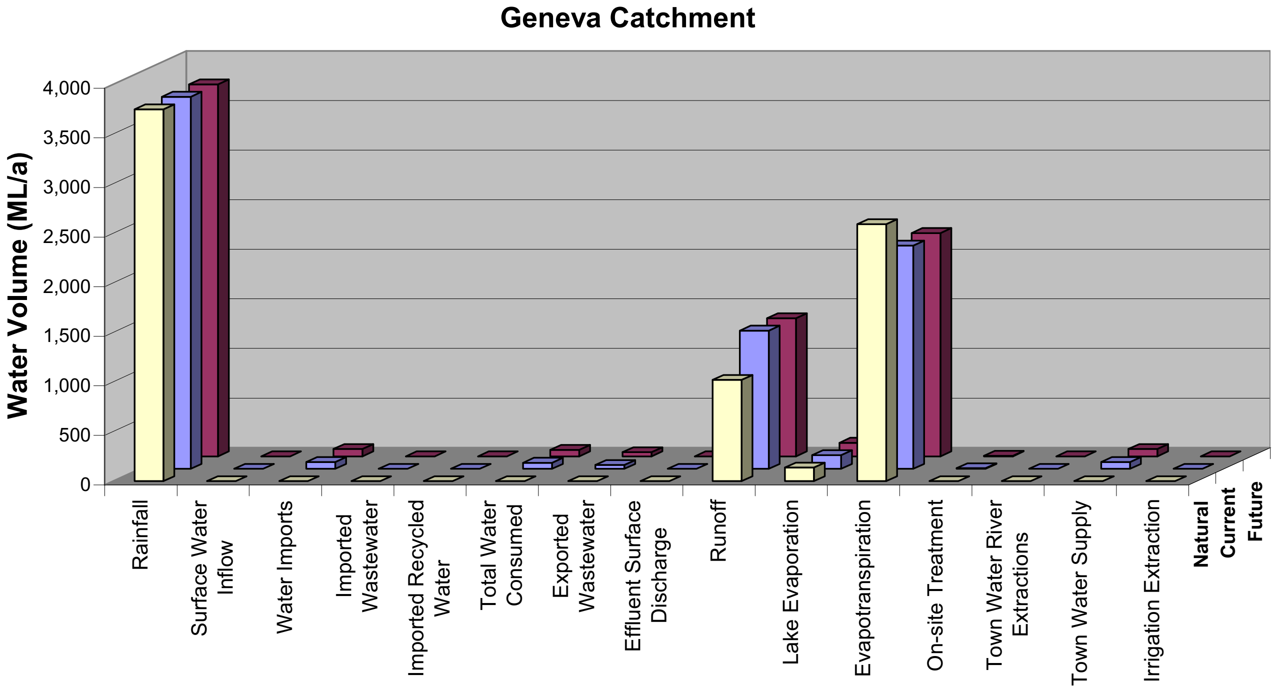


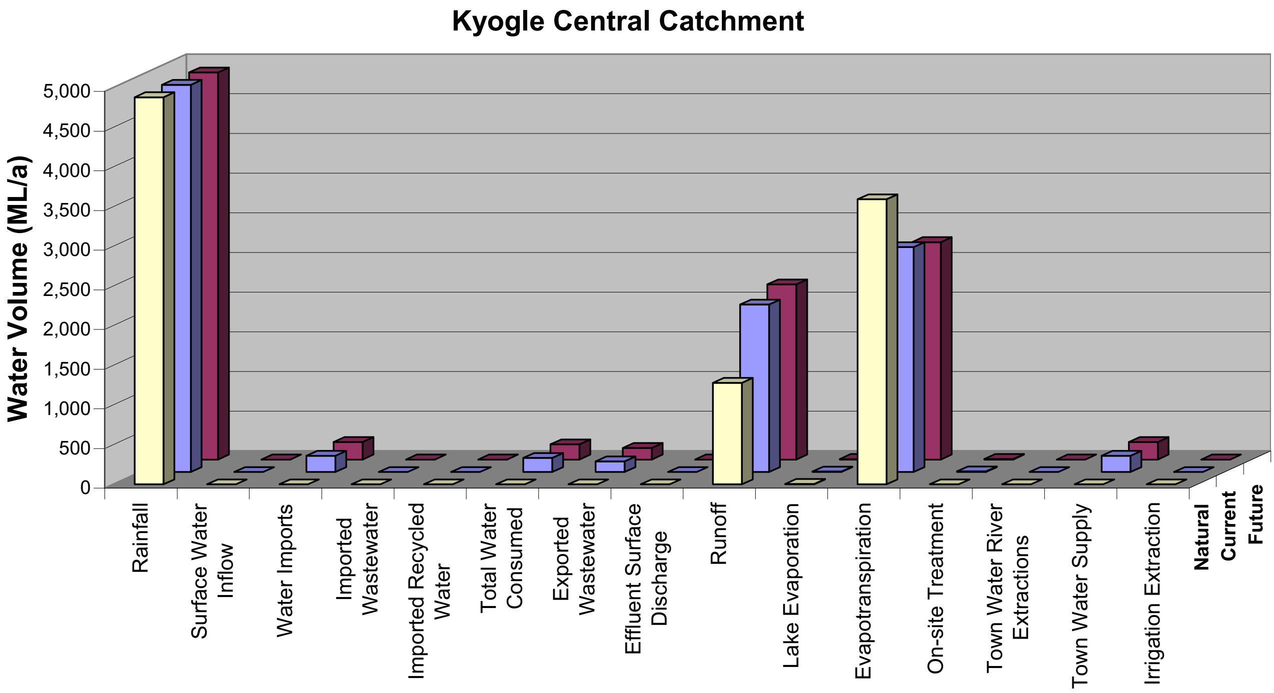
Rural Catchments

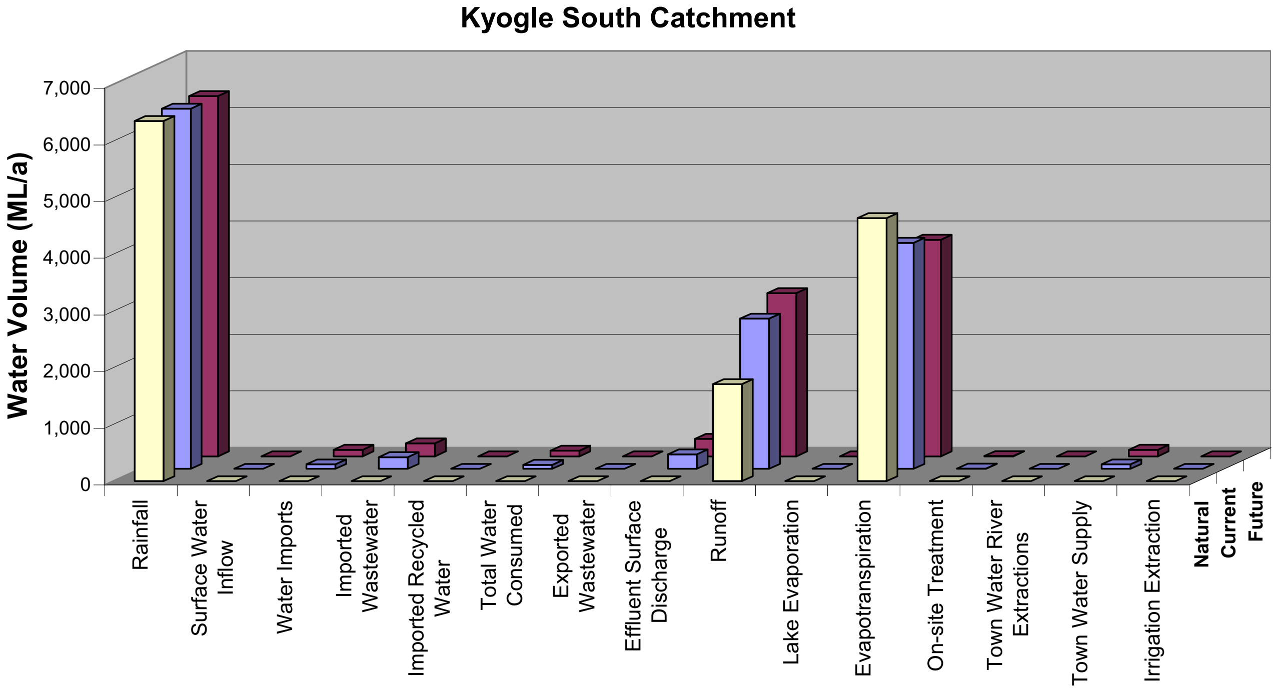


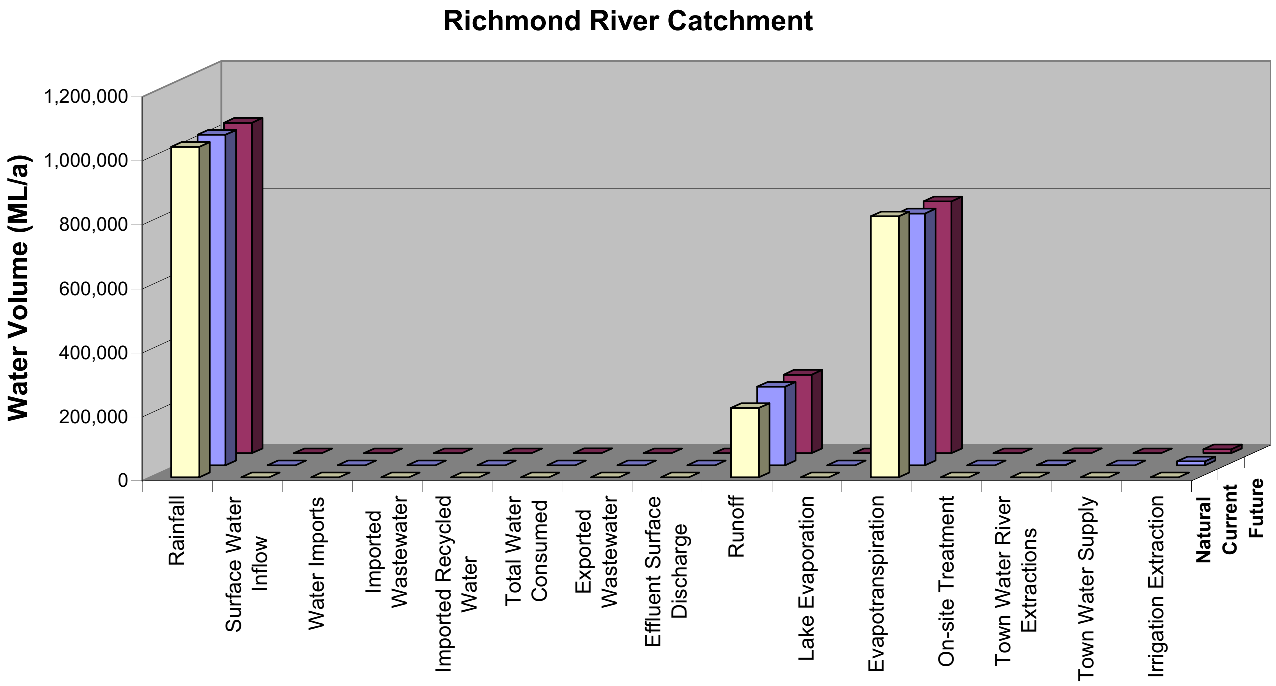

Fawcett Creek Catchment
Water Volume (ML/a)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future


Golf Course Estate Catchment
Water Volume (ML/a)
900
800
700
600
500
400
300
200
100
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future


Geneva Catchment
Water Volume (ML/a)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future


Kyogle Central Catchment
Water Volume (ML/a)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future


Kyogle South Catchment
Water Volume (ML/a)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future


Richmond River Catchment
Water Volume (ML/a)
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Rainfall
Surface Water Inflow
Water Imports
Imported Wastewater
Imported Recycled Water
Total Water Consumed
Exported Wastewater
Effluent Surface Discharge
Runoff
Lake Evaporation
Evapotranspiration
On-site Treatment
Town Water River Extractions
Town Water Supply
Irrigation Extraction
Natural
Current
Future

Appendix D – Surface Water Sharing Plan Report Card (extract)

Guidelines for Surface Water Sharing Plan Report Cards

Introduction
Water Source Report cards have been developed to assist in the consultation process for developing Macro Water Sharing Plans. They consist of three parts:

1) The nature of the water source area and the implications of water extraction.
2) The proposed rules controlling the extraction and trading of water entitlements.
3) Key factors considered in the formulation of the rules.

Report cards that have been developed for Surface Water Sharing Plans only relate to the water features (streams, lakes and estuary) that are situated upon the land surface within the area the plan. They do not describe underground water sources as they are covered by a separate Groundwater Sharing Plan.

Report Card Sections

Water Source Context Section:
This section has a simple overview of the water source area, including: average annual rainfall, proportion of forested cover and the water sources that provide inflows or receive outflows.

River Flows Section:
This section describes some elements of the hydrology of the water source.
It summarises the sources of recorded flows and uses a *Low Flow Index* flow rate to estimate how much daily water flow could typically be expected to occur during dry periods (low flows).

Licensed Water Use Section:
This section provides an overview of water that has been currently allocated within the water source via Water Act (1912) licenses and to what purpose. It does not include unresolved water licence applications submitted during amnesty periods.
Total annual entitlement is the sum total of annual entitlements of all the water licences within the water source. The percentage figure shows how significant this water source is with respect to the whole Extraction Management Unit (usually equivalent to the catchment area). Refer to the map showing Management Units for the plan.

Background Information Sections
These sections outline the nature of the water source with respect to the inherent water related values (environmental, social and economic), and the level of risk water extraction may create upon those values. If the water source includes both non-tidal and tidal waters, they are covered by separate sections.

Each water source is given a comparative rating of high, medium or low for up to five important factors:
1. Relative Instream Value and/or Estuary Value
2. Hydrologic Stress
3. Relative Economic Significance of Irrigation
4. Risk to Instream Values or Estuary Value from extraction
5. Estuary Sensitivity to Freshwater Inflows

Relative In-Stream Value (Non-Tidal):
The best available information was collated by NSW government agencies into a series of attributes for each of the water sources. Where information was not available or very limited, local knowledge or other information was used to make a subjective judgment.
The various instream attributes are given a numerical score (and weighting if required) and then combined to determine an in-stream value. The values are then ranked by comparing them with all the other water sources in the plan area to yield a range of High, Medium or Low ratings.

Estuary Value: *(Tidal Pool)*
Estuary values were determined in a similar way described above for 'Relative In-stream Value'. However, final estuary values where ranked by comparing the relative value of estuaries against other estuaries in the same coastal bioregion.

Hydrologic Stress:
By comparing the potential maximum demand (*Peak Daily Demand*) to a measure of the capacity of the water source to provide water during low flows (*Low Flow Index*), the Hydrologic Stress Rating provides a way to identify where instream values may be at risk or there may be conflict between users during dry periods. The stress is based on full licensed entitlement, whether it is fully utilised or not as water trading may re-activate unused entitlement.
The hydrologic stress rating is based on the stress caused from extractions both within and upstream of the water source. The hydrologic stress within the water source is also detailed. The stress rating is High if peak daily demand is more than 2/3 of the low flow index (available low flows), Medium if between 2/3 and 1/3 of available flows and Low if less than 1/3 of available flows.

Relative Economic Significance of Irrigation: (Non Tidal and Tidal Pool)
This section estimates the relative level of dependence the community has upon irrigated agriculture in the water source in comparison with all others in the plan area. Economic significance is based on the volume and economic value of water extracted; and the social benefit the community derives from water extraction. The various social and economic attributes are combined to determine a relative dependence ranking of High, Medium or Low.

Risk to Instream Value Rating: (Non-Tidal)
This section describes to what extent the identified in-stream values of a water source are at *risk* from the impacts of extraction within the water source. Risk is calculated from the in-stream value and hydrologic stress factors and given a rating of High, Medium or Low.

Risk to Estuary Value:
This section describes to what extent the identified estuary values of a water source are at risk from the impacts of extraction from within the tidal pool and all upstream water sources.

Inflow Sensitivity (Tidal Pool):
This rating describes how much freshwater inflows affect the salinity profile of an estuary (which includes the tidal pool).

Existing Access Arrangements During Dry Conditions Section*:*
This section details the current arrangements that the Dept of Natural Resources, have previously implemented, to limit when water extraction can occur during dry conditions. These are in the form of a suspension (Cease to Pump) and pumping time restrictions. Known water user associations are listed.

Proposed Recommendations Section

Access Rules

This describes recommended set of rules to control the extraction of water from the water source.
The range of rules includes:
Cease To Pump (CTP): that relates to the trigger at which pumping must stop until these conditions no longer prevail. Can be expressed as particular flows in ML/day at a reference point, a depth on a staff gauge or simply *visible flow* at either the reference point or pump site.
Special environmental rules: are special conditions to protect particular in-stream values and may be of a seasonal nature or have particular flow requirements.
Daily Flow Sharing is a range of conditions intended to gradually reduce extractions above the CTP. This could be implemented through hourly restrictions or daily volume limits.

Reference Point - relates to the point at which the access rules are triggered

Trading Rules

Trading rules determine if entitlement can be traded into the water source and from which particular water sources. They can also define whether there are restrictions to trading within the water source.
Trading into some water sources is capped at a specified level of stress.
Trading rules are based on the general principle of not increasing hydrologic stress in areas of high stress and high environmental value. Dealings are also subject to individual site assessment by DNR staff to ensure local impacts of the trade are within acceptable limits.

Conversion to High Flow Access
To reduce the hydrologic stress in low flow periods, some water sources have an incentive option that allows the annual entitlement to be increased by a factor of 2.5 to 1 if the licence holder surrenders the ability to take water from below the 50% percentile flow level. This may be an option for land owners if they can utilise a storage dam to store the water extracted during the high flows to be used when needed.

Key Factors for Panel Decisions Section

A Regional Panel consisting of staff from the Departments of Natural Resources, Primary Industry and Environment and Conservation were given the task of reviewing information and applying the macro water planning methodology to define the rules for each water source. This section describes what particular factors were important to the panels' deliberations.

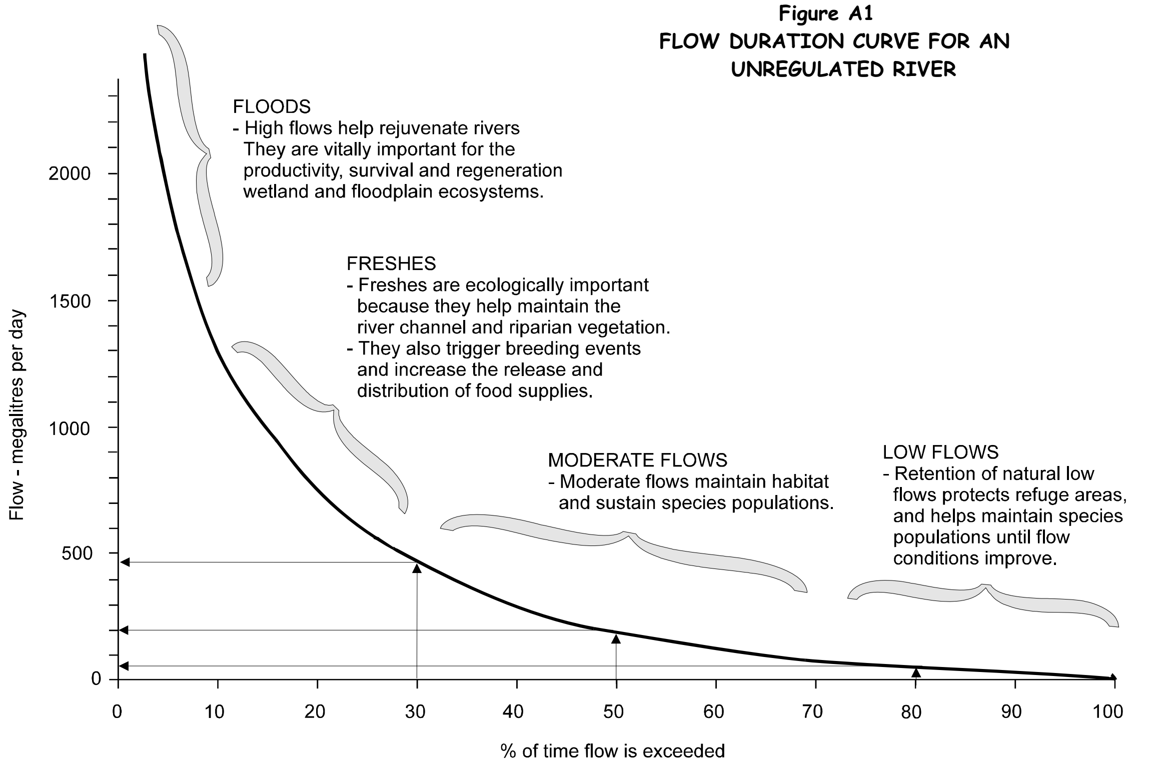
Glossary

Water Source:
A Water Source is a discrete part of a catchment that contains the rivers and streams within its topographic extents. It is the primary unit within a plan that is used for application of water sharing rules available under the Water Management Act (2000).

Extraction Management Unit:
An Extraction Management Unit (EMU) is the collection of individual water sources within the plan area that are hydrologically connected. An EMU can be as large as a whole river catchment. They are used for the management of the overall level of extraction within a plan area.

Low Flow Index:
The Low Flow Index is a comparative index of the volume of water (in megalitres per day) that typically flows out of the bottom of the water source at the 80th percentile.. This percentile figure is used as it shows the flows that are likely to occur or be exceeded 80% of the time. It also corresponds well to the period when catchment flows are noticeably diminishing and irrigation demand is often high.
This is calculated from available or estimated flow records by tabulating how often the range of daily flow volumes occur, usually called a Flow Duration Table. Graphically it can be shown as a Flow Duration Curve.

Figure A1
FLOW DURATION CURVE FOR AN UNREGULATED RIVER



Relative In-stream Value:
This is the relative value of the flow dependent plants, animals and the water related landscape features of a water source with respect to all other water sources in the plan area.

Three different types of values contribute to the relative in-stream value: ecological (intrinsic) value, economic (non-extractive use) value and cultural (place) value.

Peak Daily Demand:

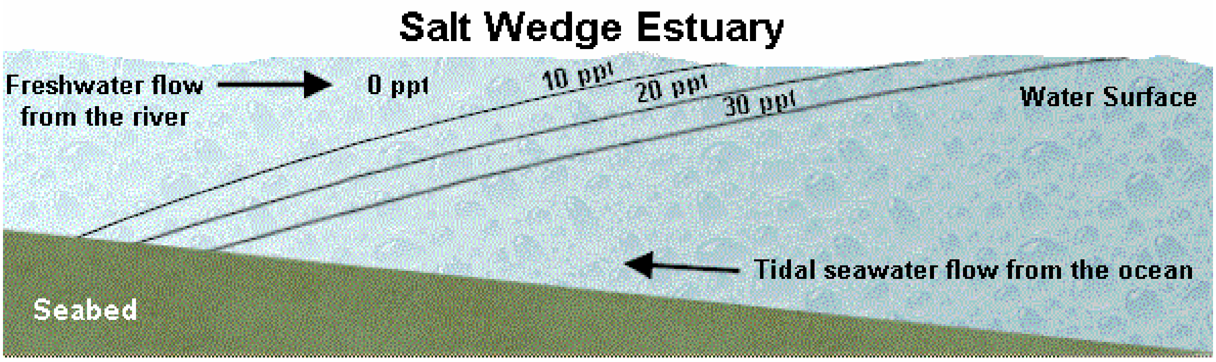
Peak Daily Demand is the maximum daily volume of water required for crops during an irrigation season. The demand is an estimate because most unregulated river licences do not have meters and the actual extraction volumes are not known. The areas and types of crops being irrigated in a water source has been derived from past surveys. Records of rainfall and evapo-transpiration rates are then used to determine the demand for irrigation within the water source.

Reference Point

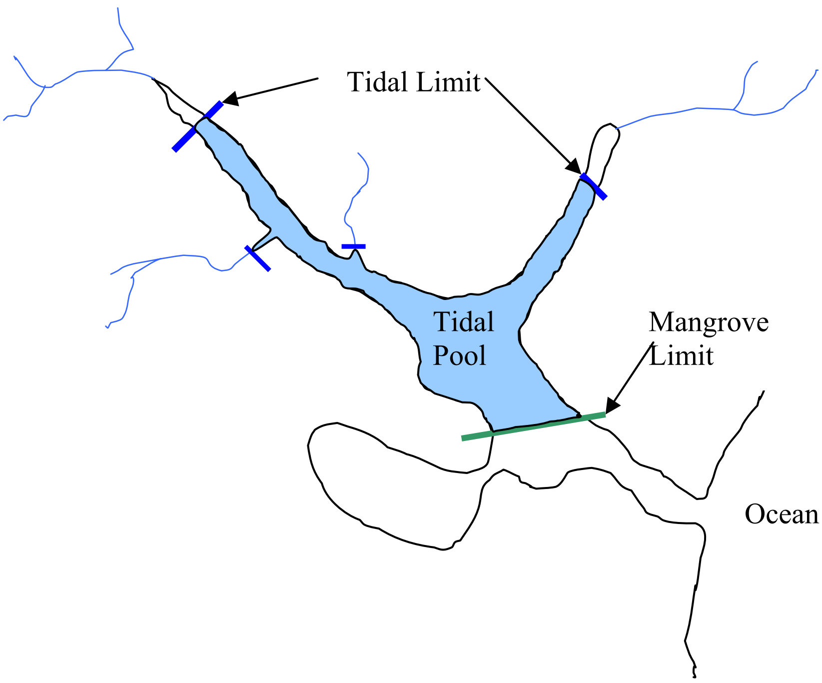
The reference point a location within or near the bottom of water source used to set pumping limitations. It is expressed as the name of a stream gauge, an established staff gauge, a road crossing structure, or the pump site (of the particular works approval of the license holder).

Tidal Pool:

The Tidal Pool is a 'pool' of useable fresh or brackish water that is present in estuaries above a wedge of salty water brought into the estuary by tides.



For the purposes of a water sharing plan, a tidal pool area is defined as the area of the estuary between the upstream limit of mangrove growth and the upstream limit of tidal influence often defined by a structure that restricts the upper tidal limit (eg. a weir or barrier).



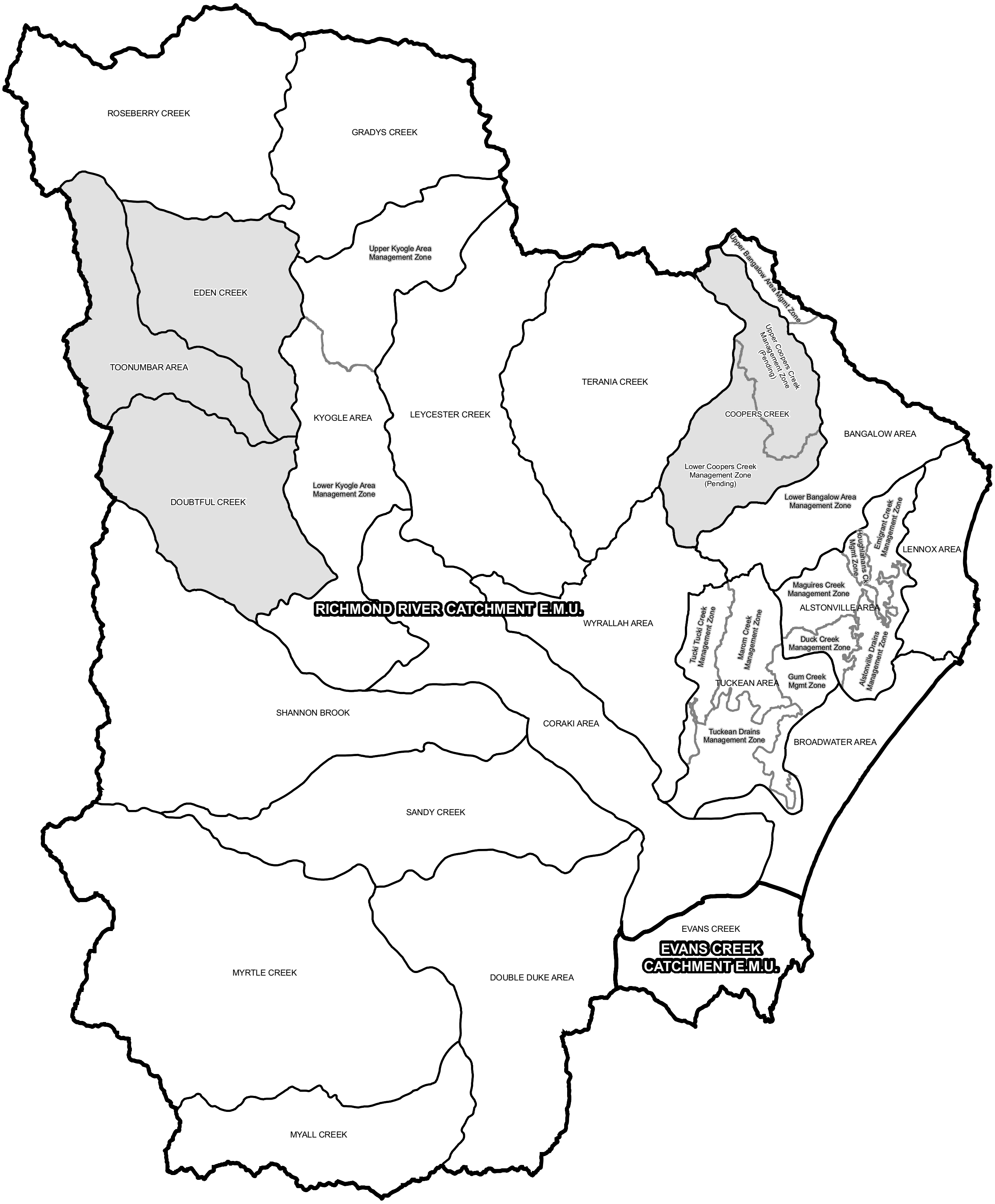
In-stream Risk:

Risk is often described as a combination of likelihood and consequence. For a water sharing plan, the consequence can be considered to be equivalent to the value of the asset under threat (the consequence of losing a high value asset is more than that of losing a low value one). The likelihood of impact can be considered to be the level of hydrologic stress (if a greater percentage of flow is extracted the likelihood of damage is greater).

Cease To Pump:
A Cease to Pump (CTP) event is when extractors are required to stop pumping. It may be based upon a reading at a river gauge or upon a reference location where the depth of water or absence of visibly flowing water is used as the CTP trigger.

Visible Flow:
Visible flow is the continuous downstream movement of water that is perceptible to the human eye.

RICHMOND RIVER AREA
UNREGULATED WATER SHARING PLAN
MANAGEMENT UNITS



DRAFT

LEGEND

- Extraction Management Units
- Water Sources
- Management Zones within a Water Source
- Excluded from Macro Water Sharing Plan Process (ie a regulated system or WSP already gazetted)

3 0 3 6 9 12
Kilometres

NSW Government
DEPARTMENT OF NATURAL RESOURCES
North Coast Resource Information Unit
February 2006
A3_gf06009_ri

Kyogle Area Water Source

Water Source Context	River Flows
Area: 45621 hectares (15% forested) **Average Annual Rainfall:** 1268 mm **Inflowing water sources:** Gradys Creek, Doubtful Creek **Receiving water source:** Coraki Area	**Low Flow Index (80th%ile) = 76 ML/day** **Flow Records:** 62 years of data from Richmond River gauge @ Casino 36 years of data from Richmond River gauge @ Kyogle
Licensed Water Use	
▪ total entitlement 13412 ML/year ▪ 146 Water Act Licenses (67% used for irrigation purposes, 30% town water supply) ▪ 15% of total Extraction Management Unit entitlement	

Background Information		
Water Source Attributes	**Rating**	**Justification**
Relative Instream Value (within catchment)	**HIGH**	▪ 1 threatened fish species ▪ 8 threatened frog species ▪ 6 threatened bird species ▪ 1 other threatened fauna ▪ 2 threatened wet flora species ▪ high diversity ▪ significant area of National Park
Hydrologic Stress	**HIGH**	▪ within water source = high ▪ cumulative stress = high - peak extraction demand exceeds available flows in November
Relative Economic Significance of Irrigation (within catchment)	**HIGH**	▪ high economic dependence of the local community on water extracted for irrigation ▪ high value of production from irrigation
Risk to Instream Value (from extraction)	**HIGH**	▪ instream values are at high risk of being impacted by extractions within the water source
Existing Access Arrangements During Drought Conditions		
Cease to Pump (CTP)	1. No visible flow 2. 15 ML/day (95th %ile) 3. 12 ML/day (85th %ile)	
Pumping Restrictions	10 hours/day at 28 ML/day 6 hours/day at 22 ML/day at Richmond River gauge @ Wiangaree	
Reference Point	1. Fawcetts Road (a) Tims Lane and (b) Green Pid Road 2. Richmond River gauge @ Kyogle 3. Richmond River gauge @ Casino	
Water Users Association	Fawcetts and Richmond River WUAs	

Proposed Recommendations for Kyogle Area Water Source

Draft Access Rules	
Cease to pump (CTP)	**Upper Kyogle Area Management Zone** - 15 ML/day **Lower Kyogle Area Management Zone** - 12 ML/day
Special Environmental Water Rule	**Upper Kyogle Area Management Zone** No pumping for 24 hours when the Richmond River gauge at Kyogle reads above the 80th %ile after reading below the CTP level the previous day. Review of this rule in year 5 to see if delivering outcomes. Based on outcomes of review from year 6 of the Plan the lower threshold can increase to a maximum of the 95th %ile and the upper threshold can change between the 85th and 75th %iles.
Reference point	**Upper Kyogle Area Management Zone** Richmond River gauge @ Kyogle **Lower Kyogle Area Management Zone** Richmond River gauge @ Casino
Daily Flow Sharing	10 hours /day pumping @ 28 ML/day at Richmond River gauge @ Wiangaree 6 hours /day pumping @ 22 ML/day at Richmond River gauge at Wiangaree Following a review of the environmental water resulting from these daily flow sharing rules, they may be increased to a more stringent level to ensure that during times of high extraction stress some environmental water is provided and user conflict is reduced. This would not be implemented earlier than year 6 of the Plan. The upper limit for change in daily flow sharing would be as outlined in Policy Advice Number 6 which is obtainable at the following internet site www.naturalresources.nsw.gov.au/water/sharing/pdf/policy06.pdf

Draft Trading Rules	
INTO water source	Permitted from Roseberry Creek or Gradys Creek water sources
WITHIN water source	Permitted
Conversion to High Flow Access	Not recommended for this water source at this stage

Key Factors for Panel Decisions

- High instream value, high hydrologic stress, high risk to instream value and high economic dependence.
- Zoned this water source to enable flexibility and better management of the water source.
- Existing cease to pump arrangements adopted as they satisfy the cease to pump rules identified through the classification process.

- Daily flow sharing proposed due to the competition between very high levels of extraction and the high instream value of the water source.
- Any change made to the daily flow sharing rules will not occur before year 6 to allow for the effectiveness of the current daily flow sharing rules to be assessed and to provide some forewarning to licensed extractors that a change could occur.
- Special environmental water rule proposed to protect fish habitat, in particular the Eastern Freshwater Cod.
- Special environmental water rule to be reviewed to ensure outcomes are being delivered.
- Trading rules identified through classification process were adopted by the Panel.

Appendix E - Source Substitution

Source Substitution Options

Demand management approaches include replacement of traditional potable water supply with alternative water sources, known as source substitution. This section provides a summary of the key aspects of source substitution. There are many informative and valuable resources available for the assessment and design of source substitution methods. Some of these resources are referenced in this report.

Four source substitution options have been considered at Kyogle:

1. Rainwater harvesting – the collection, storage and distribution of rainfall from roof structures for water supply.
2. Greywater reuse – reuse of the greywater component of wastewater ie (non toilet and kitchen wastewater) for water supply.
3. Recycled effluent - reuse of wastewater for water supply.
4. Water sensitive urban design (including stormwater harvesting) – the use of WSUD techniques and stormwater harvesting for water supply .

The application of source substitution is dependent on the quality of water available. Source substitution reuse applications are summarised in the *Draft Australian Runoff uality Guidelines* (EA, 2003). NSW reuse guidelines (ARMCANZ, 2000) and greywater reuse guidelines (DOH, 2000 & DOH, 2005) define the treatment requirements for different applications.[12] NSW Health does not prohibit the use of rainwater for any purpose provided the tank is adequately maintained (EA, 2003), however the department does not recommend rainwater tanks for drinking purposes where a reticulated potable water supply is available (DOH, 2002). A summary of these requirements is tabled below.

Table E 1: Source Substitution Application and Treatment

Source	Application						Treatment
	Agriculture Non food crops	Non contact irrigation[1]	General outdoor	Toilet flushing	Washing	Sensitive Water Quality	
Rainwater	√	√	√	√	√		Roof collection, first flush system
Greywater	√	√					Divert to garden without storage
	√	√	√				Store, secondary treatment
	√	√	√	√	√		Store, secondary treatment + disinfection
Stormwater	√	√	√	√			Variable, WSUD approaches
Sewage	√						Secondary with detention
	√	√					Secondary with disinfection
	√	√	√	√	√		Tertiary with disinfection and residual
						√	Tertiary with disinfection

1. Assumes no direct contact of water with crops

Generally speaking, it is relatively easy to adapt existing urban water system services for new developments. It is far more difficult to retrofit household and commercial plumbing to allow for source substitution than it is to fit-

[12] New reuse guidelines are anticipated and the draft *ational Guidelines for Recycling Guidelines* (NWQMS, 2005) are currently available for comment. Legislation controlling greywater diversion is expected to be modified to allow greywater diversion without the need for Council's consent.

out new premises. In fact, re-plumbing can be a constraint which limits internal source substitution uses. Houses with elevated flooring systems, such as *ueenslander* style houses, and weatherboard construction present far fewer problems for re-plumbing than slab and double brick homes. Development control plans can be established to ensure appropriate allowances and use of source substitution is made in new developments. The current BASIX requirements provide a model for this. It is understood that several Northern NSW local government authorities are jointly developing a WSUD development control plan. A key consideration to be made in DCPs is to ensure all new developments be constructed with an internal plumbing system which allows re-plumbing to accommodate third pipe or onsite recycling systems. This includes separation of toilet and kitchen sink waste streams from the remainder of the plumbing.

Rainwater Harvesting Systems

Rainwater harvesting systems collect roofwater via a first flush device, which is then stored in rainwater tanks. The rainwater system has separate plumbing and is assumed to be supplemented with town supply either via an air break top-up or a commercially available actuated valve with pressure sensor for control of rainwater and mains supply. Overflow can be directed to gardens.

Rainwater supply is generally assumed to be used for non-potable purposes where town water is available. It is becoming increasing acceptable to also be connected to the hot water system. In the Kyogle IWCM scenarios, it is assumed that rainwater may be employed for garden watering, pools, household washing (cold water) and toilet flushing.

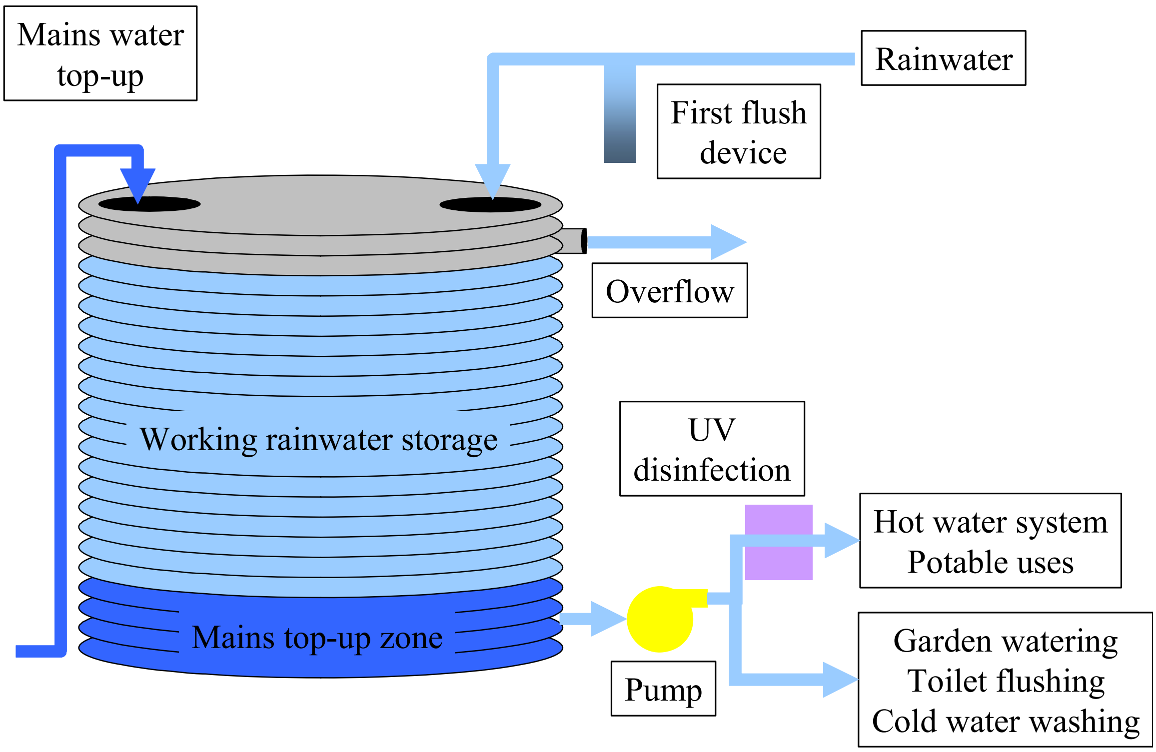


Figure E 1: Typical Rainwater Tank System

Rainwater systems can assist reduce town supply average demands and may assist control stormwater runoff. The systems' reliability is dependent on rainfall, roof catch area, storage volume and materials selection. On-going pump energy needs and non-centralised management require consideration.

A hydrological assessment of the impact of rainwater harvesting systems on water demands was undertaken utilising a probabilistic rainwater harvesting simulation. The simulation generates a large number of virtual dwellings, each with random occupancy patterns with seasonal water use determined by climate and a random element. Variation in typical roof sizes for Kyogle were estimated from aerial photographs. The impact of the rainwater tanks of different sizes on daily water demands was assessed. The modelled single dwelling water savings are provided below.

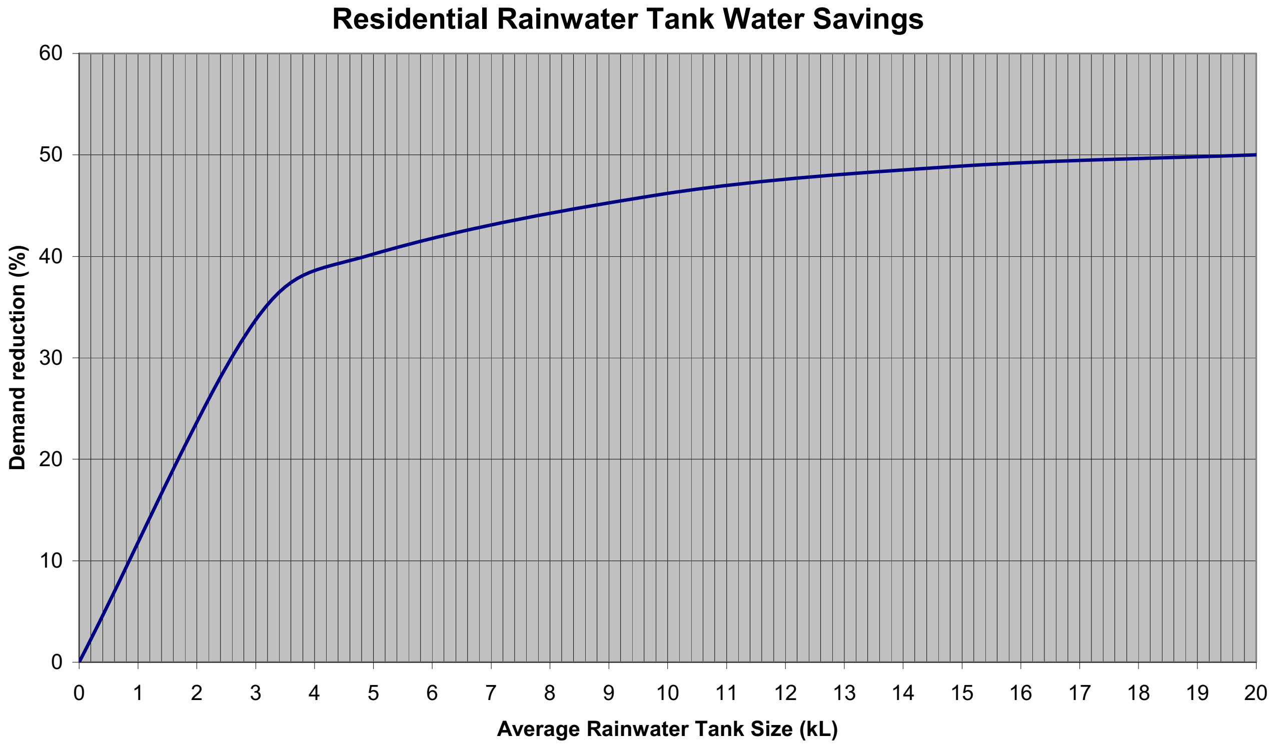


Figure E 2: Rainwater Tank Si e Efficiency

In Kyogle it is assumed that the typical household installation tank size is 5kL with a 40% reduction in total annual water demands (corresponds to a 70% reduction in the targeted outdoor, toilets and washing machine end uses). It has been assumed that under peak demand conditions that rainwater tank demand reductions are negligible.

Table E 2: Rainwater Harvesting Summary

Rainwater Harvesting				
Treatment:	Leaf litter screens and first flush diversion			
End Uses:	General outdoor, toilet flushing and washing machines			
Limitations	Dependant on rainfall reliability Space limitations for tanks, particularly in existing developments On some houses, roofing material can be unacceptable for rainwater collection for potable or primary contact uses.			
Extent of Practical Application	Generally, new and most existing homes can have rainwater tanks fitted. Existing household plumbing may limit internal household end uses. Connected for internal use with a towns supply bypass for times when tank is dry.			
Typical Household Costs[1]	2kL - $2,050	5kL - $3,000	10kL - $3,650	20kL - $5,850
	Annual pumping costs $20/y. 10 year pump life assumed.			

1. The cost for each rainwater tank scenario include litter screens ($100), 1st flush devices ($50), a pump ($500), plumbing labour costs ($500) and the cost of the tank and slab.

Greywater

Greywater includes wastewater from bathtubs, showers, wash basins, washing machines, laundry tubs and kitchen sinks (when treated). Greywater can be used as a non-potable source substitute. Its applications are restricted by the level of treatment provided. Typical household greywater systems include collection, storage and distribution facilities, including pumps and pipes to irrigation areas, as well as treatment facilities. Excess greywater is diverted to the sewer.

Greywater source substitution can significantly reduce potable water usage, both average and peak demands and is a reliable source of water. It also results in reduced sewage generation. The main disadvantages of greywater use include:

- dependence on householder management and maintenance
- relatively high installation and on-going costs to the householder
- potential for public health issues through associated pathogens
- maximum irrigation application rates (to avoid over accumulation of salts and nutrients) dependent on soil capacity, crops and flushing schedules.

Two types of greywater systems are considered in this study:

1. Low grade recycled greywater quality.
2. High grade recycled greywater quality.

The assumptions associated with these systems are tabled below.

Table E 3: Greywater Summary

Greywater Attribute	Greywater iversion ow Grade uality	Greywater Treatment High Grade uality
Treatment Level	No significant treatment.	20 mg/L BOD 20 mg/L SS 10 cfu/100mL thermotolerant coliforms (through disinfection)
Acceptable Uses	Sub-soil and sub-surface irrigation	Sub-soil irrigation Sub-surface irrigation Surface Irrigation Toilet flushing Laundry use
System requirements	Diversion valve and irrigation system. Storage of greywater is not permitted. A simple diversion valve is opened when greywater is to be applied.	Household collection and treatment system, including disinfection. Storage, irrigation system and household plumbing.

Greywater Attribute	Greywater iversion ow Grade uality	Greywater Treatment High Grade uality
Limitations	Low grade water quality results in coarse pipes for the greywater distribution system. This can lead to overloading of the soil if the system is not designed and operated properly. Low level of treatment of the greywater effluent can result in high levels of salts and chemical pollutants which may be detrimental to the soil and the local environment. Individual site environmental conditions require consideration.	As for medium grade recycled greywater. Social acceptance and associated uptake particularly for reuse in the laundry may be a limitation.
Extent of Practical Application	Generally, new and most existing homes can have diversion devices relatively easily fitted to laundry equipment and bathrooms (ie shower and bath).	Greywater treatment systems can be installed in new homes. The retrofitting of existing homes can be extremely difficult, depending on the building structure. Older style wooden houses can be retrofitted, however newer brick/slab constructed homes are virtually impossible to retrofit.
Household Costs	Simple diversion valve system: • Cost ~ $500 • Annual maintenance ~ $30	New home ~ $10, 500 Retrofit ~ $12, 500 (for Queenslander style homes only, other retrofits have not been considered) Annual Maintenance ~ $270
Potential Water Savings	Retrofitting Existing: • 10% of current external water usage Future Development • 10% of future external water usage.	Retrofitting Existing: • 90% reduction in water usage for toilets[1] • 50% reduction in water usage for laundry usage[2] • 20% of current external water usage[3]. Future Development: • 90% reduction in water usage for toilets1 • 50% reduction in water usage for laundry usage2 • 20% of future external water usage[3].

1. Remaining 10% accounts for downtime in systems.
2. Assumed acceptance rate for the reuse of greywater within the laundry.
3. Greater savings maybe possible if adequate greywater quantity is available.

Potential for On site Greywater Reuse

It is recognised that there are public health and environmental considerations which must be taken into account for greywater reuse (DOH, 2000). Design and management guidelines minimise these risks and recognise natural site conditions which may limit greywater application. One of the key principles in the design of a greywater system is to ensure that greywater is contained within the confines of the premises on which it is generated (DOH 2000). In order to determine the potential extent of application of household greywater systems for outdoor reuse in Kyogle, the NSW Department of Local Government's (DLG, 1991) risk based assessment procedure for on-site sewage treatment systems has been utilised. This procedure is designed to determine the likelihood of sewage effluent being transported from disposal trenches to surface water or groundwater, rather than greywater application. However, in the absence of a more suitable assessment approach for multiple properties, it does provide a means to classify the risk of movement from on-site application areas based on natural hazards.

The assessment process takes into account the local climate, soils and the slope of the land to determine a natural hazard classification.

Climate variability is the difference between the 90th percentile rainfall data and the mean monthly average. This is used to classify the climate of a region. Kyogle falls under the *o* classification (<1,000mm), that is, it is considered to have low rainfall variance.

The Concept Study (MEU, 2003) describes the soils in the Kyogle area as having a *lo septic absorption potential*. This information has been used to categorise the Kyogle areas soil. It has been assumed that the soils are split between having moderate (50%) to high (50%) limitations to onsite application of greywater.

Slope classifications for Kyogle's existing and future urban areas are tabled below. These proportional breakdowns where estimated based on information in *the yogle Council Strategy for Closer Rural Settlement and rban Expansion, 2 5*.

Table E 4: Kyogle rban and Slope Classification

Classification	Existing rban Area	Future rban Area
5	5%	5%
4	15%	20%
3	60%	60%
2	15%	10%
1	5%	5%

The natural hazard classification is then defined on the rainfall, soil and slope characteristics (DLG, 1991) and is tabled below for Kyogle's existing and future urban development. This table also includes the assumed potential application of greywater outdoor water use for each natural hazard classification.

Table E 5: Potential Outdoor Greywater Reuse

Natural Ha ard Classification	Potential Outdoor Application[1]	Existing evelopment	Future evelopment	escription
1	95	2.5	2.5	Minimum likelihood of loss of greywater to surface or groundwater from a well-designed and managed facility, and little or no physical limitation to on-site disposal.
2	90	7.5	5	Minor likelihood of loss of greywater to surface or groundwater from a well-designed and managed facility, and minor physical

Natural Ha ard Classification	Potential Outdoor Application[1]	Existing evelopment	Future evelopment	escription
				limitation to on-site disposal.
3	60	40	37.5	Moderate likelihood of loss of greywater to surface or groundwater from a well-designed and managed facility, and moderate physical limitation to on-site disposal.
4	15	30	30	High likelihood of loss of greywater to surface or groundwater from a well-designed and managed facility, and high physical limitation to on-site disposal.
5	0	20	25	Severe likelihood of loss of greywater to surface or groundwater from a well-designed and managed facility, and severe physical limitation to on-site disposal.
Kyogle weighted average		38%	34%	

1. Assumed outdoor application potential. These values may change dramatically depending on the level of risk willing to be accepted.

As the costs of greywater treatment systems and associated plumbing are relatively high is assumed that if installed that most owners would seek to reuse greywater in outdoor applications. For the purposes of this study, it has been assumed that there is the potential for approximately 35 percent of residential properties to utilise greywater. Due to the difficulties associated with retrofitting plumbing in existing residences, it is assumed that only half of these (ie 18% of existing properties) may potentially utilise greywater.

Recycled effluent

In this study, recycled effluent is highly treated sewage assumed to be used for non-potable applications. It is assumed that the existing wastewater system will be utilised for the collection of wastewater, with an improved treatment facility and new third pipe reticulation (including household services, pumps and storage) for distribution.

Recycled effluent may significantly reduce both average and peak town water demands. The high level of treatment required produces an effluent often suitable for return to sensitive waters. Centralised management of the system reduces health risks and operational failures. The main disadvantages of recycled use include:

- high capital and on-going costs
- relatively high installation costs to the householder
- potential for public health issues through associated pathogens, including potential for cross connections and contamination of drinking water supply
- maximum irrigation application rates (salts + nutrients) dependent on soil capacity, crops and flushing schedules.[13]

Recycled effluent schemes are most easily applied in new development areas, where the household plumbing can be setup in advance and use of recycled water made attractive (eg Rouse Hill near Sydney). It can be difficult to ensure uptake of the system in existing development areas. Most success with uptake is usually associated with non-residential applications and subsidised pricing. A summary of recycled effluent as a source substitute is provided below.

Table E 6: Recycled Effluent Summary

Recycled Effluent	
Treatment Level	Tertiary treatment with disinfection and chlorine residual ensuring: • 10 cfu/100ml thermotolerant coliforms (through disinfection) • 1mg/L Cl_2 residual after 30 minutes
Acceptable Uses	Sub-soil irrigation Sub-surface irrigation Surface Irrigation Toilet flushing Laundry use
System requirements	High level treatment system. Distribution system inclusive of RE storage, pipes and pumps. Suitable household and property plumbing.
Limitations	High capital and on-going costs. Irrigation application rates. Social acceptance and associated uptake particularly for reuse in the laundry may be a limitation.
Extent of Practical Application	Generally suitable for installation in new homes. The retrofitting of existing homes can be extremely difficult, depending on the building structure. Older style wooden houses can be retrofitted, however newer brick/slab constructed homes are virtually impossible to retrofit.

[13] Limitations associated with maximum irrigation application rates have not been assessed in this study. Should recycled effluent warrant further investigation in the future, then it is recommended that such an assessment be made.

Recycled Effluent		
Household Costs	New home ~ $1,000 Retrofit ~ $3,000 Annual water supply bills may decrease, however likely to be offset by increased household rates for capital works funding.	
Potential Water Savings	Retrofitting Existing • 100% of connected end uses (possible limitations with outdoor irrigation).	Future Development • 100% of connected end uses (possible limitations with outdoor irrigation).

Water Sensitive rban esign and Stormwater Harvesting

WSUD stormwater related practices include:

- site layout incorporating open space networks, housing layout and streetscape design
- increased permeable areas through layout and pavement selection
- flow control and sediment based treatment practices such as grass swales, buffer strips, cascades and infiltration techniques.

The techniques attempt to replicate natural system behaviour and improve urban landscape, reduce pollutant export, retard storm flows and reduce irrigation requirements. Whist WSUD is not a source substitution method per se, it does seek to use to make the most of stormwater for irrigation requirements both at the allotment and subdivision levels, and in this sense maybe used to replace potable water needs.

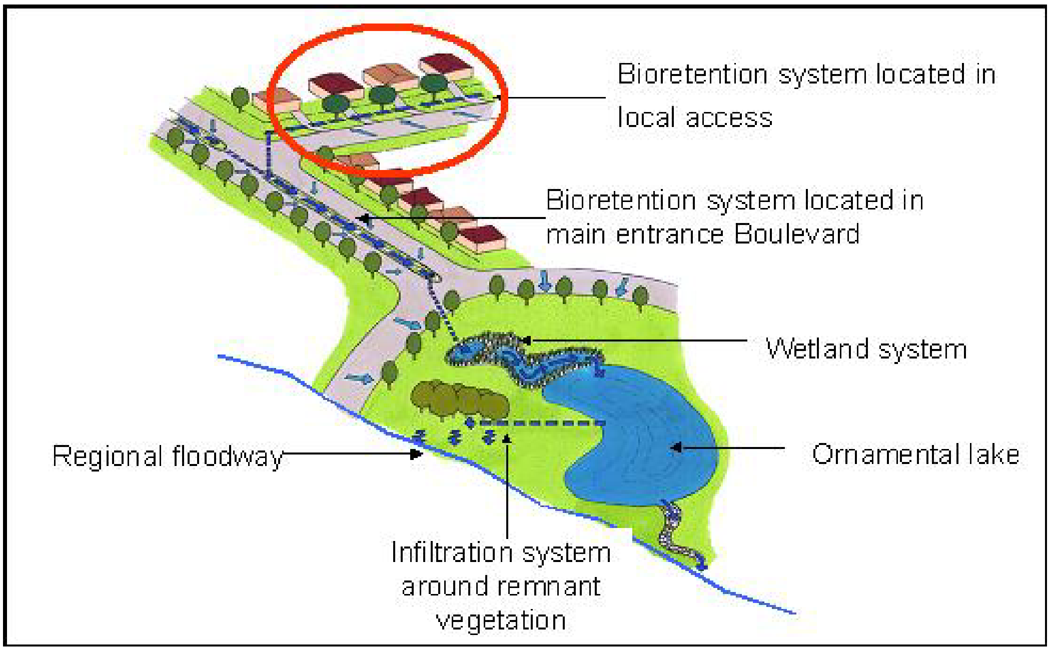


Figure E 3: Typical New evelopment WS Features

Figure E 4: Typical Swale

Erosion is a problem in some of the steep grade urban areas of Kyogle. Provision of traditional stormwater gutters and piping to these areas may limit local erosion, however is likely to increase runoff rates and exacerbate downstream stormwater flows. A WSUD alternative to street gutters is the use of cascading swales as shown below.


Prior to planting

Figure E 5: Cascading Swale uring and after construction
Source: Sarah West

Table E : WS Summary

Water Sensitive rban esign	
Benefits	Can reduce potable water supply demands through replacement of irrigation water. Improves stormwater quality by reducing peak flow rates. Improves stormwater quality by detaining pollutants and biological uptake. Encourages aquifer recharge. Aquifer recharge returns stream flows to a more natural flow pattern. Improves local environment biologically and aesthetically.
Limitations	Best suited new release areas and open spaces, however aspects can be retrofitted in existing development. DCP's facilitate WSUD in all homes, commercial/industrial developments. Site characteristics may limit application. Maintenance requirements can be higher at the local level, but lower on the catchment level.
Costs	Costs are variable, however, it can be argued that WSUD does not cost more to implement and manage than conventional stormwater management approaches.
Savings	In new residential developments with WSUD, best practice objectives include (VSC, 1999): • 80% retention of typical annual suspended solids loads • 45% retention of typical annual total nitrogen and total phosphorus loads. • discharge maintained at 1.5 ARI pre-development levels.

Direct *storm ater harvesting* utilises stormwater runoff from roofs, paved and garden areas to be captured in underground tanks, ponds or infiltration systems for reuse. In subdivision scale schemes, runoff from roads and public areas may also be captured. Many golf courses, including the Kyogle Golf Course utilise stormwater harvesting. Stormwater quality is highly variable and dependent on catchment conditions and management. Many different combinations of WSUD techniques and stormwater harvesting are possible. Stormwater interaction with the groundwater system is an important consideration for the design of harvesting systems. Aquifer storage and recovery is one approach to the utilisation of stormwater and groundwater. The main limitations include identifying suitable areas for storage and the associated environmental issues. Stormwater harvesting costs vary widely depending on the system adopted and level of treatment required.

Appendix F - Water and Wastewater Treatment Technical Memo

M E M O R A N M

To: Adam Joyner ate: 21 November 2005
Copy to: Reference: A0150600
From: Ajay Nair MWH Australia Pty Ltd
Subject: Kyogle IWCM - Review of Water Treatment Plant and Wastewater Treatment

Introduction

This document reviews the treatment strategies that have been outlined in the IWCM to understand their appropriateness and the range of costs.

Treatment Capacities

Water Treatment Plant

Under the different IWCM scenarios, the peak production capacity of the treatment plant ranges from 5.5 Ml/d down to 1.8 Ml/d under the best water consumption.

Wastewater Treatment Plant

The wastewater treatment plant capacity of 0.75 M/d ADWF (average dry weather flow) has been adopted to cover all of the IWCM scenarios.

Re uired Treatment Standards

Water Treatment Plant

The water treatment plant will be required to meet the requirements the 2005 Australian Drinking Water guidelines.

Wastewater Treatment Plant

The treated water standards for the wastewater treatment plant will be dependant upon the end use for the treated wastewater. Under each IWCM scenario, the following standards may be applicable.

Scenario	Treatment Process	Standards Re uired
Non-potable Urban Re-use	Secondary, Tertiary and Disinfection	Faecal Coliforms < 1 in 100 ml Coliforms < 10 in 100 ml (95%ile) Virus < 2 in 50 L Parasites < 1 in 50 L Turbidity < 2 NTU Geometric Mean < 5 NTU in 95% Samples pH 6.5 – 8.0
Restricted Re-use	Secondary and Disinfection	Thermotolerant Coliforms < 1,000 cfu/100ml
Land Disposal – Irrigation of Non Food Crops	Secondary	Thermotolerant Coliforms < 10,000 cfu/100ml

Review of Potential Solutions

The following sections discuss the requirements to meet the needs of each of the outlined, treated water scenarios.

Water Treatment Plant.

A new bankside storage facility of 500 Ml/d has been proposed to provide increased security to the water supply system. The introduction of the bankside storage facility will have an impact on the raw water quality as follows:-

- Reduction of pollution spikes through attenuation in storage
- Reduction of the level of silt, clay and turbidity passing to the treatment plant
- Increase risk of algal growth which can lead to filter blockages, algal toxin production
- Reservoir sediment build up and potential accumulation and release of iron and manganese.

This additional bankside storage must be considered in the development of the treatment plant.

Proposed Facility Upgrades

The February 1999 Water Supply Augmentation Strategy Report recommend the existing treatment plant be abandoned in favour of a new treatment plant, with the following recommended treatment options:-

- Direct Filtration
- Dissolved Air Flotation
- Conventional clarification and filtration.

In addition to the more conventional process streams listed above, additional process systems including:-

- Lagoon Sedimentation
- Microfiltration using membranes.

Since the development of the augmentation strategy there have been further developments both in technology and in the expectation of treatment requirements, both in terms of treated water quality and plant efficiency.

These developments include:-

- Changes to the drinking water treatment standards (ADWG 2005)
- Greater emphasis on water contaminants such as cryptosporidium, Giardia, Disinfection By Products (DPBs) which include Trihalomethanes, Halo Acetic Acids and Bromates
- Changes in technology including use of UV as an alternative disinfectant, improvements to membranes to Ultrafiltration and increased solid loading capacities
- Further understanding in optimisation of conventional treatment plants relative performance.

With these considerations in place then any new treatment plant should incorporate the following as part of its treatment stream.

- Enhanced Coagulation for the reduction of protozoa and improvement in the removal of disinfection byproduct precursors
- Provision of Iron and Manganese removal processes
- Provision for the treatment of algal toxins
- Consideration for the removal of algal cells which would result in the clogging of filters.
- Provision of backwash treatment to improve plant efficiency and reduce waste volumes.

With these considerations, a conventional process stream has been developed that addresses the raw and treated water quality requirements and would consist of the following process stream.

- Inlet reception chamber
- PAC dosing mixer
- PAC reaction chamber including aeration for iron precipitation
- Potassium Permanganate dose mixer
- Flow splitting chamber
- Enhanced coagulation process including:
    - Coagulant Dispersion
    - Coagulant Microflocculation
    - Polymer Addition
    - Polymer Flocculation
- Liquid/Solids separation clarifier
- Rapid Gravity Filtration for the entire flow, including
    - Clean backwash storage tank(s)
    - Dirty backwash storage tank(s)
- Chlorine contact tank
- Backwash water treatment using coagulation and clarification
- Sludge thickening
- Sludge dewatering.

Chemicals included for use on site include:-

- Polyaluminium Chloride
- Potassium Permanganate
- Calcium Hydroxide (Lime)
- Polymer
- Sodium Hypochlorite
- Sodium Hexaflurosilicate.

Water Treatment Plant Costing

Based upon the outlined WTP process stream, a cost estimate for a new treatment plant treating a peak water capacity of 5.5 Ml/d and 1.8 Ml/d has been developed. These are presented below in the table below.

Plant Capacity	Total Out Turn Cost	Operating Cost Per ear
5.5 Ml/d	AU$ 5,600,000	AU$ 166,000
1.8 Ml/d	AU$ 3,500,000	AU$ 115,000

*Indirect costs included as 35% of direct costs.

Assumptions on capital and operating costs

In generating the operating costs, we have made the following assumption

- Manning has levels for normal operation have increased due to increased plant complexity and requirements to achieve a higher level of treated water standard.
- There is no difficulty in obtaining the appropriate chemicals for treatment purposes.
- Thickening of sludge is carried out to 6%DS and an allowance for transport and disposal has been made. The operating costs have been broken down as following:

Operating Cost	5.5 Ml d	1. Ml d
Chemicals	52,200*	17,000
Residuals Disposal	14,000*	9,000
Manpower	70,500	70,000
Sampling	8,100	8,100
Critical Equipment Replacement	1,200*	800
Power	20,000*	10,000
Total	166,005.5	114,901.8

* Variable operation costs say $86,200/year or $172/ML. Fixed operation costs say $78,500/year.

Excluded costs include insurance, administration, and insurance costs:

- The new WTP includes new, updated facilities for laboratory, operator mess and laundry requirements.
- Site roads and landscaping have been included in the capital costs.

Wastewater Treatment

For each treated water scenario, a scope of works required to achieve the desired standards has been developed. These are presented in Table below. The scope of works does not include the works associated with maintenance on the existing treatment processes.

Scenario	Scope of Works Re uired
Unrestricted Re-use	• Primary chemical P dosing • Secondary chemical P dosing • Deep bed filtration for combined denitrification, solids reduction and P removal • External carbon dosing for dosing for denitrification • Sodium Hypochlorite dosing for disinfection • Chlorine contact tank for disinfection • Dechlorination using sodium bisulphite • PWWF storm storage (8 Ml)

Restricted Re-use	• Primary chemical P dosing • Secondary chemical P dosing • External carbon dosing for dosing for denitrification • Submerged Aerated Filter for denitrification • Sodium Hypochlorite dosing for disinfection • Chlorine contact tank for disinfection • PWWF storm storage (8 Ml) • Winter storage (30 Ml) OR • Hydroponics Wetland Setup (7 Ha) • Associated crop growing facilities • Chlorine contact tank for disinfection • Dechlorination using sodium bisulphite
Land disposal	• Land purchase and irrigation system (49 Ha) • Winter storage (22 Ml)

Wastewater Treatment Plant Capital and Operating Costs

Capital and Operating Costs

The associated capital and operating costs for each option are presented in the following table:

Scenario	Total Out Turn Cost	Additional Operating Cost Per ear
Unrestricted Re-use	AU$ 2,400,000	AU$ 72,000
Restricted Re-use (SAF)	AU$ 1,620,000	AU$ 50,000
Restricted Re-use (Hydroponics)	AU$ 970,000	AU$ 15,000*
Land Disposal (Irrigation)	AU$ 890,000	AU$ 10,000*

* Indirect costs included as 35% of direct costs.
** Includes preliminary allowance made for O&M.

Assumptions

The following assumptions have been made in developing the costs for each options:-

1. An average dry weather flow (ADWF) of 0.75 Ml/d has been assumed for treatment purposes.
2. Nitrogen and Phosphorus removal have been included for unrestricted and restricted, non-potable reuse. A standard of 10 mgN/l and 0.5 mg/l P has been assumed (50%ile), however this may be relaxed depending upon nutrient studies. TSS is anticipated to be less than 10mg/L with filtration and less than 20mg/L without filtration.
3. A peak of 3 ADWF will be treated through the treatment process. For the purposes of the re-use schemes, storm storage has been provided.
4. For Nitrogen removal, a tertiary denitrification stage has been included, using an external carbon source. Where tertiary filtration is required, a single deep bed sand filtration has been assumed to meet the requirements of both standards.
5. Methanol has been assumed to be the external carbon source.
6. Disinfection uses sodium hypochlorite dosing coupled with a contact tank providing a minimum of 1-hour contact. This is in line with NSW effluent re-use guidelines.

7. Dechlorination has been allowed to trim residual if required.
8. The operating costs are additional to existing costs.
9. The out-turn cost for the Hydroponics are as provided by the supplier.
10. Additional manpower is required due to the increased complexity of the treatment plant and the required standards to be achieved. An allowance for AU$ 20,000 and AU$ 10,000 per year has been made for non-potable and restricted reuse respectively.
11. No additional process issues are anticipated should local septage be treated at the site. Septage should be added at the intake works. A weighbridge for estimation of septage loads could be considered.

Appendix G – Bulk Water Supply - WATHNET Modelling

Kyogle Integrated Water Cycle Management Strategy

Bulk Water Supply – WATHNET

Project No. 747/05

Kyogle Integrated Water Cycle Management Strategy Bulk Water Supply - WATHNET

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March 2006

Client	Client's representative
MWH	Adam Joyner

Project					
Project Kyogle Integrate Water Cycle Management Strategy Bulk Water Supply - WATHNET		Project No 747/05			
Authors Pavel Kozarovski		Date March 2006 Approved by PK			
	Final Report		PAK	PAK	AUG 06
Revision	Description	By	Checked	Approved	Date

Key words	Classification
Water Supply Demand modelling Behaviour modelling Hydrology WATHNET	☐ Open ☐ Internal ☒ Proprietary

Distribution		No of copies
MWH	Adam Joyner	Digital copy
Kozarovski and Partners:		1

Kyogle Integrate Water Cycle Management Strategy
Bulk Water Supply - WATHNET

1 Overview

Kyogle water supply is reliant on surface water extraction from the Richmond River. Other users also extract water and the river eco-system is put under environmental stress.

Water sharing rules recognise competing water uses including environmental flows and set controls on extractions, especially during the periods of low flow. A water storage reservoir is thus necessary to provide a reliable water supply during periods when water extractions from Richmond River are not allowed.

The water sharing plan which covers the Richmond River in the Kyogle area is being prepared. Extraction rules for high flow licences (80%-ile and 95%-ile rules) were adopted for comparison of IWCM scenarios. The draft water sharing rules have recently been released for consultation purposes and a sensitivity test has been made using these rules on storage sizes. The adopted extraction rules and the rules from the water sharing plan are described further in the report.

The main objectives of the bulk water supply study is to:

- determine the reliability of the current water supply system and
- determine the sizes of the required off-stream storages which would satisfy the reliability and security criteria for each scenario of demand management.

2 Approach

Traditional approaches for defining the size of the water storage reservoir and the reliability of a water supply system were based on water balance analysis of historical streamflows and projected demands, assuming that the historical sequence would repeat itself. Generation of many synthetic sequences with statistical properties similar to historical data would overcome this assumption. The generated sequences would contain periods with more severe droughts than historical, allowing better understanding of reliability and security of water supply.

The approach adopted by NSW DEUS is based on water balance analysis of a large number of synthetic sequences of streamflows and corresponding to the streamflows water demand. Each of the synthetic sequences has an equal chance of occurrence. This approach allows a definition of the system's reliability at any point of time within the planning horizon. It was decided to use 1000 sequences of synthetic data for this project.

Three types of models were used:

- Synthetic streamflow/climate generator;
- Overall demand model and rainwater tank model and
- Water balance model.

The schematic representation of the approach and the models used is shown on Figure 1. Historical climate, streamflow and demand data were used to:

- Establish and fit a multi-site stochastic model to historical streamflow and climate data;
- generate 50 years long, 1000 sequences of daily streamflow and climate data. Note that streamflows and climate data are correlated and this correlation is preserved in the synthetic data;
- establish and calibrate a demand water tracking model (by MWH);
- develop a DSS[1] based on historical data and various demand management and system improvement options (by MWH);
- establish a detailed demand-rainwater tank model and provide feedback to DSS regarding the impact of the rainwater tanks on demand reduction;
- establish an integrated demand model based on water tracking model and DSS, providing daily demand forecast for various options as per DSS using synthetic climate data;
- generate 1000, 50 years long sequences of daily demand forecasts corresponding to the synthetic climate data and demand scenarios as per DSS.
- establish water balance models representative of the demand scenarios as per DSS;
- determine the reliability of the existing system and define the required storage size for each demand scenario which meets the performance criteria.

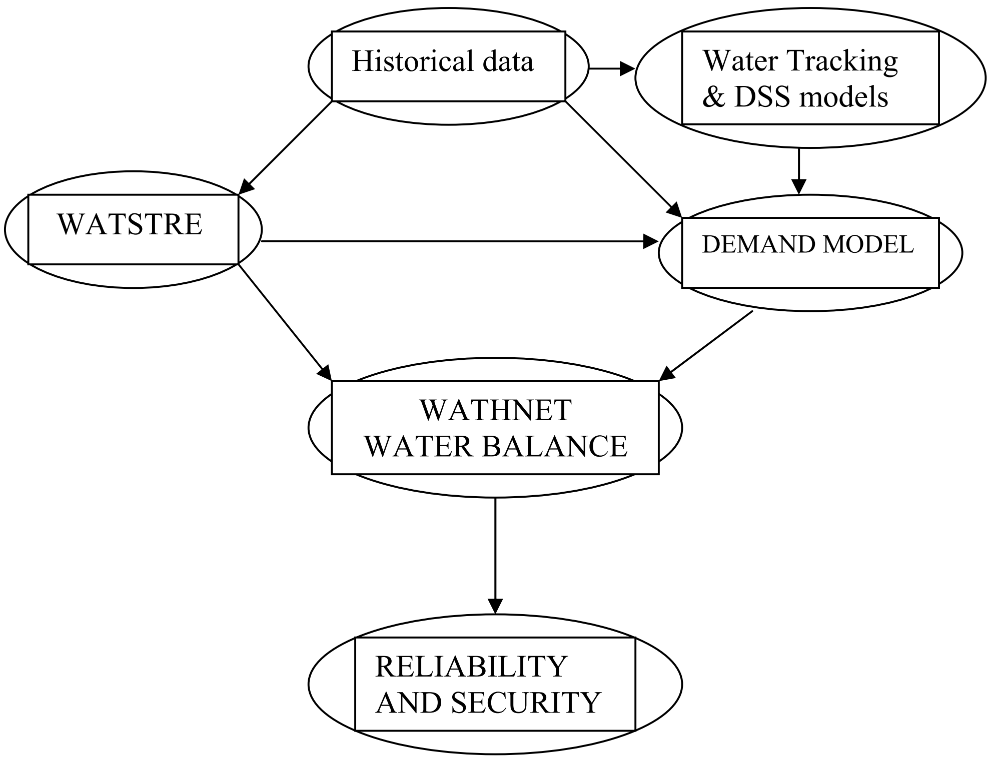

Figure 1, Schematic diagram of models used in Water Balance Study

[1] The Decision Support System (DSS) is a combined end use and financial impact model.

3 Data collection and analysis

MWH, the NSW DEUS and DNR supplied available data for the project including:

- IQQM simulated daily streamflows for Richmond River at Kyogle weir;
- historical daily rainfall records;
- historical temperature records;
- historical and generated evaporation data;
- historical demands;
- Decision Support System spreadsheet for Integrated Water Cycle Management containing the end use demand data of future water consumption;
- water tracking model for Kyogle.

3.1 Historical rainfall, temperature and evaporation data

The historical records of temperature, rainfall and evaporation records were sourced from the BoM. The records covered a period of some 113 complete years, starting in 1892. The long term averages are summarised in Table 1. Reliable evaporation records were available from 1970. An evaporation model was used to fill in the data from 1900 to 1969 using recorded temperature, rainfall and solar radiation data. It can be seen from the data that the average annual evaporation during 1900-1969 was some 180 mm higher than the average annual evaporation in 1970-2004, reflecting most likely the drier climate in 1900-1948.

Table 1, Average climatic data for Kyogle for a

Average annual rain (mm)	Average maximum daily temperature (° C)	Average annual evaporation (mm)		
		1900-2004	1900-1969	1970-2004
1174	25.7	1648	1708	1529

3.2 Streamflows

DNR provided the IQQM simulated daily streamflows for Richmond River at Kyogle weir, reflecting the current irrigation extractions, covering the period between 1892 to 2001. It is assumed that the provided time series is the best representation of the complex water management rules and issues associated with the river system.

The streamflow time series was used as an input into the water balance analysis as an independent variable, together with the correlated rainfall, maximum daily temperature and evaporation. The resulting overlapping period of useable streamflow and climate data is between 1900 to 2001, however, the 1892-2004 period contained periods of missing data.

The flow duration curve for Richmond River at Kyogle is shown on Figure 2. The 80%-ile flow is 57.5 ML/day and the 95%ile flow is 17.7 ML/day.

The proposed trigger levels for imposition of environmental flow regime when extractions would be limited were presented for consultation in February 2006 by government agencies as the 95%-ile flow with a value of 15 ML/day. The storage sizes were determined using 57.5 ML/day and 17.7 ML/day as the 80%-le and 95%-ile flows. The water sharing plan figure of 15 ML/day was used as a part of the sensitivity analysis of the preferred scenario.

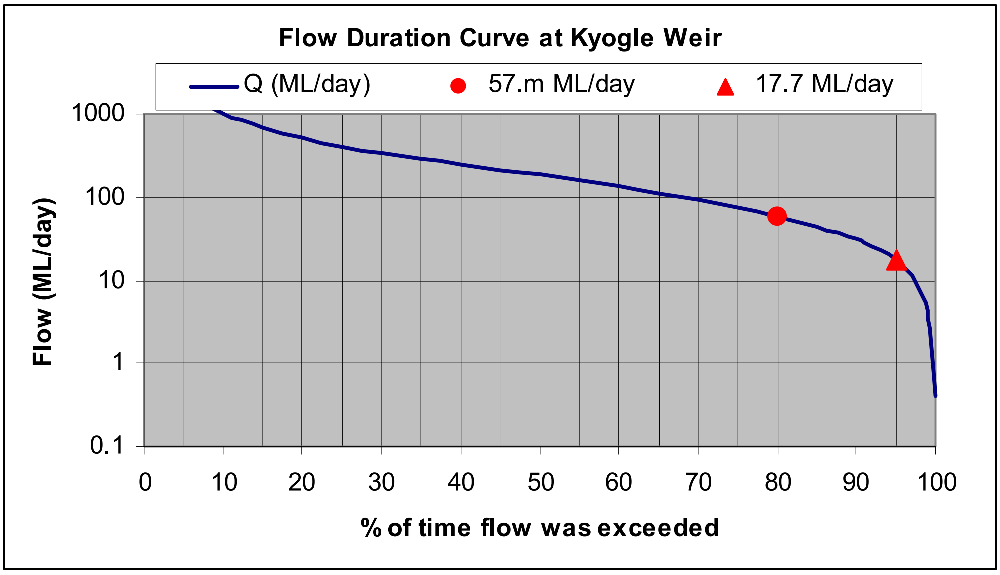

Figure 2, Flow duration curve for Richmond River at Kyogle

3.3 Characteristics of the off-stream reservoir

It is necessary to simulate the evaporation from the reservoir water surface in order to obtain realistic water balance analysis results. The area of the off-stream reservoir was estimated assuming a prismatic storage with a constant area and a maximum depth of 3.5m. The lake evaporation was assumed to be 70% of the pan evaporation. The net evaporation (evaporation-rainfall) was used to simulate the gains and the losses from the reservoir.

4 Models

4.1 Synthetic Data Generation Model WATSTRE

A multi-site synthetic data generation model "WATSTRE" (part of WATHNET package) was fitted to the historical streamflow and climate data. The model generates annual totals which are disaggregated into daily values using the method of fragments. In a case of missing data, the model fills in the annual values and then assigns the fragments from the key site.

In a case of Kyogle project, rainfall records were used as a key site, and missing evaporation data was produced using the rainfall fragments. This resulted in erroneous daily demands. The problem was overcome by amending the software package to use fragments from the data set without missing data. This feature became a part of WATSRE model. Following the correction of the software, 1000 sequences of 50 years long daily values of Richmond River streamflows at Kyogle weir, daily rainfall, maximum daily temperature and daily evaporation were generated.

The generated sequences have similar statistical properties to historical data. Each synthetic sequence (replicate) has an equal chance of occurrence. The synthetic data preserves the cross and auto correlation of annual values, while the daily values are generated using the method of fragments. The average of the generated sequences is given in Table 2, while the comparison of historical and generated overlapping low flow sequences is shown on Figure 3.

Table 2 - Average of Replicate Annual Data Statistics (1,000 replicates, 50 years)

Site Name	Hist.	Mean	Std Dev	Skew	Lag-1	Min	Max
Kyogle Rain (mm/a)	1174	1170	321	0.467	0.08	254	3108
MaxT = sum annual/365	25.7	26	203	0.053	0.214	8488	10298
Evaporation (mm/a)	1648	1647	135	-0.09	0.428	1053	2183
Streamflows (GL/a)	231	230	150	1.213	0.179	0.98	1924

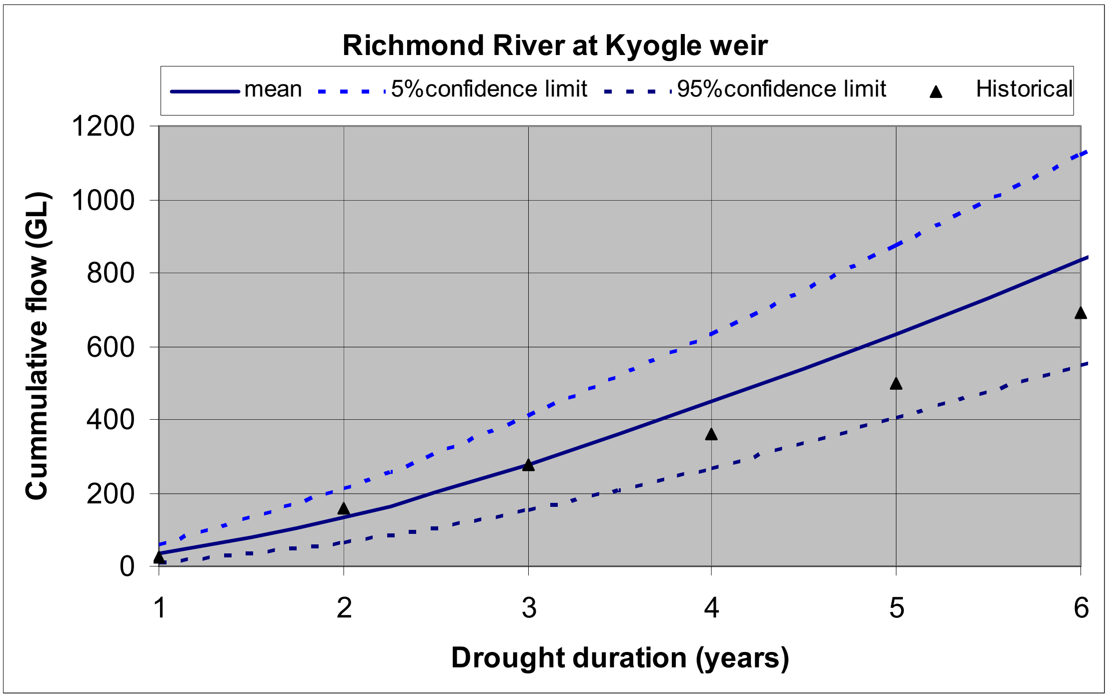

Figure 3, comparison of historical and generated overlapping low flow sequences

4.2 Demand Models

Two types of demand models were used. The first demand model simulates the internal and external daily water consumption for each household and then aggregates the demands into total daily demand. The second model calculates the total demand as specified by the DSS and disaggregates it into daily demand using the water tracking model parameter values. The description of the two models is given below.

4.2.1 Probabilistic behaviour, distributed demand model

The Kyogle probabilistic behaviour, distributed demand model was established using the demographic data, the water tracking demand model and the Decision Support System supplied by MWH. The model was calibrated to fit the historical demand records as shown on Figure 4.

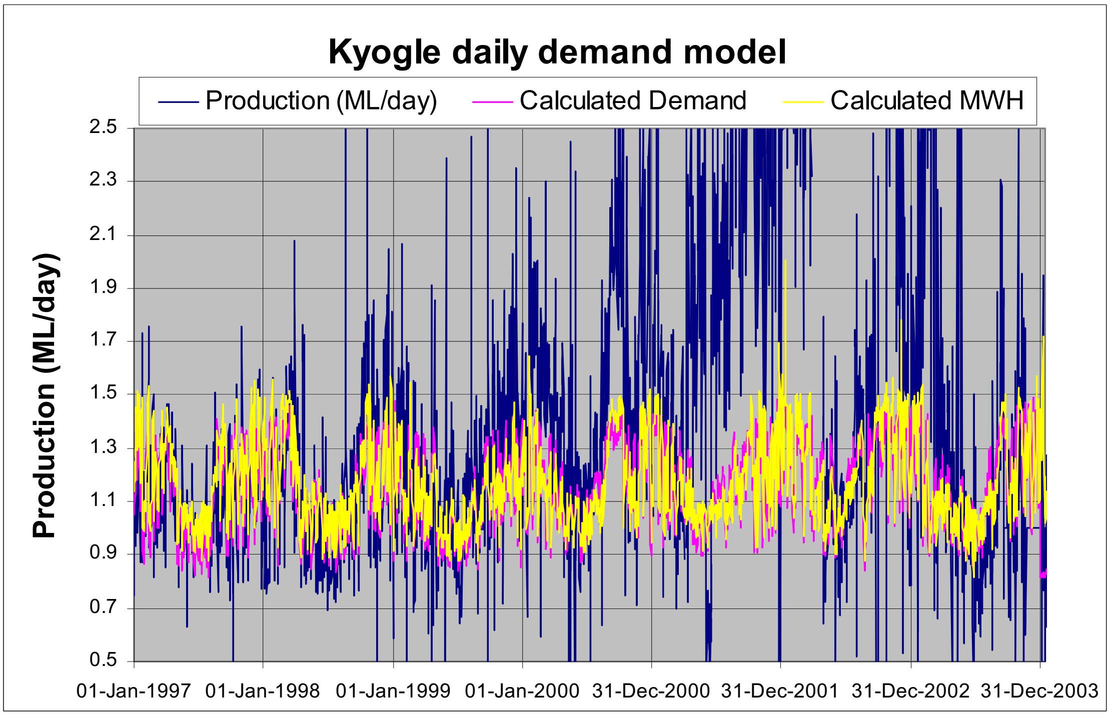

Figure 4 Kyogle daily demand model

It can be seen from the visual observation of the calculated and measured time series that the demand model does not represent the recorded production data well, however it does represent the fluctuations and the overall trends, and it also follows the demand time series estimated by the water tracking model well.

The aim of the demand model is also to represent the consumption by various account categories. 11 account categories were used and the ability of the demand model to emulate the consumption by each account category is presented in Table 3.

Table 3 Comparison of average daily consumption by account categories

Category	Average Daily Demand	% of total demand as calculated by	% of total demand as calculated	Average annual demand as calculated by the	Average Annual demand as calculated

	(KL/day)	the demand model	by DSS for year 2005	demand model (ML/a)	by the DSS for year 2005 (ML/a)
Residential	703	60	60	257	256
Commercial	185	16	16	68	68
Industrial	27	2.3	2.7	9.8	11
Institutional	26	2.3	2.2	9.6	9
Rural	151	13	13	55	56
Open Space	11	0.94	0.9	4	4
Un-metered	58	5	5	21	21
un-accounted				424	425

The model integrates the water tracking model with the DSS, and to a degree repeats the calculations provided in the DSS. It was decided that this model should be used to complement the DSS in estimating the impact of rainwater tanks on demand reduction only. The residential account category was used to estimate the impact of rainwater tank on demand. The main parameter values are given in Table 4.

Table 4, Probabilistic behaviour demand model parameter values

Parameter	value
Distribution of occupancy rate	Log-normal
Transformed average occupancy rate	0.426
Average roof area (m2)	290
St Dev of roof area	55
Average yard area (m2)	700
St Dev of yard area	350
Average period of occupancy change (years)	7
St Dev of occupancy change	0.7
Occupancy auto-correlation coefficient	0.7
St Dev of transformed occupancy	0.13
Coefficient of variation of the indoor demand	0.5
Coefficient of variation of the outdoor demand	0.6
Total number of houses	1143
Single application outdoor demand (litres/m2/day)	1.0
Indoor demand which can be supplied from rainwater tank for old fixtures (l/day/person)	61.4
Indoor demand which can be supplied from rainwater tank for new fixtures (l/day/person)	48.35
Indoor demand which can not be supplied from rainwater tank for old fixtures (l/day/person)	115.6
Indoor demand which can not be supplied from rainwater tank for old fixtures (l/day/person)	93.65
% of household with new fixtures	87

The demand model was run for various average RWT sizes from 1 KL to 20 KL and the results are shown on Figure 5.

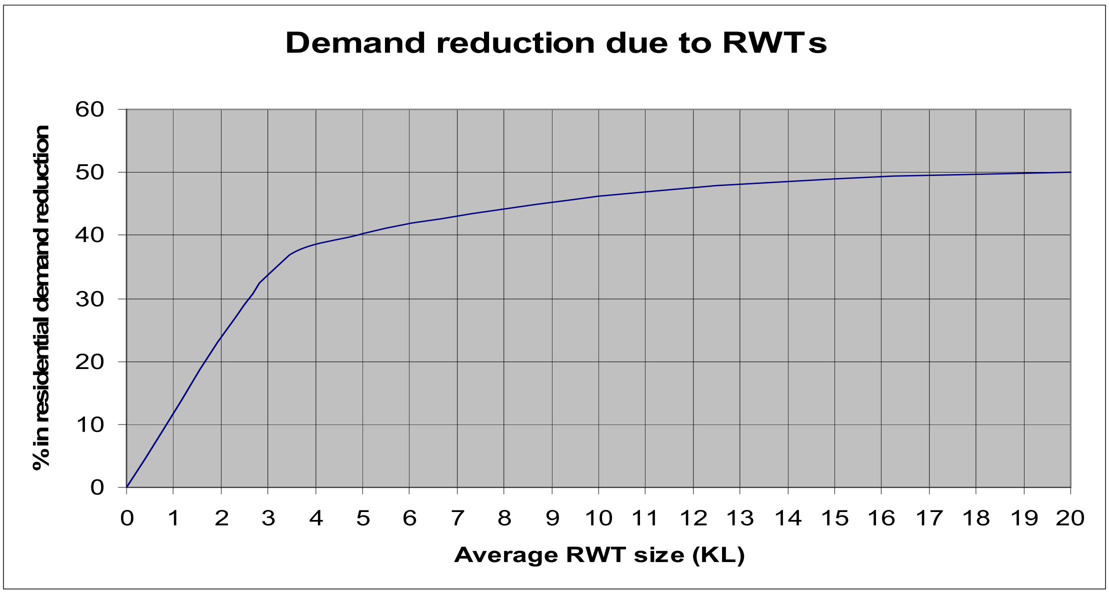

Figure 5, Demand reduction as a function of rainwater tank size (note that toilets and 70% of laundry are supplied from the tank)

The break point is for an average tank size of 3.5 KL, however a 5 KL tank was adopted for comparison of scenarios. The 3.5 and 5 KL tanks are similar in size and a 5 KL tank would have 1.9 m diameter and would be 2.3 m high. The tanks would be filled by a charged system with sealed downpipes to allow harvesting of the entire roof areas. A 5 KL tank would result in some 40% reduction in potable water use. The 40% demand reduction was fed back into DSS.

The impact of rainwater tank size on peak day demand was also investigated. The results indicated that a reasonably sized rainwater tank would not have an impact on peak day demand because peak day demands are associated with longer periods without rainfall, when the rainwater tanks are usually empty.

4.2.2 Simplified demand model emulating the DSS and the water tracking model

It was very difficult and time consuming to use the probabilistic demand behaviour model for assessment of various demand management scenarios. It was decided to develop a simplified version of the demand model which maps the annual demand from the DSS into daily demand using the water tracking model as an index for the external consumption. The produced daily demand follows the climate fluctuations, producing higher demand during drier periods and vice versa, lower demands during wetter periods. The demand is also correlated with streamflows, as these are closely correlated with the rainfall, resulting in higher demands during low flows and vice versa lower demands during higher flows.

A total of five demand management scenarios were analysed in the DSS and these are repeated in Table 5 for consistency.

Table 5, Demand management scenarios from the DSS

Scenario	Description
Base Case	Traditional approach based on current BASIX , off-stream storage and new WTP
1	Target new developments, incorporating BCP0, some minor grey water reuse, mandatory tanks on all new development, improved comm. education, leakage reduction audits and metering, self sufficient new rural
2	Retrofit existing development, incorporating BCP1, some minor dry weather flow re-use, grey water on new green field developments, retrofit rebate tanks, fixture retrofit and rebate and inclined block tariff
3	Targeted recycled water, some limited re-use, grey water retrofit
4	Full recycled water and conservation measures as for BCP1

1000, 51 years long, daily demands were generated for each scenario, using the synthetic climate data. The mean annual values of the generated demands are given in Table 6 for each demand management scenario. The last two columns are the average annual sewer flows generated by the sewer water tracking model.

Table 6, average annual synthetic demand forecast (ML/year)

Year	Scenario								
	Base Case	1	2	3	3_recycl.	4	4_recycl.	3_waste	4_waste
2005	4601	4600	4601	4601	0	4601	0	3482	3485
2006	4608	4529	4528	4521	6	4530	11	3171	3213
2007	4611	4410	4249	4148	119	3804	341	3073	3204
2008	4616	4408	4189	3999	226	3303	671	3030	3193
2009	4622	4408	4134	3942	230	2809	1004	2996	3186
2010	4628	4416	4105	3910	235	2818	1019	2966	3164
2011	4631	4412	4103	3905	238	2821	1029	2991	3188
2012	4638	4413	4105	3903	242	2825	1039	2973	3168
2013	4647	4415	4109	3903	246	2830	1050	2971	3163
2014	4663	4424	4117	3907	251	2837	1064	2955	3145
2015	4671	4426	4119	3906	254	2842	1071	2962	3150
2016	4681	4429	4124	3906	258	2849	1081	3001	3191
2017	4699	4440	4133	3913	262	2857	1093	2979	3166
2018	4710	4447	4140	3917	265	2867	1101	2963	3150
2019	4720	4453	4147	3921	268	2876	1107	2981	3167
2020	4732	4461	4156	3926	271	2887	1114	2981	3167
2021	4758	4482	4174	3941	276	2901	1129	2981	3168
2022	4768	4488	4181	3945	279	2911	1133	2987	3173
2023	4785	4499	4192	3953	282	2924	1141	3013	3202
2024	4804	4515	4207	3965	286	2938	1151	3000	3186
2025	4810	4516	4210	3966	287	2948	1150	3027	3214
2026	4830	4533	4226	3979	291	2962	1160	3039	3228

Year	Scenario								
	Base Case	1	2	3	3_recycl.	4	4_recycl.	3_waste	4_waste
2027	4855	4553	4244	3993	295	2978	1172	3032	3217
2028	4867	4561	4253	4000	298	2990	1175	3054	3242
2029	4885	4573	4266	4009	301	3004	1180	3063	3250
2030	4907	4591	4282	4024	304	3019	1190	3064	3249
2031	4920	4601	4292	4030	307	3033	1192	3093	3281
2032	4943	4618	4309	4045	310	3048	1201	3083	3270
2033	4959	4631	4321	4054	313	3063	1205	3100	3287
2034	4971	4640	4332	4062	316	3077	1206	3116	3306
2035	5000	4662	4352	4079	320	3094	1218	3122	3309

4.3 Water Balance model

WATHNET, a generic water balance model developed by Dr. George Kuzcera from University of Newcastle was used to simulate the behaviour of the water supply system.

The system's schematic for the Base case and scenarios 1 and 2 is shown on Figure 6, and for scenarios 3 and 4 on Figure 7. The description, the capacities and the relevant comments of the model components are given in Table 7.

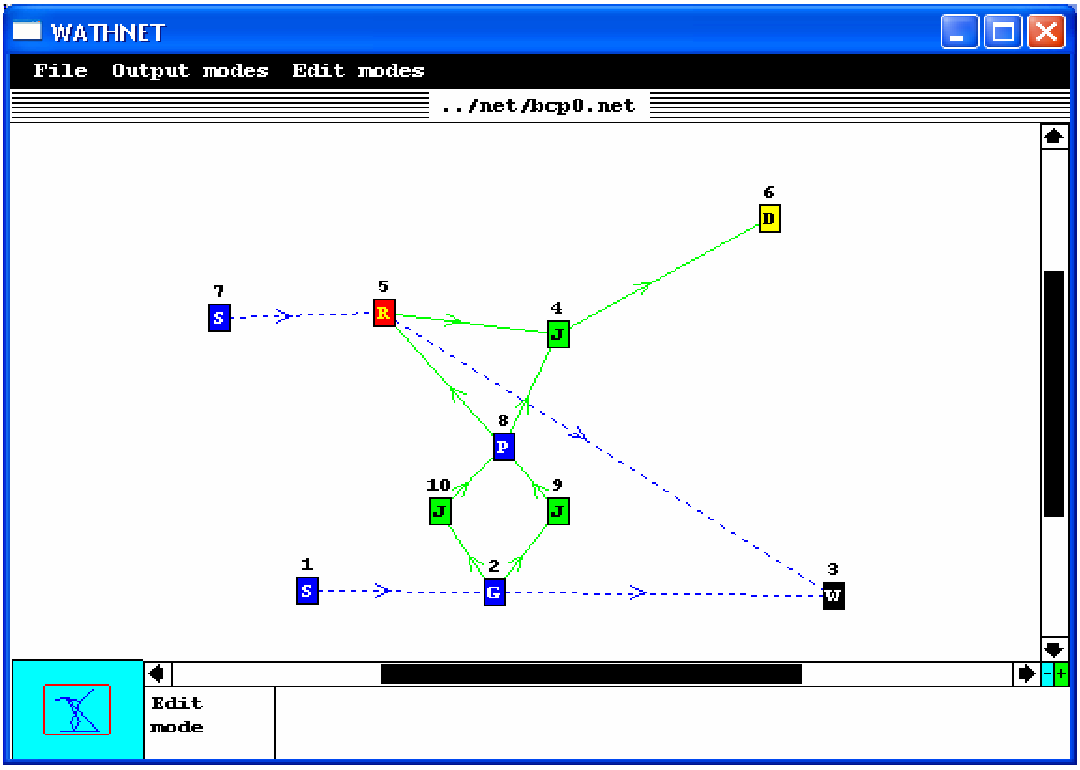

Figure 8, WATHNET network of Kyogle Water Supply System for Base Case and Scenarios 1 and 2

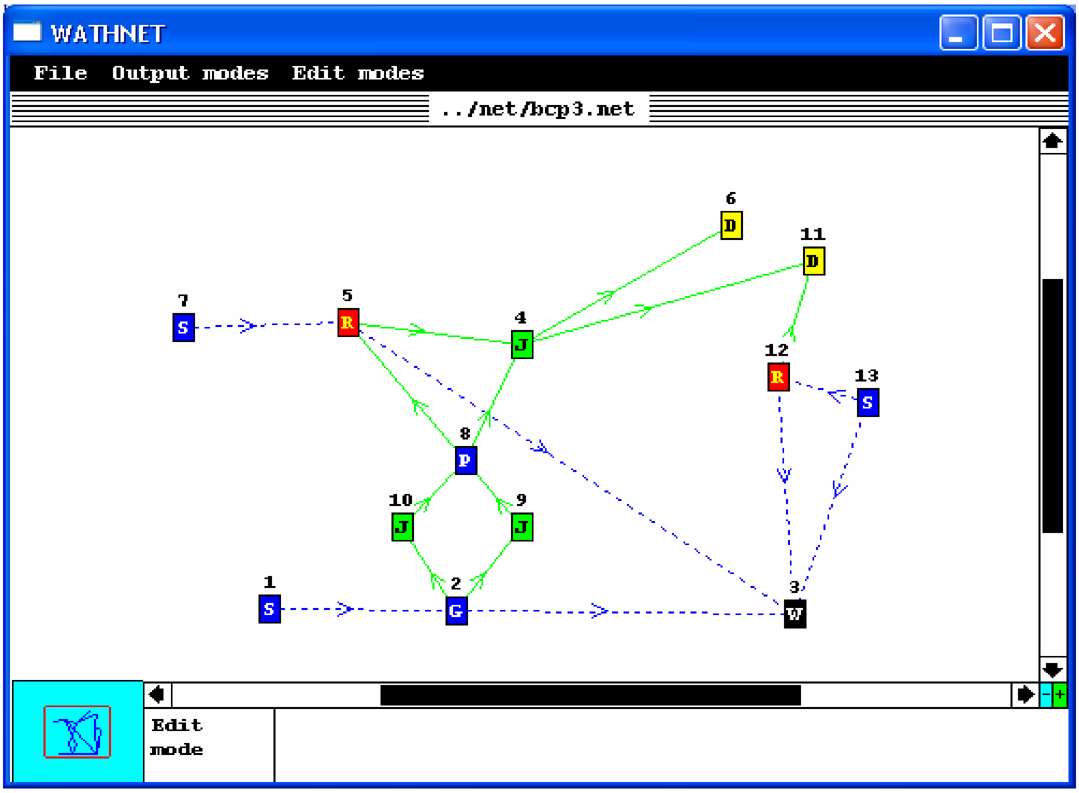

Figure 9, System's schematic for scenarios 3 and 4

Table 7 Kyogle water supply system represented by WATHNET network

Nodes & links	Description	Capacity	Comment
1, 2, 3	Richmond River	NA	Un-regulated River, with streamflows modelled by IQQM
2, 9, 8	River off-take with 85%ile and 95%ile flow controls	68 l/s	No limits on extraction when the flow is > 80%-ile flow + 68 l/s; 0 to 68 l/s when the flow is between 80%-ile and 80%-ile + 68 l/s.
2, 10, 8	River offtake with 95%-ile flow control	68 l/s	0 to 68 l/s when the off-stream storage=<50% and the streamflows are between 95%ile flow and 95%-ile flow + 68 l/s
5	Off-stream storage	variable	The storage volume is varied until the desirable outcome is achieved
4, 6	Supply to Kyogle	68 l/s	
6	Kyogle demand		
11	Recycled water Dem.		
12	Re-cycled water storage	variable	The storage is varied until the desired outcome is achieved
13	STP		Inflows simulated using the sewer water tracking model and the DSS
4, 11	Back up for recycled water demand	0	Not used

5 Water Balance Modelling Results

The existing situation was simulated using demand for the base case, with no restrictions on water extraction and with a small reservoir of 10 ML. The resulting frequency of annual restrictions is approximately 3% , hence the annual reliability is 100-3=97% (Figure 10). However, the probability of running out of water is relatively high or 0.1% in any one day, which is not acceptable. In other words, the annual reliability of the existing system is high, but the probability to run out of water is too high and is not acceptable.

Further more, with introduction of environmental flow requirements, the reliability of the system would fall dramatically, with prolonged periods without any supply.

An additional source of water is therefore required even if there is no imposition of environmental flow regime.

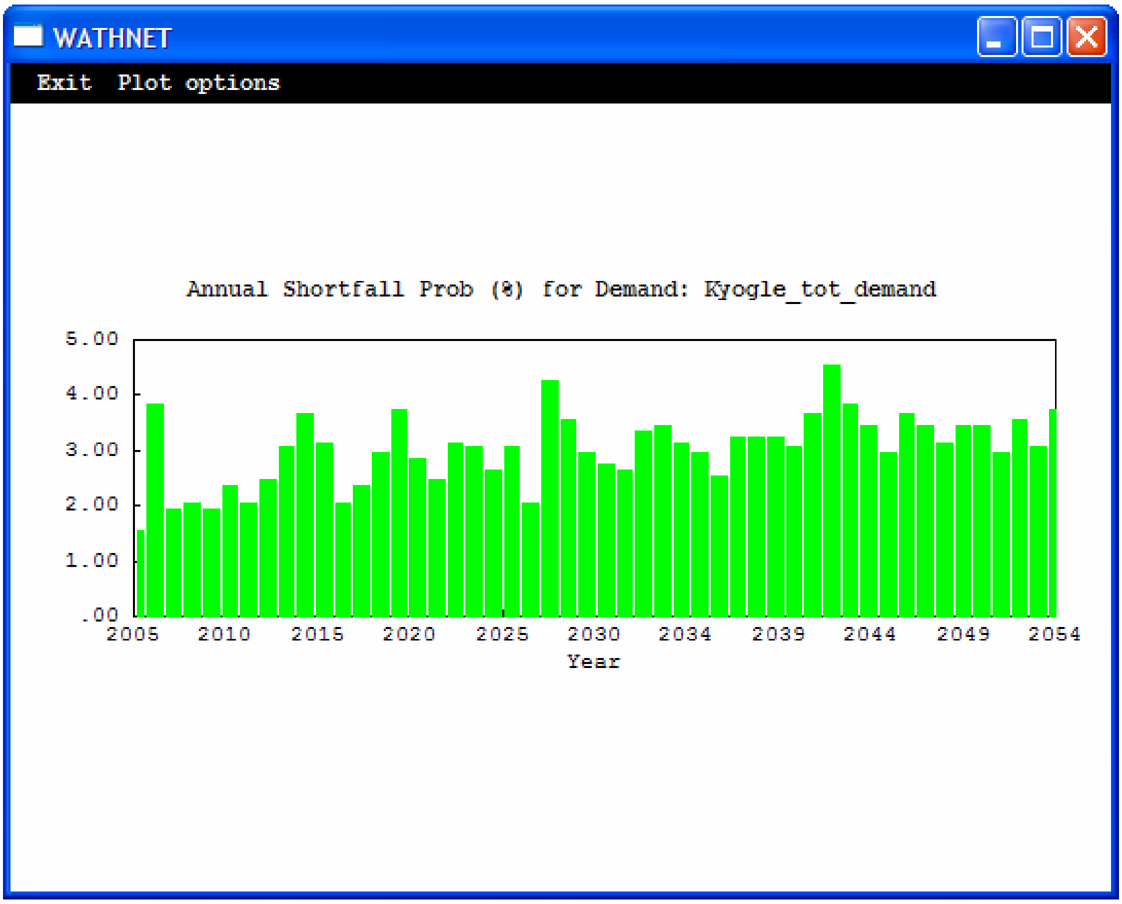

Figure 10, Annual Frequency of Restrictions for existing conditions

An off-stream storage was identified as a possible additional source of water. The size of the storage was determined by trial and error using the synthetic streamflows and the corresponding demand forecasts.

The water balance model, described above, was used in conjunction with 1000, 50 years long synthetic replicates of streamflows, evaporation and maximum daily temperatures and the corresponding synthetic demands to assess the reliability of Kyogle water supply.

The following operating rules were adopted:

- 20% demand restrictions when storage hits 50%;
- 30% demand restrictions when storage hits 25% and
- 50% demand restrictions when storage hits 12 %.

A total of five demand management scenarios were investigated. The required storage sizes were determined by trial and error using the following criteria:

- The annual reliability of 95% was adopted as a criterion for storage selection;
- A criterion reflecting the security of supply was introduced to ensure that the system will not run out of water. The probability to hit 5% storage in any day should not exceed 0.005%.

The summary of WATHNET results is given in Table 8

Table 7, required storage sizes

Scenario	Storage (ML)	Freq. of annual restrict. (%)	# of times storage less than St<5%	Probability Storage < 5% (%)	Storage required (ML)
Base Case	500	7.1	500	0.0044	570
	600	4.2	326	0.0029	
	700	2.5	262	0.0023	
1	400	11.4	666	0.0059	510
	500	5.5	401	0.0035	
	600	3.1	271	0.0024	
2	400	8.4	493	0.0044	485
	500	4.5	322	0.0028	
	600	2.5	229	0.0020	
3	300	13.5	738	0.0065	445
	400	6.8	413	0.0036	
	500	3.5	260	0.0023	
4	300	4.9	323	0.0028	295
	400	2.2	162	0.0014	
	500	0.6	50	0.0004	

The plots of annual restrictions for selected storages are shown on Figures 11, 12, 13, 14 and 15 for the base case, scenario 1, 2 ,3 and 4, respectively.

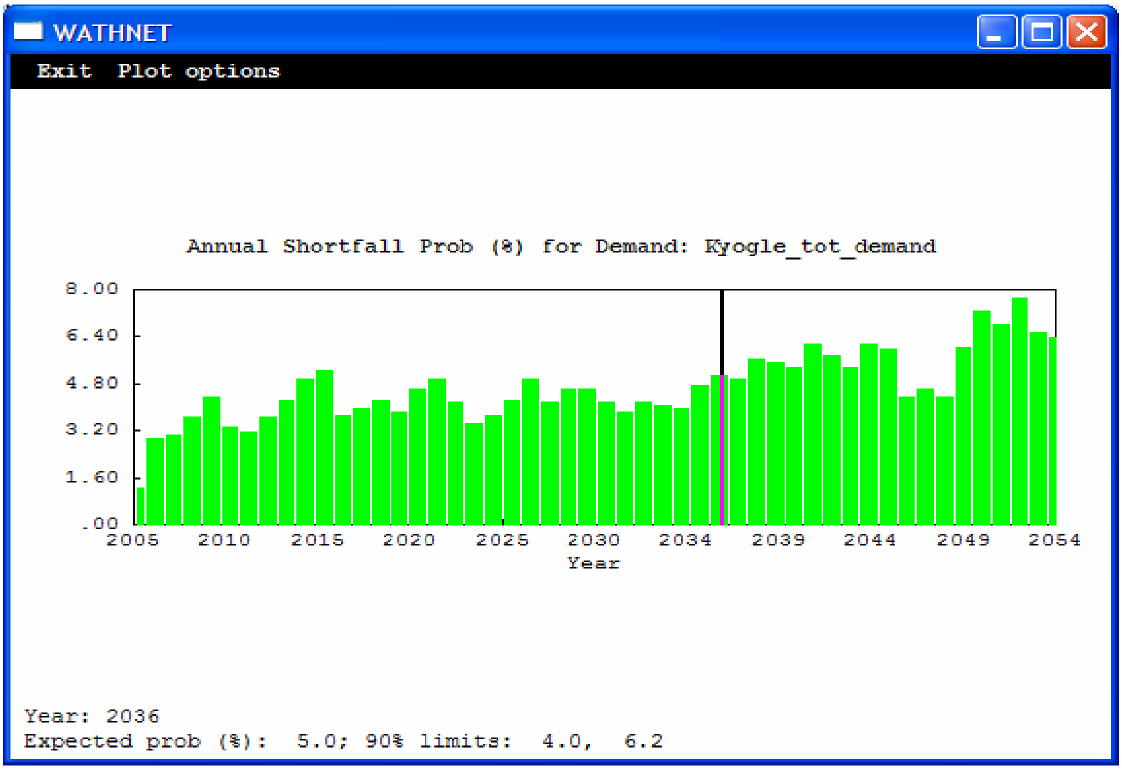

Figure 11, Annual Shortfall Probability for base case Scenario and for Storage Volume = 570 ML

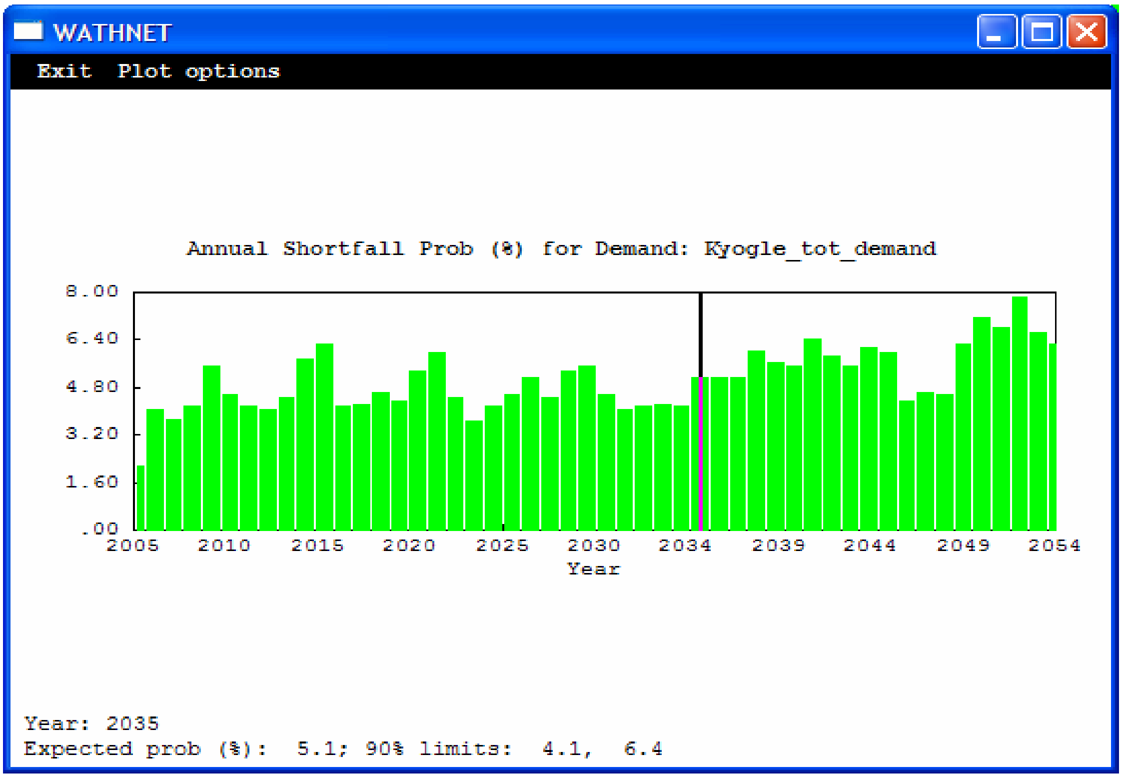

Figure 12, Annual Shortfall Probability for Scenario 1 and Storage Volume = 510 ML

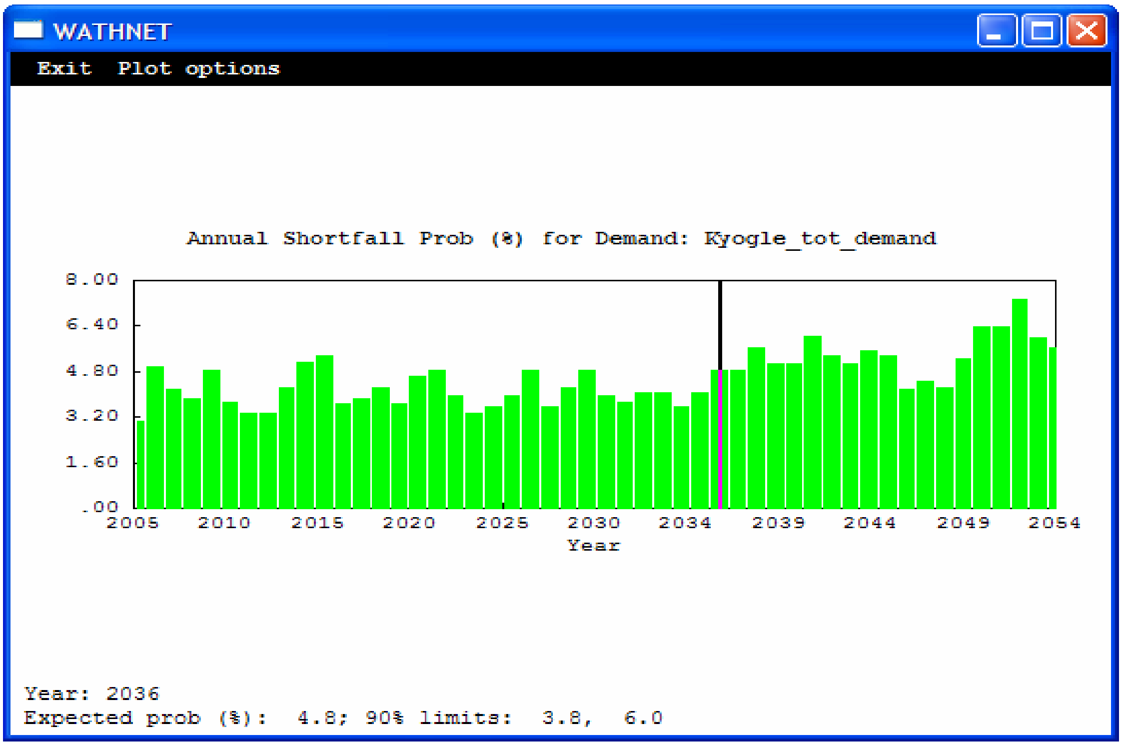

Figure 13, Annual Shortfall Probability for Scenario 2 and Storage Volume = 485 ML

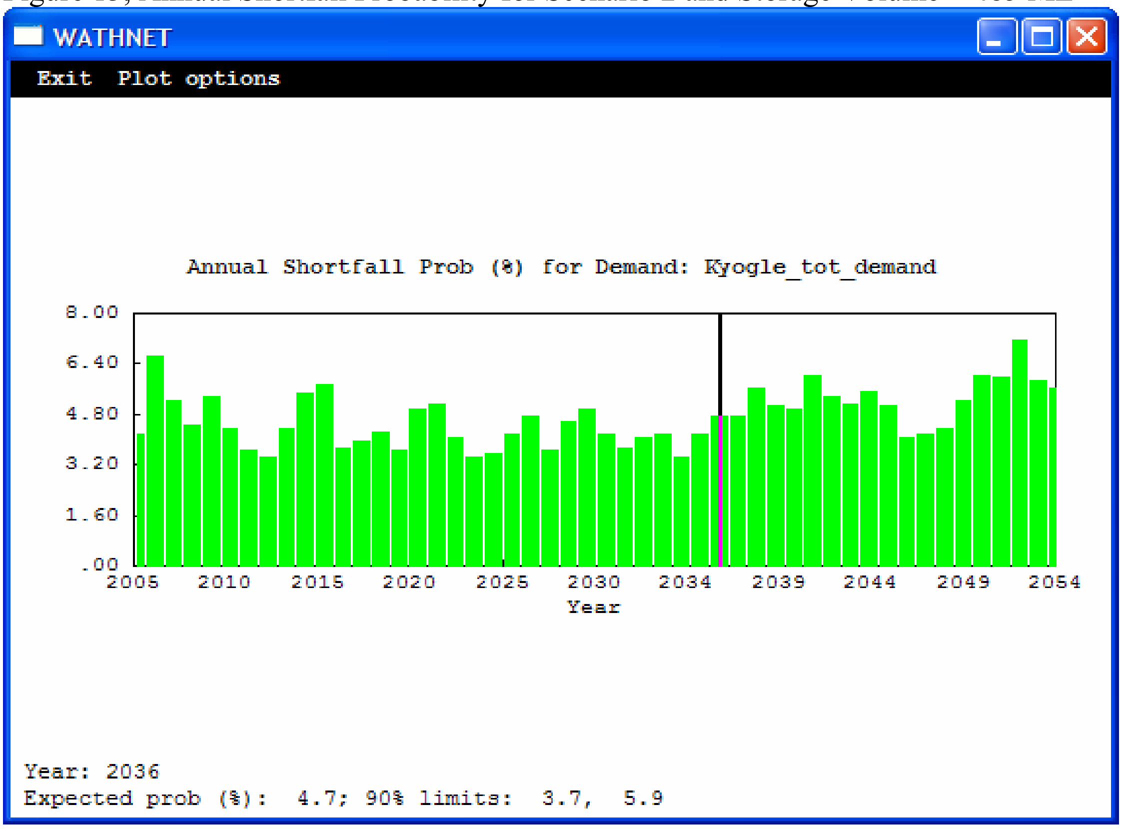

Figure 14, Annual Shortfall Probability for Scenario 3 and Storage Volume = 445 ML

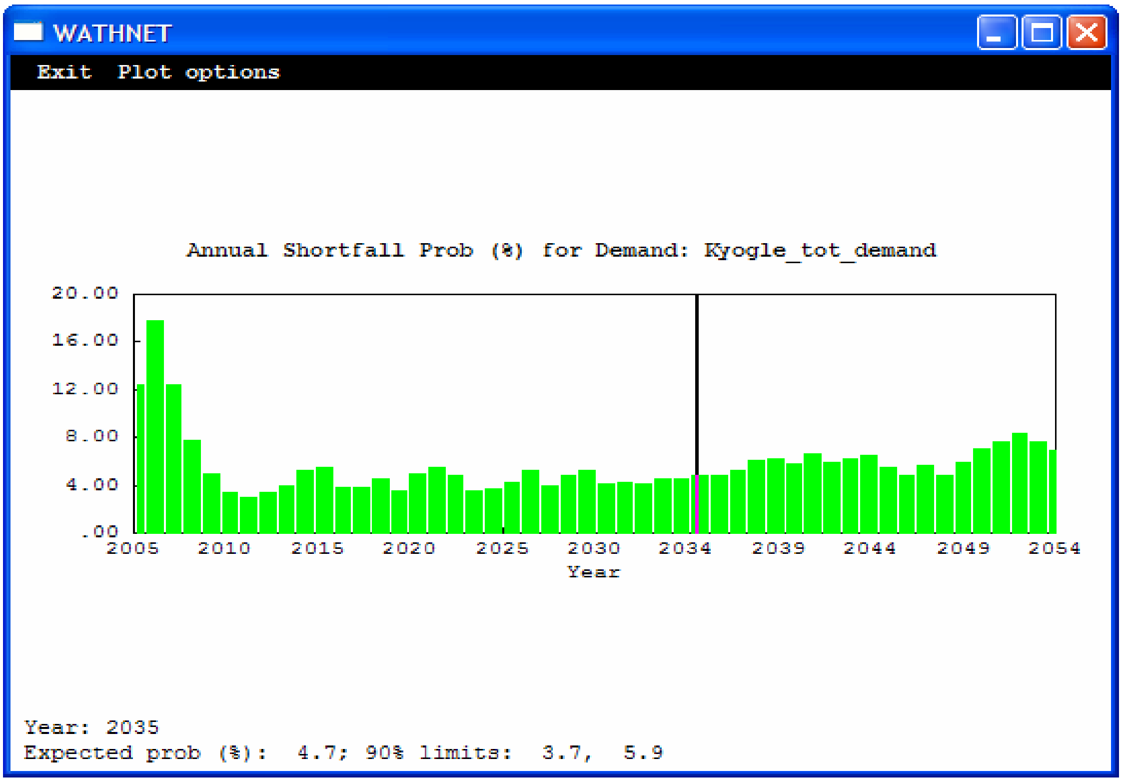

Figure 15, Annual Shortfall Probability for Scenario 4 and Storage Volume = 295 ML

It should be noted that annual restrictions for scenarios 3 and 4 are initially higher than the adopted criterion because of the time required to impose the demand management measures.

The size of the storage for recycled water for scenario 3 is nominal, as the quantity of the treated effluent generally exceeds the demand for recycled water. The size of the recycled storage for scenario 4 was estimated as 30 ML, to maintain the same annual reliability as for the potable supply. The annual frequency of restrictions for the recycled water demand for scenario 4 is shown on Figure 16.

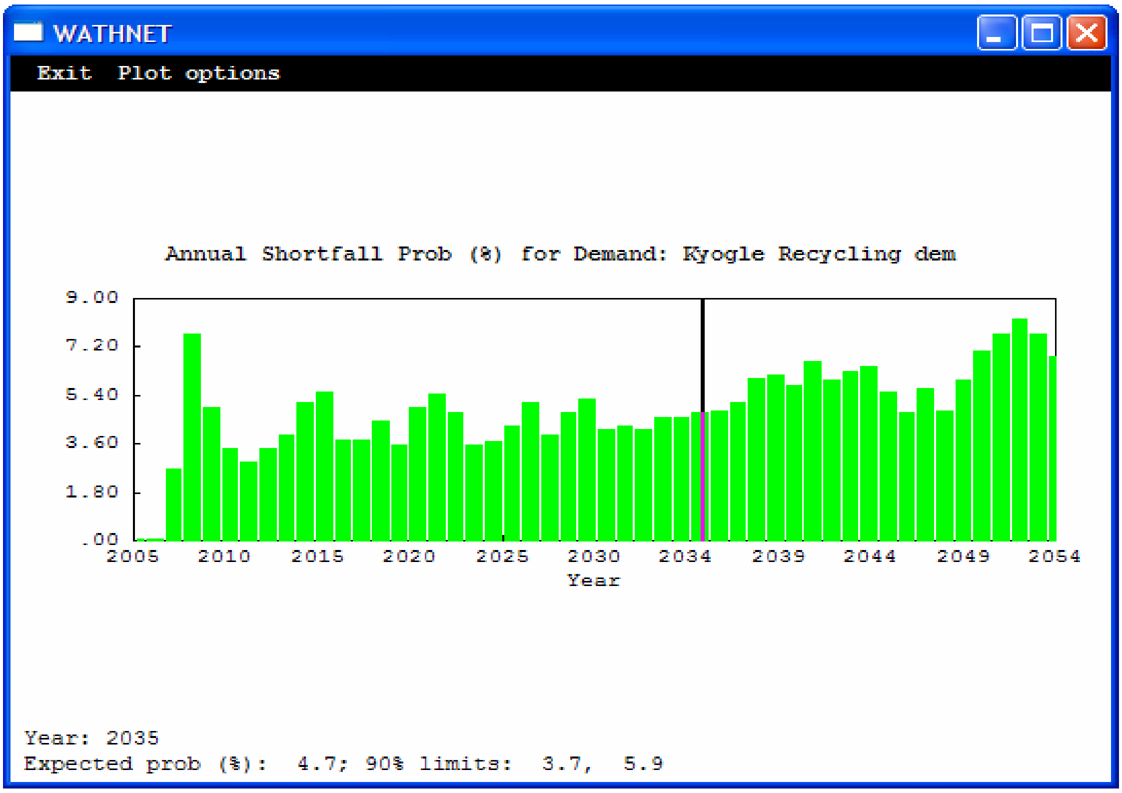

Figure 16, Annual Shortfall Probability for Scenario 4 and Recycled Storage Volume = 30 ML

6 Sensitivity analysis for Scenario 2

Two storage volume sensitivity cases have been tested:

1. The required storage size for a water supply system with 75% annual reliability, while maintaining the 80%-ile and 95%-le rules is 230 ML. The frequency of hitting 5% storage or lower would be 0.03 % in any one day, which is higher than the security criterion.
2. The draft water sharing plan identified 15 ML/day as a 95%-ile flow when extractions for Kyogle water supply should cease. In addition the water sharing plan requires no pumping for 24 hours if the gauge at Kyogle reads above the 80%-ile flow after reading flow below 95%-ile the previous day. The network layout is shown on Figure 17. The previous day flow counter was simulated as a shadow network, storing water in reservoir 10 when the flow at Kyogle weir is equal or less than 95%-ile. The model would then release water through arc 10 to 3 only if the previous day flow was below 95%-ile and the current day flow is more than 80%-ile. The capacity of arc 2 to 8 is set to zero when the flow in arc 10 to 3 is not zero, otherwise the capacity is unlimited. The capacity of arc 8 to 7 describes the 95%-ile extraction rule. These rules were simulated for 3 storages of 200, 300 and 400 ML. The run with the storage of 200 ML produced the desired outcome of 95% annual reliability. The corresponding plot is shown on Figure 18. The probability to hit the storage of 5% or lower is 0.0045%, which is below the adopted security criterion.

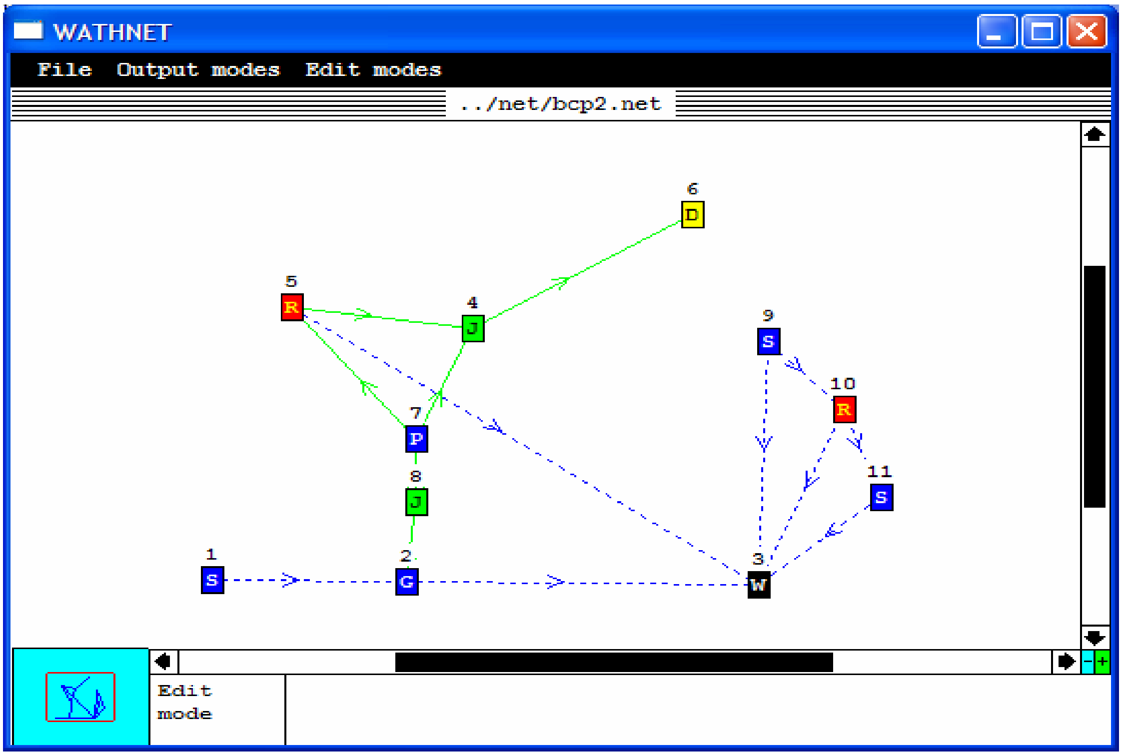

Figure 17, WATHNET network representing the water sharing plan rules for Kyogle

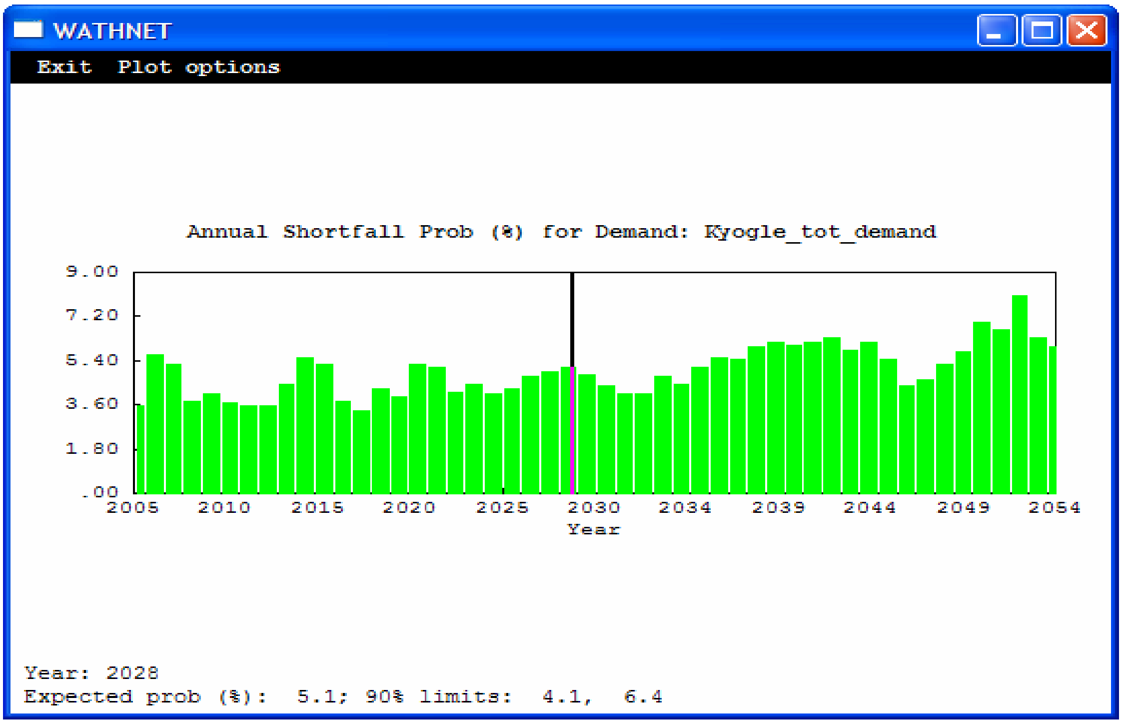

Figure 18, Annual Shortfall Probability Scenario 2 and Storage Volume = 200 ML and extraction rules as per water sharing plan

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1. NSW Department of Public Works and Services (DPWS), 1999, *Kyogle Water Supply Augmentation Strategy Report*.

Appendix H – Review of Groundwater Resources

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Review of Groundwater Resources - Kyogle Area

MWH Australia Pty Ltd
December 2005

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Review of Groundwater Resources – Kyogle Area

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CHRIS JEWELL
Auditor

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1.0 INTRODUCTION

1.1 Background

MWH Australia Pty Ltd (MWH) has been engaged to carry out an integrated water cycle management study for the area around Kyogle in North-Eastern New South Wales. As part of this study, MWH has commissioned C. M. Jewell & Associates Pty Ltd (CMJA) to undertake a desk review of groundwater resources in the area. The report has been prepared in accordance with the proposal A01506, of 12 August 2005.

1.2 Project Objectives

The objectives of this study are to provide an overview of the hydrogeology of the area around Kyogle, and an assessment of the availability of groundwater resources to supplement water supplies for the town.

1.3 Scope of Work

The scope of work for this project has included a desktop review of data available in the public domain, including spatial data from the NSW Department of Natural Resources, and Geoscience Australia.

1.4 Report Format

Section 2 very briefly describes the location and physiographic setting of the study area, to the extent necessary to place later sections of this report in the appropriate context. It is understood that these matters will be described and discussed in more detail by others. Section 3 summarises the geology of the area, and Section 4 describes the hydrogeology in some detail. Conclusions are provided in Section 5.

Appendix A (on CD) contains borehole records, and Appendix B some supplementary information.

1.5 Limitations and Intellectual Property Matters

This report has been prepared by C. M. Jewell & Associates Pty Limited for the use of the client identified in Section 1.1, for the specific purpose described in that section. The project objectives and scope of work outlined in Sections 1.2 and 1.3 were developed for that purpose, taking into consideration any client requirements and budgetary constraints set out in the proposal referenced in Section 1.1.

The work has been carried out, and this report prepared, utilising the standards of skill and care normally expected of professional scientists practising in the fields of hydrogeology and contaminated land management in Australia. The level of confidence of the conclusions reached is governed, as in all such work, by the scope of the investigation carried out and by the availability and quality of existing data. Where limitations or uncertainties in conclusions are known, they are identified in this report. However, no liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been assessed or predicted using the adopted scope of investigation and the data derived from that investigation. An information sheet – ‘Important Information about your Environmental Site Assessment’ – is provided with this report. The report should be read in conjunction with that information sheet.

Where data collected by others have been used to support the conclusions of this report, those data have been subjected to reasonable scrutiny but have essentially, and necessarily, been used in good faith. Liability cannot be accepted for errors in data collected by others.

This report, the original data contained in the report, and its findings and conclusions remain the intellectual property of C. M. Jewell & Associates Pty Ltd. A licence to use the report for the specific purpose identified in Section 1.1 is granted to the persons identified in that section on the condition of receipt of full payment for the services involved in the preparation of the report.

This report should not be used by other persons or for other purposes than those identified in Section 1.1, and should not be reproduced except in full and with the permission of C. M. Jewell & Associates Pty Ltd.

2.0 SITE SETTING AND PHYSIOGRAPHY

2.1 Site Identification

The study covers Kyogle local government area, including the valley of the Richmond River north and south of Kyogle, and the bedrock areas to the east and west of the town, as shown on Figure 1.

2.2 Topography and Drainage

As shown on Figure 1, the topographic setting of the study area is a rolling plateau dissected by the Richmond River and its tributaries.

The Richmond River has its headwaters in the border ranges 22 kilometres north of Kyogle. It has a catchment area upstream of Kyogle of 886 square kilometers and a mean annual discharge of 508,000 megalitres.

2.3 Climate

The upper Richmond River Catchment receives predominantly summer rainfall, although significant falls can occur in winter. Average annual rainfall ranges from 1197 millimetres at Kyogle to over 2000 millimetres in the upper catchment.

Evaporation across the basin is of the order of 1900 millimetres per year.

3.0 GEOLOGY

3.1 Regional Geology and History

The geological sequence in north-east NSW is made up of a complex melange of tectonic blocks and sedimentary basins which form the hinterland and western slopes of the Great Dividing Range in the area. The tectonic blocks are dominated by a series of fore-arc basin deposits, granitoid intrusions and sedimentary sequences, which during the mid to late Tertiary period were superseded by a series of volcanic eruptions. These eruptions formed part of the extensive series of basaltic and associated extrusive rock types that belong to the larger eastern Australian intra-plate volcanic belt, which stretches 4400 kilometres from the Torres Strait, along the eastern highlands of Australia, and into Tasmania. Today, the dissected remains of the flood basalts dominate the topography around Kyogle, as shown on Figure 2.

The following description has been modified from Graham (2004).

The Tertiary eruptions, in this area centered on Mt Warning, poured lava on to an ancient land surface on the eastern edge of the Clarence Moreton Basin - a long trough with a north south axis extending from north of Brisbane to south of Grafton. This trough contains metamorphic and sedimentary rocks. The oldest layers of rocks are the greywackes and phyllites of the Brisbane Metamorphic Series, which are approximately 250 to 500 million years old. A thin band of volcanic rocks known as the Chillingham volcanics - highly weathered tuffs and rhyolites approximately 200 million years old - separates the Brisbane Metamorphic Series from overlying sedimentary rocks that were laid down in the basin approximately 135 to 200 million years ago. These rocks include the Bundamba Group, Walloon coal measures and Kangaroo Creek sandstones comprising claystones, sandstones, and narrow coal seams.

The major Tertiary volcanic eruptions began approximately 23 million years ago, and over a period of about 3 million years Mt Warning built up into a large and complex central volcano. The volcano was created by many separate eruptions, punctuated by long periods of inactivity. Three major phases of eruption have been identified, an initial extrusion of basalt, followed by a more explosive phase where acid material, mainly rhyolites, were thrown out, and a final quieter extrusion of basalt. Most of the volcanic material was extruded from a central vent located at Mt Warning, but several subsidiary vents also poured out lava at various times.

The first group of lavas are identified as the Lismore basalts. This series of lava flows travelled a considerable distance and covered a large area, extending from Lismore in the south to Beechmont in the north. The east–west spread of the lava was not as great, as it flowed more easily along than across the basin, but the Lismore basalts are present in the Tweed Heads and Kyogle districts.

Many separate flows occurred and the long intervals between the flows allowed the development of a weathered soil profile. Evidence of the separate flows can be distinctly seen in the terraced landforms resulting from the erosion of these soil profiles.

The volcano then became more violent and acid rocks were extruded, sometimes explosively, from the vents. Rhyolites, volcanic 'glass', agglomerates and tuffs were included in this group. The rhyolites are particularly resistant to erosion in this environment and can be seen as the cliffs on the high plateaus forming the western half of the caldera rim. Deep gorges have been worn in the rhyolites, particularly by the streams that flow into the Richmond Valley. Spectacular waterfalls can be found at the heads of these gorges where the streams plunge in the vicinity of 120 metres over the rhyolite cliffs.

The final phase of volcanic activity was a relatively quiet series of basaltic lava flows. The rocks extruded during this period of activity form a capping on the high plateaus of Springbrook, Lamington, the Tweed Range, and the Nightcap Range.

Over 20 million years have elapsed since the cessation of volcanic activity and erosion has considerably altered the shape of the huge dome-shaped shield formed by the volcano. In places, erosion has cut through the volcanic cover, exposing the older rocks of this basin.

At first streams drained downslope, outwards from the top of the shield in a radial pattern. These streams gradually eroded valleys and deepened them over time. The streams that drained directly into the rivers on the floor of the existing valleys in the Clarence Moreton Basin, the Richmond and Nerang Rivers, cut down more rapidly because of their steeper gradients. These large valleys now separate three plateaus bounded by rhyolite cliffs (Graham 2004).

3.2 Local Geology

As indicated in the previous section, the area around Kyogle is underlain by Tertiary-age basalts and other volcanic rocks, resting on an ancient eroded land-surface composed of sedimentary and metamorphic rocks. The valleys of the major rivers, including the Richmond River, have an infill of recent alluvial deposits. The distribution of the alluvium, basalts and basement rocks beneath the basalts can be seen on Figure 2.

In the vicinity of the study area, the basalts form an extensive series of lava plains resulting from the outpouring of several eruptions from Mount Warning and other localised volcanic vents during the Tertiary Period. The basalts, which generally radiate outwards from the now dissected volcanic centres, consist mostly of basalt and alkali rhyolite, with common occurrences of trachyte throughout the unit.

The basalts are pervasively dissected by past and present erosion, other mass-wasting processes such as sapping, and varying degrees of hydrothermal alteration. The remnant has variable depths of weathering.

A brief overview of the local geology is presented in Table 1.

TABLE 1
Summary of Local Geology

Age	Group and Subgroup	Description
Quaternary	Unit not named	Alluvial deposits: sands, silts, clays, gravels.
Erosional Unconformity		
Tertiary	Lamington Group	Basalt, rhyolite, trachyte, agglomerate
Angular Unconformity		
Jurassic - Cretaceous	Grafton Formation Woodenbong beds Walloon coal measures	sandstone, siltstone, mudstone sandstone, siltstone, conglomerate, shale, sandstone, siltstone, mudstone, coal.
Unconformity (type unknown but likely to be an angular unconformity)		
Triassic	Bundamba Group Chillingham volcanics	sandstone, siltstone, conglomerate, shale. rhyolite, tuff, shale
Angular Unconformity		
Devonian - Carboniferous -	Neranleigh-Ferndale Beds	Mudstone, shale, basic metavolcanics, chert, jasper and greywacke.

The lava flows have infilled old river valleys, and the basalt–basement contact is an erosional unconformity representing the palaeo-relief of the shale surface onto which lava flowed. This has resulted in a highly variable thickness of basalt being formed in the area, potentially resulting in the presence of laterally restricted groundwater bodies. This variability is evident through the depth of each particular basalt horizon and basalt-basement interface; information from local borehole records suggest that this depth varies between 10 and 60 metres.

Geological units in the area are thought to have undergone multiple deformation events and cooling-induced fracturing. Regional jointing and structural patterns would have been adopted into the overlying basalts, contributing to the fractured nature of the unit. It is thought that most of the fractures within the basalt would have alignments consistent with those of the major regional structural orientations.

3.3 Soils and Residual Products

Soil profiles developed on the Tertiary Basalts throughout eastern Australia typically include red krasnozems, structured loams, lithosols and chocolate soils. Soils are typically well developed with deep profiles. Generally, soil thickness varies from shallow profiles on topographic high points to moderate to deep profiles within localised depressions and topographic low points. Shallow profiles are commonly underlain by relatively unweathered basalt at depths of less than 2.5 metres, although basalt may be encountered locally at much greater depths, depending on the nature of the unit. Typical features of these soils include the following.

- Moderate to strong pedality and soil structure inherited from the underlying bedrock.
- Relatively uniform lithology, and only minor gradational texture changes with increased depth.

- Soils with shallow to deep profiles depending on geomorphic position within the landscape.
- Moderate to low organic content throughout the soil profile.
- Low porosity and poor soil drainage.
- Moderate available water-holding capacity and high moisture retention.
- Slightly weathered to fresh cobbles and corestones of country rock throughout the profile.

Generally, basalts are first weathered along joint planes and other discontinuities within the parent rock, producing spherical floaters of relatively fresh basalt. All of the minerals commonly present within basalt break down into relatively inert clays and iron oxide, with base elements released into solution. Given the lack of free quartz within basalt, the ultimate weathering product is often a reddish-brown, base-rich heavy soil.

The Kyogle area has deep structured red clay loams which are strongly acidic and have soft friable topsoil with good infiltration. Although the total nutrient status is usually high, levels of calcium, magnesium and potassium are often low. The soils are high in phosphorous but also have a high phosphorous fixing ability. Problems can occur where toxic levels of aluminium are released from the soil due to increasing acidity. Notwithstanding this, these soils are some of the most productive agricultural soils in the state. The degree of aggregation and their overall moderate permeability indicate that these soils have a low septic absorption potential and are not appropriate for on-site disposal of septic effluent.

4.0 HYDROGEOLOGY

4.1 Background

Potentially, the Richmond River alluvial deposits, the basalts and the older sedimentary rocks are all capable of providing groundwater. There are many bores and shallow wells in the area around Kyogle, and these obtain groundwater from all these lithological units. However, a review of the limited available data has indicated that only the basalts have significant potential for water supply.

As indicated in Figure 2, the Tertiary basalts in the Richmond River catchment are laterally extensive. They appear to share the characteristics of Tertiary basalts elsewhere in eastern Australia, in possessing significant interconnected secondary porosity in fractures and, particularly, in inter-flow and sub-flow horizons where there is extensive chill fracturing, weathering and sometimes soil development.

4.2 Potential Yields

On the basis of a review of the detailed records for 150 bores within 5 kilometres of Kyogle (Figure 3), it appears that at Kyogle (and probably all points upstream), the Richmond River alluvium is not thick or extensive enough to be exploited with boreholes, although it does probably act as a source of recharge for the underlying fractured rocks.

Almost all the existing local boreholes are completed in fractured hard rocks, mainly in basalts, but some in sandstone. Yields vary from 0.2 L/s to 8 L/s, with most under 1.5 L/s.

This makes it unlikely that the higher yields normally required for town water supply can be obtained from aquifers in the area, although there may still be potential for small-scale or multi-borehole abstractions for specific local uses, such as sports-field watering, as part of an integrated scheme.

4.3 Current Groundwater Use

The Kyogle Integrated Water Cycle Management Study report (2003) indicated that groundwater abstractions in 1995 were as listed in Table 2. Licenced groundwater abstraction points are shown on Figure 3.

TABLE 2
Groundwater Use in 1995

Aquifer Unit	Groundwater Use (GL/yr)
Richmond River Alluvium	4.4
Tertiary Basalts	8.8
Mesozoic and Paleozoic rock of the Clarence-Moreton Basin	unknown

On the basis of our experience, it would be fair to regard these figures as estimates only, due to the great difficulty of estimating abstractions from unmetered boreholes.

4.4 Flow Directions and Gradients

It has not been possible to plot reduced groundwater levels. However, it is likely that groundwater flow direction is controlled by the topography, with flow in the basalts being towards the main valley, and flow in both the alluvial deposits and basalts within the valley being down-valley, essentially parallel to the valley orientation.

4.5 Storage and Recharge

The data presented in Section 2.3 indicate that the Richmond River catchment is, by Australian standards, a high-rainfall area with relatively low evaporation. The terrain is conducive to a high recharge fraction.

Estimates of storage and recharge within the main aquifer units are given in Table 3. The figures were provided by the NSW Department of Infrastructure, Planning and Natural Resources for the 2003 water cycle management study.

TABLE 3
Aquifer Storage and Recharge

Aquifer Unit	Storage Volume (GL)	Recharge (EL/year)
Richmond River Alluvium	426	38
Tertiary Basalts	7130	797
Mezoic and Paleozoic Rocks of the Clarence-Moreton Basin	2104	11

It must be recognised that these estimates do have a very substantial margin for error, that exploitable storage volume may be much less than total storage volume, and that safe annual yield will be less than average recharge.

It appears that exploitable groundwater resources will be limited by available bore yield (controlled by aquifer permeability), not by available recharge.

4.6 Groundwater Chemistry

Groundwater quality in the basalts is generally very good, with total dissolved solids concentrations of around 200 mg/L. The groundwater is calcium-sodium bicarbonate in dominant ion composition.

5.0 CONCLUSIONS

On the basis of this review, it can be concluded that sedimentary and meta-sedimentary rocks, and also the alluvial deposits along the Richmond River, can be discounted as potential sources of groundwater for Kyogle.

Both this review and experience elsewhere in eastern Australia indicate that the Tertiary basalts in the area are a potential source of groundwater. However, individual borehole yields are likely to be low, and below the yields generally considered practical for municipal supply. Also, although municipal supply would be entitled to higher security licences than agricultural abstraction, many of the existing abstractions appear to be for domestic use, and would have a similar level of protection to public supplies. The impact on existing uses would have to be considered.

There may be some potential for smart use of groundwater through technologies such as conjunctive use with surface water, managed aquifer recharge, and bank filtration. These technologies are well established in other parts of the world, where surface water resources have long been a premium. Some information on these technologies is provided in Appendix B.

However, given the large number of small-scale users in the area, it is likely that any managed recharge scheme would have to consider groundwater quality issues very carefully.

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Appendix I – Financial Modelling Report

MWH

MWH Australia

August 2006

INTEGRATED WATER CYCLE MANAGEMENT REPORT: APPENDIX I FINANCIAL ANALYSIS

Integran

Infrastructure Management

Document Control

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Table of Contents

1.0 Overview of the Financial Modelling:

1.1 *Structure of the Model:*

In undertaking this project, we have developed a financial model which provides a broad indication of the possible financial forecasts for each case given a range of assumptions. The overall objective of the model is to provide an indication of the likely impact on the annual rate bill which may result from increased costs (including both recurrent and capital) associated with each case.

The model has been developed in MS Excel using macro functions and has been structured to accommodate a range of variables including:

- anticipated recurrent (eg O&M) costs associated with each case;
- population and consumption assumptions (i.e., rate of growth in the population and anticipated changes in water usage); and
- Projected capital expenditure.

The key outputs from the model are a set of general purpose financial statements including:

- A **Statement of Cash flow** (i.e., will the Council have enough money available to pay its bills as and when they fall due?);
- An **Operating Statement** (i.e., are we covering ALL costs, including the cost of asset replacement.);
- A **Balance Sheet** (which summarises the changes in community equity associated with alternative scenarios); and
- A **Capital Funding Statement** (i.e. what options are available to fund components of the capital works program).

Together, these forecast financial statements provide a picture of the possible commercial implications on Council of pursuing each alternative scenario. The structure of the model is illustrated on Figure 1 below.

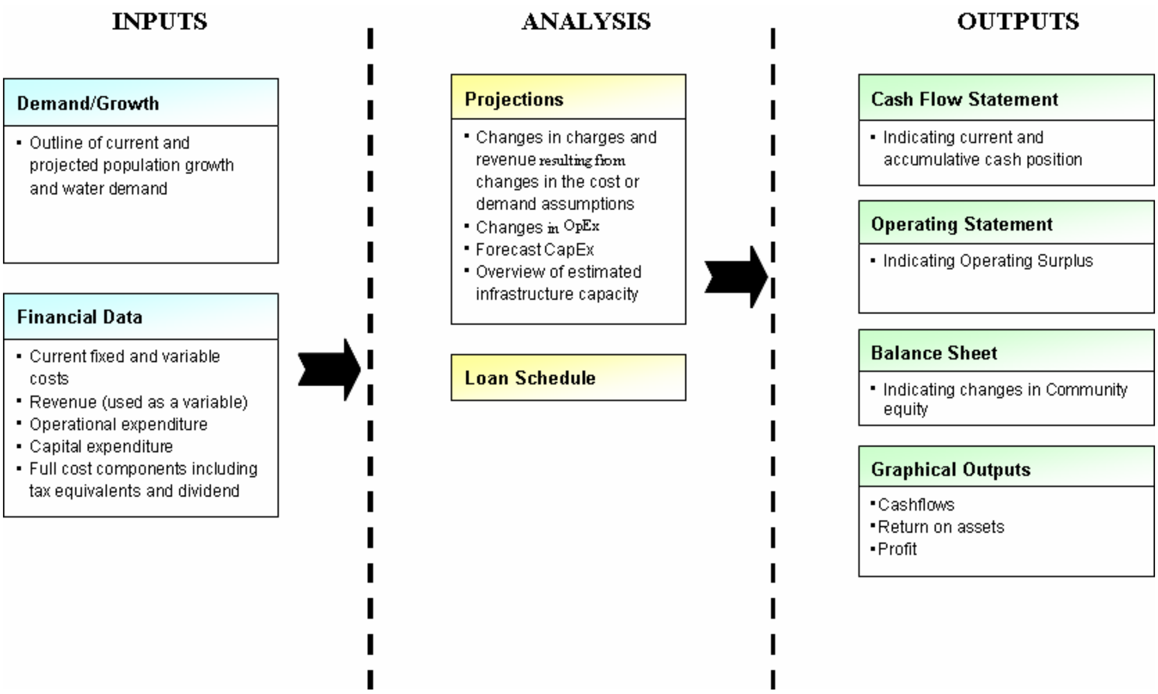


FIGURE 1: Model Schematic

1.2 *Outcomes from the modelling*

A range of alternative cases have been tested using the financial model. As with most financial assessment projects, the analysis has been undertaken in two stages. The objective of the first stage was to broadly identify which of several alternative IWCM scenarios represented the best "value for money" for Kyogle Council.

Five IWCM scenarios were reviewed. The scenarios represent increasing levels of integration between the urban water services:

1. **The Base Case** – the case likely to result from the traditional approach of undertaking separate water supply, sewerage and stormwater investigations.

2. **Integrated Scenario 1** – a low level of integration targeting new development.

3. **Integrated Scenario 2** – a medium level of integration of targeting existing development.

4. **Integrated Scenario 3** – a high level of integration including targeted recycled effluent use.

5. **Integrated Scenario 4** – a high level of integration including recycled effluent use throughout the township.

In this regard, the initial assessment identified the "Integrated 2" scenario as being that which was most likely to provide value for money.

The second stage of the analysis focussed on refinement of the "Integrated 2" option including consideration of refined costs and alternative capital funding assumptions (specifically availability of subsidy). It is important to note that, in undertaking the more detailed 'stage 2' assessment, the cost of several items were further revised and, in some cases, increased.

A summary of the outcomes of both stage 1 and stage 2 are summarised below. More detailed outcomes from the financial modelling for the "Integrated 2" scenario is provided in Attachment A.

Water Supply Infrastructure Options:

Scope of the Analysis:
A range of cases for development of water supply infrastructure and demand management strategies were been tested. These include the following:

- Case 1 – Unrestricted supply, sourced by Kyogle alone;
- Case 2 – Supply developed jointly between Casino and Kyogle; and
- Case 3 – Low cost supply, sourced by Kyogle alone.

Each of these key cases were run assuming that subsidies were available on selected items of capital infrastructure and separate cases run assuming no subsidies were available.

Impact on rates:
In order to simplify the analysis, the outcomes of the modelling are presented in terms of the effect which each may have on the average combined water rate over a five (5) year period from 2004/05 and after 10 years (i.e. average rate from 2014/15). This is summarised in Table 1 below:

Table 1 – Summary of Outcomes (Water Supply):

Case	04/05	05/06	06/07	07/08	08/09	14/15
Original Base Case	$393	$408	$428	$469	$524	$699
Original Integrated 1	$393	$413	$445	$479	$535	$747
Original Integrated 2	$393	$413	$435	$464	$509	$658
Original Integrated 3	$393	$417	$466	$520	$586	$753
Original Integrated 4	$393	$417	$495	$592	$721	$935
Revised Integrated 2 Cases:						
Case 1 – Incl Subsidies	$393	$405	$416	$427	$443	$682
Case 1a – NO subsidies	$393	$405	$432	$479	$535	$1,043
Case 2 – Incl Subsidies	$393	$405	$416	$432	$448	$708
Case 2a – NO subsidies	$393	$440	$492	$550	$614	$1,175
Case 3 – Incl Subsidies	$393	$405	$420	$436	$461	$546
Case 3a – NO subsidies	**$393**	$409	$441	$475	$511	$707

- Using the rates as a proxy for the commercial benefit of each option, this assessment indicates the relative advantage of the **"Integrated 2, Case 3"** scenario as the one which is most likely to minimise the impact on the average annual rate. Under this case, the average rate per property is likely to increase from an average of around $393[1] per connection to around $546 by 2014/15 (an increase of around 40% over 10 years).

- The outcome from several other options were broadly consistent with the "base case" scenarios, i.e. the marginal differences between the "Base Case", "Integrated 1",

[1] It is important to note that the number of connections used in the analysis is based on figures contained within the Councils audited accounts. As the number of audited connections differs slightly from the number of chargeable connections, the base case outcomes indicate a rate per connection which is marginally less than the current average charge of $452 per connection. This difference is immaterial to the outcomes of this analysis.

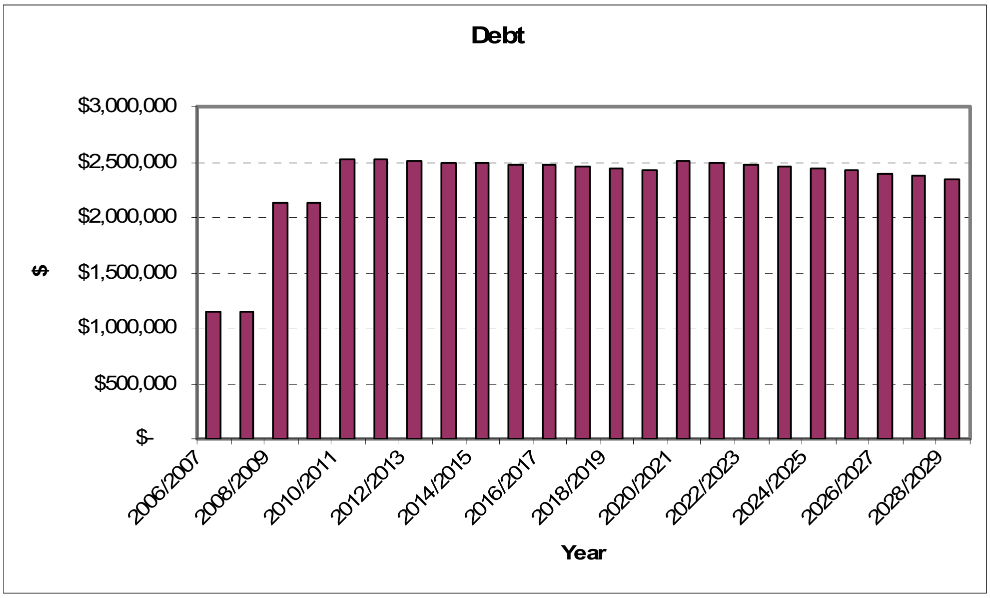
"Integrated 3" and "Integrated 2, Case 2" are not considered to be sufficiently large to provide a clear financial indicator of relative performance;

- The "Integrated 4" and "Integrated 2, Cases 1a and 2a" options were clearly the most expensive.

- **It is worth noting that the "Integrated 2, Cases 2 and 3", in particular would be very difficult to achieve in practice as Council would need to borrow for capital works at a time when it is not apparent that the Council is facing an impending cash flow problem. In addition, rates would need to be increased steadily (and at an earlier time than would be immediately apparent) to avoid significantly higher rate increases in future**. These pricing and capital funding strategies would need to be disciplined and ignore the political realities of water pricing in a local government environment. This issue is exacerbated under the "no subsidy" cases.

- The profile of loans required to deliver the project under "Integrated 2, Case 2", is summarised in the following figure:

Figure 1 - Loan Profile:



- The comparison of alternative cases under the "Integrated 2" scenario highlights the availability of subsidy and its impact on affordability of the projects. Not surprisingly, where subsidies are not available, then the impact on rates is far more marked. Under the "no subsidy" scenario, rates are likely to increase from $393 to between $707 and $1,175 per lot (an increase of up to 200% over 10 years). This component of the financial assessment illustrates how sensitive the business is to changes in the assumptions in relation to capital funding. If subsidies were not available, then any changes in the size or scope of the capital works program could have a significant impact on the Councils ability to fund the program

Sewer Infrastructure Options

<u>Scope of the analysis:</u>

The "Integrated 2" case was selected as the preferred scenario on a triple bottom line basis.

The distinguishing feature of the "Integrated 2" scenario was the assumption that current wastewater treatment processes would be upgraded to incorporate improved nutrient removal, disinfection and a hydroponic wetland. In undertaking the more detailed assessment of the "Integrated 2" scenario, only two (2) cases were run for the sewer infrastructure component of the program. These two cases reflect differences in the assumptions regarding availability of subsidy. Case 1 assumes that capital subsidy of up to 50% would be available whilst case 2 assumes that no such subsidy would be available to help undertake these works.

Impact on rates:
The outcomes of the modelling are summarised in terms of the effect of each on the average combined sewer rate over a five (5) year period from 2004/05 and after 10 years (i.e. average rate from 2014/15). These outcomes are summarised in Table 2;

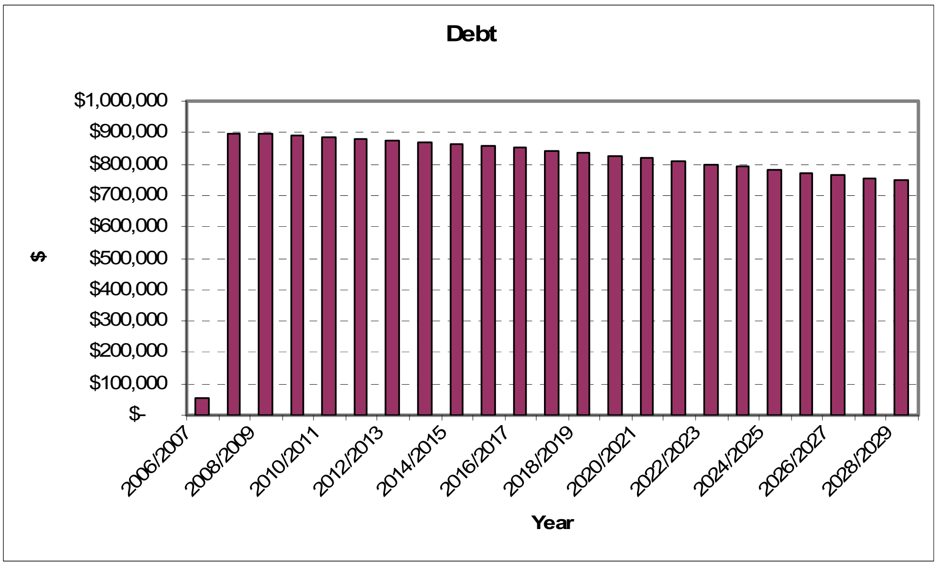
Table 2 – Summary of Outcomes (Sewerage Upgrades):

Case	04/05	05/06	06/07	07/08	08/09	14/15
Original Base Case	$412	$420	$437	$454	$468	$477
Original Integrated 1	$412	$412	$433	$497	$512	$512
Original Integrated 2	$412	$412	$420	$433	$459	$459
Original Integrated 3	$412	$412	$428	$493	$567	$584
Original Integrated 4	$412	$412	$453	$521	$578	$578
Revised Integrated 2 Cases:						
Case 1 – Incl Subsidies	$412	$412	$420	$437	$454	$473
Case 2 – NO subsidies	**$412**	$412	$428	$454	$486	$505

The analysis indicates that the proposed changes in the current sewer rate would not be significantly different than the projected "base case" scenario. Under the "Integrated 2" scenario, the total increase in rates may be in the order of 1% (in real terms) over the next 10 years. Not surprisingly, the "No subsidies" case would result in a higher increase in the total charge in the order of 6% over the corresponding period.

Under the preferred scenario (i.e. Integrated 2, Case 1), the total level of debt used to provide the proposed capital works may be in the order of $900,000. The projected loan profile is summarised in the following figure:

Figure 2 - Loan Profile:



Stormwater Infrastructure Options

<u>Scope of the analysis:</u>

The "Integrated 2" scenario, whilst not strictly the cheapest option, was selected as the preferred scenario on a triple bottom line basis.

The stormwater infrastructure model differs from the water and sewerage models slightly in the fact that the model calculates the additional impact on rates and charges which result from the proposed capital and operational cost increases. As the stormwater component of general rates is not itemised separately, this approach was adopted to illustrate the comparative differences between cases.

The key capital item which distinguished the "Integrated 2" outcomes was the scope of flood mitigation works (estimated to cost in the order of $2.2m) which will be undertaken in 2008. Once again, the two detailed cases presented differ to the extent that Case 2 assumes that no subsidy is available to help undertake these works. Case 1 assumes that capital subsidy of up to 88% would be available for the flood mitigation works.

<u>Impact on rates:</u>
The outcomes of the modelling are summarised in terms of the additional impact which either case would have on the total general rate. The impact has been measured over a five (5) year period from 2004/05 and after 10 years (i.e. average rate from 2014/15). These outcomes are summarised in table 3.

Table 3 – Summary of Outcomes (Stormwater):

Case	05/06	06/07	07/08	08/09	09/10	Max
Original Base Case	Nil	$107	$112	$124	$124	$124
Original Integrated 1	Nil	$108	$113	$126	$126	$126
Original Integrated 2	Nil	$108	$116	$126	$126	$126
Original Integrated 3	Nil	$109	$117	$130	$131	$131
Original Integrated 4	Nil	$109	$117	$130	$130	$131
Revised Integrated 2 Cases:						
Case 1 – Incl Subsidies	Nil	$105	$113	$127	$129	$129
Case 2 – NO subsidies	Nil	$105	$113	$211	$212	$211

The analysis indicates that the proposed capital works program for stormwater could have a significant impact on the general rates and charges levied by Council. Much of this increase is driven by a combination of the new capital works (specifically the flood mitigation works discussed above) and an assumed level of asset renewal in the order of $125,000 per anum[2]. The impact on rates is even more marked when subsidy is excluded from the analysis.

1.3 *Key Assumptions*

In developing any complex financial model, it is necessary to make a range of assumptions on key variables. The following discussion provides a brief outline of the main assumptions made for this project and a brief rationale for why the selected number or ranges have been chosen. Providing a list of the key assumptions not only assists the business and regulators in

[2] The earlier analysis assumed asset renewal in the order of $25,000 per year.

understanding the 'drivers' behind the financial modelling but also forces the model initiator to justify each assumption in as objective a manner as possible.

Baseline data:
The base year of the financial model has been developed form the audited 2003/04 and 200405 financial statements for both the water and sewerage funds. The information contained within these statements are generally considered the most up to date financial figures available.

Number of connections:
The audited water and sewerage financial statements included estimates of the number of connections of 1,893 and 1,578 respectively. These figures have been used in the above analysis. When the 2004/05 rates revenue is divided by these connections, it yields an average charge per connection of $393 for Water and $412 for sewer. This is marginally different form the average rate contained within Councils Management Plan of $452 for water and $490 for sewer. The differences between the audited number of connections and the number of connections used in determining the average charge rate is considered immaterial

The analysis for the marginal increase in stormwater charges is based upon the number of sewerage connections (1578).

Population growth rates:
Forecast population growth rates used in the financial analysis are the same as those used in the broader Integrated Water Cycle Management study.

Inflation:
All of the analysis is provided in present day dollars. That is, CPI has not been included in the above estimates.

Pensioner and other discounts:
The analysis is undertaken using the **net** revenues for water, sewerage and storm water. That is, revenues excluding any discounts.

Extent of Cross Subsidy:
The above assessment reflects the COSTS of each alternative. How these costs are recovered is a separate RICING decision for Council. Pricing decisions may include consideration of cross subsidization between funds (i.e. cross subsidy of the water fund by the sewerage fund or vice versa) or within a fund (i.e. cross subsidy of residents by business). For the purposes of this analysis, no cross subsidy between funds is included in the assessment.

Interest Expense:
The modeling assumes that future loans will be funded at a rate of 7% per annum, repaid over a 50 year term.

Level of Capital Subsidy:
Level of subsidies applicable to new works has been advised by Council. The model assumes that no subsidy is available for renewal works. Different scenarios have been run for the "with" subsidy and "without" subsidy cases.

Funding of Capital Works items:
Given the influence of the capital works program in the analysis, it is important to ensure that the capital funding decision making process is understood and agreed. The logic used in the analysis is as follows:

- Accumulated cash reserves are used as the first option for funding capital works (this includes developer contributions where available);

- Borrowings are then used to fund the remainder of the capital works program. Borrowings are used in preference to rate increases;
- In the case where funding of the capital works program through accumulated cash reserves and borrowings are insufficient to ensure that the cash flow remains positive, then rates are increased accordingly.

Storm water Assessment:
In the case of storm water, we have assumed that all capital works will be funded through a combination of subsidy and debt funding. This approaches 'smoothes' the increase required to accommodate the proposed works program.

Rates increases:
The modelling has been done on the assumption that rates increases in any one year will not exceed CPI + 12% per annum. This would be equivalent to a total rates increase in the order of 15% which was considered to be the absolute maximum increase possible.

Reticulation Extensions:
We have assumed that all reticulation extensions are funded by developers.

Developer Charges
The modeling has been undertaken on the basis that developer charges of $3,500 pet ET will be levied for **both** water and sewerage infrastructure from 2006/07 onward. This level of charge has been advised by Council.

Attachment A – Outcomes from the Modelling

Includes:

- Key Assumptions
- Operating Statement
- Statement of Cash flow
- Graphical Outputs
- Capital Works

Water – Integrated 2, Case 3

Kyogle Council - IWCM Review - Integrated 2 - Case 3 (Kyogle - restricted)

Growth and Demand Projections

Return to Start

General Inputs

Current Estimated LGA Population	POPULATION	9,714
Current Estimated Connected Population	CONNECTED	1,893

Variable Inputs

Demographics	Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
Projected Population Growth Rate			0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
% Change in Water Demand per Capita			0.0%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
Expenditure Projections - above CPI													
Revenue													
Change in Water Rates: Access			3.0%	4.0%	4.0%	6.0%	4.0%	4.0%	3.0%	3.0%	1.5%	1.1%	2.0%
Change in Water Rates: Useage			3.0%	4.0%	4.0%	6.0%	4.0%	4.0%	3.0%	3.0%	1.5%	1.1%	2.0%
Change in income from other Commercial Servies			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in CSO income			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Change in Non-Capital Grants and Subsidies			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in forecast Private Works Revenue			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in Other Revenue			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Expenses													
Changes in Employee Provsions			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Changes in Private Works Expense			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Changes in Other Expenses			1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Change in Section 64 (dev Contr) charges in cash				$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500
Effective Tax Rate			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dividend payout Ratio			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Key Outputs

	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
Average rate Per Premises	$ 393	$ 405	$ 420	$ 436	$ 461	$ 478	$ 496	$ 510	$ 524	$ 531	$ 536	$ 546
Noof Connections	1893	1902	1912	1922	1931	1941	1951	1960	1970	1980	1990	2000
Closing Cash Balance	$1,180,000	$1,412,339	$1,337,201	$1,281,462	$1,125,742	$1,007,668	$846,335	$773,227	$727,847	$698,342	$681,865	$688,978

Kyogle Council - IWCM Review - Integrated 2 - Case 3 (Kyogle - restricted)

Profit and Loss (Operating) Statement

Return to Start

Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Operating Revenues/Expenses											
REVENUE											
Rates and Charges (Water): Access	$ 296,000	$ 306,404	$ 317,175	$ 328,323	$ 343,163	$ 362,123	$ 393,049	$ 434,515	$ 489,090	$ 530,859	$ 544,183
Rates and Charges (Water): Usage	$ 448,000	$ 463,747	$ 478,436	$ 493,060	$ 513,230	$ 539,518	$ 583,511	$ 642,929	$ 721,432	$ 780,760	$ 798,163
Income from other commercial services	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Revenue on Cash Balance	$ 64,000	$ 45,748	$ 55,521	$ 58,723	$ 55,408	$ 49,601	$ 42,216	$ 35,768	$ 32,466	$ 35,288	$ 43,093
Community Service Obligations	$ 27,000	$ 27,270	$ 27,543	$ 27,818	$ 28,096	$ 28,377	$ 28,661	$ 28,948	$ 29,237	$ 29,530	$ 29,825
Non-Capital Grants and Subsidies		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Private Works		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other Revenue	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Total Operating Revenue	$ 839,000	$ 847,169	$ 882,674	$ 911,924	$ 943,897	$ 983,620	$ 1,051,436	$ 1,146,160	$ 1,276,225	$ 1,380,435	$ 1,419,264
EXPENDITURE											
FIXED Operations and Maintenance Expenses	$ 272,000	$ 272,000	$ 335,750	$ 335,750	$ 394,250	$ 394,250	$ 394,250	$ 394,250	$ 394,250	$ 394,250	$ 394,250
VARIABLE Operations and Maintenance Expenses	incl above	incl above	$ 42,952	$ 42,274	$ 39,675	$ 85,766	$ 84,638	$ 84,039	$ 84,086	$ 84,147	$ 84,222
Other Vilage O&M	incl above	incl above	$ 183,200	$ 183,200	$ 183,200	$ 183,200	$ 183,200	$ 171,200	$ 171,200	$ 171,200	$ 171,200
ADDN O&M Expenses from IWCM	$ -	$ -	$ 6,828	$ 6,828	$ 6,828	$ 6,828	$ 5,828	$ 5,828	$ 5,828	$ 5,828	$ 5,828
Management and Administration (incl in O&M post 2006/07	$ 194,000	$ 194,000	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above
Provision for Employee Entitlements		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Depreciation	$ 263,000	$ 263,000	$ 263,000	$ 308,005	$ 309,317	$ 336,886	$ 336,886	$ 354,886	$ 354,886	$ 354,886	$ 354,886
Private Works Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Non Recurring Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other operating expenses (specify by way of note)	$ 83,000	$ 83,830	$ 84,668	$ 85,515	$ 86,370	$ 87,234	$ 88,106	$ 88,987	$ 89,877	$ 90,776	$ 91,684
Total Operating Expenditure	$ 812,000	$ 812,830	$ 916,398	$ 961,572	$ 1,019,640	$ 1,094,164	$ 1,092,909	$ 1,099,190	$ 1,100,128	$ 1,101,088	$ 1,102,070
EBIT (Excl Capital adj)	$27,000	$34,339	-$33,724	-$49,648	-$75,743	-$110,544	-$41,473	$46,970	$176,098	$279,347	$317,194
Interest Expense	$ 1,000	$ -	$ 80,500	$ 80,302	$ 150,090	$ 149,691	$ 177,264	$ 176,739	$ 176,176	$ 175,575	$ 174,931
Net Operating Profit (Loss)	$ 26,000	$ 34,339	-$114,224	-$129,950	-$225,833	-$260,235	-$218,737	-$129,769	-$79	$103,773	$142,263
Abnormal (Capital) Adjustments											
ABNORMAL/CAPITAL RELATED REVENUE											
Capital Grants and Subsidies	$ 110,000	$ -	$ 1,173,970	$ -	$ 1,046,000	$ -	$ 450,000	$ -	$ -	$ -	$ -
Developer Contributions	$ 10,000	$ 10,000	$ 33,293	$ 33,460	$ 33,627	$ 33,795	$ 33,964	$ 34,134	$ 34,305	$ 34,476	$ 34,648
Donated assets			$ 65,000	$ 82,160	$ 17,160	$ 17,160	$ 17,160	$ 17,160	$ 17,160	$ 17,160	$ 17,160
Funds from Disposal of Non current assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Abnormal/Capital related Revenue	$ 120,000	$ 10,000	$ 1,272,263	$ 115,620	$ 1,096,787	$ 50,955	$ 501,124	$ 51,294	$ 51,465	$ 51,636	$ 51,808
ABNORMAL/CAPITAL RELATED EXPENSE											
Abnormal and Extraordinary Items					$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Abnormal/Capital Related Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PROFIT											
Total Operating Profit (EBIT + Dev Contributions)	$37,000	$44,339	-$431	-$16,188	-$42,116	-$76,749	-$7,509	$81,104	$210,402	$313,823	$351,843
Gross Profit (EBIT+dev Cont.+Donated - Abnormals)	$36,000	$44,339	-$15,931	-$14,330	-$175,046	-$209,280	-$167,613	-$78,475	$51,386	$155,409	$194,072
Taxable Income(excl abnormals)	$26,000	$34,339	-$114,224	-$129,950	-$225,833	-$260,235	-$218,737	-$129,769	-$79	$103,773	$142,263
Income Tax Payable		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Profit (After Tax, before abnormals)	$ 26,000	$ 34,339	-$ 114,224	-$ 129,950	-$ 225,833	-$ 260,235	-$ 218,737	-$ 129,769	-$ 79	$ 103,773	$ 142,263
Profit (Loss) after tax and incl. abnormals	$146,000	$44,339	$1,158,039	-$14,330	$870,954	-$209,280	$282,387	-$78,475	$51,386	$155,409	$194,072
Transfer of Funds to another Account								$ -	$ -	$ -	$ -
Repayment of Outstanding Loans (Principal Only)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Distributed Profit (Dividend Paid from Operating Profit)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

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Cashflow Statement

Cash Flow

Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Opening Balance	$956,000	$1,180,000	$1,412,339	$1,329,477	$1,257,546	$1,058,372	$912,721	$757,326	$758,543	$889,059	$1,122,997
Operating Revenue											
Water Rates: Access	$296,000	$306,404	$317,175	$328,323	$343,163	$362,123	$393,049	$434,515	$489,090	$530,859	$544,183
Water Rates: Useage	$448,000	$463,747	$478,436	$493,060	$513,230	$539,518	$583,511	$642,929	$721,432	$780,760	$798,163
Income from other commercial sources	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Revenue on Cash Balance	$64,000	$45,748	$55,521	$58,723	$55,408	$49,601	$42,216	$35,768	$32,466	$35,288	$43,093
Community Service Obligations	$27,000	$27,270	$27,543	$27,818	$28,096	$28,377	$28,661	$28,948	$29,237	$29,530	$29,825
Non-Capital Grants and Subsidies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Private Works Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Revenue	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000
Total Operating Revenue	$839,000	$847,169	$882,674	$911,924	$943,897	$983,620	$1,051,436	$1,146,160	$1,276,225	$1,380,435	$1,419,264
Operating Expenses:											
FIXED Operations and Maintenance Expenses	$272,000	$272,000	$335,750	$335,750	$394,250	$394,250	$394,250	$394,250	$394,250	$394,250	$394,250
VARIABLE Operations and Maintenance Expenses	incl above	incl above	$42,952	$42,274	$39,675	$85,766	$84,638	$84,039	$84,086	$84,147	$84,222
Other Vllage O&M	incl above	incl above	$183,200	$183,200	$183,200	$183,200	$183,200	$171,200	$171,200	$171,200	$171,200
ADDN O&M Expenses from IWCM	$0	$0	$6,828	$6,828	$6,828	$6,828	$5,828	$5,828	$5,828	$5,828	$5,828
Management and Administration (incl in O&M post	$194,000	$194,000	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above
Provision for Employee Entitlements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Expense (Loans)	$1,000	$0	$80,500	$80,302	$150,090	$149,691	$177,264	$176,739	$176,176	$175,575	$174,931
Private Works Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Recurring Expense		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other operating expense	$83,000	$83,830	$84,668	$85,515	$86,370	$87,234	$88,106	$88,987	$89,877	$90,776	$91,684
Income Tax Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividend Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Cost	$550,000	$549,830	$733,898	$733,869	$860,413	$906,969	$933,287	$921,043	$921,418	$921,776	$922,114
Operating Cash Surplus/Deficiency	$289,000	$297,339	$148,776	$178,055	$83,484	$76,651	$118,149	$225,117	$354,808	$458,659	$497,150
Capital Revenue:											
Developer Contributions (Infrastructure Charges)	$10,000	$10,000	$33,293	$33,460	$33,627	$33,795	$33,964	$34,134	$34,305	$34,476	$34,648
Funds from Disposal of Non Current Assets	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loans for Capital Expenditure	$0	$0	$1,150,000	$0	$1,000,000	$0	$400,000	$0	$0	$0	$0
Capital Subsidies/Grants	$0	$0	$1,173,970	$0	$1,046,000	$0	$450,000	$0	$0	$0	$0
Total Capital Revenue	$10,000	$10,000	$2,357,263	$33,460	$2,079,627	$33,795	$883,964	$34,134	$34,305	$34,476	$34,648
Capital Expenses											
New Capital Works Expenditure	$0	$0	$2,336,073	$30,418	$2,106,586	$0	$900,000	$0	$0	$0	$0
Replacement Capital Works Expenditure	$75,000	$75,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
Redemption on Loans	$0	$0	$2,829	$3,027	$5,699	$6,097	$7,508	$8,034	$8,596	$9,198	$9,842
Abnormal Capital Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Funds Transferred to another Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Capital Expense	$75,000	$75,000	$2,588,902	$283,445	$2,362,285	$256,097	$1,157,508	$258,034	$258,596	$259,198	$259,842
Cash Movement in year	$224,000	$232,339	-$82,862	-$71,931	-$199,174	-$145,651	-$155,395	$1,217	$130,516	$233,937	$271,956
Closing Balance	$1,180,000	$1,412,339	$1,329,477	$1,257,546	$1,058,372	$912,721	$757,326	$758,543	$889,059	$1,122,997	$1,394,953

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NEW Capital Works Program

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Project Category/Catchment	Proj. description	Est. Cost ($)	Prop. Const.Date	Ave Useful Life (Yrs)	Subsidy Available (%)
IWCM Cap X Program					
New water treatment plant		$ -	2010	50	50%
Potable water transfer system		$ 150,000	2025	80	0%
Active system leak detection and repair		$ 145,000	2040	50	0%
Installing meters on unmetered connections		$ 1,000	2006	30	0%
High water user audits	Year 1	$ 2,500	2006	30	0%
High water user audits	Year 2	$ 12,500	2007	30	0%
BASIX		$ 3,000	2006	30	0%
WELS		$ 3,500	2006	30	0%
Community IWCM education (promotion/guidelines)		$ 49,970	2006	50	100%
Enhanced conservation signal in water pricing		$ 5,000	2006	30	0%
Residential retrofit of showers and tap flow regulators	Year 1	$ 4,243	2006	20	0%
	Year 2	$ 4,264	2007	20	0%
	Year 3	$ 4,285	2008	20	0%
Dual flush toilet retrofit	year 1	$ 4,741	2006	20	0%
	year 2	$ 5,553	2007	20	0%
	year 3	$ 4,566	2008	20	0%
Washing machine rebate	Year 1	$ 6,120	2006	20	0%
	Year 2	$ 6,102	2007	20	0%
	Year 3	$ 5,735	2008	20	0%
Rainwater tank rebate program		$ 5,000	2006	20	0%
On-site greywater recycling - diversion		$ 999	2006	20	0%
On-site greywater recycling - treatment	year 1	$ 2,000	2006	20	0%
		$ 2,000	2007	20	0%
General Cap X Program (LOS etc)					
Kyogle WTP remedial works		$ -	2006	50	0%
Kyogle IWCM Part 2		$ 75,000	2006	50	50%
Bonalbo WTP construction		$ 1,100,000	2006	50	50%
Bonalbo Alternate Water Sources		$ 278,000	2006	80	50%
Bonalbo PS 1 Upgrade Peacock Creek source 2006/07		$ 70,000	2006	80	50%
UMMWWS WTP Construction		$ 725,000	2006	50	50%
UMMWWS Off-stream Storage 2010/11		$ -	2006	80	50%
Additions/Modifications for this Case					
Off-Stream Storage Stage 1 - 190ML		$ 2,000,000	2008	80	50%
Raw Water P/S		$ 92,000	2008	50	50%
Upgrade/Remedial Works to existing WTP		$ 900,000	2010	50	50%
New Water Supply Reservoir (2ML)		$ 435,000	2020	100	0%
0					
Total Proposed Cap X		$ 6,103,077			

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Graphs

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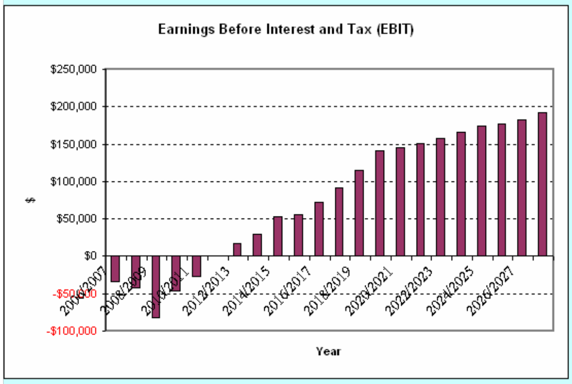

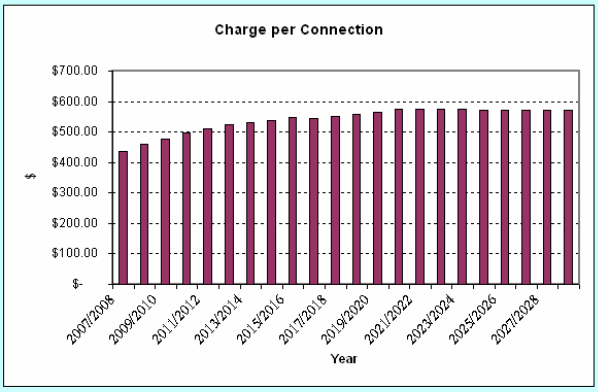

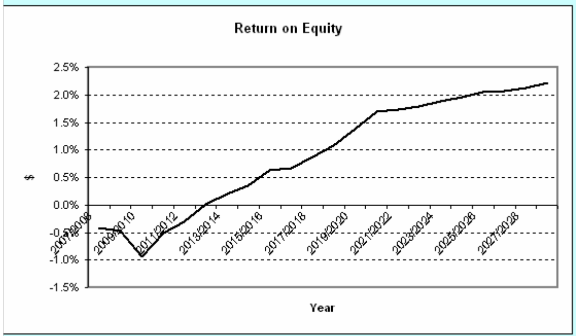

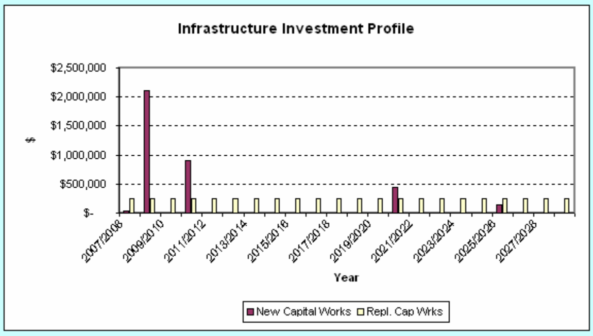

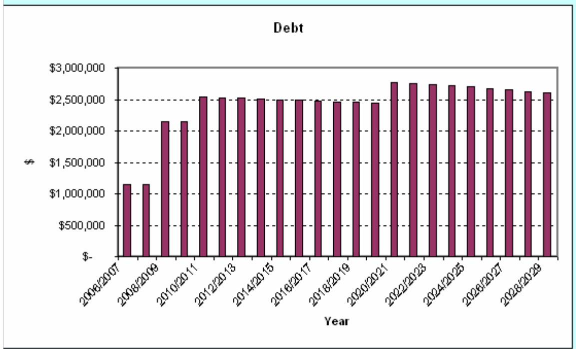

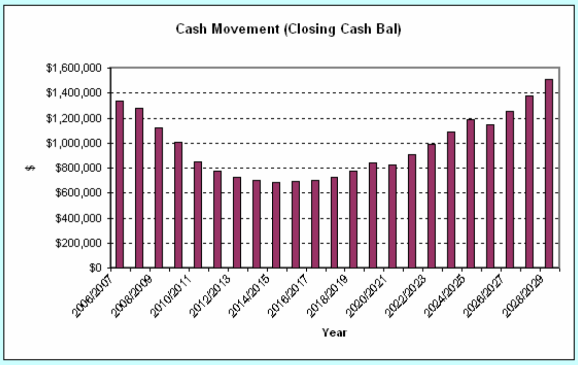

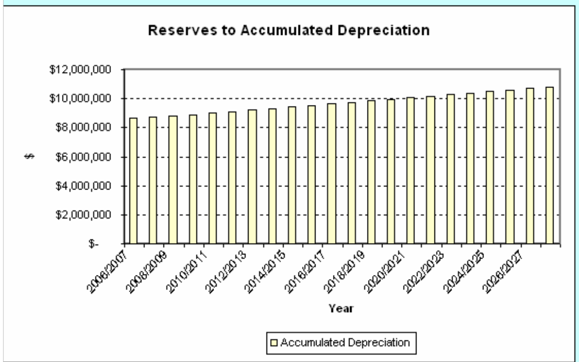

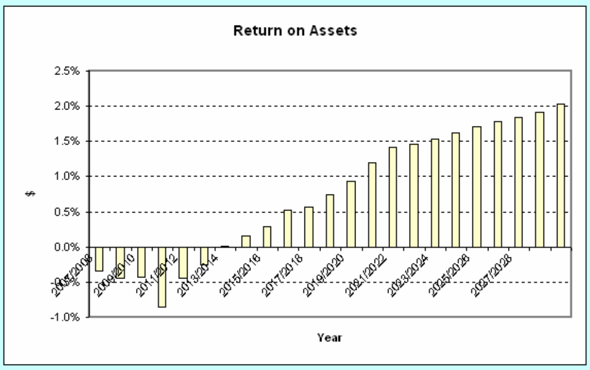

Sewer – Integrated 2, Case 1

Kyogle Council - IWCM Review - SEWER - Integrated 2

Growth and Demand Projections

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General Inputs

Current Estimated LGA Population	POPULATION	9,714
Current Estimated Connected Population	CONNECTED	1,578

Variable Inputs

Demographics / Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
Projected Population Growth Rate		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
% Change in Water Demand per Capita		0.0%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
Expenditure Projections - above CPI												
Revenue												
Change in Sewer Rates		0.0%	2.0%	4.0%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in Trade Waste Charges		0.0%	2.0%	4.0%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in income from other Commercial Servies		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in CSO income		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Change in Non-Capital Grants and Subsidies		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in forecast Private Works Revenue		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in Other Revenue		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Expenses												
Changes in Employee Provsions		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Changes in Private Works Expense		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Changes in Other Expenses		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Change in Section 64 (dev Contr) charges in cash			$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500	$ 3,500
Effective Tax Rate		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dividend payout Ratio		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Key Outputs

	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
Average rate Per Premises	$ 412	$ 412	$ 420	$ 437	$ 454	$ 473	$ 473	$ 473	$ 473	$ 473	$ 473	$ 473
Noof Connections	1578	1586	1594	1602	1610	1618	1626	1634	1642	1650	1659	1667
Closing Cash Balance	$44,000	$267,274	$373,596	$160,629	$130,265	$130,658	$134,257	$323,858	$522,129	$733,253	$957,705	$1,196,063

Kyogle Council - IWCM Review - SEWER - Integrated 2

Profit and Loss (Operating) Statement

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Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Operating Revenues/Expenses											
REVENUE											
Residential Charges	$ 650,000	$ 653,250	$ 669,647	$ 699,915	$ 731,551	$ 764,617	$ 768,440	$ 772,282	$ 776,144	$ 780,024	$ 783,924
Non Residential (including Trade Waste)	$ 63,000	$ 63,315	$ 64,904	$ 67,838	$ 70,904	$ 74,109	$ 74,480	$ 74,852	$ 75,226	$ 75,602	$ 75,980
Income from other commercial services	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Revenue on Cash Balance	$ 14,000	-$ 3,020	$ 6,667	$ 13,631	$ 11,155	$ 5,745	$ 4,894	$ 4,762	$ 8,671	$ 16,740	$ 25,259
Community Service Obligations	$ 26,000	$ 26,260	$ 26,523	$ 26,788	$ 27,056	$ 27,326	$ 27,600	$ 27,876	$ 28,154	$ 28,436	$ 28,720
Non-Capital Grants and Subsidies		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Private Works		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other Revenue	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Total Operating Revenue	$ 755,000	$ 741,805	$ 769,740	$ 810,171	$ 842,666	$ 873,797	$ 877,413	$ 881,771	$ 890,195	$ 902,802	$ 915,883
EXPENDITURE											
FIXED Operations and Maintenance Expenses	$ 310,000	$ 310,000	$ 294,500	$ 294,500	$ 294,500	$ 294,500	$ 294,500	$ 294,500	$ 294,500	$ 294,500	$ 294,500
VARIABLE Operations and Maintenance Expenses	incl above	incl above	$ 24,999	$ 39,603	$ 38,789	$ 38,459	$ 38,170	$ 38,044	$ 38,019	$ 38,003	$ 37,995
Other Vllage O&M	incl above	incl above	$ 145,000	$ 145,000	$ 145,000	$ 145,000	$ 145,000	$ 145,000	$ 145,000	$ 145,000	$ 145,000
ADDN O&M Expenses from IWCM	$ -	$ -	$ 3,000	$ 181,615	$ 182,508	$ 183,406	$ 184,308	$ 3,000	$ 3,000	$ 3,000	$ 3,000
Management and Administration (incl in O&M post 2006/07	$ 139,000	$ 139,000	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above
Provision for Employee Entitlements		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Depreciation	$ 300,000	$ 300,000	$ 300,000	$ 300,900	$ 339,233	$ 339,233	$ 339,233	$ 339,233	$ 339,233	$ 339,233	$ 339,233
Private Works Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Non Recurring Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other operating expenses (specify by way of note)	$ 14,000	$ 14,140	$ 14,281	$ 14,424	$ 14,568	$ 14,714	$ 14,861	$ 15,010	$ 15,160	$ 15,312	$ 15,465
Total Operating Expenditure	$ 763,000	$ 763,140	$ 781,780	$ 976,042	$ 1,014,599	$ 1,015,312	$ 1,016,072	$ 834,787	$ 834,912	$ 835,048	$ 835,193
EBIT (Excl Capital adj)	-$8,000	-$21,335	-$12,040	-$165,871	-$171,934	-$141,515	-$138,659	$46,984	$55,283	$67,755	$80,690
Interest Expense	$ 12,000	$ 2,649	$ 2,566	$ 61,980	$ 61,743	$ 61,492	$ 61,225	$ 60,942	$ 60,642	$ 60,322	$ 59,983
Net Operating Profit (Loss)	-$ 20,000	-$ 23,984	-$14,606	-$227,851	-$233,677	-$203,007	-$199,884	-$13,958	-$5,358	$7,432	$20,707
Abnormal (Capital) Adjustments											
ABNORMAL/CAPITAL RELATED REVENUE											
Capital Grants and Subsidies	$ 108,000	$ -	$ -	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Developer Contributions	$ 11,000	$ 11,000	$ 23,330	$ 23,447	$ 23,564	$ 23,682	$ 23,800	$ 23,919	$ 24,039	$ 24,159	$ 24,280
Donated assets			$ 79,000	$ 95,700	$ 16,700	$ 16,700	$ 16,700	$ 16,700	$ 16,700	$ 16,700	$ 16,700
Funds from Disposal of Non current assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Abnormal/Capital related Revenue	$ 119,000	$ 11,000	$ 102,330	$ 869,147	$ 40,264	$ 40,382	$ 40,500	$ 40,619	$ 40,739	$ 40,859	$ 40,980
ABNORMAL/CAPITAL RELATED EXPENSE											
Abnormal and Extraordinary Items					$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Abnormal/Capital Related Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PROFIT											
Total Operating Profit (EBIT + Dev Contributions)	$3,000	-$10,335	$11,290	-$142,424	-$148,369	-$117,833	-$114,859	$70,903	$79,322	$91,914	$104,970
Gross Profit (EBIT+dev Cont.+Donated - Abnormals)	-$9,000	-$12,984	$87,724	-$108,704	-$193,413	-$162,625	-$159,384	$26,661	$35,381	$48,292	$61,687
Taxable Income(excl abnormals)	-$20,000	-$23,984	-$14,606	-$227,851	-$233,677	-$203,007	-$199,884	-$13,958	-$5,358	$7,432	$20,707
Income Tax Payable		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Profit (After Tax, before abnormals)	-$ 20,000	-$ 23,984	-$ 14,606	-$ 227,851	-$ 233,677	-$ 203,007	-$ 199,884	-$ 13,958	-$ 5,358	$ 7,432	$ 20,707
Profit (Loss) after tax and incl. abnormals	$99,000	-$12,984	$87,724	$641,296	-$193,413	-$162,625	-$159,384	$26,661	$35,381	$48,292	$61,687
Transfer of Funds to another Account								$ -	$ -	$ -	$ -
Repayment of Outstanding Loans (Principal Only)		$ 1,742	$ 1,825	$ 1,911	$ 2,002	$ 2,096	$ 2,195	$ 2,299	$ 2,408	$ 2,522	$ 2,641
Distributed Profit (Dividend Paid from Operating Profit)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

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Cashflow Statement

Cash Flow

Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Opening Balance	**-$185,000**	**$44,000**	**$267,274**	**$369,173**	**$151,667**	**$116,549**	**$111,967**	**$110,360**	**$294,514**	**$487,088**	**$692,253**
Operating Revenue											
Residential Charges	$650,000	$653,250	$669,647	$699,915	$731,551	$764,617	$768,440	$772,282	$776,144	$780,024	$783,924
Non Residential (including Trade Waste)	$63,000	$63,315	$64,904	$67,838	$70,904	$74,109	$74,480	$74,852	$75,226	$75,602	$75,980
Income from other commercial sources	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Revenue on Cash Balance	$14,000	-$3,020	$6,667	$13,631	$11,155	$5,745	$4,894	$4,762	$8,671	$16,740	$25,259
Community Service Obligations	$26,000	$26,260	$26,523	$26,788	$27,056	$27,326	$27,600	$27,876	$28,154	$28,436	$28,720
Non-Capital Grants and Subsidies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Private Works Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Revenue	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
Total Operating Revenue	$755,000	$741,805	$769,740	$810,171	$842,666	$873,797	$877,413	$881,771	$890,195	$902,802	$915,883
Operating Expenses:											
FIXED Operations and Maintenance Expenses	$310,000	$310,000	$294,500	$294,500	$294,500	$294,500	$294,500	$294,500	$294,500	$294,500	$294,500
VARIABLE Operations and Maintenance Expenses	incl above	incl above	$24,999	$39,603	$38,789	$38,459	$38,170	$38,044	$38,019	$38,003	$37,995
Other Vllage O&M	incl above	incl above	$145,000	$145,000	$145,000	$145,000	$145,000	$145,000	$145,000	$145,000	$145,000
ADDN O&M Expenses from IWCM	$0	$0	$3,000	$181,615	$182,508	$183,406	$184,308	$3,000	$3,000	$3,000	$3,000
Management and Administration (incl in O&M post	$139,000	$139,000	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above
Provision for Employee Entitlements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Expense (Loans)	$12,000	$2,649	$2,566	$61,980	$61,743	$61,492	$61,225	$60,942	$60,642	$60,322	$59,983
Private Works Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Recurring Expense		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other operating expense	$14,000	$14,140	$14,281	$14,424	$14,568	$14,714	$14,861	$15,010	$15,160	$15,312	$15,465
Income Tax Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividend Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Cost	$475,000	$465,789	$484,347	$737,122	$737,109	$737,570	$738,064	$556,496	$556,320	$556,137	$555,943
Operating Cash Surplus/Deficiency	$280,000	$276,016	$285,394	$73,049	$105,556	$136,226	$139,349	$325,275	$333,875	$346,666	$359,940
Capital Revenue:											
Developer Contributions (Infrastructure Charges)	$11,000	$11,000	$23,330	$23,447	$23,564	$23,682	$23,800	$23,919	$24,039	$24,159	$24,280
Funds from Disposal of Non Current Assets	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loans for Capital Expenditure	$0	$0	$0	$850,000	$0	$0	$0	$0	$0	$0	$0
Capital Subsidies/Grants	$0	$0	$0	$750,000	$0	$0	$0	$0	$0	$0	$0
Total Capital Revenue	$11,000	$11,000	$23,330	$1,623,447	$23,564	$23,682	$23,800	$23,919	$24,039	$24,159	$24,280
Capital Expenses											
New Capital Works Expenditure	$0	$0	$45,000	$1,750,000	$0	$0	$0	$0	$0	$0	$0
Replacement Capital Works Expenditure	$62,000	$62,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000
Redemption on Loans	$0	$1,742	$1,825	$4,002	$4,239	$4,490	$4,757	$5,040	$5,341	$5,660	$5,999
Abnormal Capital Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Funds Transferred to another Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Capital Expense	$62,000	$63,742	$206,825	$1,914,002	$164,239	$164,490	$164,757	$165,040	$165,341	$165,660	$165,999
Cash Movement in year	$229,000	$223,274	$101,899	-$217,506	-$35,118	-$4,582	-$1,608	$184,155	$192,574	$205,165	$218,221
Closing Balance	**$44,000**	**$267,274**	**$369,173**	**$151,667**	**$116,549**	**$111,967**	**$110,360**	**$294,514**	**$487,088**	**$692,253**	**$910,474**

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NEW Capital Works Program

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Project Category/Catchment	Proj. description	Est. Cost ($)	Prop. Const.Date	Ave Useful Life (Yrs)	Subsidy Available (%)
					Yr
IWCM Cap X Program					
20 treatment + nutrient removal + disinfection - hydroponic wetland		$ 1,500,000	2007	50	50%
Infiltration and inflow reduction program		$ -	2006	30	0%
Septage treatment at STW		$ 250,000	2007	30	0%
Improve on-site systems	Year 1	$ -	2006	30	0%
	Year 2	$ -	2007	30	0%
	Year 3	$ -	2008	30	0%
General Cap X Program (LOS etc)					
Woodenbong STP augmentation		$ 45,000	2006	50	0%
Total Proposed Cap X		$ 1,795,000			

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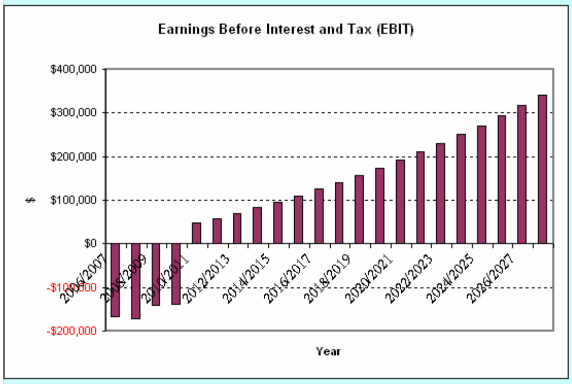
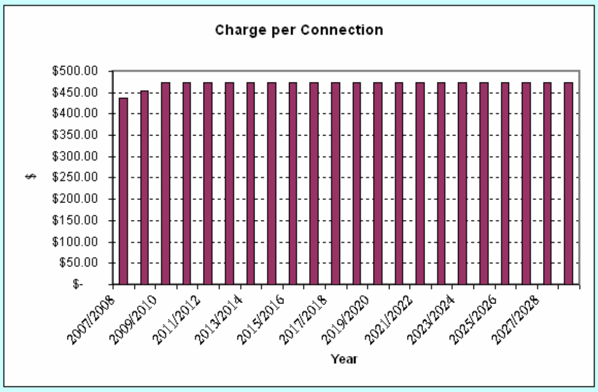
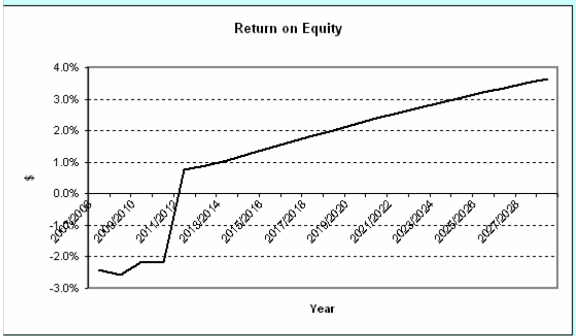
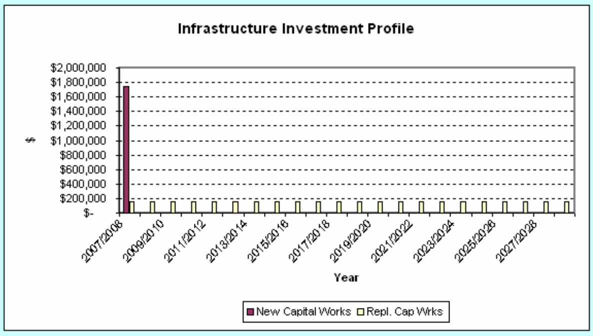
Graphs

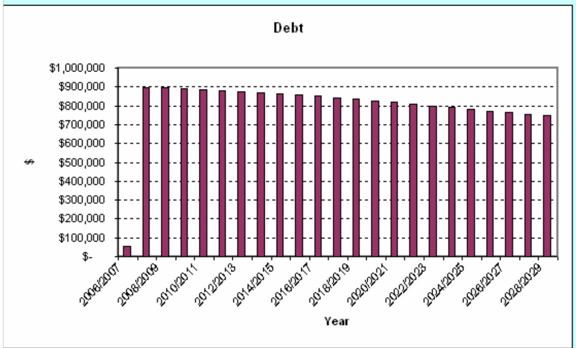
Return to Start

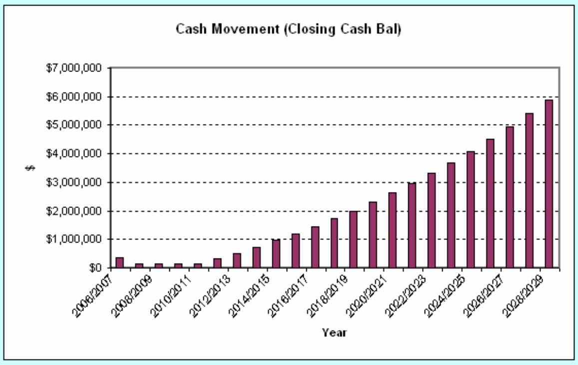


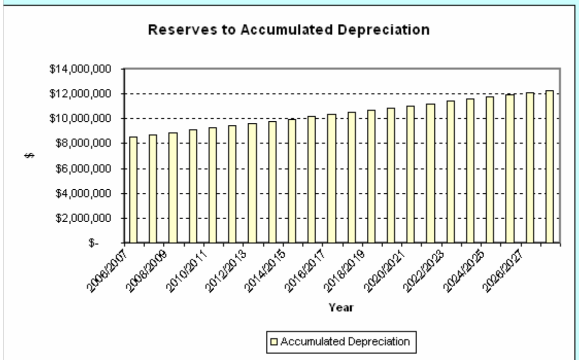


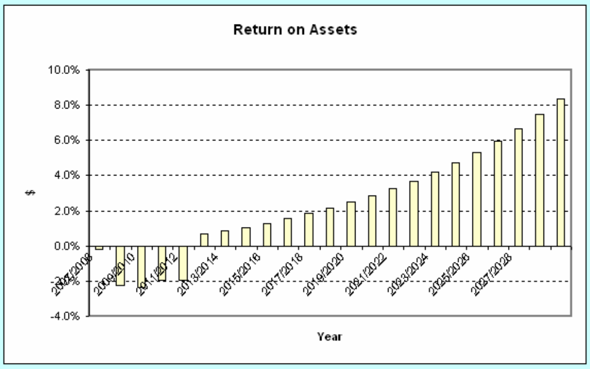












Stormwater –Integrated 2, Case 1

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Growth and Demand Projections

Return to Start

General Inputs

Current Estimated LGA Population	POPULATION	9,714
Current Estimated Connected Population	CONNECTED	1,650

Variable Inputs

Demographics	Year 2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014
Projected Population Growth Rate		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
% Change in Water Demand per Capita		0.0%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%
Expenditure Projections - above CPI										
Revenue										
Change in Rates		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in income from other Commercial Servies		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in CSO income		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in Non-Capital Grants and Subsidies		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in forecast Private Works Revenue		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Change in Other Revenue		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Expenses										
Changes in Employee Provsions		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Changes in Private Works Expense		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Changes in Other Expenses		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Change in Section 64 (dev Contr) charges in cash		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Effective Tax Rate		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dividend payout Ratio		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Key Outputs

Solve

Impact on Rates	$ 0	$ 0	$ 105	$ 113	$ 127	$ 129	$ 130	$ 130	$ 129	$ 128
Noof Connections	1650	1658	1667	1675	1683	1692	1700	1709	1717	1726
Closing Cash Balance	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1

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Profit and Loss (Operating) Statement

Return to Start

	Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Operating Revenues/Expenses	**REVENUE**											
	Residential Charges	$ 1	$ 1	#########	#########	#########	#########	$ 221,662	$ 221,662	$ 221,662	$ 221,662	$ 221,662
	Income from other commercial services		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Interest Revenue on Cash Balance		-$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
	Community Service Obligations		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Non-Capital Grants and Subsidies		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Private Works		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other Revenue		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total Operating Revenue	$ 1	$ 1	$ 175,130	$ 189,239	$ 213,691	$ 217,677	$ 221,662	$ 221,662	$ 221,662	$ 221,662	$ 221,662
	EXPENDITURE											
	FIXED Operations and Maintenance Expenses		$ -	$ -	$ 10,000	$ 11,000	$ 11,000	$ 11,000	$ 11,000	$ 11,000	$ 11,000	$ 11,000
	VARIABLE Operations and Maintenance Expenses		incl above									
	Other Vllage O&M		incl above	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000
	ADDN O&M Expenses from IWCM		$ -									
	Management and Administration (incl in O&M post 2006/07)		$ -	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above
	Provision for Employee Entitlements		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Depreciation		$ -	$ -	$ 1,140	$ 2,274	$ 47,374	$ 48,474	$ 49,574	$ 49,574	$ 49,574	$ 49,574
	Private Works Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Non Recurring Expense		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Other operating expenses (specify by way of note)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total Operating Expenditure	$ -	$ -	$ 45,000	$ 56,140	$ 58,274	$ 103,374	$ 104,474	$ 105,574	$ 105,574	$ 105,574	$ 105,574
	EBIT (Excl Capital adj)	$1	$1	$130,130	$133,099	$155,417	$114,303	$117,188	$116,088	$116,088	$116,088	$116,088
	Interest Expense	$ -	$ -	$ 3,990	$ 7,949	$ 30,585	$ 34,358	$ 38,116	$ 38,007	$ 37,892	$ 37,768	$ 37,635
	Net Operating Profit (Loss)	$ 1	$ 1	$126,140	$125,149	$124,832	$79,945	$79,072	$78,080	$78,196	$78,320	$78,453
Abnormal (Capital) Adjustments	**ABNORMAL/CAPITAL RELATED REVENUE**											
	Capital Grants and Subsidies		$ -	$ -	$ -	$ 1,931,336	$ -	$ -	$ -	$ -	$ -	$ -
	Developer Contributions		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Donated assets											
	Funds from Disposal of Non current assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total Abnormal/Capital related Revenue	$ -	$ -	$ -	$ -	$ 1,931,336	$ -	$ -	$ -	$ -	$ -	$ -
	ABNORMAL/CAPITAL RELATED EXPENSE											
	Abnormal and Extraordinary Items					$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Total Abnormal/Capital Related Expense	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PROFIT	**Total Operating Profit (EBIT + Dev Contributions)**	$1	$1	$130,130	$133,099	$155,417	$114,303	$117,188	$116,088	$116,088	$116,088	$116,088
	Gross Profit (EBIT+dev Cont.+Donated - Abnormals)	$1	$1	$126,140	$125,149	$124,832	$79,945	$79,072	$78,080	$78,196	$78,320	$78,453
	Taxable Income(excl abnormals)	$1	$1	$126,140	$125,149	$124,832	$79,945	$79,072	$78,080	$78,196	$78,320	$78,453
	Income Tax Payable		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Operating Profit (After Tax, before abnormals)	$ 1	$ 1	$ 126,140	$ 125,149	$ 124,832	$ 79,945	$ 79,072	$ 78,080	$ 78,196	$ 78,320	$ 78,453
	Profit (Loss) after tax and incl. abnormals	$1	$1	$126,140	$125,149	$2,056,168	$79,945	$79,072	$78,080	$78,196	$78,320	$78,453
	Transfer of Funds to another Account								$ -	$ -	$ -	$ -
	Repayment of Outstanding Loans (Principal Only)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Distributed Profit (Dividend Paid from Operating Profit)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

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Cashflow Statement

Cash Flow

Year	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Opening Balance	-$1	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1
Operating Revenue											
Residential Charges	$1	$1	$175,130	$189,239	$213,691	$217,677	$221,662	$221,662	$221,662	$221,662	$221,662
Income from other commercial sources	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Revenue on Cash Balance	$0	-$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Community Service Obligations	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non-Capital Grants and Subsidies	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Private Works Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Revenue	$1	$1	$175,130	$189,239	$213,691	$217,677	$221,662	$221,662	$221,662	$221,662	$221,662
Operating Expenses:											
FIXED Operations and Maintenance Expenses	$0	$0	$0	$10,000	$11,000	$11,000	$11,000	$11,000	$11,000	$11,000	$11,000
VARIABLE Operations and Maintenance Expenses	$0	incl above	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Vllage O&M	$0	incl above	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
ADDN O&M Expenses from IWCM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Management and Administration (incl in O&M post	$0	$0	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above	incl above $0
Provision for Employee Entitlements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Expense (Loans)	$0	$0	$3,990	$7,949	$30,585	$34,358	$38,116	$38,007	$37,892	$37,768	$37,635
Private Works Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Non Recurring Expense		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other operating expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Income Tax Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Dividend Paid	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Cost	$0	$0	$48,990	$62,949	$86,585	$90,358	$94,116	$94,007	$93,892	$93,768	$93,635
Operating Cash Surplus/Deficiency	$1	$1	$126,140	$126,289	$127,106	$127,319	$127,546	$127,654	$127,770	$127,894	$128,027
Capital Revenue:											
Developer Contributions (Infrastructure Charges)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Funds from Disposal of Non Current Assets	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Loans for Capital Expenditure	$0	$0	$57,000	$56,700	$323,664	$55,000	$55,000	$0	$0	$0	$0
Capital Subsidies/Grants	$0	$0	$0	$0	$1,931,336	$0	$0	$0	$0	$0	$0
Total Capital Revenue	$0	$0	$57,000	$56,700	$2,255,000	$55,000	$55,000	$0	$0	$0	$0
Capital Expenses											
New Capital Works Expenditure	$0	$0	$57,000	$56,700	$2,255,000	$55,000	$55,000	$0	$0	$0	$0
Replacement Capital Works Expenditure	$0	$0	$126,000	$126,000	$126,000	$126,000	$126,000	$126,000	$126,000	$126,000	$126,000
Redemption on Loans	$0	$0	$140	$289	$1,106	$1,319	$1,546	$1,654	$1,770	$1,894	$2,027
Abnormal Capital Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Funds Transferred to another Fund	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Capital Expense	$0	$0	$183,140	$182,989	$2,382,106	$182,319	$182,546	$127,654	$127,770	$127,894	$128,027
Cash Movement in year	$1	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0
Closing Balance	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1

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NEW Capital Works Program

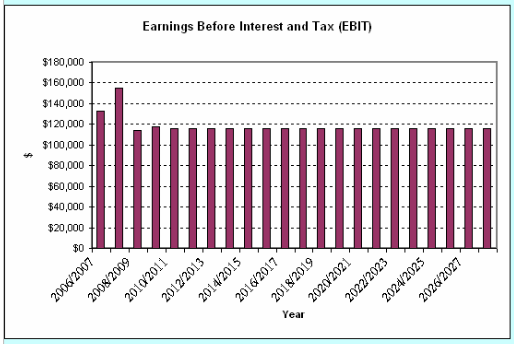
Return to Start

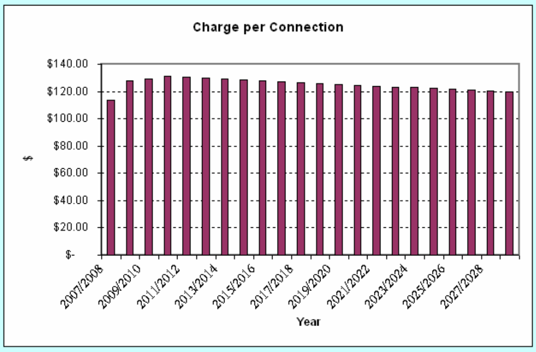
Project Category/Catchment	Proj. description	Est. Cost ($)	Prop. Const.Date	Ave Useful Life (Yrs)	Subsidy Available (%)
IWCM Cap X Program					
SMP Flood mitigation		$ 2,200,000	2008	50	88%
SMP Upgrade and quality		$ 1,700	2007	50	0%
Water sensitive urban design DCPs		$ 2,000	2006	50	0%
Retrofit of water sensitive urban desi	Year 1	$ 25,000	2006	50	0%
	Year 2	$ 25,000	2007	50	0%
	Year 3	$ 25,000	2008	50	0%
	Year 4	$ 25,000	2009	50	0%
	Year 5	$ 25,000	2010	50	0%
CMA supported catchment activities	year 1	$ 10,000	2006	50	0%
	Year 2	$ 10,000	2007	50	0%
	Year 3	$ 10,000	2008	50	0%
	Year 4	$ 10,000	2009	50	0%
	Year 5	$ 10,000	2010	50	0%
Other catchment activities	year 1	$ 20,000	2006	50	0%
	Year 2	$ 20,000	2007	50	0%
	Year 3	$ 20,000	2008	50	0%
	Year 4	$ 20,000	2009	50	0%
	Year 5	$ 20,000	2010	50	0%
General Cap X Program (LOS etc)					
Total Proposed Cap X		$ 2,478,700			

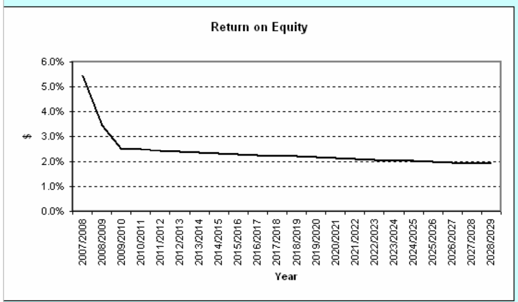
Kyogle Council - IWCM Review - Stormwater - Integrated 2

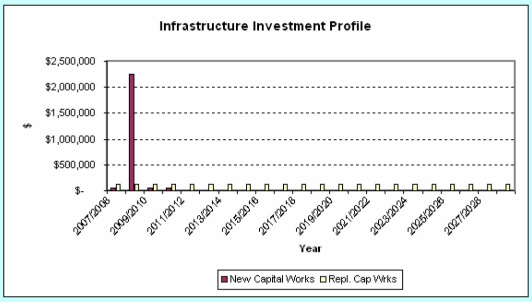
Graphs

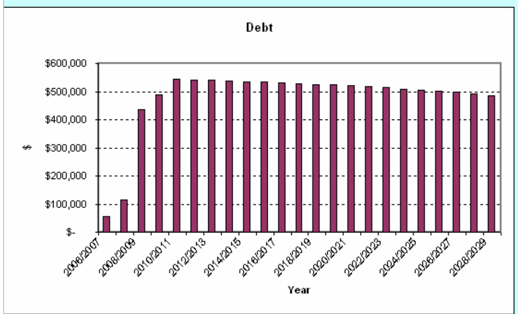
Return to Start

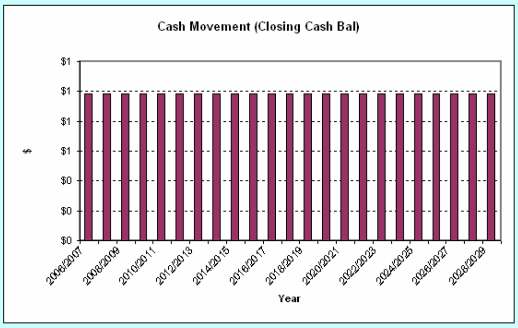


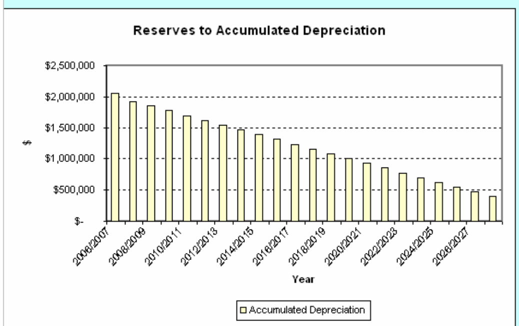


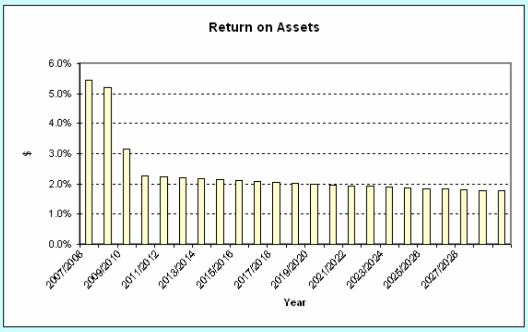


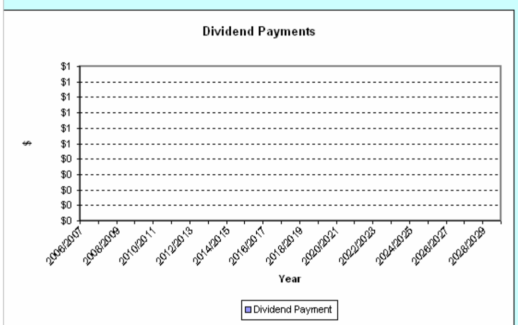


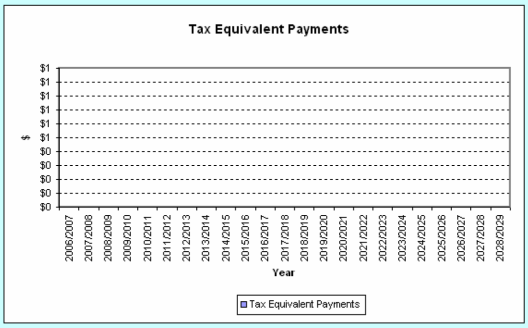












Appendix J – Water Monitoring Program

Water uantity Monitoring

System	Site	Description of Measured Value	Current Method	Proposed Improvements
Kyogle Water Supply	Wiangaree Gauging Station on the Richmond River upstream of the water supply weir pool	Richmond River river height and river flow	Department of Natural Resources gauging station (203005) data accessed via the web at http://waterinfo.dlwc.nsw.gov.au	Council to liase with DNR with a view to the installation of an additional gauging station at or near the Kyogle Water Supply Weir
Kyogle Water Supply	Raw Water Pumping Station	Pump run hours	Hour meters installed on both pumps, and pump run times logged and totalised through telemetry system	Raw water extraction volumes are to be metered as part of the works associated with the provision of an off-stream storage.
Kyogle Water Supply	Water Filtration Plant	Clear water output	Paddle wheel type flow sensor with 4-20mA output to digital flow meter and totaliser. Totalised flows manually recorded each day, and telemetry system records pump run times and totalises flows.	Regular calibration checks
Kyogle Water Supply	Three (3) service reservoirs	Reservoir water level	Level transducers installed in each reservoir and levels recorded by the telemetry system every 20 minutes	
Kyogle Water Supply	Individual service connections	Total flow to premises	Mechanical water meters of various size, commercial premises read every quarter and residential read every six months for billing purposes.	Location and metering of unmetered connections, and regular meter replacement program for meters over 10 years old.
Kyogle Sewerage System	Kyogle Sewage Treatment Works	Total inflow (excludes bypass flows over 105L/s)	Magflow meter, chart recorder, and totaliser on site. Totalised flows manually recorded each day, and telemetry system records flow rate using 4-20mA output from magflow, and telemetry also totalises.	Monitoring requirements to be reviewed as part of the STP Augmentation.
Kyogle Sewerage System	Kyogle Sewage Treatment Works	Rainfall	Rain gauge read manually each day.	Installation of tipping bucket rain gauge and connection to telemetry
Kyogle Sewerage System	Six (6) sewage pumping stations	Pump run hours	Hour meters installed on both pumps in each pump station, and pump run times logged and totalised through telemetry system	Telemetry system to be upgraded to allow for monitoring and measurement of any overflows, as required by EPA system licence.
Bonalbo Water Supply	Petrochillos Dam Site	Rainfall	Rain gauge read manually each day.	Installation of tipping bucket rain gauge and connection to telemetry
Bonalbo Water Supply	Petrochillos Dam Site	Total flow to reticulation system	Mechanical water meter on trunk gravity main to reticulation read manually each day.	Monitoring requirements to be reviewed as part of the Bonalbo Water Treatment Plant construction.
Bonalbo Water Supply	Petrochillos Dam Site	Service reservoir level	Reservoir level recorded manually each day by the operator	Level transducer to be installed in the reservoir and levels recorded by the telemetry system at regular intervals as part of the Bonalbo Water Treatment Plant construction.
Bonalbo Water Supply	Petrochillos Dam Site	Pump run hours	Not recorded at present	Hour meters to be installed on both pumps, and pump run times logged and totalised through telemetry system as part of the Bonalbo Water Treatment Plant construction.
Bonalbo Water Supply	Peacock Creek Pumping Station	Volume of water extracted from creek	Mechanical water meter on rising main to dam read manually each day.	Pump station electrical works to be upgraded and connected to telemetry, meter will most likely be replaced with a mag flow device with a 4-20mA output and totalising capacity.
Bonalbo Water Supply	Peacock Creek upstream of extraction point	Richmond River river height and river flow	Department of Natural Resources gauging station (204043) data accessed via the web at http://waterinfo.dlwc.nsw.gov.au	Council to liase with DNR with a view to the installation of an additional gauging station at or near the Bonalbo water supply extraction point
Bonalbo Water Supply	Individual service connections	Total flow to premises	Mechanical water meters of various size, commercial premises read every quarter and residential read every six months for billing purposes.	Location and metering of unmetered connections, and regular meter replacement program for meters over 10 years old.
Bonalbo Sewerage System	Sewage pumping station	Pump run hours	Hour meters installed on both pumps in the pump station, and pump run times logged and totalised through telemetry system NOTE: as the entire flow to the Bonalbo STP is via this pump station, this record also represents the inflow to the Bonalbo STP as per EPA licence conditions	Telemetry system to be upgraded to allow for monitoring and measurement of any overflows, as required by EPA system licence.
Bonalbo Sewerage System	Sewage Treatment Plant	discharge to the environment	V-Notch weir with level transmitter connected to totaliser and logged to the telemetry system. The v-notch weir is also manually checked for a visual flow daily	Some calibration issues to be resolved.
Urbenville Muli Muli Woodenbong Water Supply	Tenterfield Shire Council and Kyogle Council Local Government Area boundary at Tooloom Creek just north of Urbenville	Total water supplied to Kyogle Council	Mechanical water meter on rising main to pump station read quarterly by TSC for billing purposes, and read by Kyogle Council at end of financial year for reporting purposes	Telemetry system to be installed as part of the UMMWWS Augmentation
Urbenville Muli Muli Woodenbong Water Supply	Muli Muli branch connection	Total water supplied to Muli Muli	Read every quarter for billing purposes	To be removed as part of the transfer of the Muli Muli reticulation to Kyogle Council and replaced with individual meters to each premises read every six months for billing purposes
Urbenville Muli Muli Woodenbong Water Supply	Individual service connections	Total flow to premises	Mechanical water meters of various size, commercial premises read every quarter and residential read every six months for billing purposes.	Location and metering of unmetered connections, and regular meter replacement program for meters over 10 years old.
Urbenville Muli Muli Woodenbong Water Supply	Booster Pump Station Site	Pump run hours	Not recorded at present	Hour meters to be installed on both pumps, and pump run times logged and totalised through telemetry system as part of the UMMWWS Augmentation
Urbenville Muli Muli Woodenbong Water Supply	Woodenbong Service Reservoir site	Service reservoir level	Level transducers installed in each reservoir and levels recorded by the telemetry system every 20 minutes	
Woodenbong Sewerage System	Sewage pumping station	Pump run hours	Hour meters installed on both pumps in the pump station, and pump run times logged and totalised through telemetry system	Telemetry system to be upgraded to allow for monitoring and measurement of any overflows, as required by EPA system licence.
Woodenbong Sewerage System	Sewage Treatment Plant	Outflow from Pasveer decant pipeline	V-Notch weir with level transmitter connected to totaliser and logged to the telemetry system. NOTE: this flow is used to record STP inflow in accordance with EPA licence conditions	Some calibration issues to be resolved, possible replace with inlet flow meter.
Woodenbong Sewerage System	Sewage Treatment Plant	Discharge to the environment	V-Notch weir with level transmitter connected to totaliser and logged to the telemetry system. The v-notch weir is also manually checked for a visual flow daily	Some calibration issues to be resolved.

Testing Schedule

System	Site ID and/or description	Testing Frequency	Sampled By	Testing Location	Parameters	Purpose
Bonalbo Sewerage System	Bonalbo STP Inflow	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Inflow monitoring for comparison & information
Bonalbo Sewerage System	Effluent reuse storage "Bonalbo School Pond"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Faecal Coliforms, E-Coli	Effluent reuse water quality guideline compliance
Bonalbo Sewerage System	Licensed Monitoring Point "Bonalbo STP"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Sewerage System Licence Requirements
Bonalbo Water Supply	Bonalbo water supply reticulation "Bonalbo Amenities"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Bonalbo Water Supply	Bonalbo water supply reticulation "Bonalbo Pool Shed"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Bonalbo Water Supply	Raw water source in off-stream storage "Petrochillos Dam"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Bonalbo Water Supply	Raw water source in off-stream storage "Petrochillos Dam"	Six Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Alkalinity(as CaCO3), Aluminium (Dissolved), Ammonia-N, BOD, Chlorophyll a, colour apparent, gross Alpha, Gross Beta, Hardness (as CaCO3), Iron (Dissolved), Non Filterable Residue, pH, Total Aluminium, Total Iron, Total Manganese, Total Nitrogen, Total Phosphorus, True Colour, Turbidity.	Raw water quality monitoring
Bonalbo Water Supply	Bonalbo water supply reticulation "Bonalbo Amenities"	Six Monthly	Richmond Water Laboratories	Division of Analytical Laboratories (DAL) Sydney	Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iodine, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrate, Nitrite, pH, Selenium, Silver, Sodium, Sulphate, TDS, Hardness (as CaCO3), True Colour, Turbidity, Zinc	NSW Health chemical analysis
Kyogle Sewerage System	Kyogle STP Inflow	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Inflow monitoring for comparison & information
Kyogle Sewerage System	Effluent reuse storage "Varys Dam"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, BOD5, Suspended Solids	Effluent reuse water quality guideline compliance and treatment process monitoring
Kyogle Sewerage System	Licensed Monitoring Point "Kyogle Discharge Point"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Sewerage System Licence Requirements
Kyogle Sewerage System	Discharge to natural waters "Varys River Inlet"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, BOD5, Suspended Solids	Inflow monitoring for comparison & information
Kyogle Water Supply	Water supply weir pool on the Richmond River "Clarkes Lane"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, BOD5, Suspended Solids	Raw water quality and receiving waters quality comparison.
Kyogle Water Supply	Geneva area water supply reticulation "James Street"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Kyogle Water Supply	Kyogle area water supply reticulation "Hurley Park"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Kyogle Water Supply	Kyogle water supply reticulation	Six Monthly	Richmond Water Laboratories	Division of Analytical Laboratories (DAL) Sydney	Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iodine, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrate, Nitrite, pH, Selenium, Silver, Sodium, Sulphate, TDS, Hardness (as CaCO3), True Colour, Turbidity, Zinc	NSW Health chemical analysis
Kyogle Water Supply	Kyogle water supply reticulation	Six Monthly	Richmond Water Laboratories	Division of Analytical Laboratories (DAL) Sydney	Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iodine, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrate, Nitrite, pH, Selenium, Silver, Sodium, Sulphate, TDS, Hardness (as CaCO3), True Colour, Turbidity, Zinc	NSW Health chemical analysis
Kyogle Water Supply	Kyogle water supply reticulation fluoride sampling connection	Daily	Kyogle Council	Kyogle Water Treatment Plant	Fluoride Ion	NSW Health Fluoride monitoring requirements
Kyogle Water Supply	Kyogle water supply reticulation random sample	Monthly	Kyogle Council	Kyogle Water Treatment Plant	Fluoride Ion	NSW Health Fluoride monitoring requirements
Kyogle Water Supply	Kyogle water supply reticulation fluoride sampling connection	Monthly	Richmond Water Laboratories	Division of Analytical Laboratories (DAL) Sydney and Kyogle Water Treatment Plant	Fluoride Ion	NSW Health Fluoride monitoring requirements, monthly comparative sample
Kyogle Water Supply	Water Treatment Plant Clear Water Tank	Daily	Kyogle Council	Kyogle Water Treatment Plant	pH, Chlorine, Turbidity, Colour	Daily water quality testing by WTP operator, also pH and chlorine probes monitored through telemetry system
Kyogle Water Supply	Water Treatment Plant Raw Water Tank	Daily	Kyogle Council	Kyogle Water Treatment Plant	pH, Turbidity, Colour	Daily water quality testing by WTP operator
Kyogle Water Supply	Water Treatment Plant Clarifiers	Daily	Kyogle Council	Kyogle Water Treatment Plant	Turbidity, Colour	Daily water quality testing by WTP operator
Urbenville Muli Muli Woodenbong Water Supply	Muli Muli community water supply reticulation "Muli Muli"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Urbenville Muli Muli Woodenbong Water Supply	Urbenville village water supply reticulation "Urbenville Park"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Urbenville Muli Muli Woodenbong Water Supply	Woodenbong village water supply reticulation "Woodenbong Police Station"	Weekly	Richmond Water Laboratories	Richmond Water Laboratories Lismore and Northern Rivers Pathology Service Lismore	Total Coliforms and E-Coli	Water supply microbiological quality, NSW Health free samples tested at Northern Rivers Pathology, additional samples tested at Richmond Water Laboratories
Urbenville Muli Muli Woodenbong Water Supply	Raw water source within natural weir pool on Tooloom Creek "Tooloom Falls"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Urbenville Muli Muli Woodenbong Water Supply	Woodenbong village water supply reticulation "Woodenbong"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Urbenville Muli Muli Woodenbong Water Supply	Urbenville village water supply reticulation "Urbenville"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Urbenville Muli Muli Woodenbong Water Supply	Muli Muli community water supply reticulation "Muli Muli"	Monthly (or more frequent as required)	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Algae cells/mL reported by type and species	Blue Green Algae monitoring
Urbenville Muli Muli Woodenbong Water Supply	Raw water source within natural weir pool on Tooloom Creek "Tooloom Falls"	Six Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Alkalinity(as CaCO3), Aluminium (Dissolved), Ammonia-N, BOD, Chlorophyll a, colour apparent, gross Alpha, Gross Beta, Hardness (as CaCO3), Iron (Dissolved), Non Filterable Residue, pH, Total Aluminium, Total Iron, Total Manganese, Total Nitrogen, Total Phosphorus, True Colour, Turbidity.	Raw water quality monitoring
Urbenville Muli Muli Woodenbong Water Supply	Urbenville village water supply reticulation	Six Monthly	Richmond Water Laboratories	Division of Analytical Laboratories (DAL) Sydney	Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chloride, Chromium, Copper, Fluoride, Iodine, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrate, Nitrite, pH, Selenium, Silver, Sodium, Sulphate, TDS, Hardness (as CaCO3), True Colour, Turbidity, Zinc	NSW Health chemical analysis
Woodenbong Sewerage System	Woodenbong STP Inflow	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Inflow monitoring for comparison & information
Woodenbong Sewerage System	Effluent reuse storage "Woodenbong School Pond"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	Faecal Coliforms, E-Coli	Effluent reuse water quality guideline compliance
Woodenbong Sewerage System	Licensed Monitoring Point "Woodenbong STP"	Monthly	Richmond Water Laboratories	Richmond Water Laboratories Lismore	pH, Total N, Total P, Faecal Coliforms, E-Coli, BOD5, Oils & Grease, Suspended Solids	Sewerage System Licence Requirements

Sampling Sites

Area	Site Description	System Monitored	Longitude	Latitude
Bonalbo	Bonalbo STP Inflow	Sewerage System	152.61578	-28.741386
Bonalbo	Effluent reuse storage "Bonalbo School Pond"	Sewerage System	152.617369	-28.741056
Bonalbo	Licensed Monitoring Point "Bonalbo STP"	Sewerage System	152.6164641	-28.7425577
Bonalbo	Bonalbo water supply reticulation "Bonalbo Amenities"	Water Supply	152.623191	-28.739003
Bonalbo	Bonalbo water supply reticulation "Bonalbo Pool Shed"	Water Supply	152.627244	-28.740403
Bonalbo	Raw water source in off-stream storage "Petrochillos Dam"	Water Supply	152.625707	-28.735531
Kyogle	Water supply weir pool on the Richmond River "Clarkes Lane"	Richmond river	152.989838	-28.61485493
Kyogle	Discharge to natural waters "Varys River Inlet"	Sewerage System	152.9891415	-28.64442498
Kyogle	Effluent reuse storage "Varys Dam"	Sewerage System	152.99035	-28.6442
Kyogle	Kyogle STP Inflow	Sewerage System	152.99224	-28.63985
Kyogle	Licensed Monitoring Point "Kyogle Discharge Point"	Sewerage System	152.989992	-28.64247997
Kyogle	Geneva area water supply reticulation "James Street"	Water Supply	152.978816	-28.61938836
Kyogle	Kyogle area water supply reticulation "Hurley Park"	Water Supply	153.0040994	-28.62913142
Kyogle	Kyogle water supply reticulation fluoride sampling connection	Water Supply	153.0013363	-28.62302478
Kyogle	Water Treatment Plant Clarifiers	Water Supply	153.001115	-28.622992
Kyogle	Water Treatment Plant Clear Water Tank	Water Supply	153.001115	-28.622992
Kyogle	Water Treatment Plant Raw Water Tank	Water Supply	153.001115	-28.622992
Muli Muli	Muli Muli community water supply reticulation "Muli Muli"	Water Supply	152.58332	-28.42004
Urbenville	Raw water source within natural weir pool on Tooloom Creek "Tooloom Falls"	Water Supply	152.5257736	-28.51480231
Urbenville	Urbenville village water supply reticulation "Urbenville Park"	Water Supply	152.54788	-28.46914
Woodenbong	Effluent reuse storage "Woodenbong School Pond"	Sewerage System	152.604449	-28.394414
Woodenbong	Licensed Monitoring Point "Woodenbong STP"	Sewerage System	152.6044	-28.394077
Woodenbong	Woodenbong STP Inflow	Sewerage System	152.606004	-28.395049
Woodenbong	Woodenbong village water supply reticulation "Woodenbong Police Station"	Water Supply	152.607655	-28.390319

NSW Health Sites

Kyogle Council - Drinking Water Database Sampling Sites		
Kyogle Water Supply	Kyogle area water supply reticulation "Hurley Park"	Site ID KG-01-001 - Mount Street Kyogle - Tap adjacent to reservoir, Hurley Park
Kyogle Water Supply	Geneva area water supply reticulation "James Street"	Site ID KG-01-002 - 22 James Street Kyogle - House yard tap
Bonalbo Water Supply	Bonalbo water supply reticulation "Bonalbo Amenities"	Site ID KG-02-001 - Tap adjacent to the park Bonalbo
Urbenville Muli Muli Woodenbong Water Supply	Urbenville village water supply reticulation "Urbenville Park"	Site ID KG-03-001 - Urbenville Park Urbenville - Tap adjacent to the Tenterfield Shire Depot
Urbenville Muli Muli Woodenbong Water Supply	Muli Muli community water supply reticulation "Muli Muli"	Site ID KG-03-002 - Muli Muli Community office Muli Muli - Front tap
Urbenville Muli Muli Woodenbong Water Supply	Woodenbong village water supply reticulation "Woodenbong Police Station"	Site ID KG-03-003 - Swimming pool Woodenbong - tap adjacent to amenities

Appendix K – Community Survey

Report Prepared by Graham Kennett, Engineer Asset Services, Kyogle Council.

Kyogle Integrated Water Cycle Management Strategy
Report on March 2006 Community Survey
Report Dated June 30, 2006

Introduction

This report has been prepared to provide feedback on the community survey distributed in March 2006 relating to Councils water services and the draft Kyogle Integrated Water Cycle Management Strategy (IWCMS) particularly in the context of the 2006/2007 Management Plan.

Background

In August 2005 Council organised a Project Reference Group (PRG) to assist with stakeholder consultation during the preparation of the Kyogle IWCMS. This PRG developed a preferred option for the water services in Kyogle over six three to four hour workshops. The PRG was found to be an excellent format for consultation with both government and community groups and all involved found the exercise valuable and informative.

In February 2006 Council held a broader community workshop in Kyogle. All properties serviced by water and/or sewerage were invited to attend via an information leaflet distributed by Australia Post. The workshop was held as an informal information session which ran from 1:00pm to 5:00pm and then a formal presentation and question time in the evening. Whilst the input provided by those who attended was quite valuable, Council was most disappointed with the number of people attending this workshop. Excluding Council staff, consultants and Councillors, less than a dozen members of the public attended during the course of the workshop.

Due to the apparent lack of interest, and in order to obtain feedback in relation to specific areas where a decision still needed to be made, Council sought further community feedback through a survey to be distributed with the monthly newsletter throughout the entire Kyogle Local Government Area. This survey is the subject of this report.

Report

The survey as distributed is attached to this report as well as a summary of the responses received up to June 30, 2006. The responses received to date have been considered in the preparation of Councils 2006/2007 Management Plan. The responses were of particular importance in relation to the Kyogle Water supply options and this is discussed in detail below. The other main issues raised in the survey responses are also discussed below.

1. Kyogle Water Supply Issues

The main issues raised in relation to the Kyogle water supply specifically were;

- *Suggestions of other water source options such as raising the weir at Kyogle, building a dam and/or a series of weirs on the Richmond River, piping water from Gradys Creek and/or Toonumbar*
- *Find a cheaper option for the water supply to the village of Kyogle*

1.1 Kyogle Water Supply Discussion

The Kyogle IWCMS process considered many water supply options including use of Toonumbar Dam and even damming of the Richmond River. Of these options only three were found to be viable and achievable options. These are;

- **Case 1 - Unrestricted supply, sourced by Kyogle alone**
  This option consists of an off-stream storage of 485ML based on high flow environmental licence requirements and high level of drought security, associated raw water transfer equipment and a new water treatment plant with a capacity of 4.6ML/day. No additional reservoir storage was required for this option.
- **Case 2 - Supply developed jointly between Casino and Kyogle**

This option consists of a pipeline and booster pumping station to run from Casino to Kyogle, and a contribution to Richmond Valley Council. This option would see the abandoning of the existing weir, raw water pump station and water treatment plant in Kyogle. No additional reservoir storage was required for this option.

- **Case 3 - Low cost supply, sourced by Kyogle alone**
  This option consists of an off-stream storage of 190ML and associated raw water transfer equipment and remedial works and minor improvements to the existing water treatment plant to ensure it can operate consistently at its 3ML/day capacity. This option requires the permanent imposition of water restrictions whilst still offering some improvement to drought security. An additional reservoir storage of 2ML is required by 2010/2011 for this option.

The main purpose of the community survey was to assist Council in determining the preferred option for the Kyogle water supply, and specific questions were aimed towards obtaining the communities views. Both Case 1 and Case 2 would have required an increase in charges of around 66% and Council sought to ascertain the level of support for the Casino option. The results of the survey show that whilst this option was supported by some, it was not generally supported and in some cases was strongly opposed. Whilst some reasons given were based on a lack of understanding of the two systems, the most common reasons given was simply to maintain independence and management responsibility within Kyogle.

Having said this, it also became apparent from the detailed financial modelling of the three proposals that both Case 1 and Case 2 would be extremely difficult to fund, from both a revenue generation and cash flow perspective. These two options would put the water fund under high risk of financial problems in future years.

These two factors combined to leave Case 3 as the only remaining viable option.

1.2 Kyogle Water Supply Recommendation

The 2006/2007 Management Plan includes budget allocations for the works required under Kyogle Water Supply Case 3. This will still require a total increase in charges of around 35% above CPI over the next ten years. It is proposed to increase the revenue raised by 10% in 2006/2007 in line with this requirement.

2 Charges and Pricing Issues

There were three main issues raised in relation to charges and pricing. These were;

- *The ability of pensioners and other low income earners to pay for the proposed increase in charges.*
- *Any increases in charges should be phased in over a longer period than one year.*
- *Why should good water users subsidise the poor high water users, and/or increase the cost to high water users and developers.*

2.1 Charges and Pricing Discussion

Whilst the proposed increase in charges was shown in the survey as 45.4% over all water services, the main concern was in relation to the 65.9% increase shown for water supply. The ability of individuals, particularly pensioners and low income earners, to afford such a large increase was obviously the driver for the comments made above.

2.2 Charges and Pricing Recommendation

Council proposes to make a change to the way it charges for water where consumption charges are made on the basis of a two-tiered pricing system. The proposed two-tiered consumption pricing outlined in the 2006/2007 Management Plan is expected to provide an increase in total revenue of around $82,000 as compared to last years figures. It should be noted that this additional income is coming from the higher water users only, and not the lower water users groups such as pensioners. This is achieved by charging for water consumption on the following basis;

- $1.05 per kL for the first 200kL in each financial year

1. $1.75 per kL for consumption above 200kL in each financial year

It should be noted that whilst the proposed pricing structure allows an overall increase in revenue of around 10%, it also offers an opportunity for some water users to decrease their bills with efficient water use practices. The pricing structure does not increase the fixed price component at all, not even to cover CPI. This is of particular importance to the "average" residential customer who is at present using around 176kL/year. This pricing structure has been developed to achieve three goals;

1. Generate additional revenue to assist in funding water supply improvement works
2. Eliminate existing cross-subsidy of high water users by residential customers
3. Send a clear message out to the high water users that they will need to begin to improve their water efficiency and be prepared to pay a fair price for the water which they use

Based on the outcomes of the IWCMS and the 2006/2007 Management Plan, Council will be reviewing its Developer Charges made under Section 64 of the Local Government Act for water supply, sewerage and stormwater contributions. It is anticipated that an increase of around 200-300% in current developer charges will result from this review. It is not possible to complete this review without first establishing Councils 30 year capital works program in each of these areas, and as such these charges cannot be accurately calculated until the IWCMS is finalised and formally adopted

3 General Water and Sewer Issues

There were three main issues raised in relation to general water and sewerage services. These were;

- *Give rebates for rainwater tanks and other water efficiency improvements such as grey water reuse and/or require rainwater tanks on all new developments and improve development control in relation to water issues.*
- *Lack of support for essential services such as water and sewerage from the tax dollars raised by state and federal governments and/or concerns over the lack of political pressure applied to state and federal governments by Council to provide additional funding for water services, and requests to further explore other grants available.*
- *Lack of forward planning and general incompetence of previous Councils and Council staff in planning for the required investment in capital works for water and sewerage in particular.*

3.1 General Water and Sewer Discussion

The preferred scenario outlined in the IWCMS includes provision for a rebate program which will provide subsidy to users who are increasing their water efficiency through things such as installation of rainwater tanks, and retro fitting dual flush toilets and other water efficient devices. Details of the proposed rebate program will developed over the next few months.

In the past Council was able to rely on financial assistance under the Country Towns Water Supply and Sewerage Program (CTWSSP) for water supply and sewerage augmentation works such as those proposed in the Kyogle IWCMS. A recent review of the CTWSSP led to Council receiving advice that the water supply augmentation works would have funding available under the CTWSSP, but the sewerage augmentation works would not. There has been information compiled by the NSW Water Directorate and the Local Government and Shires Association to put the case for an increase for funding for the CTWSSP, but to date the NSW state government has not provided any additional funding to the program. As such it would not be wise for Council to budget for subsidy under this program.

There may be scope for some projects to be funded under other programs such as the Federal Governments Water Fund but initial assessments of the criteria for funding have shown that the major projects such as the Kyogle Sewage Treatment Plant augmentation are not eligible for funding under this program. Having said this Council staff will be exhausting every avenue made available to try to obtain funding for individual projects, and should any funding become available Council will again review its pricing structure and/or capital works program.

As early as 1984 reports on the water supply have identified the need to address major issues with the Kyogle water supply including the provision of an off stream storage and a new water treatment plant. For reasons beyond the scope of this report, little has been done since 1984 to address these significant issues. Councils Strategic Business Plan for Water Supply prepared in 1999/2000 also detailed a capital works program which would have seen these works commence in 1999/2000 and be completed by 2009/2010. The financial modeling also showed the need to increase revenue to fund these works. For reasons beyond the scope of this report these were never implemented.

The sewerage services are in a better position because following augmentation works in the late 1980's and early 1990's, the then EPA negotiated a Pollution Reduction Program with Council in 1996 to improve the quality of effluent being discharged from the STP. This eventuated into an effluent reuse scheme which was approved by the EPA, but was not considered eligible for subsidy under the CTWSSP by the then DLWC. Council then embarked on the IWCMS process with assistance from the DLWC. Even though the scope of works were unknown, Council made the decision to increase the sewerage charges over a six year period to help fund the outcomes of the IWCMS. Unfortunately Council has now been advised that CTWSSP funding is not available for the sewerage augmentation works and adjustments to the capital works program have had to be made in order to ensure the vital works at the Kyogle STP are completed.

3.2 General Water and Sewer Recommendation

The 2006/2007 Management Plan includes budget provisions for a conservation and rebate program of up to $81,000 over the next five years to help existing customers improve their water efficiency. The 2006/2007 Management Plan includes the required revenue policy and capital works program to achieve the strategic goals of the IWCMS in the areas of water supply, sewerage and stormwater and flood mitigation. The 2006/2007 Management Plan and the draft Kyogle IWCMS together represent a sound long term plan for the delivery of water services from 2006/2007 and beyond.

4 Villages Water Services Issues

The main issues raised in relation to villages water services were;

- *Lack of water, sewerage and stormwater services to other villages such as Wiangaree and Tabulam and no long term planning to provide them has ever been undertaken*
- *Poor water quality in Bonalbo and Woodenbong*
- *Poor supply reliability in Bonalbo*

4.1 Villages Water Services Discussion

The issues of poor water quality and drought security in Bonalbo and Woodenbong will be addressed with works already approved by Council and currently in progress.

The perceived lack of services and planning for the other villages, particularly Wiangaree and Tabulam, are not really within the scope of this report, but Council staff are currently conducting initial investigations into the village areas concentrating particularly on on-site sewerage capacity and drinking water supplies.

4.2 Villages Water Services Recommendation

Council staff will report the findings of investigations into these village areas to Council once they are completed. Any findings of these investigations will need to be considered in a long term planning context.

Attachments:

1. A copy of the blank *"Kyogle Integrated Water Cycle Management Strategy Community Survey March 2006"* as distributed across the Local Government Area with the March 2006 Kyogle Council Newsletter
2. Report titled *"Kyogle Integrated Water Cycle Management Strategy Community Survey March 2006 Analysis of results as at June 30, 2006"* prepared by Kyogle Council

Kyogle Integrated Water Cycle Management Strategy
Community Survey March 2006

All comments made in this survey will be considered in the finalisation of the Kyogle Integrated Water Cycle Management Strategy. All comments, be they positive or negative, will be given equal consideration. All feedback from the community is considered valuable and your contribution and interest are appreciated by Council.

Name: (optional) ____

Address: (optional)____

____

____

Contact Phone: (optional)____________________

Is your property connected to town water and/or town sewerage? If Yes please indicate which village; Bonalbo Kyogle Woodenbong	Yes, Water and sewer		Yes, water only		No

	Strongly Agree	**No Strong Opinion**	**Strongly Disagree**
Are you satisfied with the process of consultation that Council has undertaken for its urban water services?			
Do you think that the proposed increased charges for water and sewerage are reasonable and justifiable? *(proposed increases are shown over the page and in the newsletter article)*			
Are you prepared to pay extra to see an improvement in things such as water quality, drought security, sewerage treatment levels?			
Would you support the imposition of an additional charge dedicated to support storm water, flood mitigation and catchment based improvements?			
Connection of Kyogle to the Casino Water Supply will provide improved drought security and improved river health in the Richmond River at the same cost to users as the upgrade of the Kyogle Water Supply, which requires a new water treatment plant and off-stream storage. Would you support the connection of Kyogle to the Casino Water Supply? If not, why?			
In recent years the State Government has reviewed the Country Towns Water Supply and Sewerage Program and indicated they will be able to provide a reduced level of subsidy for the proposed Kyogle Water Supply upgrade, but they will not be providing any subsidy to help fund the upgrade of the Kyogle Sewerage System, despite concerns from the NSW EPA in relation to the quality of water being discharged to the Richmond River. The Catchment Management Authority has also indicated that they do not have funds available to assist with the upgrade of the sewerage system. Would you say you are satisfied with the level of state government assistance for the outcomes of the strategy?			
Are you satisfied with the current level of service from each of the urban water services in your village;			
Water supply			
Sewerage system			
Storm water and flood mitigation			

Proposed Increases in Water Services Charges:

Water Services	Current Average Annual Charge	Proposed Average Annual Charge	Total Increase	% Increase
Water Supply	$452	$750	$298	65.9%
Sewerage	$490	$546	$56	11.4%
Stormwater and Flood Mitigation	$0	$74	$74	-
Totals	**$942**	**$1,370**	**$428**	**45.4%**

General Comments:____________________________________

Please place completed survey in an envelope and return to;

Kyogle Council
Reply Paid 11
Kyogle NSW 2474

No postage is required if posted before May 26, 2006

Kyogle Integrated Water Cycle Management Strategy
Community Survey March 2006
Analysis of results as at June 30, 2006

Scope of Analysis
In total 4,400 copies of the survey were distributed throughout the Kyogle Local Government Area with the March 2006 edition of the Kyogle Council Newsletter. A total of 160 replies were received up to June 30, 2006 representing a total of 3.6% of the total distributed. It is important to consider that this indicates around 96.3% of those the survey was distributed to did not respond to the survey and that the results presented below only represent a small section of the community. However, the feedback is still valuable and the indicators below are the best representation of the overall community views that is available to Council.

For the purposes of reporting the summary of the survey results the replies have been divided into four groups;

1. Kyogle water and/or sewerage customers (total of 118 responses)
2. Bonalbo water and/or sewerage customers (total of 7 responses)
3. Woodenbong water and/or sewerage customers (total of 19 responses)
4. All other areas (total of 16 responses)

Note also that one enterprising Woodenbong resident made at least 35 copies of the survey and returned them with the same responses on each copy. These 35 were only counted as one response.

General Comments
In addition to answers to specific questions asked in the survey people were invited to provide any additional comments they thought were appropriate. These are grouped and listed below in order of priority within each grouping based on how many times a particular issue or group of issues was raised in the written comments.

Issues raised	Times raised	Comments
Issues relating to charges and pricing		
Ability of pensioners and other low income earners to pay for the proposed increase in charges	40	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Rates and charges in Kyogle are already too high	30	Not discussed
Implement increases over a longer period than one year.	12	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Why should good water users subsidise the poor high water users, and/or increase the cost to high water users and developers	11	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Administration costs should be cut first before charges are increased including comments on "luxury" cars provided to staff	5	Not discussed
Already had price increases with no improvements to services	7	Not discussed
Concern that there may be a perception that the increases in charges are associated with the connection of Muli Muli to the Urbenville Muli Muli Woodenong Water Supply and the Woodenbong Sewerage Systems	4	Not discussed

Concern about advice from the previous administration stating Council has a budget surplus yet still asking for rate increases	1	Not discussed

Issues relating to general water services matters

Give rebates for rainwater tanks and other water efficiency improvements such as grey water reuse and/or require rainwater tanks on all new developments and improve development control in relation to water issues.	22	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Lack of support for essential services such as water and sewerage from the tax dollars raised by state and federal governments and/or concerns over the lack of political pressure applied to state and federal governments by Council to provide additional funding for water services, and requests to further explore other grants available.	20	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Lack of forward planning and general incompetence of previous Councils and Council staff in planning for the required investment in capital works for water and sewerage in particular	19	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
More information required to be distributed to the community and/or requests to hold another community meeting	11	Further information is to be sent out to those who supplied their names and addresses with the survey.
Previous water and sewer fund reserves were inappropriately used and this is why we have to pay more now	3	Not discussed
Keep water restrictions on all the time and improve water efficiency	1	Not discussed
Concern that a stormwater levy or charge will be used to fund things other than stormwater and flood mitigation works	1	Not discussed
Want the stormwater and flood mitigation charge extended to the whole LGA to help with catchment based improvements outside the village areas	1	Not discussed
Contamination of the Richmond River by cattle and poor land management	1	Not discussed

Issues specifically relating to the Kyogle Water Supply

Suggestions of other water source options such as raising the weir at Kyogle, building a dam and/or a series of weirs on the Richmond River, piping water from Gradys Creek and/or Toonumbar	14	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Find a cheaper option for the water supply to the village of Kyogle	9	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
High levels of pesticide residue within the Kyogle water supply	2	Not discussed
Remove fluoridation and save costs	1	Not discussed

Issues specifically relating to villages water services

Lack of water, sewerage and stormwater services to other villages such as Wiangaree and Tabulam and no long term planning to provide them has ever been undertaken	14	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006
Poor water quality in Bonalbo and Woodenbong	15	WTP construction projects underway
Poor supply reliability in Bonalbo	3	Addressed in Councils 2006/2007 Management Plan and Report on March 2006 Community Survey dated June 30, 2006

Issues not specifically relating to the scope of the survey

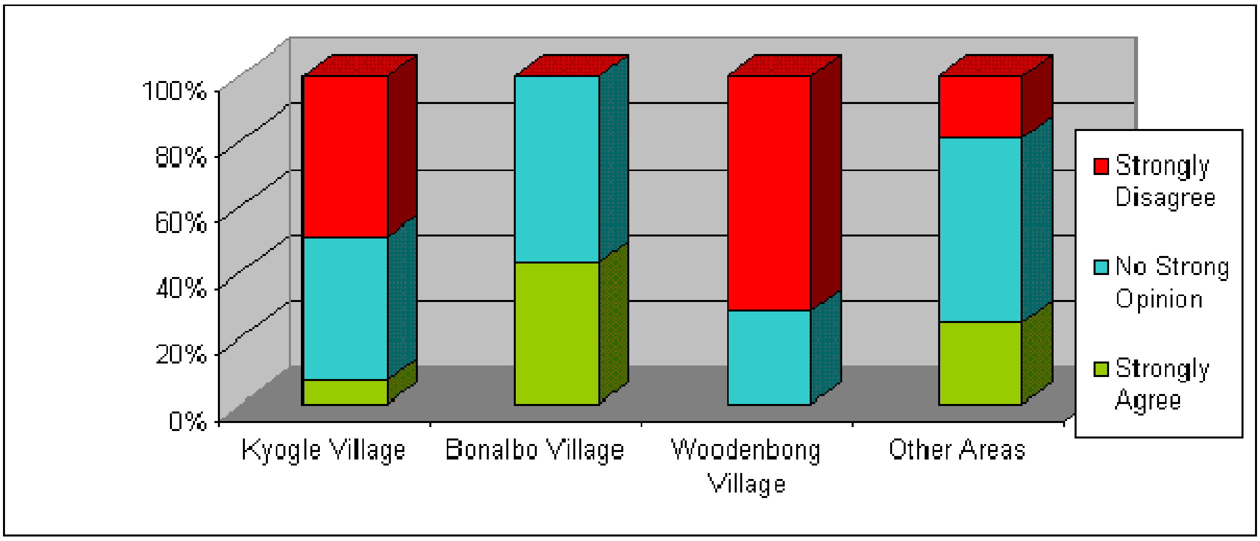
Overall poor level of service from general areas such as roads, stormwater, water, sewerage, garbage and community facilities	13	Not discussed
Concern that volunteers in the villages are doing so much and Council is doing so little	3	Not discussed
Lack off garbage recycling and/or want garbage services extended to the rural areas	2	Not discussed
Tourist information center a waste of money	1	Not discussed
No off street parking provided but fines for parking in street adding to residents costs	1	Not discussed

Responses to Specific Questions

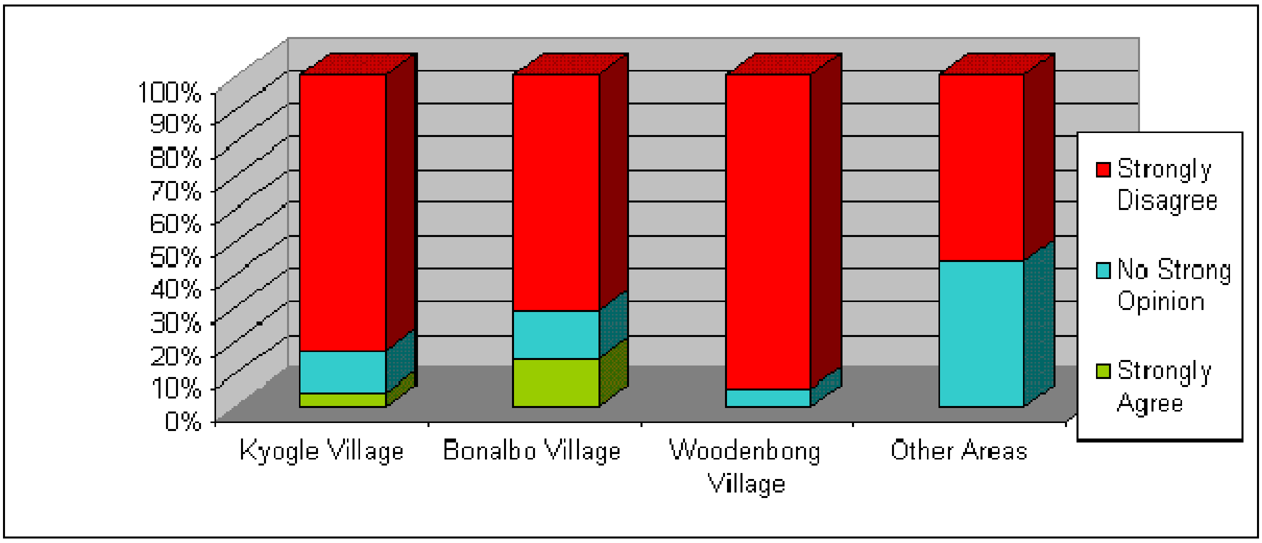
The responses to each of the specific questions asked in the survey have been compiled and the summary of the results are shown tabulated and graphically in the following pages.

Summary of responses to specific questions asked in the Kyogle Integrated Water Cycle Management Strategy Community Survey March 2006

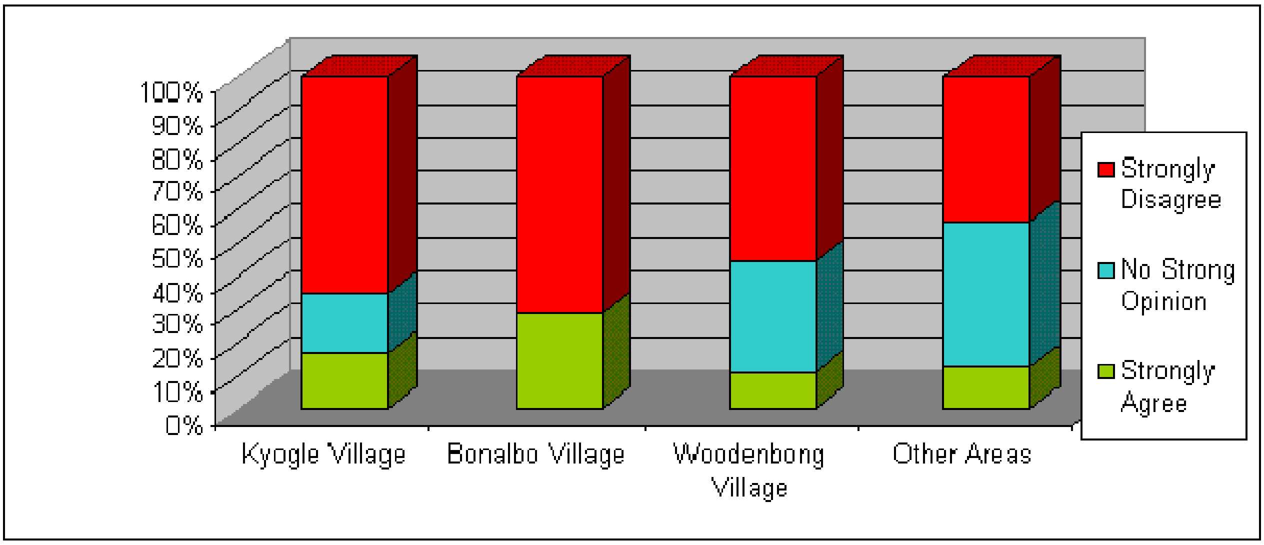
Q: Are you satisfied with the process of consultation that Council has undertaken for its urban water services	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	9	51	58
Bonalbo Village	3	4	0
Woodenbong Village	0	6	15
Other Areas	4	9	3



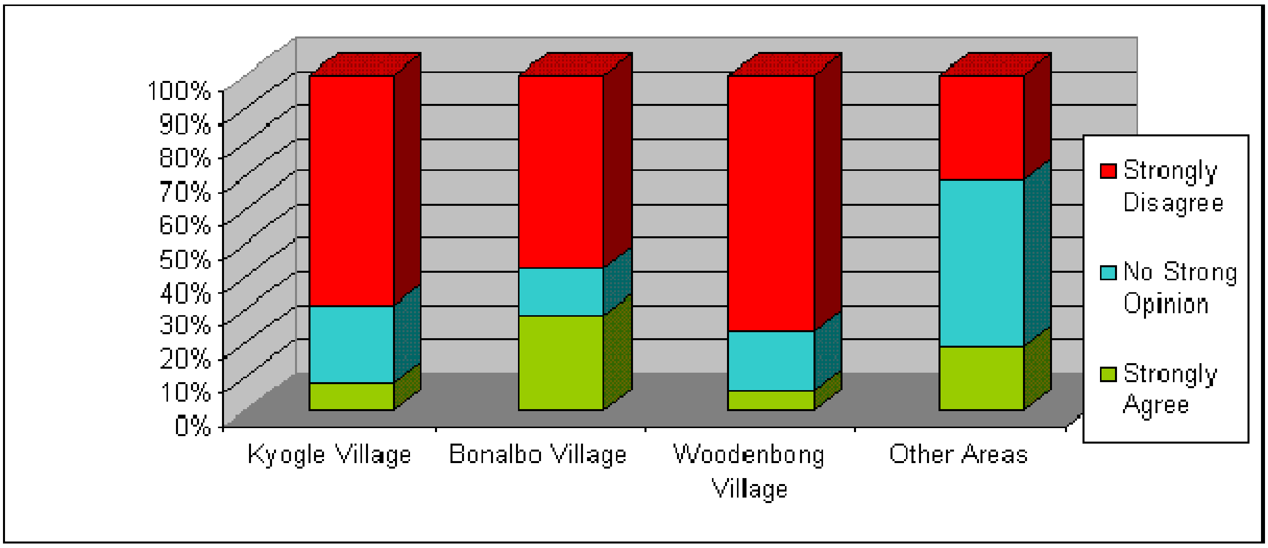
Q: Do you think that the proposed increased charges for water and sewerage are reasonable and justifiable?	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	5	15	98
Bonalbo Village	1	1	5
Woodenbong Village	0	1	18
Other Areas	0	7	9



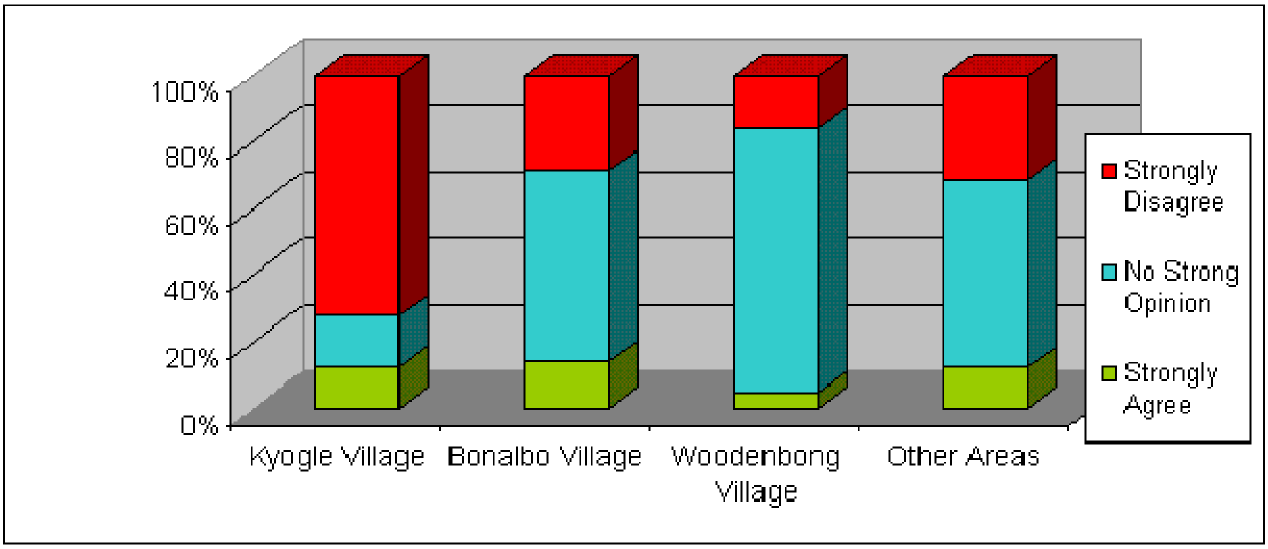
Q: Are you prepared to pay extra to see an improvement in things such as water quality, drought security, sewerage treatment levels?	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	20	21	77
Bonalbo Village	2	0	5
Woodenbong Village	2	6	10
Other Areas	2	7	7



Q: Would you support the imposition of an additional charge dedicated to support storm water, flood mitigation and catchment based improvements?	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	10	27	81
Bonalbo Village	2	1	4
Woodenbong Village	1	3	13
Other Areas	3	8	5

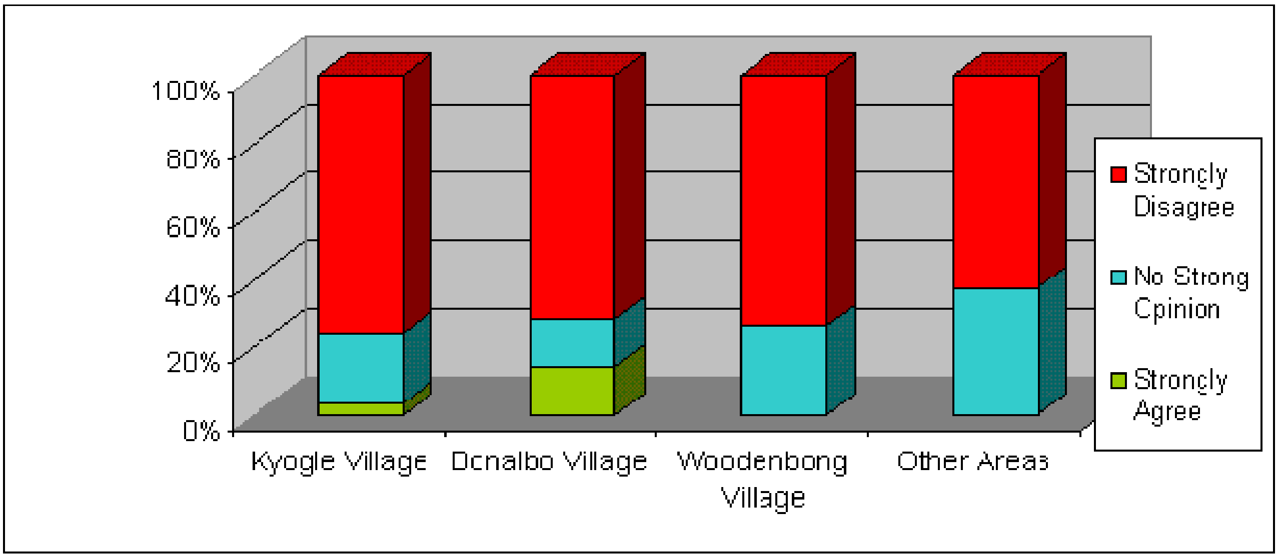


Q: Would you support the connection of Kyogle to the Casino Water Supply?	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	15	18	85
Bonalbo Village	1	4	2
Woodenbong Village	1	15	3
Other Areas	2	9	5

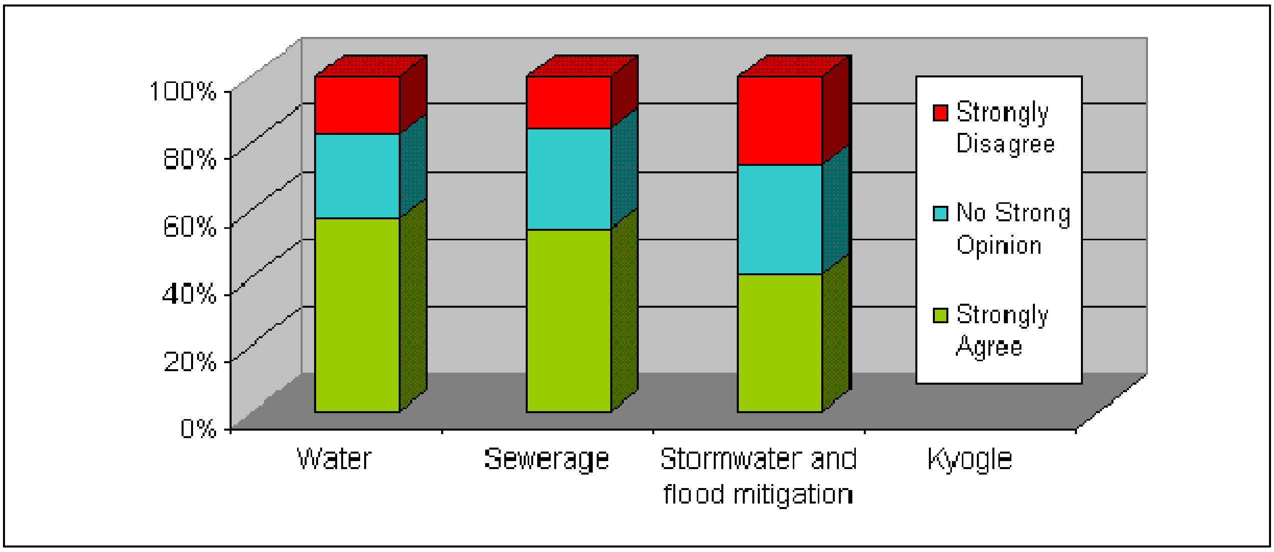


Reason	Times raised
Want to maintain and independent water supply	21
Kyogle Council would lose control over costs	20
Casino is less drought proof than Kyogle	12
Kyogle water tastes better	6
Pesticide and/or blue green algae problems in the Casino water supply	2
Downstream of Kyogle Sewerage System	1

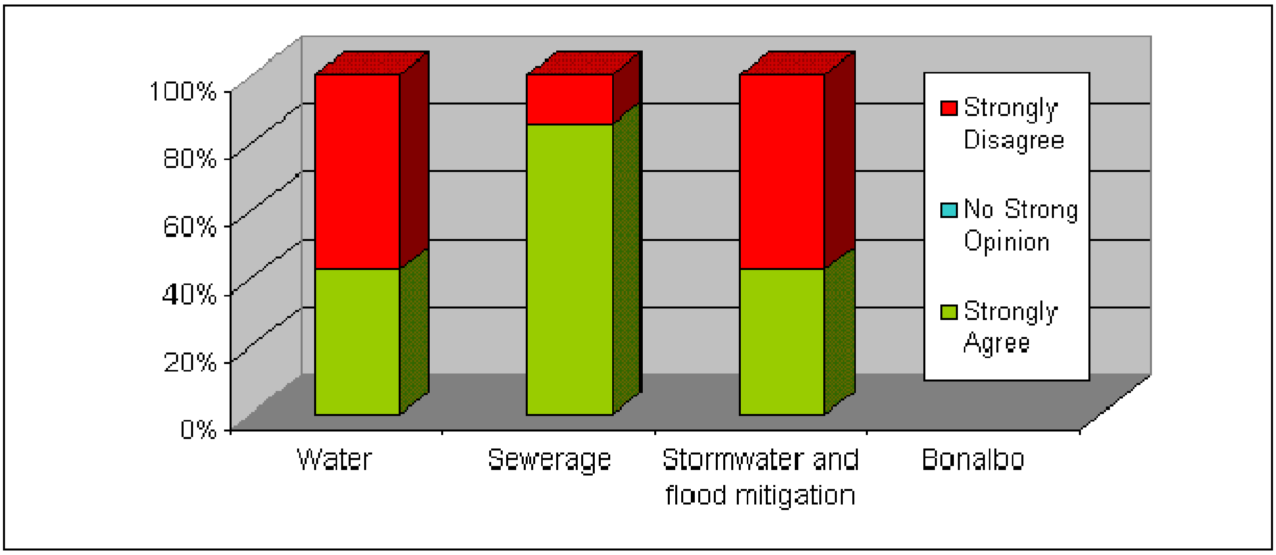
Q: Would you say you are satisfied with the level of state government assistance for the outcomes of the strategy?	Strongly Agree	No Strong Opinion	Strongly Disagree
Kyogle Village	4	24	88
Bonalbo Village	1	1	5
Woodenbong Village	0	5	14
Other Areas	0	6	10



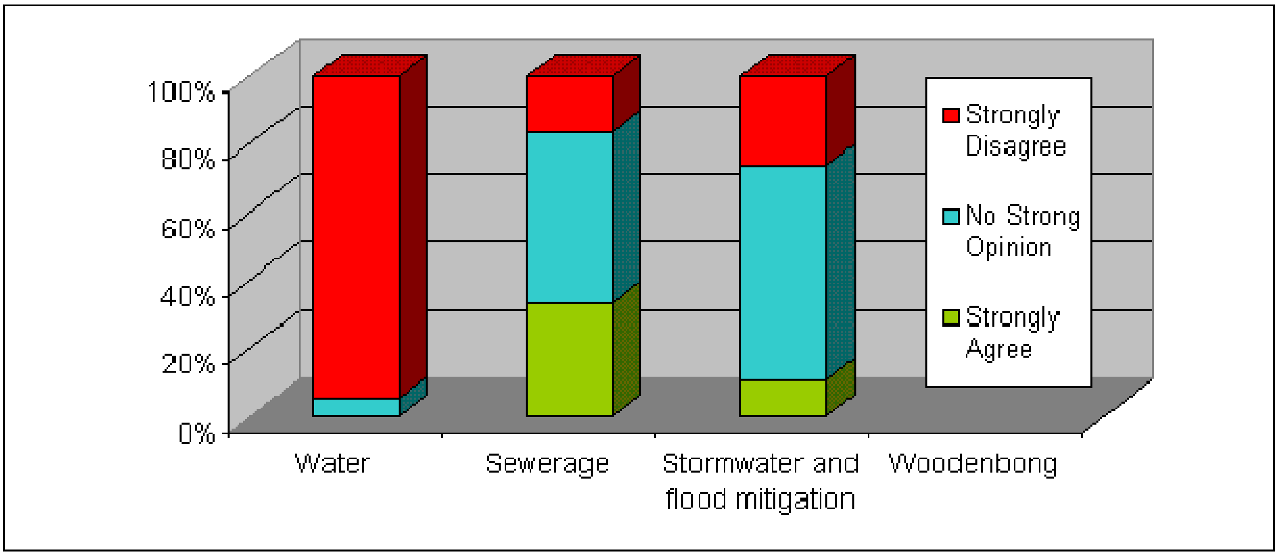
Q: Are you satisfied with the current level of service from each of the urban water services in your village?	Strongly Agree	No Strong Opinion	Strongly Disagree
Water	67	30	20
Sewerage	64	35	18
Stormwater and flood mitigation	48	38	31
Kyogle Customers			



Q: Are you satisfied with the current level of service from each of the urban water services in your village?	Strongly Agree	No Strong Opinion	Strongly Disagree
Water	3	0	4
Sewerage	6	0	1
Stormwater and flood mitigation	3	0	4
Bonalbo Customers			



Q: Are you satisfied with the current level of service from each of the urban water services in your village?	Strongly Agree	No Strong Opinion	Strongly Disagree
Water	0	1	18
Sewerage	6	9	3
Stormwater and flood mitigation	2	12	5
Woodenbong Customers			



Q: Are you satisfied with the current level of service from each of the urban water services in your village?	Strongly Agree	No Strong Opinion	Strongly Disagree
Water	0	8	8
Sewerage	1	9	6
Stormwater and flood mitigation	0	10	6
Other Areas