Riverina Water County Council

Drought Management Plan

NOVEMBER 2012

HydroScience

Strategic Water Solutions

Riverina Water County Council

Job Number A428

Drought Management Plan

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Document Control					
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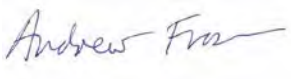
Rev	Author	Reviewer	Name	Signature	Date
2	SLA	AFR	Andrew Fraser		29 November 2012

Executive Summary

This Drought Management Plan has been developed to address demand-side and supply-side management of drought issues in the Riverina County Council (RWCC) water supply area. These actions are key components of RWCC's Drought Management System. The underlying approach is to address drought in accordance with the NSW Office of Water's Best-Practice Management Guidelines and the Water Directorate Guidelines.

This plan is presented to satisfy NSW Office of Water Best-Practice Management Guidelines' requirement and aims to regulate water supply in the events of reduced supply in RWCC water supply area. It includes actions and responses to drought situations that may affect RWCC's water supply.

This Drought Management Plan provides a series of scenarios and actions required by RWCC to respond to drought situations. These responses are in the form of water restrictions and options for additional actions addressing both demand and supply.

A drought end use model has been applied to develop demand triggers for the Wagga Wagga & Southern Trunk Main Systems and the Western Trunk Main System. Demand triggers were also developed for each of the independent village systems and the Holbrook System.

This plan includes a new set of water restrictions triggers for each water restriction trigger zone. These triggers are developed on the basis of considering the supplies from each trigger zones.

Council also needs to ensure there are appropriate documented drought communication systems in place. These are needed to implement and to monitor the effectiveness of the drought management actions implementation. This will ensure the community is informed in a timely manner and comply with restriction requirements.

Drought Management is subject to weather variability and consumer reactions to restrictions. This Plan provides a guide to management of drought and will need to be varied if circumstances require.

Contents

1 Introduction

1.1 Background & Purpose

The NSW Office of Water's Best-Practice Management of Water Supply and Sewerage Guidelines 2007, requires Local Water Utilities to have a sound Drought Management Plan in place and be ready to implement their plan when drought conditions arise. This plan has been developed to satisfy this requirement and ensure the community recognises the issues associated with drought management and their role in supporting Council's actions. A copy of NSW Office of Water's Best Practice Guidelines Drought Management checklist is included in Appendix A.

1.2 This Drought Management Plan

This Drought Management Plan (DMP) aims to describe how Riverina Water County Council (RWCC) will regulate reduced water supplies during drought. It can also be used, in an event of temporary system failure or emergency interruption of supply due to contamination e.g. blue green algae. It includes actions and responses to drought situations that may affect the RWCC's water supply systems.

It has been proposed for RWCC to adopt the modified water restrictions definition (see Appendix B) developed in conjunction with this Drought Management Plan.

This plan provides a series of scenarios of reduction in water availability and actions required by RWCC to respond to these situations. The responses are in the form of water restrictions and options for additional actions addressing both demand and supply.

The document has a number of uses:

- Firstly, as an operational support document for management;
- Secondly, as a public awareness and community communication tool for use by RWCC and individual councillors demonstrating transparent and responsible drought management;
- Thirdly, as an authorised approach to drought management enabling staff to act with the understanding that necessary actions have been endorsed beforehand;
- And fourthly, as the basis for further Government grant applications to address needs identified in the drought management plan.

2 Climate

The RWCC supply area covers the LGAs of Wagga Wagga City Council (WWCC), part of Greater Hume (GHSC), Lockhart (LSC) and Urana Shire Councils (USC). It is dominated by persistently dry semi-arid climate and characterized by hot summers and cool winters. Seasonal temperatures vary little across the area, both summer and winter temperatures tend to be higher in the north.

The highest levels of rainfall in the RWCC supply area occur in May and October. Annual rainfall tends to increase from west to east and from north to south. Average maximum temperature, monthly rainfall and evaporation profiles of the RWCC supply area are shown in Figure 1.

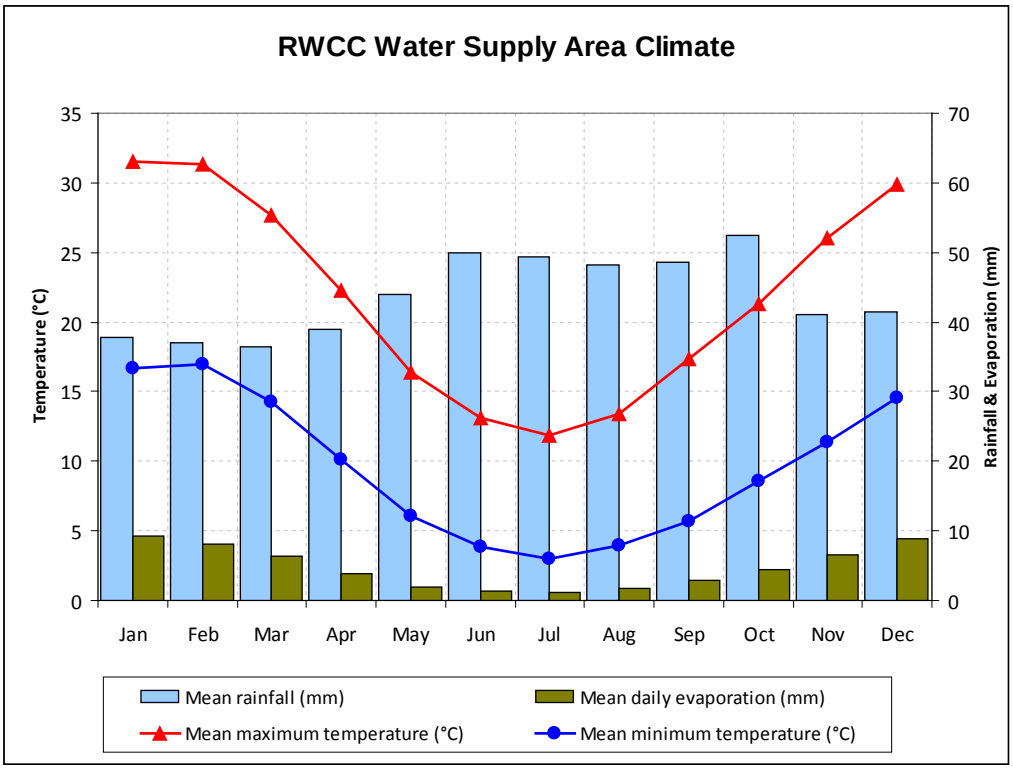


Figure 1: Temperature, Mean Rainfall & Daily Evaporation

(Source: mean max & min temperature (1913 – 1975), mean rainfall (1898 – 2012) & mean daily evaporation (1959-2007) at Wagga Wagga Agricultural Institute 35.05ºS 147.35ºE, Bureau of Meteorology)

3 Past Drought History

The Australian Bureau of Meteorology (BOM) defines drought as "a prolonged, abnormally dry period when there is not enough water for users' normal needs". BOM monitors rainfall deficiencies across Australia. The records of the total annual rainfall in Wagga Wagga in the past 100 years are shown in Figure 2.

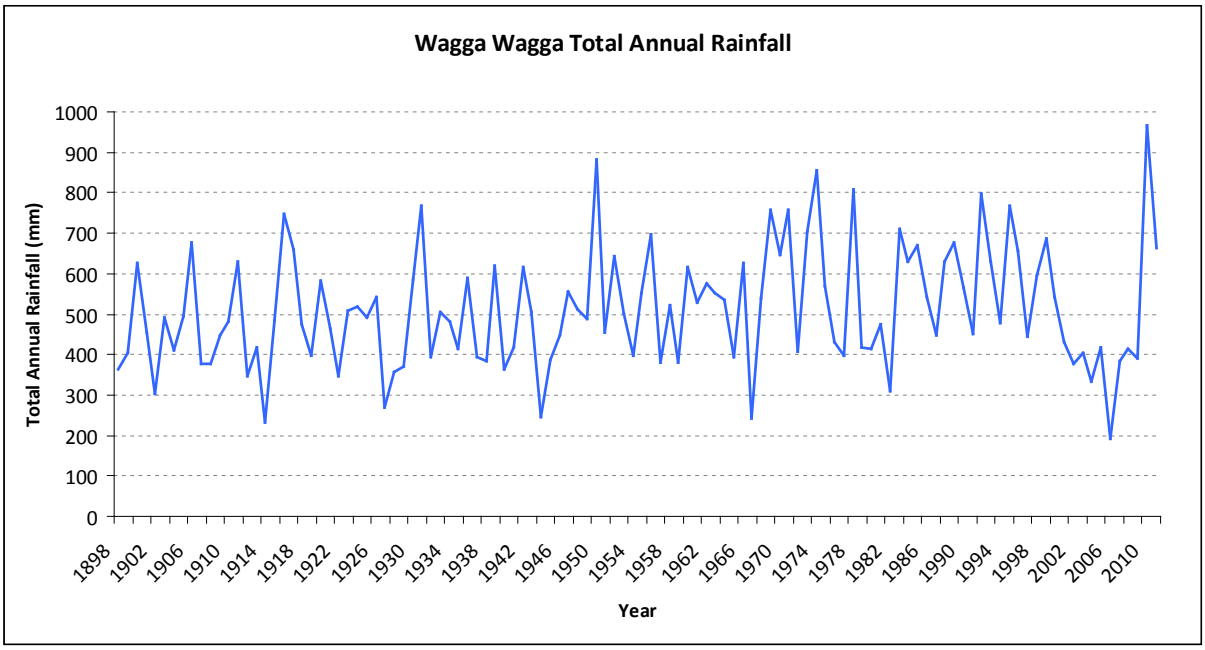


Figure 2: Total Annual Rainfall in Wagga Wagga

(Source: Monthly rainfall recorded at Wagga Wagga Agricultural Institute 1898 - 2011, Bureau of Meteorology)

However, the declaration of drought and the provision of drought assistance is the responsibility of the relevant State and Federal Government departments, which consider many factors apart from rainfall.

Investigations into irrigation using water from the Murrumbidgee River began in the 1890s and were further stimulated by the devastating drought at the turn of the century. In 1906, the NSW Government approved construction of the Burrinjuck Dam and the Berembed Weir on the Murrumbidgee. Work on Burrinjuck Dam; Berembed Weir and the Main Canal were completed in 1911 and irrigation water was available to the newly proclaimed Murrumbidgee Irrigation Area (MIA) in 1912. This huge irrigation scheme brings water from the Murrumbidgee River via a system of existing water courses and man-made channels (source: The Irrigation Industry in the Murray and Murrumbidgee Basins, CSIRO June 2005).

The reliability of RWCC surface supply from the Murrumbidgee River was further enhanced with the development of the Burrinjuck storage, the Snowy Mountains Scheme and the subsequent construction of the Blowering Dam. The increase in water supply reliability is indicated by the increase of minimum stream water level of Murrumbidgee River as shown Figure 3.

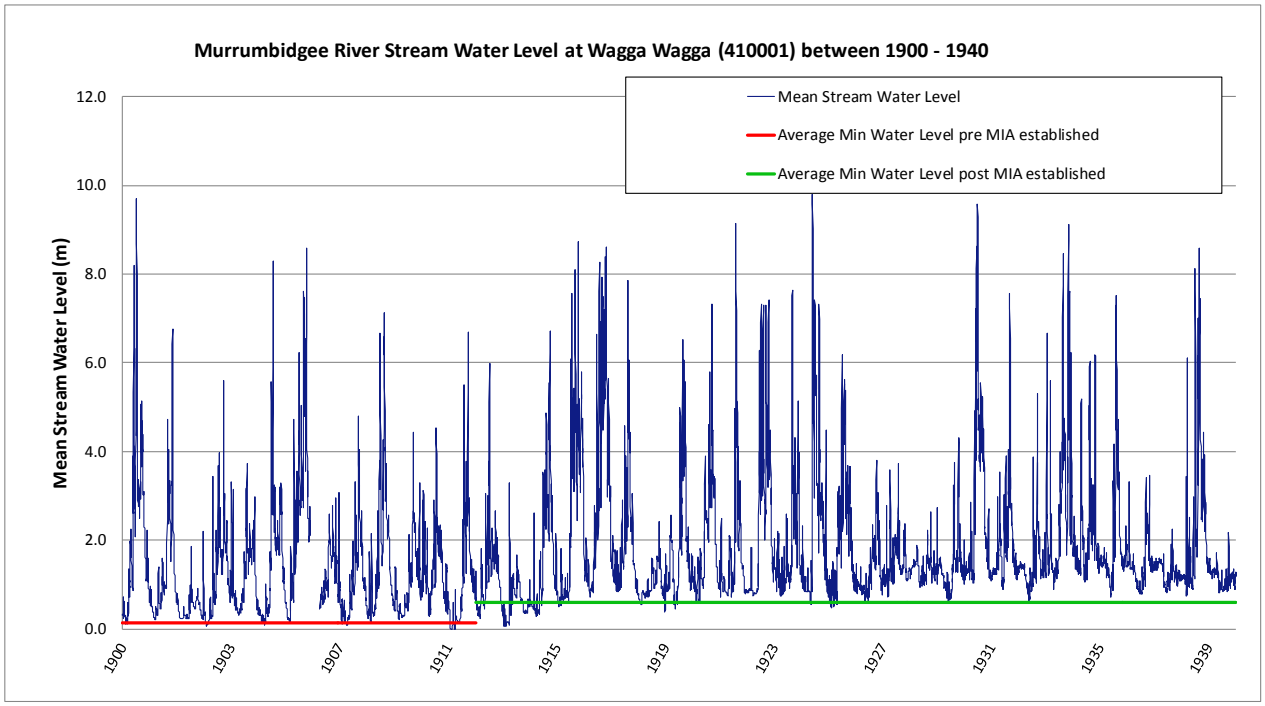


Figure 3: Murrumbidgee River Stream Water Level at Wagga Wagga in 1900 to 1940

(Source: RWCC provided data, Jan 2012)

The most recent critical water supply event occurred in 2007/08 when water supplies in the Murrumbidgee Valley became critically low as shown in Figure 4.

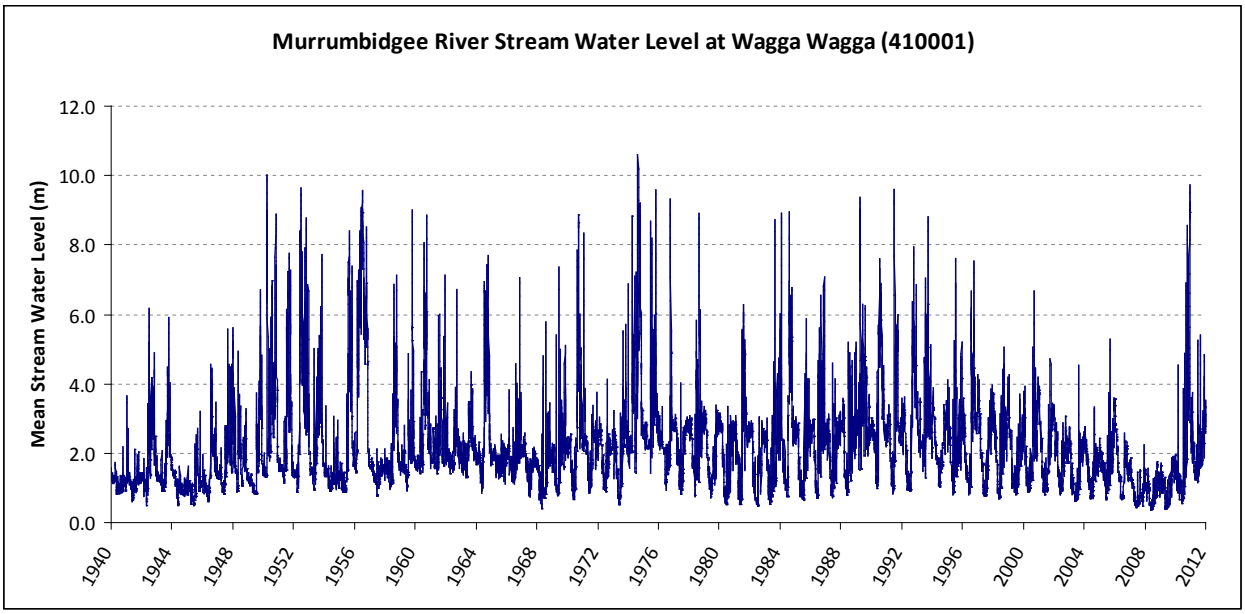


Figure 4: Murrumbidgee River Stream Water Level at Wagga Wagg in 1940 to 2012

(Source: RWCC provided data, Jan 2012)

Town surface water allocations were reduced. A summaries of the allocation changes from 2006 to 2008 and RWCC past water restrictions (2003 to 2009) are included in Table 1 and Figure 5 respectively.

Table 1: Past Critical Water Supply Events

Date	Event	Results
2006/07	Emphasis was placed to extract surface water from Murrumbidgee River in order to reduce stress on groundwater sources in Wagga Wagg.	Adjustment was made to the proportion of water taken from the groundwater source. 50.3% of the surface water - water access licence (WAL) extraction limit (8,000 ML) and 77.35% of the groundwater WAL extraction limit (14,000 ML) was used.
2007/08	Murrumbidgee Valley water supply remained critically low	Town surface water WAL were reduced to 50% in July 07 but increased to 100% by end of Dec 07. Underground WALs were not affected
2 Oct 2007	The Minister of Climate Change, Environment and Water (now Minister for Primary Industries) announced changes to availability of surface water WALs for the Murrumbidgee Valley	RWCC decided to maintain current water restrictions into Oct 07.

(Source: Minister of Climate Change, Environment and Water past media releases summary, RWCC emailed 14 Feb 2012)

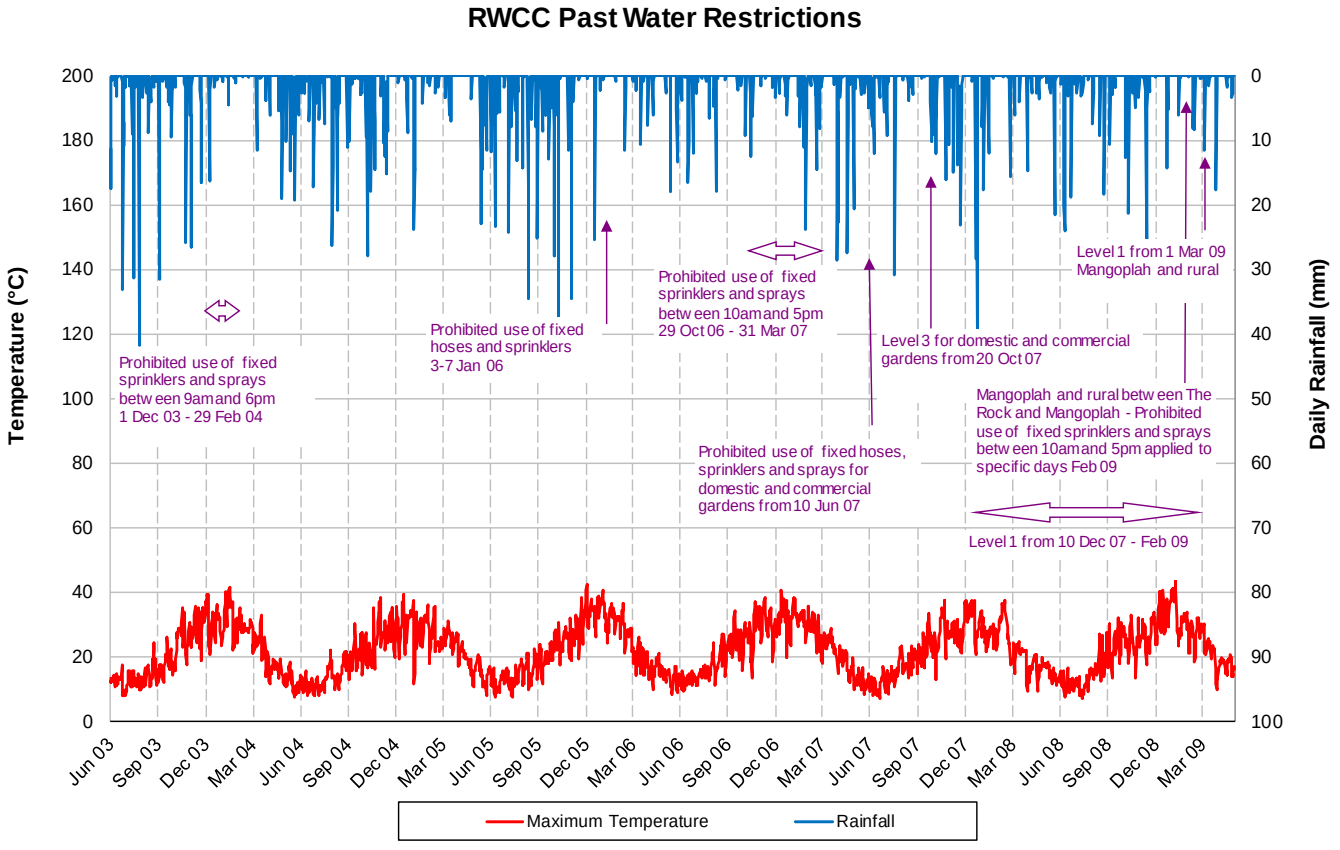


Figure 5: RWCC Past Water Restriction Levels and Durations

4 Water Supply Schemes

4.1 Water Sources

The river and underground water resources of the Murrumbidgee Valley form the major sources of supply for RWCC.

Around seventy per cent of the RWCC supply system is sourced from groundwater, the remaining thirty per cent is from surface water (source: Joint IWCM Evaluation Study, March 2010).

The aquifers in the Murrumbidgee Valley yield high flows and provide excellent quality groundwater suitable for town and domestic use (source: RWCC Description of Water Supply System, 2010).

4.2 Water Supply Schemes Overview

Riverina Water County Council (RWCC) provides reticulated water supplies to towns and villages within the Local Government Areas of Wagga Wagga City Council, Lockhart Shire, Urana Shire, and parts of Greater Hume Shire Councils. There are currently some 32,000 service connections within the approximately 15,400 sq. km served. The RWCC water supply area is shown in Figure 6 (source: RWCC website [accessed March 2012]).

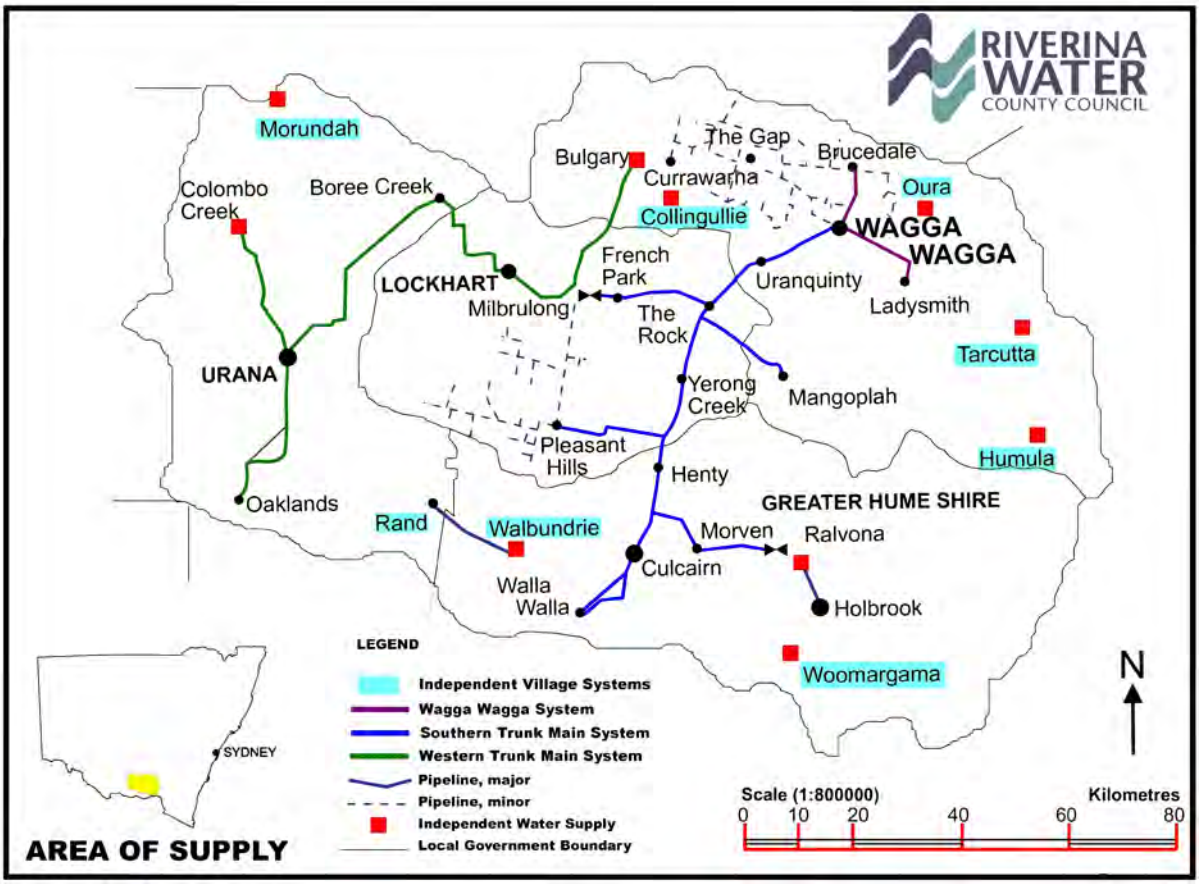


Figure 6: RWCC Water Supply Area

(Source: modified map, RWCC Description of Water Supply System, 2010)

The RWCC supply system consists of the following components:

- Principle headworks at Wagga Wagga – consisting of pumping, filtration and a treatment plant on the banks of the Murrumbidgee River and several underground bores situated at East, North and West Wagga Wagga;
- The Wagga Wagga pumps, reservoirs, trunk mains and reticulation mains;
- The pumps, mains, reservoirs and reticulation which serve the township and rural areas which receive supply from Wagga Wagga headworks as well as the Holbrook, Walla Walla, Urana and Bulgary sources and;
- The independent systems

The RWCC water supply systems are summarised in Table 2 and detailed in the following sections.

Table 2: RWCC Water Supply Systems

RWCC Water Supply Systems	Wagga Wagga system	Southern Trunk Main System	Western Trunk Main System	The Independent Systems
Systems included	(Including sources at both north & south of the Murrumbidgee River) ▪ Ladysmith ▪ Brucedale ▪ Currawarna	▪ Holbrook System (Although a pipeline connects Holbrook, it is generally operated alone) ▪ Walla Walla System ▪ Mangoplah System ▪ Pleasant Hills	▪ Urana System ▪ Bulgary System	▪ Tarcutta ▪ Humula ▪ Collingullie ▪ Morundah ▪ Oura ▪ Walbundrie/Rand ▪ Woomargama
Supply Areas	Northern source supplies to Brucedale, Estella, The Gap, Currawarna, Bomen and East Bomen. Southern source supplies to Ladysmith, suburbs of Wagga Wagga	Uranquinty, the Rock, Pleasant Hills, Mangoplah, Yerong Creek, Henty, Morven, Walla Walla, Holbrook	Milbrulong, Lockhart, Boree Creek, Urana, Oaklands	Towns in the area of the corresponding independent systems.

4.3 Wagga Wagga System

Wagga Wagga System water is sourced from the Murrumbidgee River and the East Wagga Borefields. The treated water is pumped to service reservoirs and then reticulated throughout the system.

Water is provided from the Wagga Wagga headworks system to the south of the Murrumbidgee River including Wagga Wagga, Turvey Park, South Wagga Wagga, Mount Austin, Tolland, Ashmont, Kooringal, Lake Albert, Forest Hill, Gumly Gumly, Glenfield, Bourkelands, Lloyd, Springvale, Tatton, Lakehaven and Glenoak.

North Wagga Wagga, Estella and Bomen, including Charles Sturt University and the Bomen industrial estate, are normally supplied entirely by the North Wagga Wagga source. North and South of the river are connected by 150 mm diameter pipelines on the Wiradjuri and Railway bridges, for use when circumstances require (Source: RWCC Description of Water Supply System, 2007).

The Wagga Wagga system also supplies to Ladysmith, Brucedale and Currawarna Systems.

4.4 The Southern Trunk Main System

Water is supplied to the Southern Trunk Main from the Wagga Wagga System. The system provides water supply to the following towns:

- The Rock, French Park, Milbrulong, Pleasant Hills and Yerong Creek in Lockhart Shire Council and Uranquinty.
- Henty, Morven, Walla Walla, a small number of customers in Culcairn and in emergency situation to Holbrook. These towns are all in the Greater Hume Shire.

4.4.1 Holbrook System

The Holbrook source works extracts water from 3 bores at Ralvona. The water is of good quality and requires simple system of chlorination and aeration for reticulation. RWCC operates 7 pumps and 2 reservoirs which serve Holbrook. This system has an unused connection to the Wagga Wagga system. However it can be supplied by the Southern Trunk Main System if required (source: RWCC Description of Water Supply System, 2007).

4.4.2 Walla Walla System

A supplementary source was established in Walla Walla in 1979 due to water shortages during summer months at Gardiner's Crossing. This bore is equipped with a submersible pumping unit. A second bore (#2) originally provided back up, however fine silica sand has restricted use to emergency situations only. Further development or treatment of the bore is required to maximise production.

Water from the bore discharges to an aeration tower at Gardiners Crossing and supply is then injected into Culcairn/Walla Walla trunk main by means of two high lift pumps. Flow towards Walla Walla arrives at two 90 kilolitre balance tanks at Mountain View where it is boosted to the Walla Walla service reservoir (Source: RWCC Description of Water Supply System, 2007).

4.5 The Western Trunk Main System

Additional sources were introduced Urana in 1966, and at Bulgary in 1983 to augment supply from the Wagga Wagga headworks. The Rural (Western Trunk Main) System then became, in effect a five separate system. However, the physical link at Milbrulong with the Wagga Wagga sources has not been severed (the valve is usually closed) and this original source is still capable of supplying all parts of the overall system (Source: RWCC Description of Water Supply System, 2007). The Western Trunk Main system is comprised of 25 rural reservoirs, 23 booster pumps, trunks mains and reticulation.

4.5.1 Urana System

Water is extracted from Colombo Creek and treated at the Urana Filtration Plant. RWCC is also responsible for 2 pumps, 1 reservoir and the reticulation system in Urana Shire Council. This system is usually used to boost supply is summer.

Oaklands and Urana towns are both supplied with water from the Bulgary system during winter months (source: RWCC Description of Water Supply System, 2007).

4.5.2 Bulgary System

RWCC operates 2 bores in Bulgary, the aeration plant, 4 pumps and an en-route reservoir. This en-route reservoir ensures supply to rural customers at times when the high lift pumps are not operating. Water from this reservoir is available to the Milbrulong balance tank. Supply from the balance tank is then available for distribution to Lockhart, Boree Creek, Urana and Oaklands as well as intervening rural customers (Source: RWCC Description of Water Supply System, 2010).

Figure 7 shows the supply areas cover by the Wagga Wagga, the Southern Trunk Main and the Western Trunk Main Systems.

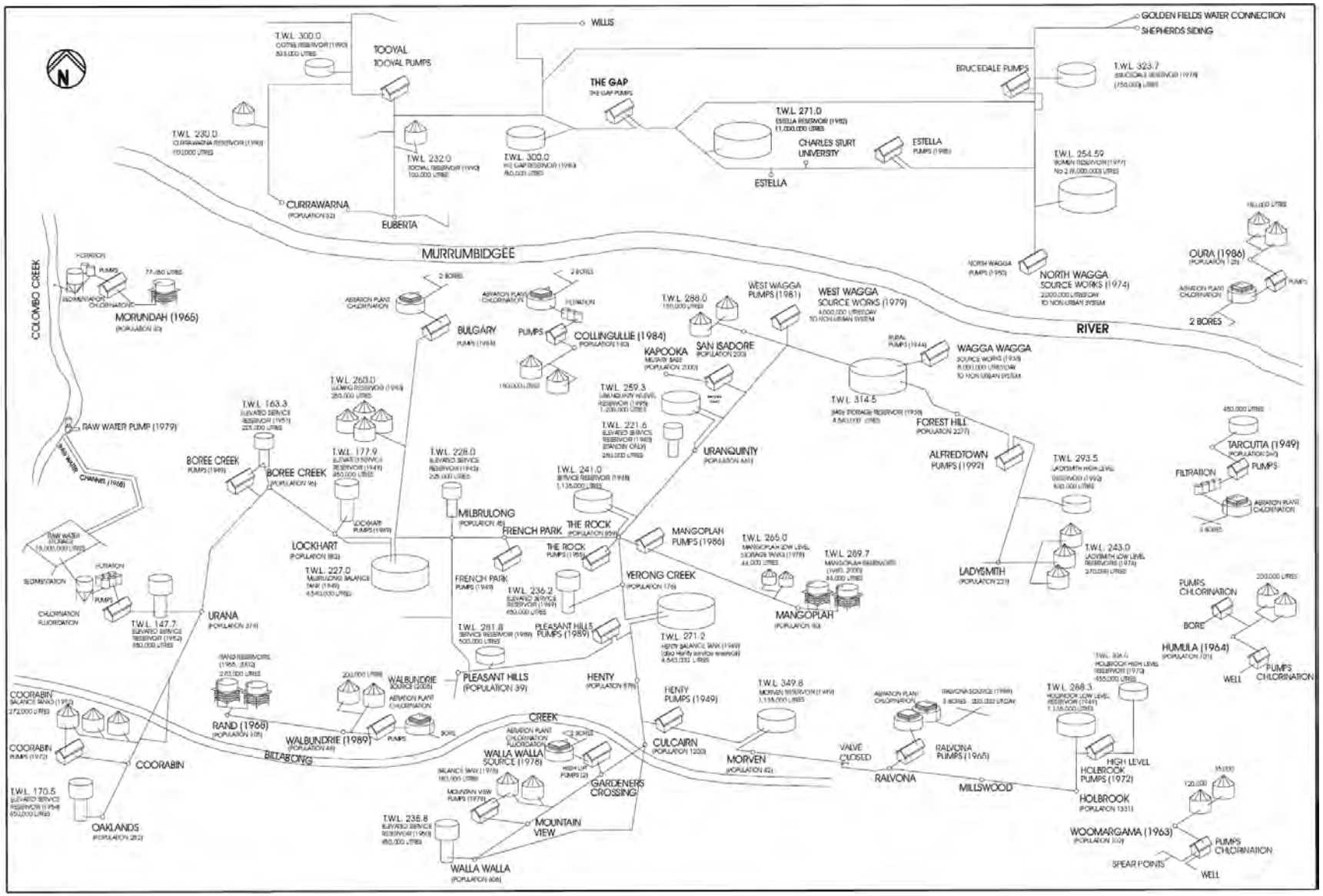


Figure 7: Wagga Wagga, Southern & Western Trunk Main Systems Water Supply Areas

(Source: RWCC Description of Water Supply System, 2010)

4.6 Independent Systems

RWCC operates the water supply components of the independent systems, which are listed below:

4.6.1 Tarcutta

Five bores have been drilled to draw groundwater alongside the Tarcutta Creek. Only two bores are currently in use and licensed. Bore no. 4 (40BL188929) is on the bank close to Tarcutta Creek and it will be submersed when the creek floods. Bore no. 5 (40BL188615) is located within the grounds of the treatment plant.

A two stage filtration treatment process is applied to remove the high levels of iron and manganese in all the bore supplies. The plant has a total capacity of 0.5ML/day. The filtered water is pumped into two Clear Water Storage tanks then pumped by high lift pumps through the reticulation to the reservoir. The three other bores have been decommissioned by means of grouting and there is no replacement bores planned (source: RWCC Water Quality Management System HACCP Manual, Dec 2011).

4.6.2 Humula

Humula water supply comes from two separate sources. A well (40BL013790) lies on the banks of the Umbango Creek and a bore (40BL190345) at the town's sportsground. The bore was drilled after the drought in 2002/03 when the well struggled to maintain supply for the village. Heavy restrictions were placed on the consumers and at times water had to be carted from Tarcutta.

The quality of the well water is extremely good with only chlorination required. The bore water however has low pH levels and must be aerated and chlorinated. The plant usually runs with both the well and the bore to ensure that pH levels meet the Australian Drinking Water Guidelines (ADWG).

The water is pumped from both sites into two 100 KL reservoirs which can be delivered directly to the village and also can be fed back to the village. The main concern for the distribution system was the saw mill, where timber is treated with chemicals. However the saw mill is closed and is unlikely to reopen.

A third WAL exists which allows for abstraction of surface water from the Umbango and Carabost Creeks (WAL6490). This water is not treated and was only supplied to the saw mill for use in their processes (source: RWCC Water Quality Management System HACCP Manual, Dec 2011).

4.6.3 Collingullie

The water supply for the village is drawn from a groundwater source located on the river flats of the Murrumbidgee River. Bore No. 1(40BL130644) delivers around 7L/s and Bore No. 3 (40BL188029) delivers around 10L/sec. The availability of power supply only allows for running one bore at a time.

The treatment plant consists of chlorination using sodium hypochlorite to oxidize the manganese and disinfect the water, aeration to remove dissolved gases and enhance oxidation and filtration to remove the precipitate. Water is then pumped through the reticulation en route to the two reservoirs. Periodic flushing may be required to scour the mains from the build-up of manganese. Additional spur lines exist to provide water to rural consumers.

4.6.4 Morundah

Morundah is a remote supply located 50km south of Narranderra. The water supply is drawn from the Colombo Creek which is part of the Murrumbidgee regulated river source. The system consists of a filtration plant that incorporates an upward flow clarifier and sand filter. The water is treated with soda ash pre and post filtration for pH adjustment. The water is then chlorinated before being pumped to the reservoir via the reticulation. The plant has a capacity of 200kl/day and the reservoir is 80kl (source: RWCC Water Quality Management System HACCP Manual, Dec 2011)

4.6.5 Oura

Water is sourced from 2 bores located at Oura alongside the Murrumbidgee River under the same license (40BL187952). This serves approximately 38 customers in Oura. Each bore, can produce around 7L/s, but only one bore is ever used at a time. The second bore located closest to the Murrumbidgee River remains as an emergencies backup due to the increasingly high levels of iron in recent years.

Treatment processes of chlorination and aeration are carried out before the water is transported through the reticulation system to a reservoir (source: RWCC Water Quality Management System HACCP Manual, Dec 2011).

4.6.6 Walbundrie/ Rand

The two surface water treatment plants were replaced in 2005 by a single bore located 3km east of Walbundrie (bore license number 50BL199213). The aquifer is part of the Billabong Valley, part of the Murray Catchment Area. A second bore provides a backup supply to the original production bore.

The treatment process consists of chlorination and aeration. The water can go directly to the Walbundrie reservoir or can continue through to supply Rand. The two villages have separate controls and either can call for water at anytime (source: RWCC Water Quality Management System HACCP Manual, Dec 2011).

4.6.7 Woomargama

Water is sourced from a single production bore alongside the Woomargama Creek (bore license number 50BL199264) and from an alternate source of two spear points direct into the creek as backup supply (50BL198112). The treatment process consists of chlorination before being pumped via the reticulation system to the reservoirs.

The distribution system sometimes suffers from iron and manganese build-up where pigging/air scouring has been required. It is planned to upgrade the plant in the future (source: RWCC Water Quality Management System HACCP Manual, Dec 2011).

4.7 Water Dependent Industries

Agriculture provides a significant economic return and employment in the Wagga Wagga area. Other top water users in the RWCC water supply areas are identified in Table 3 and Table 4.

Table 3: Top water users in Wagga Wagga, Southern Trunk Main & Western Trunk Main Systems

Ranking	Description	Connection Type	Average annual consumption (kL/y) 2010/2011
Wagga Wagga Main Systems (Including Ladysmith, Brucedale, Currawarna)			
1	Teys Australia Southern Property Pty, abattoir, Bomen	Industrial	632,025
2	Heinz H J Company Australia Limited, Bomen	Industrial	162,147
3	RAAF Base, Forest Hill	Bulk	139,304
4	Charles Sturt University, Estella	Education	130,502
5	Base Hospital, Wagga Wagga	Hospital	70,837
6	Fonterra Brands (Aust) Pty, Dairy Manufacturer, Wagga Wagga	Industrial	62,902
7	Botanic Gardens, Wagga Wagga	Parks	31,109
8	Health Administration Corporation, Laundry Services, Wagga Wagga	Commercial	31,044
9	Jubilee Park Sporting Fields, Wagga Wagga	Parks	28,390
10	Mount Austin High School, Wagga Wagga	Education	27,263
Southern Trunk Main System			
1	Army Base, Kapooka	Bulk	255,335
2	Hospital, Henty	Hospital	2,972
3	Lutheran Church & School, The Rock	Education	2,456
4	Lockhart Pool	Pool	2,417
5	Culcairn Hotel, Culcairn	Commercial	2,099
6	Abattoir, Culcairn	Industrial	2,068

Ranking	Description	Connection Type	Average annual consumption (kL/y) 2010/2011
7	Rural Farm, Pleasant Hills	Stock & Domestic	2,061
8	The Rock Bowling Club	Commercial	2,023
9	Rural Farm, Pleasant Hills	Stock & Domestic	2,022
10	School, The Rock	Education	1,985
Western Trunk Main System			
1	Urana Swimming Pool	Pool	6,843
2	Hospital, Lockhart	Hospital	2,332
3	Cemetery, Lockhart	Commercial	2,194
4	Showgrounds & Treatment Plant	Commercial	2,010
5	Retirement Village, Lockhart	Commercial	1,768
6	Lockhart Public School	Education	1,563
7	Hospital, Urana	Hospital	1,474
8	Central School, Oaklands	Education	1,372
9	Caravan Park, Urana	Commercial	1,247
10	Protea Farm, Oaklands	Commercial	1,185

(Source: RWCC data provided, Oct 2012)

Table 4: Top water users in Independent Village Systems & Holbrook

Ranking	Description	Connection Type	Average annual consumption (kL/y) 2010/2011
Independent Village Systems & Holbrook			
1	Diary, Oura	Stock & Domestic	10,277
2	Caltex Truck Stop, Holbrook	Commercial	4,194
3	Holbrook Swimming Pool	Pool	4,074
4	Rural Farm, Collingullie	Stock & Domestic	3,177
5	Holbrook Public School	Education	2,782
6	Retirement Village, Holbrook	Commercial	2,521
7	Caravan Park, Holbrook	Commercial	2,466
8	Rural Farm, Collingullie	Stock & Domestic	2,397
9	Amenities Block & Park, Holbrook	Park	2,325
10	Rural Farm, Collingullie	Stock & Domestic	2,295

(Source: RWCC data, Oct 2012)

It appears that there may be opportunity for potable water replacement with treated effluent reuse in parks and open space connection types. This may reduce the impact of top water consumption particular during drought period.

5 Drought Management: Demand

During drought, existing water resources are expected to decrease at a rate dependent on the respective water demand at a particular water restriction level.

RWCC has an existing Water Restrictions Policy which includes definitions; trigger points and actions correspondence to each of the stages of water restrictions. RWCC also has a permanent water conservation measure in place.

The following sections include details of a RWCC 5 stage water restriction level regime which has been developed based on modification to RWCC's previous restriction regime. This is recommended to address progressive reductions in water availability to the RWCC water supply areas.

Each proposed water restriction stage incorporates:

- Triggers – the situations that will cause the water restriction level to be declared.
- Water restriction definitions – aimed at reducing the water demand by customers through regulating the type and duration of water-using activities. If not specifically mentioned, the restrictions regime of each successive level includes at least the step of the previous levels.
- Targets – the demand levels that the water restriction levels aim to achieve.
- Other Actions – additional actions by RWCC that address either demand or supply and are aimed to supporting the restrictions as well as preparing for worsening situations. Public information should form part of these other actions, even when not specifically listed.

5.1 Triggers

In response to the reduction of water supply due to decrease in water allocation or diminishing water sources, water restrictions are declared with the intention to ensure the reduced water supply will meet the restricted demand.

5.1.1 Water Restrictions Trigger Zones

Due to the different water sources within the RWCC supply area, water restriction triggers and targets were developed based on "water restriction trigger zones" identified during the Drought Management workshop. These Water Restriction Trigger Zones details are summarized in Table 6. Water restriction targets and triggers for the 5 stage water restrictions are estimated based on the total water demand within each water restriction trigger zone.

Table 5: Water Restriction Trigger Zones

Water Restriction Trigger Zone		Water Source	Water Availability – Water Access Licence (WAL) Extraction Limit (ML per annum)
1	Wagga Wagga System (Including Ladysmith, Brucedale, Currawarna)	West Wagga (bores 1, 2, 4, 5) East Wagga (bores 1, 2, 3) North Wagga (bores 1, 2, 3), Murrumbidgee River	12,371 (groundwater) + 7000 (Murrumbidgee River); 1000 (Murrumbidgee River – High Security) (Note: for the purpose of the Drought End Use Model analysis, the Wagga Wagga System water availability was estimated on a population pro rata basis to calculate water available to the Wagga Wagga System after subtracting Southern Trunk's supply portion.)
2	Southern Trunk Main System	Both groundwater and surface supply from the Wagga Wagga System Walla bores	(Note: for the purpose of the Drought End Use Model analysis, the Southern Trunk water availability was estimated on a population pro rata basis to calculate the portion of water available from the Wagga Wagga System's supply.)
3	Western Trunk Main System	Colombo Creek, Bulgary Bore 1 & 3	1000 (Bulgary bores)+ 805 (Colombo Creek); 195 (Colombo Creek – Stock & Domestic)
4	Collingullie	2 Bores	150
5	Holbrook	3 Bores	500
6	Humula	Well beside Umbango Creek & 1 bore	20 (groundwater) +30 (surface water)
7	Morundah	Yanko Creek	13 +1(supplementary)
8	Oura	2 Bores	200
9	Tarcutta	2 Bores	100
10	Walbundrie - Rand	Billabong Creek & 2 bores	125
11	Woomargama	Woomargama Creek spear points & bore adjacent to Woomargama Creek	40

(Source: RWCC water access licences, RWCC Dec 2011)

5.2 Water Restrictions

5.2.1 Permanent Water Conservation Measure

Since January 2010 RWCC has established a permanent water conservation measure applicable to residential and non-residential usage within the RWCC water supply area. Fixed sprinklers usage is limited to between the hours of 5pm to 10am with the

intention to “increase water use efficiency by greatly reducing evaporation losses” (source: Water Restrictions - RWCC website [accessed March, 2012])

RWCC has also provided Wagga Wagga customers with weekly water targets and advised to reduced water consumption (source: RWCC website updated 15 Dec, 2011).

5.2.2 Water Restriction Definitions

It is understood that Council intends to standardise the 5 stage water restriction definitions and apply them across the entire RWCC water supply area. A set of modified water restrictions definitions has therefore been developed on this basis. A summary of the modified water restriction definitions are included in Appendix B.

The average per capita residential demand levels have been estimated for Wagga Wagga Urban (including Ladysmith, Brucedale and Currawarna), Southern Trunk and Western Trunk by applying a Drought End Use Model. For the independent villages and Holbrook System, it is assumed that the estimated targeted water supply of these systems have a similar pattern of water usage reduction percentage as the Southern Trunk Main System supply area.

5.3 Demand Targets

Water sources and availability for these water restriction trigger zones are different. In order to evaluate the drought demand target each water restriction level aims to achieve, analyses have been carried out for each of the Independent Systems and the Holbrook System. Drought End Use Models were applied for the more complex Wagga Wagga, Southern Trunk Main and Western Trunk Main System.

5.3.1 Drought End Use Model

The Drought End Use Model was developed to identify the community's water usage based on different customer types and the individual customer type usage.

The targeted reductions in water use will be dependent on the specific volumes of water used in each community. The development of the Drought End Use Model allows more accurate estimates to be prepared for communities in cooler/wetter and hotter/drier climate zones.

The Drought End Use Model was used to estimate the change in demand for each water end use under each level of water restrictions. This change in each end use is then aggregated to generate an estimate of the change in total water demand under each level of water restrictions.

Estimates of the volume of water use in different customer types are based on:

- Breakdowns in water use from water industry research (both residential and non-residential customer types); and

- A consideration of the total residential water use per connection and the number of persons per connection in the residential sector.

There are a variety of climate conditions across RWCC's supply area. While it can be expected that indoor water use per person in the residential sector will be quite consistent, it is likely that there will be much larger variations in external water use. By making these assumptions of uniform indoor water use, estimates of the volume of outdoor use can be made by subtracting the estimated volume of indoor use from the total use.

The model allows for assumptions on percentage of external use that goes to irrigation, leakage and "others". "Others" could, for instance, be car washes and evaporative cooling. The latter is a variable that changes according to climate and can be a large player in the demand analyses.

The major outcomes of the end use model are the expected residential water consumption per person and expected total annual consumption for each water restriction level.

5.4 Triggers and Demand Summary

A set of triggers were derived for each water restriction trigger zone. This section outlines the recommended triggers to be used for guidance in implementing RWCC water supply area-wide drought restrictions. If the expected demand reduction is not achieved by introduction of a restriction level, the next highest level should be applied.

Table 6: RWCC Proposed Water Restrictions Triggers

1. Wagga Wagga System (including Ladysmith, Brucedale and Currawarna)				
Water Sources:	Groundwater WAL extraction limit (12,371 ML per annum) Surface water WAL extraction limit - Murrumbidgee River (7,000per annum) (Note: for the purpose of the Drought End Use Model analysis, the Wagga Wagga System water availability was estimated on a population pro rata basis excluding the Southern Trunk Main System's supply portion.)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available is greater than or equal to 75% of the total WAL extraction Limits		**No Water Restriction**		
Water supply available is less than 75% of the total WAL extraction Limits		**Stage 1**	31.3	370
Water supply available less than 70% of the total WAL extraction Limits		**Stage 2**	28.1	320
Water supply available less than 60% of the total WAL extraction Limits		**Stage 3**	24.0	267
Water supply available less than 50% of the total WAL extraction Limits		**Stage 4**	15.5	131
Water supply available less than 40% of the total WAL extraction Limits		**Stage 5**	14.1	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Wagga Wagga Systems including Ladysmith, Brucedale and Currawarna)

1. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
2. Demand values were estimated by using a drought end use model on the basis of past consumption
3. Residential consumption per person at each water restriction levels was estimated by using a drought end use model on the basis of percentage reduction from the RWCC water restriction definitions.

2. Southern Trunk Main System	
Water Sources:	Groundwater WAL extraction limit (12,371 ML per annum) Walla Walla Bores WAL extraction limit (400 ML per annum) Surface water WAL extraction limit - Murrumbidgee River (7,000per annum) (Note: for the purpose of the Drought End Use Model analysis, the Southern Trunk Main water availability was estimated on a population pro rata basis to calculate the Southern Trunk Main's portion.)

Supply[1] Water Restriction Triggers	RWCC Water Restrictions	Demand[2] Estimated Total Demand Expected (incl. system leakage) ML/d	Demand[2] Residential Consumption per Person L/person/d
Water supply available is greater than or equal to 85% of the total WAL extraction Limits	No Water Restriction		
Water supply available is less than 85% of the total WAL extraction Limits	Stage 1	4.11	163
Water supply available less than 80% of the total WAL extraction Limits	Stage 2	3.95	159
Water supply available less than 75% of the total WAL extraction Limits	Stage 3	3.52	152
Water supply available less than 70% of the total WAL extraction Limits	Stage 4	3.09	131
Water supply available less than 60% of the total WAL extraction Limits	Stage 5	2.76	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Southern Trunk Main Systems including Ladysmith, Brucedale and Currawarna)

1. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
2. Demand values were estimated by using a drought end use model on the basis of past consumption
3. Residential consumption per person at each water restriction levels was estimated by using a drought end use model on the basis of percentage reduction from the RWCC water restriction definitions.

3. Western Trunk Main System	
Water Sources:	Groundwater WAL extraction limit – 2 Bulgary bores (1,000 ML per annum) Surface water WAL extraction limit - Colombo Creek (805 ML per annum)

Supply[1]	RWCC Water Restrictions	Demand[2]	
Water Restriction Triggers		Estimated Total Demand Expected (incl. system leakage)	Residential Consumption per Person
		ML/d	L/person/d
Water supply available greater than or equal to 35% of the total WAL extraction limit	No Water Restriction	1.38	-
Water supply available less than 35% of the total WAL extraction limit	Stage 1	1.20	340
Water supply available less than 30% of the total WAL extraction limit	Stage 2	1.08	296
Water supply available less than 25% of the total WAL extraction limit	Stage 3	0.92	250
Water supply available less than 20% of the total WAL extraction limit	Stage 4	0.64	131
Water supply available less than 15% of the total WAL extraction limit	Stage 5	0.53	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Western Trunk Main System)

1. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
2. Demand values were estimated by using a drought end use model on the basis of past consumption
3. Residential consumption per person at each water restriction levels was estimated by using a drought end use model on the basis of percentage reduction from the RWCC water restriction definitions.

4. Collingullie System				
Water Sources:	Total groundwater WAL extraction limit – 2 bores (150 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 55% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 55% of the total WAL extraction limit		**Stage 1**	0.208	163
Water supply available less than 45% of the total WAL extraction limit		**Stage 2**	0.172	159
Water supply available less than 35% of the total WAL extraction limit		**Stage 3**	0.136	152
Water supply available less than 25% of the total WAL extraction limit		**Stage 4**	0.100	131
Water supply available less than 25% of the total WAL extraction limit		**Stage 5**	0.028	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Collingullie System)

1. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
2. Demand values were estimated by using drought end use model on the basis of past consumptions
3. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

5. Holbrook System				
Water Sources:	Total groundwater WAL extraction limit – 3 bores (500 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 65% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 65% of the total WAL extraction limit		**Stage 1**	0.844	163
Water supply available less than 55% of the total WAL extraction limit		**Stage 2**	0.713	159
Water supply available less than 45% of the total WAL extraction limit		**Stage 3**	0.581	152
Water supply available less than 35% of the total WAL extraction limit		**Stage 4**	0.450	131
Water supply available less than 25% of the total WAL extraction limit		**Stage 5**	0.187	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Holbrook System)

4. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
5. Demand values were estimated by using drought end use model on the basis of past consumptions
6. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

6. Humula System				
Water Sources:	Groundwater WAL extraction limit – 1 bore (20 ML per annum), Surface water WAL extraction limit – Umbango Creek(30 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 50% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 50% of the total WAL extraction limit		**Stage 1**	0.039	163
Water supply available less than 40% of the total WAL extraction limit		**Stage 2**	0.033	159
Water supply available less than 35% of the total WAL extraction limit		**Stage 3**	0.027	152
Water supply available less than 30% of the total WAL extraction limit		**Stage 4**	0.021	131
Water supply available less than 20% of the total WAL extraction limit		**Stage 5**	0.009	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Humula System)

7. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
8. Demand values were estimated by using drought end use model on the basis of past consumptions
9. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

7. Morundah System				
Water Sources:	Surface water WAL extraction limit - Yanko Creek (14 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 85% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 85% of the total WAL extraction limit		**Stage 1**	0.028	163
Water supply available less than 75% of the total WAL extraction limit		**Stage 2**	0.024	159
Water supply available less than 70% of the total WAL extraction limit		**Stage 3**	0.019	152
Water supply available less than 65% of the total WAL extraction limit		**Stage 4**	0.015	131
Water supply available less than 60% of the total WAL extraction limit		**Stage 5**	0.006	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Morundah System)

10. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
11. Demand values were estimated by using drought end use model on the basis of past consumptions
12. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

8. Oura System				
Water Sources:	Total groundwater WAL extraction limit - 2 bores (200 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 30% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 30% of the total WAL extraction limit		**Stage 1**	0.122	163
Water supply available less than 25% of the total WAL extraction limit		**Stage 2**	0.102	159
Water supply available less than 20% of the total WAL extraction limit		**Stage 3**	0.081	152
Water supply available less than 15% of the total WAL extraction limit		**Stage 4**	0.060	131
Water supply available less than 10% of the total WAL extraction limit		**Stage 5**	0.018	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Oura System)

13. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
14. Demand values were estimated by using drought end use model on the basis of past consumptions
15. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

9. Tarcutta System				
Water Sources:	Total groundwater WAL extraction limit - 3 bores (100 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 55% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 55% of the total WAL extraction limit		**Stage 1**	0.141	163
Water supply available less than 50% of the total WAL extraction limit		**Stage 2**	0.119	159
Water supply available less than 45% of the total WAL extraction limit		**Stage 3**	0.097	152
Water supply available less than 40% of the total WAL extraction limit		**Stage 4**	0.075	131
Water supply available less than 35% of the total WAL extraction limit		**Stage 5**	0.031	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Tarcutta System)

16. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
17. Demand values were estimated by using drought end use model on the basis of past consumptions
18. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

10. Walbundrie – Rand System				
Water Sources:	Total groundwater (2 bore) & surface water WAL extraction limit - (125 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 35% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 35% of the total WAL extraction limit		**Stage 1**	0.105	163
Water supply available less than 30% of the total WAL extraction limit		**Stage 2**	0.087	159
Water supply available less than 25% of the total WAL extraction limit		**Stage 3**	0.068	152
Water supply available less than 20% of the total WAL extraction limit		**Stage 4**	0.050	131
Water supply available less than 15% of the total WAL extraction limit		**Stage 5**	0.013	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Walbundrie - Rand System)

19. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
20. Demand values were estimated by using drought end use model on the basis of past consumptions
21. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

11. Woomargama System				
Water Sources:	Total groundwater & surface water WAL extraction limit - (40 ML per annum)			
Supply[1]		**RWCC Water Restrictions**	**Demand[2]**	
Water Restriction Triggers			**Estimated Total Demand Expected (incl. system leakage)**	**Residential Consumption per Person**
			ML/d	**L/person/d**
Water supply available greater than or equal to 50% of the total WAL extraction limit		**No Water Restriction**		
Water supply available less than 50% of the total WAL extraction limit		**Stage 1**	0.054	163
Water supply available less than 45% of the total WAL extraction limit		**Stage 2**	0.045	159
Water supply available less than 40% of the total WAL extraction limit		**Stage 3**	0.035	152
Water supply available less than 30% of the total WAL extraction limit		**Stage 4**	0.025	131
Water supply available less than 20% of the total WAL extraction limit		**Stage 5**	0.005	123

(Note: Values in the table above were developed based on 2008/09 water consumption data from the Woomargama System)

22. Supply triggers developed for guidance in implementing drought restrictions. The water restriction triggers are initiated on the basis of a percentage of the combined WAL extraction limits for each water supply system.
23. Demand values were estimated by using drought end use model on the basis of past consumptions
24. Residential consumption per person at each water restriction levels was estimated by using drought end use model on the basis of percentage reduction from the RWCC water restriction definitions. For independent villages, it was assumed that they have a similar pattern of water usage reduction as the Southern Trunk Main System water supply area.

5.4.1 Drought Demand Targets

Water consumption is not the same in summer as it is in winter. The following section provides guidance on implementing restriction levels in different seasons.

For the Wagga Wagga, the Southern Trunk Main and the Western Trunk Main System, a seasonalised cumulative approach was developed for each of these systems to meet their water restriction trigger levels.

In Figure 8, Figure 9 and Figure 10, the seasonalised cumulative approach also infers the effect of evaporation on external consumption. The graphs show that the seasonal cumulative consumption rate is more prominent for water restriction Level 1 to 3 and lower for Levels 4 and 5 where consumption is mostly based on internal consumption.

RWCC would need to examine the consumption rates and on a monthly seasonalised basis determine if water restrictions are required to be tightened to achieve the expected restricted consumption levels.

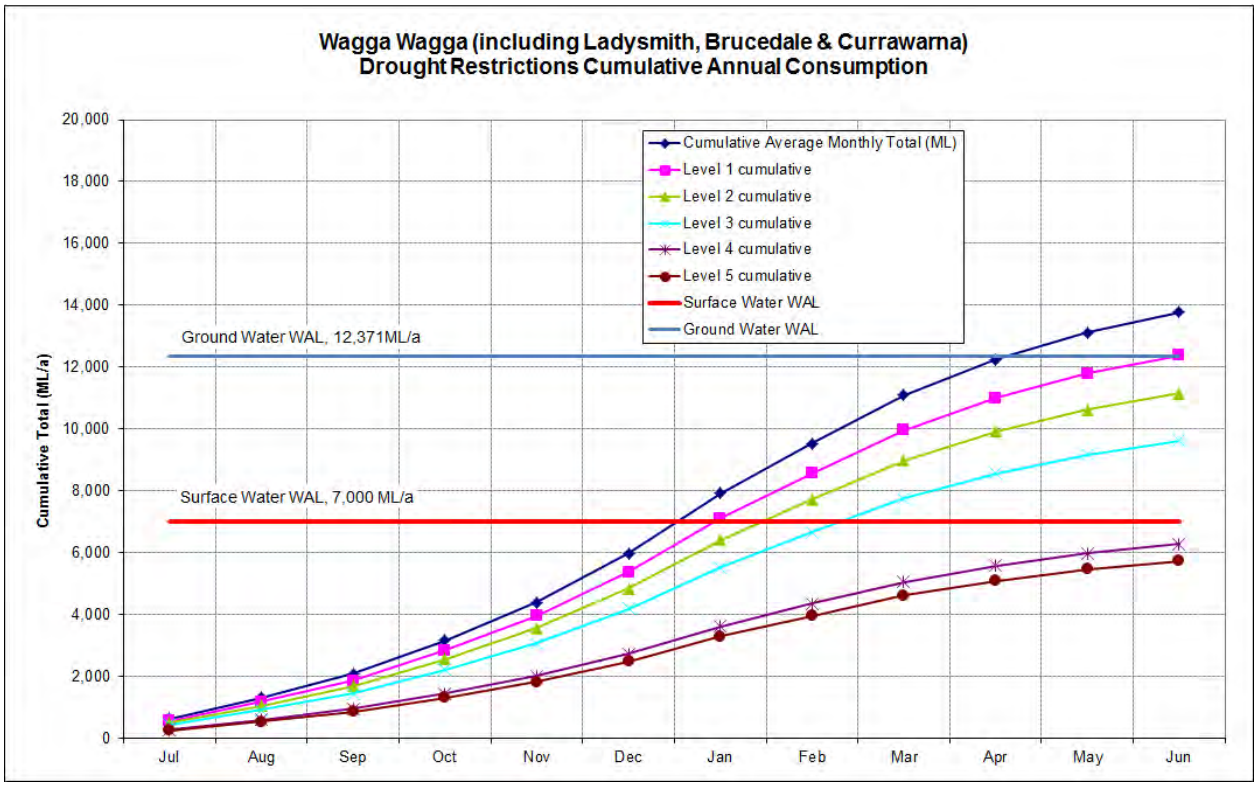


Figure 8: Wagga Wagga System Drought Restrictions Cumulative Annual Consumption (Seasonalised)

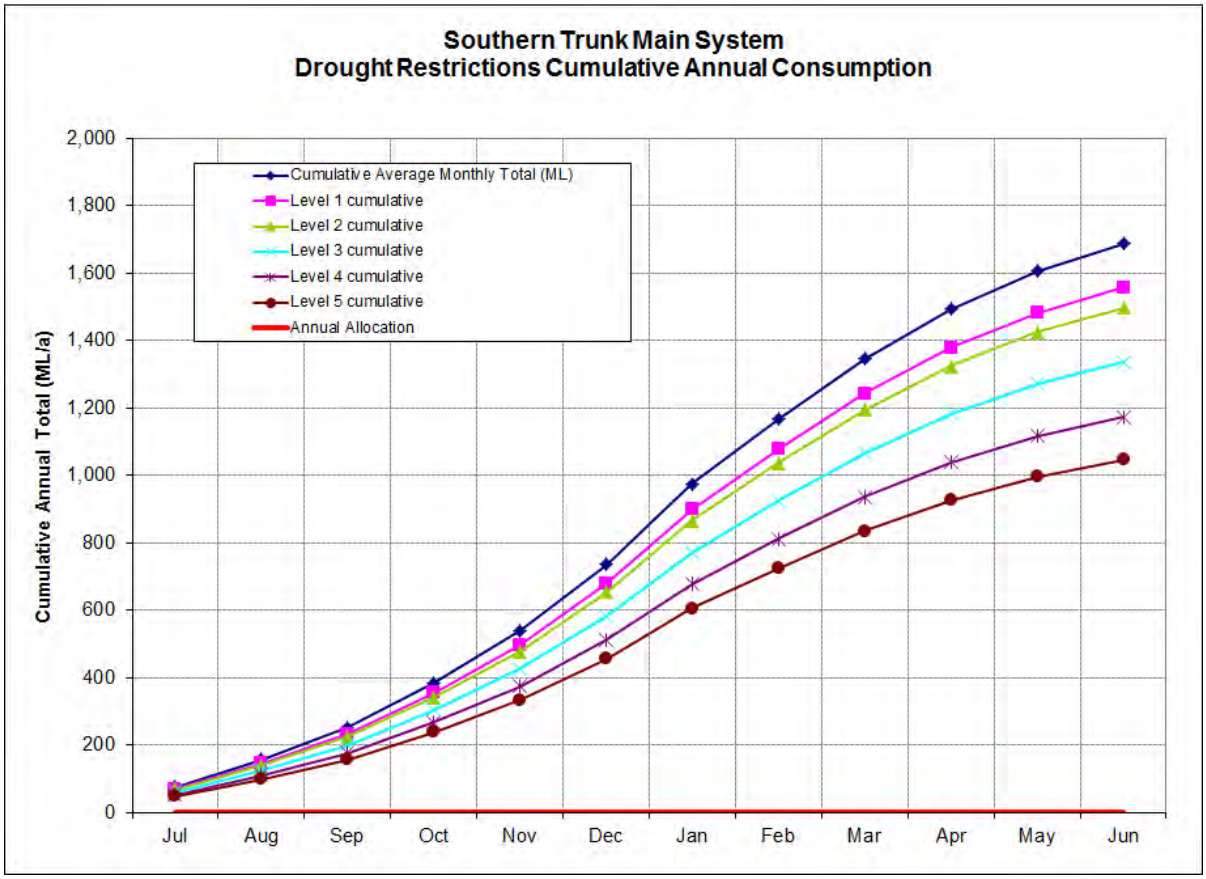


Figure 9: Southern Trunk Main System Drought Restrictions Cumulative Annual Consumption (Seasonalised)

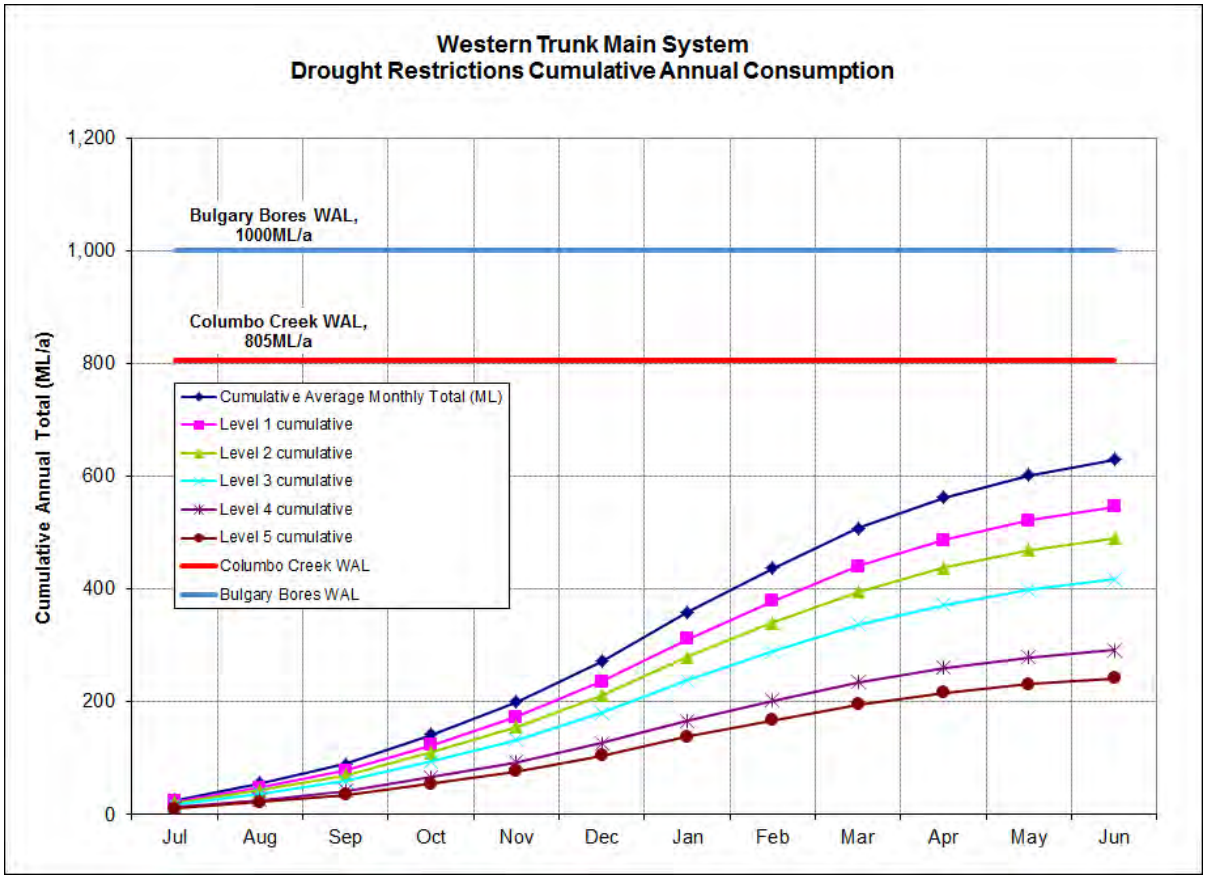


Figure 10: Western Trunk Main System Drought Restrictions Cumulative Annual Consumption (Seasonalised)

6 Drought Management – Supply

During drought, existing water resources are expected to decrease at a rate dependent on the respective water demand at the particular water restriction level being applied. While the existing water resources are diminishing, other supply options may be considered for preparation as potential alternatives for supplementary or emergency water source.

6.1 Alternate Supply Options

Alternate surface water resources have been considered on the basis of water supply communities, however for the purpose of this Drought Management Plan, alternative water sources are grouped on the basis of water restrictions triggers zones. Details of these alternative water sources are summarised in Table 7.

Table 7: Alternative Water Source

Community	Primary Water Sources	Alternative Water Source
Wagga Wagga & Southern Trunk Main Systems (Including Ladysmith, Brucedale, Currawarna)		
Wagga Wagga – North Includes North Wagga, Bomen, Brucedale, The Gap and Currawarna	3 Bores within Murrumbidgee Aquifers	Limited supply from Wagga Wagga Waterworks via pipeline across railway bridge Supply North Wagga from Wagga Low Level System via Hampden Bridge
Wagga Wagga – South includes all suburbs south of Murrumbidgee River	Murrumbidgee River 3 East Wagga bores 4 West Wagga bores	The mix of primary sources provides the only security of a size to cover this system
Culcairn	Water supply run by Greater Hume Shire Council	Not applicable
Henty	As for Wagga Wagga South with additional water available from Walla Walla Bore	As for Wagga Wagga South Option to use Greater Hume Water Supply at Culcairn
Morven		
Pleasant Hills		
Mangoplah	As for Wagga Wagga South	As for Wagga Wagga South Option to use Greater Hume Water Supply at Culcairn
The Rock		
Uranquinty		
Yerong Creek		

Community	Primary Water Sources	Alternative Water Source
Walla Walla	As for Wagga Wagga South Walla Bore (normally summer only)	As for Wagga Wagga South Walla Bore Option to use Greater Hume Water Supply at Culcairn
Various rural communities along trunk mains	As per the relevant town/village supplied by trunk mains	As per the relevant town/village supplied by trunk mains
Western Trunk Main System		
Boree Creek	Bulgary Bores (1 duty, 1 standby)	Limited supply from Wagga Wagga via The Rock and Milbrulong Balance Tank
Lockhart		
Milbrulong	As for Wagga Wagga South	As for Wagga Wagga South
Oaklands	Bulgary Bores (1 duty, 1 standby) Urana WTP (source from Colombo Creek)	Two independent primary sources Limited supply from Wagga Wagga via The Rock and Milbrulong Balance Tank
Urana		
Independent Village Systems & Holbrook		
Collingullie	2 Bores	No alternative should both bores fail
Holbrook	3 Bores	Limited supply from Wagga Wagga should all 3 bores fail
Humula	Well beside Umbango Creek & 1 bore	No alternative should both Umbango Creek and bore supplies fail
Morundah	Colombo Creek	No alternate supply
Oura	2 Bores	No alternative should both bores fail
Tarcutta	2 Bores	No alternative should both bores fail
Walbundrie /Rand	Billabong Creek & 2 bores	No alternative surface water as Water Treatment Plant is unserviceable
Woomargama	Woomargama Creek spear points & bore adjacent to Woomargama Creek	Two sources provide limited backup as they are tapping similar aquifers

6.1.1 Other Potential Alternative Sources

Recycled water reuse and stormwater harvesting are commonly considered for the potential to reduce and replace potable water usage. Wagga Wagga City Council (WWCC) has existing treated effluent reuse schemes in Wagga Wagga (Narrung Reuse Schemes). Greater Hume Shire Council (GHSC) has schemes at Henty, Holbrook and Walla Walla. Lockhart Shire Council (LSC) also has a reuse scheme. However, low water consumption rates during drought water restriction periods will deliver low inflow to the wastewater treatment facilities and consequently less recycled water is produced. Recycled water is therefore, at this time an unlikely alternative supply option during drought except WWCC, GHSC and LSC's reuse schemes.

There are previous studies on potential stormwater harvesting by Wagga Wagga City Council. However, stormwater is also likely to be in low supply during drought and is therefore not likely to be considered as a reliable alternative water resource.

6.1.2 Demand Measures

RWCC currently has permanent water conservation measure in place. The permanent water conservation measure does not apply to sub-soil or drip irrigation systems, car washing, hand-held watering and filling pools.

RWCC provides advice to customer on how to achieve water usage reduction. In addition, water targets for Wagga Wagga customers are published on a weekly basis (source: RWCC website updated 15 Dec, 2011.

RWCC is currently developing a formal demand management or water conservation program. Details are included in the Demand Management Plan.

6.1.3 Water Carting & Evacuation

Water Carting may be identified as an acceptable option when all other supplies fail. Table 8 provides a preliminary guide to water carting feasibility based on trucking via road transportation. This can only be a guide, as towns distant from alternative emergency supply sources suffering extreme drought may have no choice, other than evacuation, but to utilise water carting.

Table 8: Water Carting Appropriateness

Number of people	Water Carting Option Feasibility	Advantages/ Disadvantages
10	Yes	Low cost, quick to implement
100	Yes	Low cost, quick to implement
1000	Maybe	
5000	Probably not	
20000	No	Very Expensive
50000	No	Very Expensive, logistically almost impossible to organise and coordinate, long lead times required to prepare.

From the above table it is clear that water carting to Wagga Wagga is not practicable.

Under extreme circumstances evacuation is a possible option for small populations. However for large populations evacuation is very difficult. The social disruption would be very difficult to manage for a large population.

During drought, Government assistance towards the cost of water cartage is available from the Minister for Primary Industries but is subject to quantities and cartage arrangements being agreed with the NSW Office of Water.

The subsidy is reviewed periodically. Currently the NSW Government may meet all freight charges in excess of $1.86 per kilolitre to supply towns with a reticulated supply, or $3.73 per kilolitre for those without a reticulated supply. Financial assistance is not available for hiring or operating temporary pumps or pipelines, or for costs of management measures. However in considering drought assistance for capital works water carting cost provide a benchmark for NSW Office of Water and NSW Treasury to assess their volume. (Source: Drought Relief for Country Towns, NSW Office of Water, Nov 2009)

Water Carting Implementation

Based on the population supplied by each of the water restrictions trigger zones as shown in Table 9, water carting is only considered to be appropriate for the Western Trunk Main system and the 8 Independent Village Supply systems. However the Western Trunk Main system has an existing valved connection to Wagga Wagga System. Therefore as long as the main wagga system is viable, water carting would not be necessary.

Table 9: Water Supply Population

Water Supply Systems	Population (2008)
Wagga Wagga & Southern Trunk Main Systems (Including Ladysmith, Brucedale, Currawarna)	**Zone Total = 60,352**
Wagga Urban System	54,012
Southern Trunk System	5,972 (excluding 1,300 people from Culcairn)
Brucedale	138 rural properties
Currawarna	80
Ladysmith	150
Western Trunk Main System	**Zone Total = 3,194**
Western Trunk System	3,194
Independent Village Systems & Holbrook	
Collingullie	140
Holbrook	1400
Humula	145
Morundah	29
Oura	76
Tarcutta	350
Walbundrie/Rand	40/120
Woomargama	120

The optimum water carting locations for each of the 8 independent village supply systems would be based on the minimal transport distance and the water availability at an alternative supply source. In the event of drought when water carting is required, it is recommended for each of these 8 independent village supply systems to access a water source along the Wagga Wagga supply network via the shortest transport distance.

During a drought event, it is assumed that water carting is intended for domestic internal consumption only.

Based on RWCC's past water carting record of $787 (including GST) to transport 55 kL from Junee to Oura, an assumption of $0.40 per kilometre per kilolitre transport cost was made for the water carting cost estimations shown below.

Calculation:

Water Carting Cost	=	**Water Carting Cost** [i.e. Unit cost per kilometre per kilolitres x distance travel (km) x Carting Volume (kL)]	+	**Water Supply Cost** (Cost of water if is supplied from other Councils)

Table 10: Cost Estimation for Water Carting

(Note: the estimated water carting costs below has not included Government subsidy)

Water Carting to:	Collingullie System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	Bulgary			Estimate Distance (km):			18.1
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	133	266	398	929	1,859	3,983	12,083
Source Water From:	Uranquinty			Estimate Distance (km):			22.0
Estimated Water Carting Cost ($)	161	323	484	1,130	2,259	4,842	14,687

Water Carting to:	Humula System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	Tarcutta			Estimate Distance (km):			27.7
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	210	421	631	1,473	2,947	6,314	19,152
Source Water From:	Ladysmith			Estimate Distance (km):			61.4
Estimated Water Carting Cost ($)	467	933	1,400	3,266	6,531	13,996	42,453

Water Carting to:	Morundah System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	Colombo Creek			Estimate Distance (km):			50
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	36	71	107	250	500	1,071	3,247

Water Carting to:	Oura System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	**Wagga Wagga**			**Estimate Distance (km):**			**18.1**
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	24	119	178	415	830	1,778	5,394

Water Carting to:	Tarcutta System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	**Ladysmith**			**Estimate Distance (km):**			**50**
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	798	1,596	2,393	5,585	11,169	23,934	72,599
Source Water From:	**Humula**			**Estimate Distance (km):**			**27.7**
Estimated Water Carting Cost ($)	508	1,016	1,524	3,556	7,112	15,241	46,230

Water Carting to:	Walbundrie Rand System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	**Culcairn**			**Estimate Distance (km):**			**31.8**
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	267	533	800	1,866	3,733	7,998	24,262
Water Cost @$1.20/kL (Greater Hume Shire Council 2011/12 water pricing for 0-200kL)	25	50	75	176	352	755	2,289
Total Cost ($)	292	584	875	2,042	4,085	8,753	26,550
Source Water From:	**Albury City Council**			**Estimate Distance (km):**			**50.5**
Estimated Water Carting Cost ($)	423	847	1,270	2,964	5,927	12,702	38,529
Water Cost @$0.76/kL (Albury City Council 2011/12 water pricing for 0-225kL)	16	32	48	112	223	478	1,450
Total Cost ($)	439	879	1,318	3,075	6,151	13,180	39,978

Water Carting to:	Woomargama System			Assumed demand for internal consumption (L/person/d):			131
Source Water From:	Holbrook			Estimate Distance (km):			14.1
Water Carting Duration (days)	1day	2 days	3 days	1 week	2 weeks	One month	Three months
Estimated Water Carting Cost ($)	222	443	665	1552	3103	6650	20170
Source Water From:	Albury City Council			Estimate Distance (km):			48.2
Estimated Water Carting Cost ($)	303	606	909	2,122	4,243	9,092	27,580
Water Cost @$0.76/kL	12	24	36	84	167	358	1,087
Total Cost ($)	315	630	945	2,205	4,410	9,451	28,668

Note: Albury City Council 2011/2012 water rate for 0-225kL is $0.76/kL; 226 – 20,000kL is $1.55/kL

6.2 Drought Management Supply Actions

When drought occurs, actions must be taken to mitigate the effects of water shortage and assure a reliable water supply is available to meet the health and safety needs of the community.

Drought management supply actions should begin to be implemented while the community takes action to reduce water demand using water restrictions. The supply actions shown here are proposed to be implemented within a time frame of which the available water supply is sufficient to sustain the estimated water demand at the particular water restriction level.

RWCC's water restriction levels would be implemented within a time frame with consideration of water availability during drought. The respective drought supply side actions have been derived to suit this. Details of the drought supply side actions for each water restriction trigger zone are included in Table 11. These water restriction triggers are meant to be used as a guide to when supply actions need to be implemented. The triggers provide indications as to when the water supply is approaching the water demands at each water supply system (based on the end use model analysis) at each water restrictions levels.

Table 11: Proposed Triggers & Staged Drought Supply Side Actions

1. Wagga Wagga System (Including Ladysmith, Brucedale, Currawarna)		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available is less than 75% of the total WAL extraction Limits	**Stage 1**	▪ Monitor and document all bore capacities ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 70% of the total WAL extraction Limits	**Stage 2**	▪ Monitor and document all bore capacities ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 60% of the total WAL extraction Limits	**Stage 3**	▪ Monitor and document all bore capacities ▪ Monitor and document Murrumbidgee River flow rate ▪ Concept design and REF for connection to GWCC bores
Water supply available less than 50% of the total WAL extraction Limits	**Stage 4**	▪ Monitor and document all bore capacities ▪ Monitor and document Murrumbidgee River flow rate ▪ Detailed design of connection to GWCC bores
Water supply available less than 40% of the total WAL extraction Limits	**Stage 5**	▪ Construct and operate connections to GWCC bores ▪ Possible partial or full evacuation

2. Southern Trunk Main System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available is less than 85% of the total WAL extraction Limits	**Stage 1**	▪ Monitor and document all bore capacities (including Walla Walla bores) ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 80% of the total WAL extraction Limits	**Stage 2**	▪ Monitor and document all bore capacities (including Walla Walla bores) ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 75% of the total WAL extraction Limits	**Stage 3**	▪ Monitor and document all bore capacities ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 70% of the total WAL extraction Limits	**Stage 4**	▪ Monitor and document all bore capacities (including Walla Walla bores) ▪ Monitor and document Murrumbidgee River flow rate
Water supply available less than 60% of the total WAL extraction Limits	**Stage 5**	▪ Possible partial or full evacuation

3. Western Trunk Main System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 35% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document Bulgary bore capacities ▪ Monitor and document Colombo Creek flow rate ▪ Monitor trend in allocation levels
Water supply available less than 30% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document Bulgary bore capacities ▪ Monitor and document Colombo Creek flow rate ▪ Review of arrangement to access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 25% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document Bulgary bore capacities ▪ Monitor and document Colombo Creek flow rate ▪ Review and inspection access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 20% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document all bore capacities ▪ Review and inspection access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 15% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Enquire and verify the availability of water supply from the Wagga Wagga & Southern Trunk Main Systems

4. Collingullie System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 55% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document all bore capacities
Water supply available less than 45% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document all bore capacities ▪ Review of water carting arrangement and infrastructure required to obtain water from the closest standpipe or filling station connected to the Wagga Wagga & Southern Trunk Main Systems or the Western Trunk Main System
Water supply available less than 35% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document all bore capacities ▪ Review and inspection of water carting infrastructure.
Water supply available less than 25% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document all bore capacities ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 25% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

5. Holbrook System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 65% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document all bore capacities
Water supply available less than 55% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document all bore capacities ▪ Review of arrangement to access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 45% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document all bore capacities ▪ Review and inspection access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 35% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document all bore capacities ▪ Review and inspection access to water supply via valve connection to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 25% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Enquire and verify the availability of water supply from the Wagga Wagga & Southern Trunk Main Systems

6. Humula System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 50% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document Umbango Creek flow rate ▪ Monitor and document bore capacity
Water supply available less than 40% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document Umbango Creek flow rate ▪ Monitor and document bore capacity ▪ Review of water carting arrangement and infrastructure required to obtain water from Tarcutta or from the closest standpipe or filling station connected to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 35% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document Umbango Creek flow rate ▪ Monitor and document bore capacity ▪ Review and inspection of water carting infrastructure.
Water supply available less than 30% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document Umbango Creek flow rate ▪ Monitor and document bore capacity ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 20% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

7. Morundah System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 85% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document Colombo Creek flow rate
Water supply available less than 75% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document Colombo Creek flow rate ▪ Review of water carting arrangement and infrastructure required to obtain water from the closest standpipe or filling station connected to the Western Trunk Main System
Water supply available less than 70% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document Colombo Creek flow rate ▪ Review and inspection of water carting infrastructure.
Water supply available less than 65% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document Colombo Creek flow rate ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 60% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

8. Oura System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 30% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document all bore capacities
Water supply available less than 25% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document all bore capacities ▪ Review of water carting arrangement and infrastructure required to obtain water from the closest standpipe or filling station connected to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 20% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document all bore capacities ▪ Review and inspection of water carting infrastructure.
Water supply available less than 15% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document all bore capacities ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 10% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

9. Tarcutta System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 55% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document all bore capacities
Water supply available less than 50% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document all bore capacities ▪ Review of water carting arrangement and infrastructure required to obtain water from Humula System or the closest standpipe or filling station connected to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 45% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document all bore capacities ▪ Review and inspection of water carting infrastructure.
Water supply available less than 40% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document all bore capacities ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 35% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

10. Walbundrie - Rand System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 35% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document bore capacity
Water supply available less than 30% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document bore capacity ▪ Review of water carting arrangement and infrastructure required to obtain water from the closest standpipe or filling station connected to the Wagga Wagga or Western Trunk Main System
Water supply available less than 25% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document bore capacity ▪ Review and inspection of water carting infrastructure.
Water supply available less than 20% of the total WAL extraction limit	**Stage 4**	▪ Monitor and document off-stream storage level ▪ Investigate alternative water supply i.e. decommissioned surface Water Treatment Plant ▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 15% of the total WAL extraction limit	**Stage 5**	▪ Monitor and document off-stream storage level ▪ Enquire and verify the availability of water supply from alternative water sources e.g. Lake Hume, Albury City Council, local decommissioned surface Water Treatment Plant ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

11. Woomargama System		
Water Restriction Triggers	**RWCC Water Restrictions**	**Supply Action**
Water supply available less than 50% of the total WAL extraction limit	**Stage 1**	▪ Monitor and document bore capacity
Water supply available less than 45% of the total WAL extraction limit	**Stage 2**	▪ Monitor and document bore capacity ▪ Review of water carting arrangement and infrastructure required to obtain water from Holbrook System or the closest standpipe or filling station connected to the Wagga Wagga & Southern Trunk Main Systems
Water supply available less than 40% of the total WAL extraction limit	**Stage 3**	▪ Monitor and document bore capacity ▪ Review and inspection of water carting infrastructure.
Water supply available less than 30% of the total WAL extraction limit	**Stage 4**	▪ Ensure of water carters are available and contracts are ready to operate. ▪ Prepare water carting operation systems. ▪ Contact NSW Office of Water to notify the water supply situation & ensure funding for water carting available.
Water supply available less than 20% of the total WAL extraction limit	**Stage 5**	▪ Enquire and verify the availability of water supply from alternative water sources e.g. Holbrook, Lake Hume or Albury City Council ▪ Request for the NSW Office of Water to commence support on water carting subsidy. ▪ Enquire and verify the availability of water supply from water carting locations.

7 Regulatory Framework

7.1 Riverina Water County Council

RWCC delivers water under the provisions of the NSW Local Government Act (1993). Some aspects of the water business are carried out under the provision of the NSW Water Management Act (2000).

Breaches of the water restrictions could attract an on the spot fine of $220.00. Under the Local Government (General) Regulation 2005 Section 637, "a person who wilfully or negligently wastes or misuses water from a public water supply, or causes any such water to be wasted, is guilty of an offence". This offence could incur a maximum penalty: 20 penalty units.

This plan is administered by the Council. During drought, this plan will be overseen by the Council's Drought Committee which will be appointed by Council's General Manager and Councillors. The implementation of this Drought Management Plan will be the responsibility of the Council staff.

7.2 NSW Office of Water

The NSW Office of Water works with partner agencies and with the community to provide a reliable, sustainable supply of water for households, irrigators, farmers, industry and the environment.

In drought, State Water operates the major rural dams across NSW under instruction from NSW of Water. Water supplies to households are the responsibility of local water utilities such as RWCC across most of NSW and State-owned Corporations in the major metropolitan centres.

For non-metropolitan areas the Office of Water provides managerial, technical and financial support under the Country Towns Water Supply and Sewerage Program.

Available water determinations (AWDs) are made for each water source generally at the start of a water year. The licensed volume or the percentage of the share component is defined by NSW Office of Water. Such AWDs are key triggers during drought (source: NSW Office of Water website [accessed Sep 2011]).

7.3 Water Sharing Plans

The NSW Office of Water has developed water sharing plans (WSPs) in order to "establish rules for sharing water between the environmental needs of the river or aquifer and water users, and also between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation." (Source: NSW Office of Water website [accessed Sep 2011])

However these WSPs are sometime suspended during drought (as in 2006).

Water sharing plans are developed for rivers and groundwater systems across New South Wales following the introduction of the Water Management Act 2000. Water sharing plans are in place for 10 years, providing certainty of access for environmental health and for all licensed water users during the life of the plan.

The water sharing plans applicable to RWCC supply area include:

- Murrumbidgee Regulated River (commenced in 2004, suspended due to the drought in 2006 and recommenced in September 2011)(Figure 11)

Murrumbidgee Unregulated and Alluvial Water Sources (currently on exhibition and is anticipated to commence in late 2012) (

- Figure 12)

- NSW Murray and Lower Darling Regulated Rivers (commenced in 2004, suspended due to the drought in 2006 and recommenced in September 2011) (Figure 13)

Details of the water sharing plans can be accessed through the NSW Office of Water website.

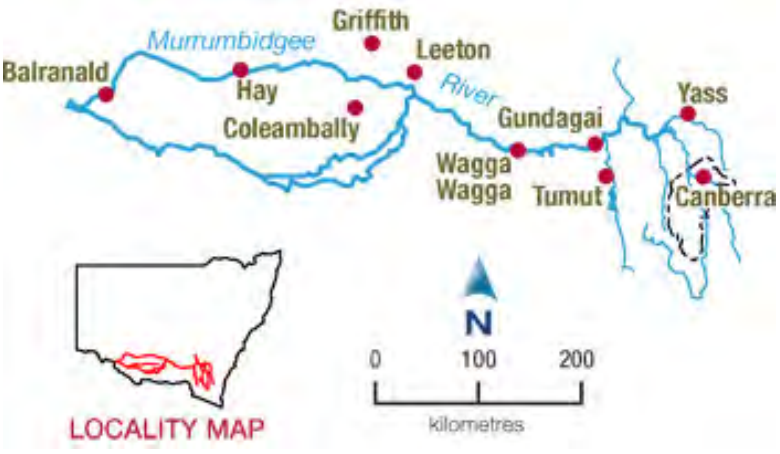


Figure 11: Murrumbidgee Regulated River Water Source

(Source: Water Sharing Plan, NSW Office of Water)

Figure 12: Murrumbidgee Unregulated and Alluvial Water Sources

(Source: Water Sharing Plan, NSW Office of Water)

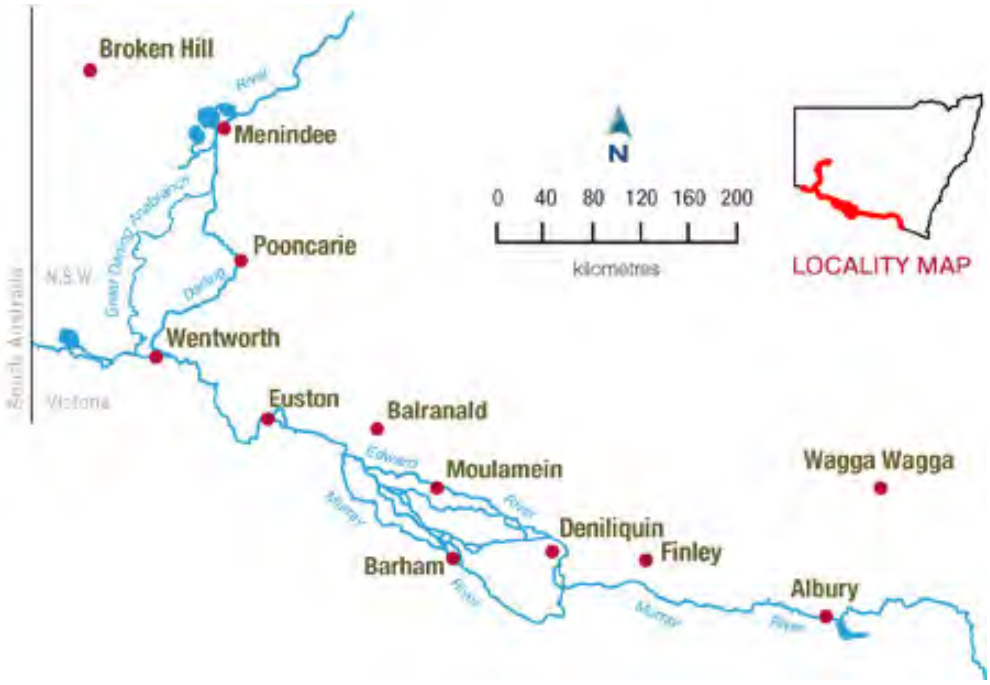


Figure 13: NSW Murray and Lower Darling Regulated Rivers Water Sources

(Source: Water Sharing Plan, NSW Office of Water)

The NSW Office of Water is currently developing a new groundwater Mid-Murrumbidgee Water Sharing Plan. (Draft on exhibition as at November 2011). RWCC has met with NSW Office of Water to determine RWCC groundwater extraction limits. RWCC has advised to use a groundwater extraction limit of 12,371 ML/a for the purpose of the IWCM Detailed Strategy.

The uncertainty of surface water allocations may or may not be solved with the determination of the new surface water sharing plan to be finalised in 2014. Until then it is considered advisable that RWCC take a conservative approach to ensure a secure water supply, especially during drought.

8 Monitoring During Drought

The following monitoring is required during drought.

- Daily demands for water supply
- Monitoring of water supply sources (surface water & groundwater) including:
  - daily capacity and flow rate (depth) of Murrumbidgee River
  - twice weekly capacity and flow rate (depth) of Colombo Creek (Urana off take)
  - twice weekly capacity and flow rate (depth) of Umbango Creek
  - twice weekly capacity and flow rate (depth) of Columbo Creek (Morundah off take)
  - daily capacity of Wagga, Bulgary and Walla bore supply source (draw down, recovery time and standing water levels)
  - twice weekly capacity of all other bore supply sources
- Daily temperature and rainfall for Wagga (draw down, recovery time and standing water levels)
- Monitoring impact of restrictions on water consumptions at each water restriction trigger zones
- Monitoring of potential alternative water supply sources
- Water source quality
  - Electrical conductivity(monthly)
  - Total Dissolved Solids (monthly)
  - pH (weekly)
  - Alkalinity (weekly)
  - Algae levels (weekly)
  - Taste and odour (on complaint)
  - Chemical analysis (monthly)
  - Microbial analysis(weekly)

9 Consultation

9.1 Public Engagement

Engagement with the community is a critical element of an effective drought management program, as it ensures customer acceptance and behavioural changes required to reduce water demand.

Notice of water restrictions or change in level of restrictions may be given via:

- Newspapers
- Radio
- Television
- Letter drops (to residential, commercial, industrial consumers)
- Notice on water services bills
- Council website
- Water carters that supply water to rural properties which are not connected with the retic system.
- Signage at outskirts of towns

In addition, media releases and interviews with Council's staff would assist in conveying the message about the need to reduce water usage.

Special engagement with industry and institutions will be required to develop specific industry plans relating to drought Management.

9.2 Government Agency Consultation

Consultation on the implementation of the Drought Management Plan would be expected to be with

- NSW Office of Water
- NSW Health (especially in relation to water quality)
- Transport agencies for NSW.

9.3 Consultation Schedule

- Council internal staff e.g. weekly, daily etc.
- State Agencies and Council
- Federal agencies

10 References

1. Bureau of Meteorology website
2. Drought Relief for Country Towns, NSW Office of Water, Nov 2009
3. NSW Office of Water website
4. Water Sharing Plan, NSW Office of Water
5. The Irrigation Industry in the Murray and Murrumbidgee Basins, CSIRO June 2005
6. Joint IWCM Evaluation Study, HydroScience March 2010
7. Riverina Water County Council Description of Water Supply System, 2010
8. RWCC Water Quality Management System HACCP Manual, Dec 2011

Appendix A

Best-Practice Management Guidelines Drought Management Plan Checklist

Drought Management

Check List – August 2007

A comprehensive drought management plan details the demand and supply issues to be addressed during drought conditions and includes adoption of a schedule of trigger points for the timely implementation of appropriate water restrictions. Appropriate drought management planning will ensure that town water supplies with significant storage do not fail in times of drought.

Drought management planning includes documenting basic data on water demands, rainfall, evaporation, records of past droughts, the existing water supply system, and its water resources, and strategies to achieve the objective of having sufficient water to satisfy the basic needs of the community.

This check list is essentially a road map to assist LWUs to quickly implement sound drought management planning. LWUs should have a sound drought management plan in place and be ready to implement their plan when drought conditions arise.

Drought Management – Check List

Topic		Outcome Achieved
1. Executive Summary		☑ Covers all major issues, objectives, planning, strategies and monitoring for existing essential supplies of water to the service area(s).
		☑ Includes a summary of the drought management plan and an adopted schedule of trigger points for timely implementation of appropriate water restrictions.
2. Background	A.	☑ Includes the existing water supply system(s) in the service area(s) and a locality map.
	B.	☑ Includes history of past droughts.
	C.	☑ Includes information on the impact of past droughts on water services, eg. restrictions, effect of restrictions on demands, any emergency sources identified, etc.
3. Objectives	A.	☑ Identifies key objectives required to maintain a basic/restricted supply to all users. There is a need to consider social and environmental impacts.
	B.	☑ Tailor strategies relevant to the service areas.
	C.	☑ Endorse and implement a plan that minimises the risk of the community running out of water.

Drought Management – Check List

Topic	Outcome Achieved
4. Data	A. ☑ Identification of all communities served by the LWU's reticulated water supply, those with private reticulated water services and those with no reticulated water services within the service area(s).
	B. ☑ Identification of any properties, businesses, other LWUs etc. that may seek water in times of drought.
	C. ☑ Identification of all water requirements. Identify the normal and minimum potable and non-potable water requirements.
	D. ☑ Identify water dependent industry/businesses, any fire fighting requirements and opportunities for recycled water use.
	E. ☑ Includes a description and plan of all water supply schemes in the service area(s).
	F. ☑ Includes height/storage volume and height/surface area graphs for all water supply dams and weirs.
	G. ☑ Historical performance of rivers, dams, weirs and bores in previous droughts.
	H. ☑ Includes the average rainfall figures and evaporation rates.
Note: All data to be specified on a daily basis.	
5. Plan	A. ☑ Demand management options.
	B. ☑ Restriction strategies including means and methods for the enforcement of restrictions and the expected results of imposing restrictions.
	C. ☑ Adopted schedule of trigger points for the timely implementation of appropriate water restrictions in order to minimise the risk of failure in times of drought.
	D. ☑ Availability of alternative water sources (including estimated costs and times to implement).
	E. ☑ Water cartage options.
	F. ☑ Identify legislation, local laws and council policies affecting the contingency arrangements.
	G. ☑ Links to water sharing plans/committees, water management plans/committees, irrigators, etc.

Drought Management – Check List

Topic		Outcome Achieved
	H.	☑ Impact of extraction on downstream stakeholders.
	I.	☑ Impact of reduced flows in watercourses.
	J.	☑ Level of prediction and intervention.
	K.	☑ Identify human resource requirements.
6. Monitoring During Drought	A.	☑ Daily monitoring of demands.
	B.	☑ Daily monitoring of water supply sources (dams, bores and streams).
	C.	☑ Monitoring impact of restrictions on consumption
	D.	☑ Monitoring the electrical conductivity, alkalinity and algae levels in the water sources.
7. Consultation		☑ Comprehensive media strategy and public consultation.
		☑ Regular consultation with appropriate government agencies (DWE, DECC, NSW Health etc).
8. Operation of Drought Management Plan (DMP)	A.	☑ DMP should discuss, analyse and identify any impact on other regions and localities ie. upstream, downstream or conjunctive water users.
	B.	☑ DMP should demonstrate a sustainable strategy that considers all other stakeholders.
	C.	☑ DMP documents an agreed procedure for progressive implementation of water restrictions.

REFERENCE

Drought Management Guidelines, NSW Local Government Water Directorate, December 2003.

Appendix B

Modified RWCC Water Restrictions Definitions

Riverina Water County Council Modified Water Restriction Stages		Permanent Water Conservation Measure	Stage 1	Stage 2	Stage 3	Mostly Internal Usage Only Stage 4	Water Carting begins Stage 5
Estimated Wagga Wagga Residential Consumption Target (L/Person/d)		370	320	267	131	123	120
RWCC Estimated (for Wagga Wagga) Targeted Water Supply %		90%	75%	50%	40%	32%	90%
Domestic/ Public/ Commercial	Watering gardens & lawns						
	Fixed hoses, sprays	✓	5pm -10am three days per week and once on weekend	5pm -10am one day per week and once on weekend	5pm -10am one day per week	×	×
	Fixed sprinkler systems	5pm -10am each day	5pm -10am three days per week and once on weekend	5pm -10am one day per week and once on weekend	5pm -10am one day per week	×	×
	Hand-held hose	✓	✓	5pm -10am each day	5pm -10am each day	×	×
	Watering cans/buckets	✓	✓	✓	✓	✓	×
	Swimming pool						
	Private pools	✓	✓	Topping up only	×	×	×
	Public pools	✓	✓	Topping up only	Topping up only	Only with Council permission	×
	Bowling greens & sports grounds						

Riverina Water County Council Modified Water Restriction Stages		Permanent Water Conservation Measure	Stage 1	Stage 2	Stage 3	Mostly Internal Usage Only Stage 4	Water Carting begins Stage 5
Domestic/ Public/ Commercial	Fixed sprinkler systems & in-ground water systems from town water supply	✓	✓	5pm -10am one day per week and once on weekend	5pm -10am one day per week	Only with Council permission	Only with Council permission
	Nurseries						
	Fixed sprinkler systems & in-ground water systems from town water supply	✓	✓	5pm -10am one day per week and once on weekend	5pm -10am one day per week	Only with Council permission	Only with Council permission
	Building & Outside Area						
	External Building & Window Cleaning	✓	✓	✓	Buckets for windows only	Buckets for windows only	×
	Hosing paved areas	✓	✓	Domestic with Council permission	Only with Council permission	Only with Council permission	Only with Council permission
	Washing motor vehicles	✓	allowed with hoses but not on hard surface	allowed with hoses but not on hard surface	Buckets only surface	prohibited unless at a commercial car wash	×
	Construction & Related Activities						
	water used for dust or pollutant suppression or cleaning purpose with hose fitted with a trigger nozzle or vehicle fitted with sprinklers	✓	✓	✓	Only with Council permission	Only with Council permission	Only with Council permission

Riverina Water County Council Modified Water Restriction Stages		Permanent Water Conservation Measure	Stage 1	Stage 2	Stage 3	Mostly Internal Usage Only Stage 4	Water Carting begins Stage 5
Domestic/ Public/ Commercial	**Rural stock watering**						
	Stock watering	✓	✓	✓	✓	✓	✓
Industrial							
	Production	✓	✓	✓	✓	✓	✓
	External landscape watering	✓	5pm -10am three days per week and once on weekend	5pm -10am one day per week and once on weekend	5pm -10am one day per week	×	×
Exemptions							
	Fire Fighting	✓	✓	✓	✓	✓	✓
	Water Cartage (water filling stations only)	✓	✓	✓	✓	Critical human and stock needs only	Critical human needs only

Note: Water restriction exemption applications are subjected to Council's set criteria

✓	No restrictions
	Restrictions with conditions
×	Not Permitted

Appendix C

Drought End Use Model & Water Restriction Triggers Analysis (Wagga Wagga, Southern Trunk Main & Western Trunk Main Systems)

Drought End Use Model Methodology

A Drought End Use Model was applied to develop the water restriction triggers for Wagga Wagga (including Ladysmith, Brucedale, and Currawarna), Southern Trunk Main and Western Trunk Main System.

During the drought management workshop, assumptions were made for each level of the expected reduction level of residential water consumption for the Wagga Wagga, Southern Trunk and Western Trunk systems.

Input data in Table 1, 2 & 3 of the Drought End Use model are shown in light yellow cells. These 2008/09 data were also applied as input data for the DSS model for the Demand Management Analysis. They included:

- Population and occupancy ratio
- Number of accounts and the consumptions per accounts for residential, commercial, industrial and other usage
- Total historical water production data in 2008/09
- System leakage percentage

Residential, non-residential internal and external water restriction percentage reduction figures in Model Table 4 were based on assumptions made on the basis of RWCC's water restrictions definitions.

The estimated residential consumption reduction for each water restriction level has been detailed in Model Table 5. The estimated total annual demand expected at each water restriction levels (including system leakage) has been included in Table 6. The values in Model Table 5 and Table 6 become the Demand estimation components of the Water Restriction Triggers in Model Table 8 (right hand side).

The water source available for the particular water supply system has been summarised in Model Table 7. The values in Model Table 7 become the Supply estimation components of the Water Restriction Triggers in Table 8 (left hand side).

The triggers were set by perturbing the percentage of combined WAL extraction limits available (column A) so that the combined WAL extraction limits available (column B) would be greater than or equal to the total demand expected for each level (including leakage) (column C).

The resultant percentages of combined WAL extraction limits available in column A became the triggers of water restriction levels.

As the water supply is depleting during drought, water restriction levels are triggered when the water availability reaches each of the equivalent percentage of combined WAL extraction limits detailed in the trigger table (Model Table 8).

The Wagga Wagga Main System Water Restriction Triggers

The Wagga Wagga System water restriction triggers were evaluated by combining the drought end use model results from the Wagga Wagga Urban System and monthly demand at Ladysmith System, Brucedale System and Currawarna System.

Drought End Use Model

Wagga Urban

Year	2008/09
Population	53854 (DSS Model Wagga Urban RevE)
No. of Residential Accounts:	22011 (DSS Model Wagga Urban RevE)
Occupancy Rate:	2.4 (DSS Model Wagga Urban RevE)

Legends:

Actual Data cells
Assumptions cells
Data calculated cells
Revised Data
Data source

Table 1 Residential End Use Breakdown

Internal Consumption

Type of Consumption	Consumption per Person (L/d)	Consumption per Account (L/d)	% of Total Internal
Toilets	21.8	52.2	15.1%
Baths	7.2	17.2	5.0%
Showers	54.3	130.2	37.6%
Taps/Sinks	19.1	45.9	13.3%
Dishwashers	2.0	4.7	1.4%
Washing Machines	32.7	78.6	22.7%
Int. Leakage	7.2	17.3	5.0%
Total Internal	**144.2**	**346.2**	

External Consumption

Type of Consumption	Consumption per Account (L/d)	% of Total External	
Ext. Irrigation	528.7	80%	
Ext. Other	99.1	15%	incl. evaporative cooling, car wash
Ext. Leakage	33.0	5%	
Total External	**660.8**	**100%**	

Total Observed Consumption

	Average Consumption	% Internal	% External	
Total Residential Consumption per Account (L/d)	1007	34.4%	65.6%	Avg water supply/property/d
Total Residential Consumption (ML/d)	**22.2**			

Table 2 Non-Residential End Use Breakdown

Category	Consumption per Account (L/d)	No. of Accounts	% Internal	% External	Internal Consumption per Account (L/d)	External Consumption per Account (L/d)	% of Non-residential Usage	
Commercial	2457	1700	80%	20%	1,965.6	491.4	41.9%	
Industrial	96376	30	90%	10%	86,738.4	9,637.6	29.0%	
Other	31772	91	10%	90%	3,177.2	28,594.9	29.0%	Public+Parks & Open Space+Rural
Total Non-Residential Consumption per Account					**91881.2**	**38723.9**		

Total Non-Residential Consumption (ML/d)	**10.0**

Table 3 Total Production & System Leakage

Production (L/person/d)	626.7	outcome of DSS (historical) Wagga Urban RevE (actual 2008/09)
Production (ML/person/a)	0.23	
Total Production (ML/a)	12327.3	
System Leakage (% of total production)	4%	National performance framework Nov 2010
System Leakage (ML/a)	493.1	

% Residential Annual Consumption (excl leakage)	69%
% Non-residential Annual Consumption (excl leakage)	31%

Table 4 End Use Analyses

End Use Summary Table

Description	Category	Internal or External (int or ext)	% of Total Int or Ext	Consumption per Account (L/d)	Annual Consumption per Account (ML/a)	% of Total Consumption (excl. leakage)
RES Toilets	Residential	int	15.1%	52.2	0.019	
RES Baths	Residential	int	5.0%	17.2	0.006	
RES Showers	Residential	int	37.6%	130.2	0.048	
RES Taps/Sinks	Residential	int	13.3%	45.9	0.017	23.72%
RES Dishwashers	Residential	int	1.4%	4.7	0.002	
RES Washing Machines	Residential	int	22.7%	78.6	0.029	
RES Int. Leakage	Residential	int	5.0%	17.3	0.006	
RES Ext. Irrigation	Residential	ext	80.0%	528.7	0.193	
RES Ext. Other	Residential	ext	15.0%	99.1	0.036	45.28%
RES Ext. Leakage	Residential	ext	5.0%	33.0	0.012	
COM Internal	Commercial	int	80.0%	1965.6	0.718	10.40%
COM External	Commercial	ext	20.0%	491.4	0.179	2.60%
IND Internal	Industrial	int	90.0%	86738.4	31.681	8.10%
IND External	Industrial	ext	10.0%	9637.6	3.520	0.90%
OTH Internal	Other	int	10.0%	3177.2	1.160	0.90%
OTH External	Other	ext	90.0%	28594.9	10.444	8.10%
System Leakage	Leakage				493.1	

% Reductions

Restriction Impact (Level 1)	Restriction Impact (Level 2)	Restriction Impact (Level 3)	Restriction Impact (Level 4)	Restriction Impact (Level 5)
2.0%	2.0%	2.0%	5.0%	8.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	10.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	40.0%	60.0%	100.0%	100.0%
5.0%	20.0%	35.0%	100.0%	100.0%
2.0%	4.0%	8.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	80.0%	95.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	80.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	60.0%	75.0%
1.0%	2.0%	4.0%	8.0%	10.0%

Total Consumption

	(ML/d)	(ML/a)
Residential + Non-Residential (excluding system leakage)	**32.1**	**11733.5**

Table 5 Target and Expected Residential Water Consumption per Person

		Unrestricted Consumption	LEVEL 1 Low	LEVEL 2 Moderate	LEVEL 3 High	LEVEL 4 Very high	LEVEL 5 Extreme
	End Use Model Residential Consumption (L/Person/d)	419.6	370	320	267	131	123
Workshop estimates for comparison	RWCC Estimated Targeted Residential Average Daily Usage (L/Person/d)	375	340	280	200	150	120

Table 6 Total Annual Demand Analyses

Total Annual Consumption Expected by End Use

Description	Category	Reduction Level 1	Reduction Level 2	Reduction Level 3	Reduction Level 4	Reduction Level 5
RES Toilets	Residential	411.5	411.5	411.5	398.9	386.3
RES Baths	Residential	135.8	135.8	135.8	124.7	110.8
RES Showers	Residential	1025.9	1025.9	1025.9	942.1	837.5
RES Taps/Sinks	Residential	361.7	361.7	350.6	332.2	313.7
RES Dishwashers	Residential	37.2	37.2	36.0	34.1	32.2
RES Washing Machines	Residential	619.0	619.0	600.1	568.5	568.5
RES Int. Leakage	Residential	136.4	136.4	132.3	125.3	118.3
RES Ext. Irrigation	Residential	3400.1	2550.1	1700.0	0.0	0.0
RES Ext. Other	Residential	757.1	637.5	518.0	0.0	0.0
RES Ext. Leakage	Residential	260.3	255.0	244.4	0.0	0.0
COM Internal	Commercial	1196.1	1196.1	1159.5	1098.4	1037.4
COM External	Commercial	244.1	213.6	167.8	61.0	15.3
IND Internal	Industrial	931.4	931.4	902.9	855.4	807.9
IND External	Industrial	103.5	103.5	21.1	0.0	0.0
OTH Internal	Other	103.5	103.5	100.3	95.0	89.8
OTH External	Other	760.3	665.3	522.7	380.2	237.6
System Leakage	Leakage	488.2	483.2	473.4	453.6	443.8

Total of Actual incl. leakage

	Production	Consumption
ML/a	12327.3	12226.6
Total Demand Expected for each Level (incld System Leakage) (ML/d)		33.5
Average Daily Usage based on RWCC Target % (ML/d)		36.42
Peak Day Consumption (ML/d)		99.5
Peak/Average water demand ratio		2.60
Peak/Average water demand ratio		2.68

Wagga Urban Daily Consumption 2008/09
2008/09 DSS Input data
2009 - 2012 Daily Consumption

Total Annual Consumption Expected

Total Demand Expected for each Level (incl. System Leakage)				
10972.0	9866.7	8502.3	5469.5	4999.1
30.0	27.0	23.3	15.0	13.7
32.8	27.3	18.2	12.0	11.7

End Use Model Estimtated Water Supply %	100%	90%	81%	70%	45%	41%
RWCC Estimated Targeted Water Supply %		90%	75%	50%	40%	32%

Table 6	Ladysmith, Brucedale, Currawarna Drought Security End Use Model

Total of Actual incl. leakage

	Average Annual Consumption
ML/a	505.9
Total Demand Expected for each Level (incld System Leakage) (ML/d)	1.4

Total Annual Consumption Expected

Total Demand Expected for each Level (incl. System Leakage)				
455.3	379.4	252.9	202.4	161.9
1.2	1.0	0.7	0.6	0.4

Calculation based on **Southern Trunk** Main reduction percentage of **RWCC Estimated Targeted Water**

Table 6	Wagga Urban + Ladysmith, Brucedale, Currawarna Drought Security End Use Model

Total of Actual incl. leakage

	Average Annual Consumption
ML/a	12732.4
Total Demand Expected for each	34.9

Total Annual Consumption Expected

Total Demand Expected for each Level (incl. System Leakage)				
11427.3	10246.1	8755.2	5671.9	5161.0
31.3	28.1	24.0	15.5	14.1

Table 7 Supply Source

	Southern Trunk	Wagga Urban + LBC	Southern Trunk + Wagga	% of Southern Trunk
Population	3822	54222	58044	6.58%
No. of	1654	22117		
Occupancy	2.4	2.5		

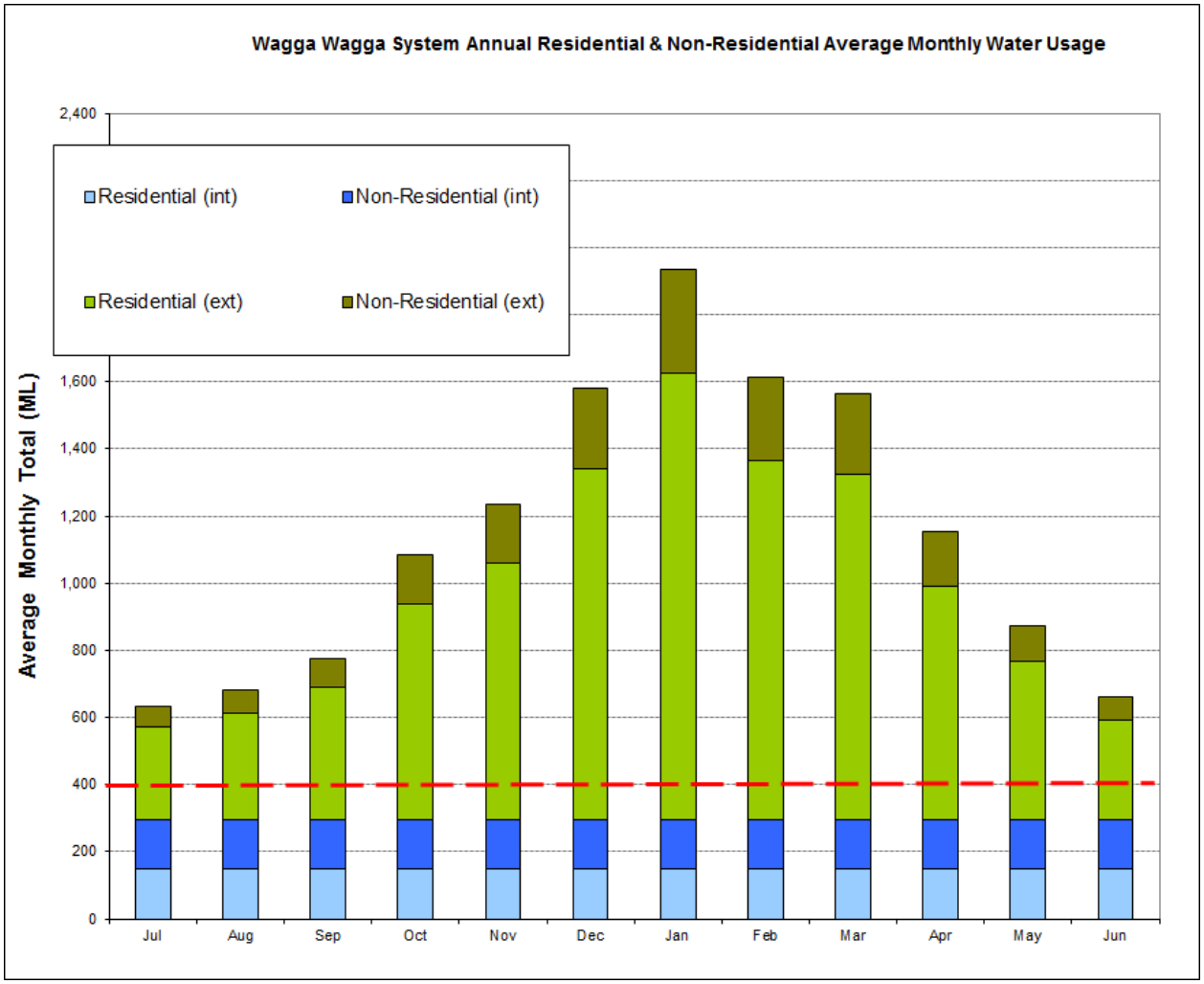
Allocation	Licenced Volume (ML/a)	Allocation Reduction	Licenced Allocation	Assumed pro rata Wagga Trunk Allocation less Southern Trunk (ML/a)
Surface water - Murrumbidgee River	7000	100%	7000	6539
Surface water - Columbo Crk	805			
Columbo Creek - Stock & Domestic	195			
Bulgary Bores	1000			
Wagga Groundwater (W+E+N)	14000	88%	12371	11556

Table 8 Water Restriction Triggers

Supply (refer to Table 7) — **Demand (refer to Table 6)**

(less southern trunk allocation)

Ground Water Wagga Groundwater	Surface Murrumbidgee River	Combined WAL Extraction Limits available		A: % of Combined WAL Extraction Limits available	Water Restrictions Level	C: Total Demand Expected for each Level (incl. System Leakage)		End Use Model Residential Consumption (L/Person/d)	RWCC Estimated Targeted Residential Average Daily
ML/a	ML/a	ML/a	ML/d			(ML/y)	(ML/d)	L/person/day	L/person/day
11556	6539	18095	49.6	> 100%	0	12732.4	34.86		
			37.2	> 75%	1	11427.3	31.3	370	340
			34.7	> 70%	2	10246.1	28.1	320	280
			29.7	> 60%	3	8755.2	24.0	267	200
			24.8	> 50%	4	5671.9	15.5	131	150
			19.8	> 40%	5	5161.0	14.1	123	120


Wagga Wagga System Annual Residential & Non-Residential Average Monthly Water Usage
Average Monthly Total (ML)
2,400
1,600
1,400
1,200
1,000
800
600
400
200
0
Residential (int)
Non-Residential (int)
Residential (ext)
Non-Residential (ext)
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun

The Southern Trunk Main System Water Restriction Triggers

The Southern Trunk Main Systems water restriction triggers were evaluated by applying the drought end use model results from the Southern Trunk Main System historical consumption data.

Drought End Use Model

Southern Trunk

Year	2008/09	
Population	3822	(DSS Model Southern Trunk RevM)
No. of Residential Accounts:	1654	(DSS Model Southern Trunk RevM)
Occupancy Rate:	2.4	(DSS Model Southern Trunk RevM)

Legends

Actual Data cells
Assumptions cells
Data calculated cells
Revised Data
Data source

Table 1 Residential End Use Breakdown

Internal Consumption

Type of Consumption	Consumption per Person (L/d)	Consumption per Account (L/d)	% of Total Internal
Toilets	21.8	52.2	15.1%
Baths	7.2	17.2	5.0%
Showers	54.3	130.2	37.6%
Taps/Sinks	19.1	45.9	13.3%
Dishwashers	2.0	4.7	1.4%
Washing Machines	32.7	78.6	22.7%
Int. Leakage	7.2	17.3	5.0%
Total Internal	**144.2**	**346.2**	

External Consumption

Type of Consumption	Consumption per Account (L/d)	% of Total External	
Ext. Irrigation	51.0	80%	
Ext. Other	9.6	15%	incl. evaporative cooling, car wash
Ext. Leakage	3.2	5%	
Total External	**63.7**	**100%**	

Total Observed Consumption

	Average Consumption	% Internal	% External	
Total Residential Consumption per Account (L/d)	409.9	84.5%	15.5%	Avg water supply/property/d
Total Residential Consumption (ML/d)	**0.7**			

Table 2 Non-Residential End Use Breakdown

Category	Consumption per Account (L/d)	No. of Accounts	% Internal	% External	Internal Consumption per Account (L/d)	External Consumption per Account (L/d)	% of Non-residential Usage	
Commercial	366	208	80%	20%	292.7	73.2	2.3%	
Industrial	59954	29	90%	10%	53,958.6	5,995.4	52.9%	(Note: including Kapooka extensive consumption register under 1 account)
Other	3106	474	10%	90%	310.6	2,795.0	44.8%	Public+Parks & Open Space+Rural
Total Non-Residential Consumption per Account					**54561.9**	**8863.6**		

Total Non-Residential Consumption (ML/d)	**3.3**

Table 3 Total Production & System Leakage

Production (L/person/d)	900.68	outcome of DSS (historical) Southern Trunk RevM (actual 2008/09)
Production (ML/person/a)	0.33	
Total Production (ML/a)	1257.3	
System Leakage (% of total production)	14%	% UFW water 2008/09
System Leakage (ML/a)	176.0	

% Residential Annual Consumption (excl leakage)	**17%**
% Non-residential Annual Consumption (excl leakage)	**83%**

Table 4 End Use Analyses

End Use Summary Table

Description	Category	Internal or External (int or ext)	% of Total Int or Ext	Consumption per Account (L/d)	Annual Consumption per Account (ML/a)	% of Total Consumption (excl. leakage)
RES Toilets	Residential	int	15.1%	52.2	0.019	
RES Baths	Residential	int	5.0%	17.2	0.006	
RES Showers	Residential	int	37.6%	130.2	0.048	
RES Taps/Sinks	Residential	int	13.3%	45.9	0.017	14.44%
RES Dishwashers	Residential	int	1.4%	4.7	0.002	
RES Washing Machines	Residential	int	22.7%	78.6	0.029	
RES Int. Leakage	Residential	int	5.0%	17.3	0.006	
RES Ext. Irrigation	Residential	ext	80.0%	51.0	0.019	
RES Ext. Other	Residential	ext	15.0%	9.6	0.003	2.66%
RES Ext. Leakage	Residential	ext	5.0%	3.2	0.001	
COM Internal	Commercial	int	80.0%	292.7	0.107	1.54%
COM External	Commercial	ext	20.0%	73.2	0.027	0.38%
IND Internal	Industrial	int	90.0%	53958.6	19.708	39.47%
IND External	Industrial	ext	10.0%	5995.4	2.190	4.39%
OTH Internal	Other	int	10.0%	310.6	0.113	3.71%
OTH External	Other	ext	90.0%	2795.0	1.021	33.42%
System Leakage	Leakage				176.0	

% Reductions

Restriction Impact (Level 1)	Restriction Impact (Level 2)	Restriction Impact (Level 3)	Restriction Impact (Level 4)	Restriction Impact (Level 5)
2.0%	2.0%	2.0%	5.0%	8.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	10.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	40.0%	60.0%	100.0%	100.0%
5.0%	20.0%	35.0%	100.0%	100.0%
2.0%	4.0%	8.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	80.0%	95.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	80.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	60.0%	75.0%
1.0%	2.0%	4.0%	8.0%	10.0%

Total Consumption

	(ML/d)	(ML/a)
Residential + Non-Residential (excluding system leakage)	**4.0**	**1448.1**

Table 5 Target and Expected Residential Water Consumption per Person

	Unrestricted Consumption	LEVEL 1 Low	LEVEL 2 Moderate	LEVEL 3 High	LEVEL 4 Very high	LEVEL 5 Extreme
End Use Model Residential Consumption (L/Person/d)	170.8	163	159	152	131	123
RWCC Estimated Targeted Residential Average Daily Usage (L/Person/d)	375	340	280	200	150	120

Table 6 Total Annual Demand Analyses

Total Annual Consumption Expected by End Use

Description	Category	Reduction Level 1	Reduction Level 2	Reduction Level 3	Reduction Level 4	Reduction Level 5
RES Toilets	Residential	30.9	30.9	30.9	30.0	29.0
RES Baths	Residential	10.2	10.2	10.2	9.4	8.3
RES Showers	Residential	77.1	77.1	77.1	70.8	62.9
RES Taps/Sinks	Residential	27.2	27.2	26.3	25.0	23.6
RES Dishwashers	Residential	2.8	2.8	2.7	2.6	2.4
RES Washing Machines	Residential	46.5	46.5	45.1	42.7	42.7
RES Int. Leakage	Residential	10.3	10.3	9.9	9.4	8.9
RES Ext. Irrigation	Residential	24.6	18.5	12.3	0.0	0.0
RES Ext. Other	Residential	5.5	4.6	3.8	0.0	0.0
RES Ext. Leakage	Residential	1.9	1.8	1.8	0.0	0.0
COM Internal	Commercial	21.8	21.8	21.1	20.0	18.9
COM External	Commercial	4.4	3.9	3.1	1.1	0.3
IND Internal	Industrial	560.1	560.1	543.0	514.4	485.8
IND External	Industrial	62.2	62.2	12.7	0.0	0.0
OTH Internal	Other	52.7	52.7	51.1	48.4	45.7
OTH External	Other	387.1	338.7	266.1	193.6	121.0
System Leakage	Leakage	174.3	172.5	169.0	161.9	158.4

Total of Actual incl. leakage

Total Annual Consumption Expected

	Production	Consumption	Total Demand Expected for each Level (incl. System Leakage)				
ML/a	1257.3	1624.2	1499.6	1441.8	1286.2	1129.2	1008.0
Total Demand Expected for each Level (incld System Leakage) (ML/d)		4.4	4.1	3.9	3.5	3.1	2.8
Average Daily Usage based on RWCC Target % (ML/d)		5.2	4.7	3.9	2.6	2.0	1.7
Peak Day Consumption (ML/d)		12	Southern Trunk Daily Consumption 2008/09				
Peak/Average water demand ratio		2.10	2008/09 DSS Input data				
Peak/Average water demand ratio							
End Use Model Estimated Water Supply %		100%	92%	89%	79%	70%	62%
RWCC Estimated Targeted Water Supply %			90%	75%	50%	40%	32%

Table 7 Supply Source

	Southern Trunk	Wagga Urban + LBC	Southern Trunk + Wagga	% of Southern Trunk
Population	3822	54222	58044	6.58%
No. of Residential Accounts:	1654	22117		
Occupancy Rate:	2.4	2.5		

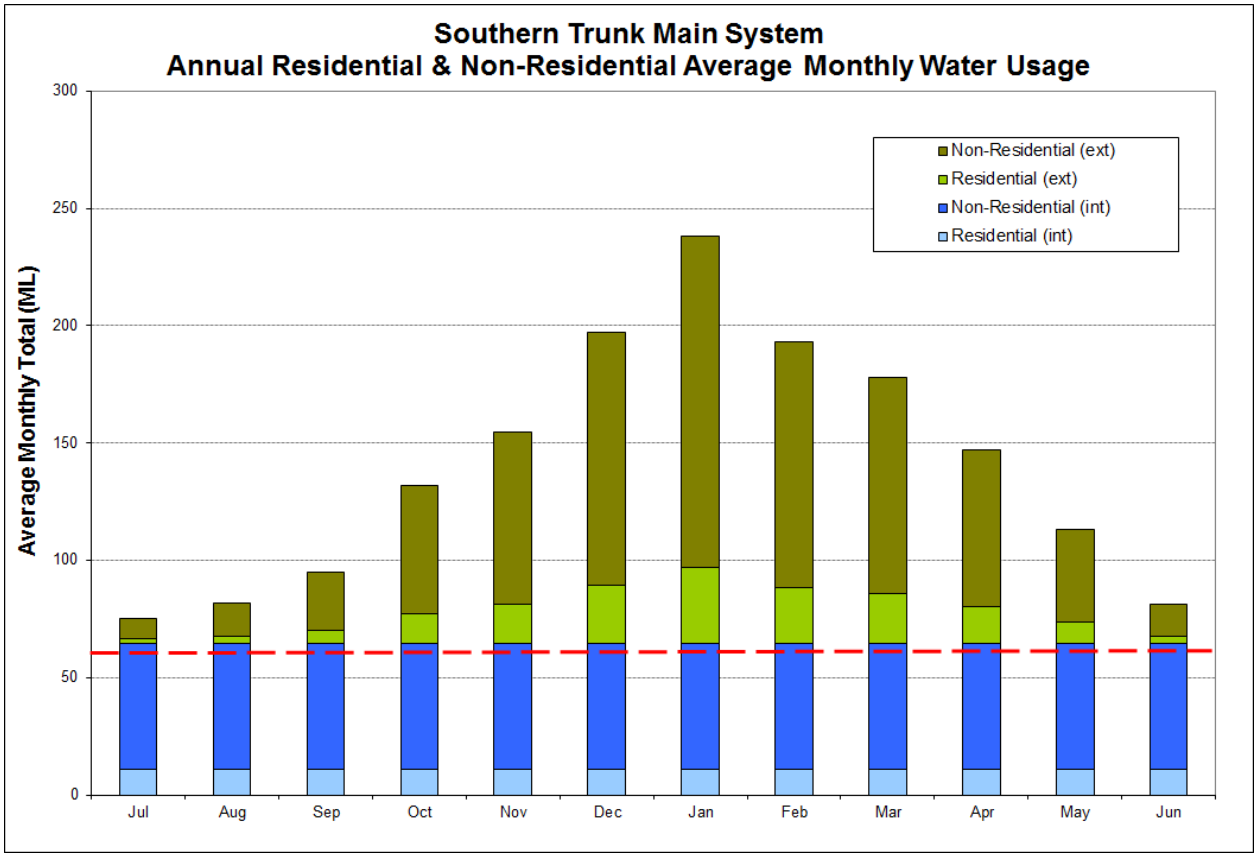
Allocation	Licenced Volume (ML/a)	Allocation Reduction	Licenced Allocation	Assumed pro rata Southern Trunk Allocation (ML/a)	
Surface water - Murrumbidgee River	7000	100%	7000	460.9	Note: to be substituted by West Wagga (2015)
Surface water - Columbo Crk	805				
Columbo Creek - Stock & Domestic	195				
Bulgary Bores	1000				
Wagga Groundwater (W+E+N)	14000	88%	12371	814.6	

Walla Bores (L/s)	23.0	pumping (hours/d)	22	Assuming Walla bore is in operation all year (12 mths) during drought
Walla Bores (ML/a) (Theoretical bore capacity)	665			
Walla Bores Licence Extraction Limits (ML/a)	400	(source: RWCC email Nov 2012)		

Table 8 Water Restriction Triggers

Supply | **Demand**

			A	B			C		
Ground Water		Surface Water	Combined WAL Extraction Limits available	% of Combined WAL Extraction Limits available		Water Restrictions Level	Total Demand Expected for each Level (incl. System Leakage)		End Use Model Residential Consumption (L/Person/d)	RWCC Estimated Targeted
Walla	Wagga Groundwater	Wagga Surface Water								
ML/a	ML/a	ML/a	ML/a	ML/d			(ML/y)	(ML/d)	L/person/day	L/person/day
400	815	461	1676	4.59	> 100%	0	1624.2	4.45		
				3.90	> 85%	1	1499.6	4.11	163	340
				3.67	> 80%	2	1441.8	3.95	159	280
				3.44	> 75%	3	1286.2	3.52	152	200
				3.21	> 70%	4	1129.2	3.09	131	150
				2.75	> 60%	5	1008.0	2.76	123	120


Southern Trunk Main System
Annual Residential & Non-Residential Average Monthly Water Usage
Average Monthly Total (ML)
300
250
200
150
100
50
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Non-Residential (ext)
Residential (ext)
Non-Residential (int)
Residential (int)

The Western Trunk Main System Water Restriction Triggers

The Western Trunk Main Systems water restriction triggers were evaluated by applying the drought end use model results from the Western Trunk Main System historical consumption data.

Drought End Use Model

Western Trunk

Year	2008/09	
Population	1438	Census 2011
No. of Residential Accounts:	755	(DSS Model Western Trunk RevF)
Occupancy Rate:	1.9	(DSS Model Western Trunk RevF)

Legends:

Actual Data cells
Assumptions cells
Data calculated cells
Revised Data
Data source

Table 1 Residential End Use Breakdown

Internal Consumption

Type of Consumption	Consumption per Person (L/d)	Consumption per Account (L/d)	% of Total Internal
Toilets	21.8	41.5	15.1%
Baths	7.2	13.7	5.0%
Showers	54.3	103.3	37.6%
Taps/Sinks	19.1	36.4	13.3%
Dishwashers	2.0	3.7	1.4%
Washing Machines	32.7	62.4	22.7%
Int. Leakage	7.2	13.7	5.0%
Total Internal	**144.2**	**274.7**	

External Consumption

Type of Consumption	Consumption per Account (L/d)	% of Total External	
Ext. Irrigation	363.4	80%	
Ext. Other	68.1	15%	incl. evaporative cooling, car wash
Ext. Leakage	22.7	5%	
Total External	**454.3**	**100%**	

Total Observed Consumption

	Average Consumption	% Internal	% External	
Total Residential Consumption per Account (L/d)	729	37.7%	62.3%	Avg water supply/property/d
Total Residential Consumption (ML/d)	**0.6**			

Table 2 Non-Residential End Use Breakdown

Category	Consumption per Account (L/d)	No. of Accounts	% Internal	% External	Internal Consumption per Account (L/d)	External Consumption per Account (L/d)	% of Non-residential Usage	
Commercial	688	190	80%	20%	550.4	137.6	17.3%	(DSS Model Western Trunk RevF)
Industrial	1307	1	90%	10%	1,176.3	130.7	0.2%	
Other	1958	319	10%	90%	195.8	1,762.5	82.6%	Public+Parks & Open Space+Rural
Total Non-Residential Consumption per Account					**1922.5**	**2030.8**		

Total Non-Residential Consumption (ML/d)	**0.8**

(RWCC Western Trunk Billing provided 29/9/09)

Table 3 Total Production & System Leakage

Production (L/person/d)	1052.4	outcome of DSS (historical) Western Trunk RevF) (actual 2008/09)
Production (ML/person/a)	0.38	
Total Production (ML/a)	552.7	
System Leakage (% of total	5%	% UFW water 2007/08
System Leakage (ML/a)	27.6	

% Residential Annual Consumption (excl leakage)	**42%**
% Non-residential Annual Consumption (excl leakage)	**58%**

Table 4 End Use Analyses

End Use Summary Table

Description	Category	Internal or External (int or ext)	% of Total Int or Ext	Consumption per Account (L/d)	Annual Consumption per Account (ML/a)	% of Total Consumption (excl. leakage)
RES Toilets	Residential	int	15.1%	41.5	0.015	
RES Baths	Residential	int	5.0%	13.7	0.005	
RES Showers	Residential	int	37.6%	103.3	0.038	
RES Taps/Sinks	Residential	int	13.3%	36.4	0.013	15.87%
RES Dishwashers	Residential	int	1.4%	3.7	0.001	
RES Washing Machines	Residential	int	22.7%	62.4	0.023	
RES Int. Leakage	Residential	int	5.0%	13.7	0.005	
RES Ext. Irrigation	Residential	ext	80.0%	363.4	0.133	
RES Ext. Other	Residential	ext	15.0%	68.1	0.025	26.24%
RES Ext. Leakage	Residential	ext	5.0%	22.7	0.008	
COM Internal	Commercial	int	80.0%	550.4	0.201	8.00%
COM External	Commercial	ext	20.0%	137.6	0.050	2.00%
IND Internal	Industrial	int	90.0%	1176.3	0.430	0.09%
IND External	Industrial	ext	10.0%	130.7	0.048	0.01%
OTH Internal	Other	int	10.0%	195.8	0.072	4.78%
OTH External	Other	ext	90.0%	1762.5	0.644	43.01%
System Leakage	Leakage				27.6	

% Reductions

Restriction Impact (Level 1)	Restriction Impact (Level 2)	Restriction Impact (Level 3)	Restriction Impact (Level 4)	Restriction Impact (Level 5)
2.0%	2.0%	2.0%	5.0%	8.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	2.0%	10.0%	20.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	5.0%	10.0%	10.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	40.0%	60.0%	100.0%	100.0%
5.0%	20.0%	35.0%	100.0%	100.0%
2.0%	4.0%	8.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	80.0%	95.0%
2.0%	2.0%	5.0%	10.0%	15.0%
2.0%	2.0%	80.0%	100.0%	100.0%
2.0%	2.0%	5.0%	10.0%	15.0%
20.0%	30.0%	45.0%	60.0%	75.0%
1.0%	2.0%	4.0%	8.0%	10.0%

Total Consumption

	(ML/d)	(ML/a)
Residential + Non-Residential (excluding system leakage)	**1.3**	**477.4**

Table 5 Target and Expected Residential Water Consumption per Person

	Unrestricted Consumption	LEVEL 1 Low	LEVEL 2 Moderate	LEVEL 3 High	LEVEL 4 Very high	LEVEL 5 Extreme
End Use Model Residential Consumption (L/Person/d)	382.8	340	296	250	131	123
RWCC Estimated Targeted Residential Average Daily Usage (L/Person/d)	375	340	280	200	150	120

Table 6 Total Annual Demand Analyses

Total Annual Consumption Expected by End Use

Description	Category	Reduction Level 1	Reduction Level 2	Reduction Level 3	Reduction Level 4	Reduction Level 5
RES Toilets	Residential	11.2	11.2	11.2	10.9	10.5
RES Baths	Residential	3.7	3.7	3.7	3.4	3.0
RES Showers	Residential	27.9	27.9	27.9	25.6	22.8
RES Taps/Sinks	Residential	9.8	9.8	9.5	9.0	8.5
RES Dishwashers	Residential	1.0	1.0	1.0	0.9	0.9
RES Washing Machines	Residential	16.9	16.9	16.3	15.5	15.5
RES Int. Leakage	Residential	3.7	3.7	3.6	3.4	3.2
RES Ext. Irrigation	Residential	80.2	60.1	40.1	0.0	0.0
RES Ext. Other	Residential	17.9	15.0	12.2	0.0	0.0
RES Ext. Leakage	Residential	6.1	6.0	5.8	0.0	0.0
COM Internal	Commercial	37.4	37.4	36.3	34.4	32.5
COM External	Commercial	7.6	6.7	5.3	1.9	0.5
IND Internal	Industrial	0.4	0.4	0.4	0.4	0.4
IND External	Industrial	0.0	0.0	0.0	0.0	0.0
OTH Internal	Other	22.4	22.4	21.7	20.5	19.4
OTH External	Other	164.3	143.8	112.9	82.1	51.3
System Leakage	Leakage	27.4	27.1	26.5	25.4	24.9

Total of Actual incl. leakage

Total Annual Consumption Expected

	Production	Consumption	Total Demand Expected for each Level (incl. System Leakage)				
ML/a	552.7	505.1	438.0	393.2	334.5	233.5	193.4
Total Demand Expected for each Level (incld System Leakage) (ML/d)		1.4	1.2	1.1	0.9	0.6	0.5
Average Daily Usage based on RWCC Target % (ML/d)		1.7	1.5	1.3	0.9	0.5	0.5
Peak Day Consumption (ML/d)		4.5	Western Trunk Daily Consumption 2008/09				
Peak/Average water demand ratio		2.80	2008/09 DSS Input data				
Peak/Average water demand ratio		2.68	2009 - 2012 Daily Consumption				
End Use Model Estimtated Water Supply %		100%	87%	78%	66%	46%	38%
RWCC Estimated Targeted Water Supply %			90%	75%	50%	40%	32%

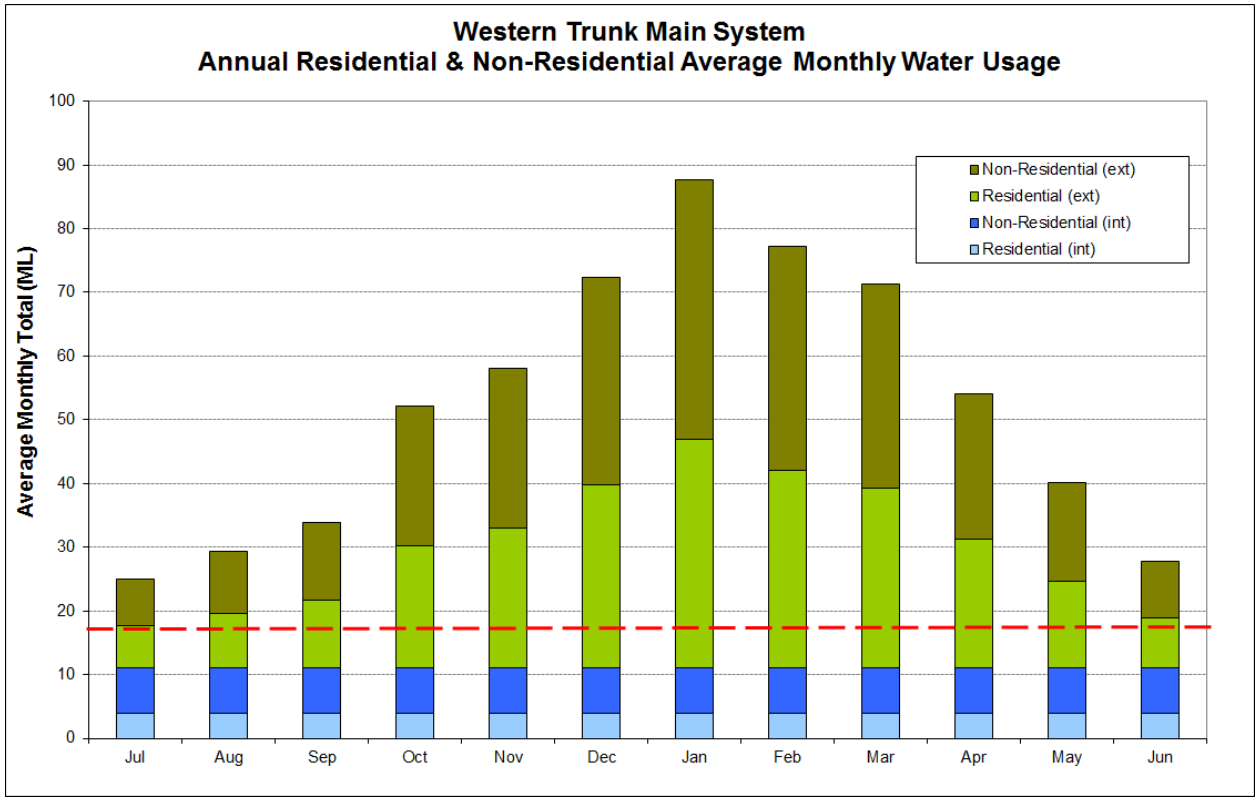
Table 7 Supply Source

	Western Trunk
Population	1438
No. of Residential Accounts:	755
Occupancy Rate:	1.9

Allocation	Licenced Volume (ML/a)	Allocation Reduction	Licenced Allocation	
Surface water - Murrumbidgee River	7000			
Surface water - Columbo Crk	805	100%	805	
Columbo Creek - Stock & Domestic	195			(Private)
Bulgary Bores	1000	100%	1000	2.8 ML/d
Wagga Groundwater (W+E+N)	14000			

Table 8 Water Restriction Triggers

Supply						Demand			
		A	B			C			
Surface Water		Combined WAL Extraction Limits available		% of Combined WAL Extraction Limits available	Water Restrictions Level	Total Demand Expected for each Level (incl. System Leakage)		End Use Model Residential Consumption	RWCC Estimated Targeted
Bulgary Bores	Columbo Creek								
ML/a	ML/a	ML/a	ML/d			(ML/y)	(ML/d)	L/person/day	L/person/day
1000	805	1805	4.94	> 100%	0	505.1	1.38		
			1.73	> 35%	1	438.0	1.20	340	340
			1.48	> 30%	2	393.2	1.08	296	280
			1.24	> 25%	3	334.5	0.92	250	200
			0.99	> 20%	4	233.5	0.64	131	150
			0.74	> 15%	5	193.4	0.53	123	120

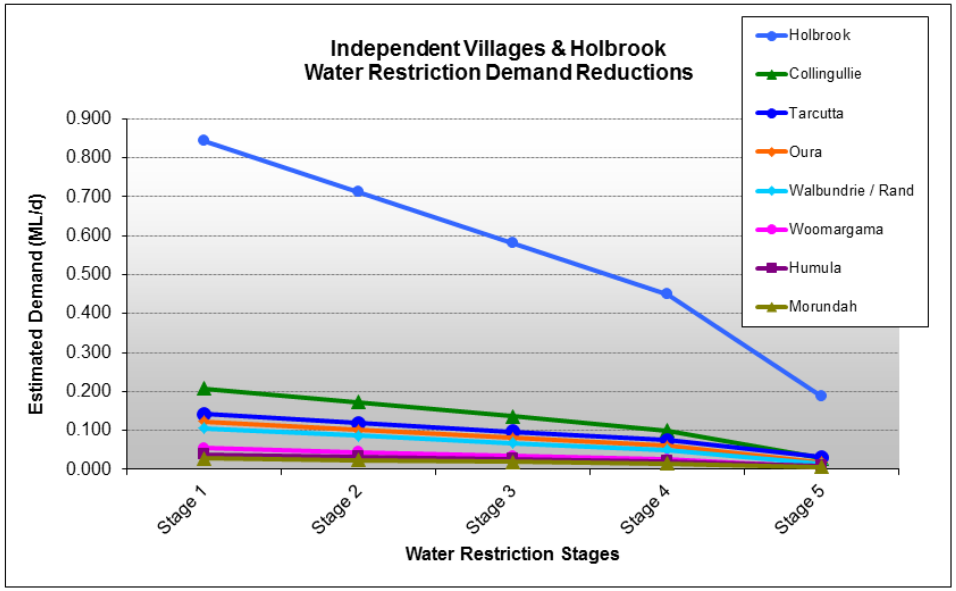

Western Trunk Main System
Annual Residential & Non-Residential Average Monthly Water Usage
Average Monthly Total (ML)
100
90
80
70
60
50
40
30
20
10
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Non-Residential (ext)
Residential (ext)
Non-Residential (int)
Residential (int)

Appendix D

Water Restriction Triggers Analysis (Independent Villages and Holbrook Systems)

Independent Villages & Holbrook Water Restriction Triggers

Systems	Collingullie		Holbrook		Humula		Morundah		Oura		Walbundrie / Rand		Tarcutta		Woomargama		Average Southern Trunk Demand Reduction %	
	Go to System Tab		Go to System Tab		Go to System Tab		Go to System Tab		Go to System Tab		Go to System Tab		Go to System Tab		Go to System Tab			
Restrictions	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger	Estimated Demand ML/d	Supply Trigger		
																	100%	
Stage 1	0.208	55%	0.844	65%	0.039	50%	0.028	85%	0.122	30%	0.105	35%	0.141	55%	0.054	50%	85%	
Stage 2	0.172	45%	0.713	55%	0.033	40%	0.024	75%	0.102	25%	0.087	30%	0.119	50%	0.045	45%	80%	
Stage 3	0.136	35%	0.581	45%	0.027	35%	0.019	70%	0.081	20%	0.068	25%	0.097	45%	0.035	40%	75%	
Stage 4	0.100	**25%**	0.450	**35%**	0.021	**30%**	0.015	**65%**	0.060	**15%**	0.050	**20%**	0.075	**40%**	0.025	**30%**	**70%**	**Internal Consumption**
Stage 5	0.028	15%	0.187	25%	0.009	20%	0.006	60%	0.018	10%	0.013	15%	0.031	35%	0.005	20%	60%	



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