



Urban & Rural Water Strategy

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1. Foreword

The aim of this strategy is to detail how GWMWater will manage its water security to provide water supply services under a range of possible climate futures determined by the Victorian Government guidelines. The guidelines support GWMWater to discharge its responsibilities under Clause 6-A of the Statement of Obligations issued by the Minister for Environment, Climate Change and Water in December 2015. The Statement of Obligations require water corporations to 'comply with guidelines for forecasting the impacts of climate change on water supplies' as issued by the Department of Environment Land Water and Planning.

The completion of the Northern Mallee Pipeline in 2004 and Wimmera Mallee Pipeline system in 2010 has contributed significantly to the future security of water supply across the Wimmera-Mallee region. The collective pipeline systems across the region will continue to underpin highly efficient water supply into the future. Current water demand levels and the ability to carryover unused water each year has enabled GWMWater to maintain a high degree of water security for its customers through recent dry periods, particularly in the Grampians and Murray supplied systems.

2. Executive Summary

2.1 Background

The purpose of this Urban Water Strategy is to identify the best mix of measures to provide water services in our towns and cities now and into the future. Urban Water Strategies have a long-term outlook of 50 years.

This strategy meets requirement 6-A of the Statement of Obligations (General) issued to all water corporations and has been produced in accordance with DELWP Urban Water Strategy Development Guidelines.

As GWMWater has both urban and rural water corporation responsibilities, this Urban and Rural Water Strategy (U&R WS) considers both urban and rural pipeline supplied customers in each of our five water supply systems – Murray, Goulburn, Grampians, Pyrenees & Eastern Grampians and Groundwater towns. These supply systems are very different to each other in terms of supply source, number of customers and options available to manage any shortfalls in supply.

2.2 Development of this Strategy

The GWMWater Urban & Rural Water Strategy comprises of this Strategy document, supported by three background technical reports:

- Water Demands
- Modelling
- Review of 2012 Water Supply Demand Strategy

Historical water demands (2011-2016), combined with population projections have informed the baseline demand forecast for the 2017 U&R WS. The baseline demand forecast compared against the 9 prescribed climate change scenarios has identified where demand is projected to exceed supply in the next 50 years, or where there is a low level of confidence in a key factor impacting upon demands. Of particular interest is the new baseline climate planning scenario which is 1975 to current.

Key observations from developing urban demand projections were that:

- Small town populations are projected to decline, while larger centres are projected to grow slowly.
- 2040 urban demand is near identical to present demand of 11,600 ML/yr, due to decline in small towns offset by growth in larger centres.
- A 2% increase in urban demand is projected between current baseline and 2065. This is equivalent to a 270 ML/yr increase in bulk water to service this demand.

The rural demand baseline of 5,725 ML for the Wimmera-Mallee Pipeline (WMP) and Northern Mallee Pipeline (NMP) systems has been based on the average end user demand

over the last 5 years. This period incorporated seasons of varying climate, from wet (2011) to very dry (2015). Climatic factors are the most prominent driver of rural pipeline demand. An assessment of the security of supply for GWMWater's systems was made under a range of demand and climate scenarios, including those prescribed in the Urban Water Strategy Guidelines. These plausible climate scenarios range from the "bookends" – repeat of the historic climate to the very dry climate scenario, (post 1997) step climate change.

2.3 Supply System Key Findings

Murray System

GWMWater entitlements held in the Murray and Goulburn systems support the Northern Mallee Pipeline, Wimmera Mallee Pipeline (Supply System 5) and three private pipeline schemes. Historically, demand in this system has been far less than entitlement holdings, making this system relatively secure.

The Murray system assessment showed that based on population projections, urban demand is likely to remain relatively stable for Murray supplied towns. Future demand from recreation lakes (Ouyen Lake, Green Lake – Sea Lake) and the South West Loddon pipeline scheme will reduce the current level of security for existing users by placing greater demand on existing entitlement. It was also apparent that carryover is crucial to balancing supply and demand over multiple years.

Grampians Supply System

Supply system performance was assessed at both a total Grampians Supply System scale and also at individual Reservoir Supply System scale, with use of a REALM hydrologic model, and spreadsheet analysis.

For the total Grampians system, analysis of model outputs showed GWMWater Wimmera-Mallee Pipeline product (urban, rural, industrial) demand can be met in all years at current levels of demand, and under all climate scenarios. Security of supply reduced by 3% for 2040 and 2065 levels of demand under a post 1975 climate baseline (i.e. 3 years in 100 some level of restriction would be necessary). Security of supply was found to be poor, particularly under high climate scenarios with 2040 and 2065 levels of demand (between 13 and 50 years in 100 where some level of restriction would be required). The analysis also highlighted the importance of 'unlimited' carryover in the Grampians headworks system as a tool to manage multi-year water security by continual carryover of unused allocation to meet demands in dry years. It was also observed that the current GWMWater business strategy to sell all remaining (uncommitted) growth water is sound as it has only a minor effect on the number of years in which some level of restriction would be required (1-2 years in 100).

At an individual Grampians Reservoir scale

It was observed that the security of supply from Wartook & Moora Reservoir to Horsham/Natimuk & Supply System 6 can be impacted in scenarios where other water users draw disproportionately more water from Lake Wartook than GWMWater. This is because water allocations in the Grampians system considers all water in the headworks as a collective pool, and does not consider where in the system that water is physically located. This is exacerbated under severe climate scenarios.

Lake Bellfield and Taylors Lake supply to the Wimmera-Mallee Pipeline remains secure under all but extreme climate change scenarios.

Lake Fyans supply to Stawell, Ararat and Great Western remains relatively secure, as there is sufficient resource between Lake Fyans and Lake Bellfield to meet demand in all but extreme climate scenarios.

Eastern Grampians & Pyrenees Systems

The Eastern Grampians system is not generally resource constrained, however, physical capacity of the pipelines between the headworks (weirs and bores) and Willaura/Moyston storages presents a constraint to moving water within the system, and can also present a risk to water security in this system during dry periods. Current operating practices can reduce the volume which can be harvested, particularly during the winter months. Options for addressing constraints within the Willaura system are currently being investigated.

Elmhurst and Buangor systems are isolated and could become at risk in very dry periods. An absence of streamflow monitoring means that there is little data recorded as to the reliability of streamflow in the waterways which feed these towns.

Groundwater towns

GWMWater's groundwater supplied towns span a range of groundwater management areas with differing levels of security. In most cases, the existing groundwater resource provides a long term supply option which is influenced little by climatic factors.

Edenhope has been identified as a tapping a finite groundwater resource. A technical assessment is being progressed to determine the remaining 'life-span' of this resource, which will inform augmentation planning and timelines. The South West Wimmera Feasibility Study may also present an opportunity to pursue alternate supply options.

GWMWater's groundwater licence for Harrow is insufficient to meet current levels of demand, requiring water trade to meet demand. Harrow accesses a relatively secure groundwater resource, and increasing the current licence volume is a viable option. Further supply options may become available through the South West Wimmera Feasibility Study.

Integrated Water Management

Integrated Water Management for towns and cities is a priority in *Water for Victoria*. GWMWater has successfully worked with local government local communities to develop and implement integrated water management plans at towns such as Nhill. Priorities for future integrated water management plans include Murtoa, Edenhope and Horsham. It is anticipated that these will be addressed through an integrated water management forum approach.

2.4 Priority Actions

Action	Recommendation
1	GWMWater to undertake further detailed assessments to determine the level of security GWMWater wishes to maintain for Murray/Goulburn supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.
2	GWMWater to work with the Storage Manager to investigate options or a framework which provides rules-based equitable access to reservoirs.
3	Stawell Urban Reservoir operating rules are to be developed.
4	Continuous streamflow monitoring should be installed upstream of Eastern Grampians diversion weirs to build understanding of water availability..
5	Develop Storage Operating Rules for Eastern Grampians Urban Storages.
6	GWMWater to undertake further assessment on which combination of options will best improve water security in the East Grampians water supply system.
7	Continuous streamflow monitoring should be installed on Hickmans and McCleods Creeks to build understanding of water availability.
8	Develop Storage Operating Rules for Elmhurst and Buangor Urban Storages.
9	Investigate an increase to the Buangor Bulk Entitlement volume to reflect improvements in bulk metering of diversions.
10	Continue current Edenhope groundwater monitoring regime and undertake a technical assessment 'health check' of the current supply to determine expected remaining life and identify triggers as to when resource is becoming stressed.
11	GWMWater to commence work to apply for an increase in licence volume for Harrow.
12	GWMWater to undertake further detailed assessments in conjunction with the Murray assessment (Recommendation 1) to determine the desired level of security GWMWater will maintain for Goulburn supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.

3. Background

GWMWater has both urban and rural water corporation responsibilities. This GWMWater Urban & Rural Water Strategy (U&R WS) applies the *Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy (DELWP, 2016)*, herein referred to as 'Urban Water Strategy Guidelines', to our urban and rural pipeline supplied customers. These rural customers have similar characteristics to urban users, as they are both supplied under GWMWater's consumptive entitlements, in most cases using the same pipeline distribution systems.

This Strategy does not consider rural users who access water directly from groundwater or unregulated surface sources (not from a reservoir), by way of licence issued under the *Water Act 1989*.

In the Grampians reservoir system (Wimmera-Glenelg system) GWMWater has both entitlement holder and Storage Manager responsibilities. This strategy only considers the water available to GWMWater as an entitlement holder, under its consumptive urban and rural entitlements for supply to its customers. The demands of GWMWater's other entitlements (such as Recreation) are not considered within this strategy.

Other entitlement holders' requirements are within the domain of the Storage Manager, and so are not discussed within this strategy. Further information on the Storage Manager and its responsibilities can be found at www.storage manager.com.au.

GWMWater's Urban & Rural Water Strategy is supported by the following background and technical reports:

- Water Demands
- Modelling
- Review of 2012 Water Supply Demand Strategy

An assessment of the security of supply for GWMWater's individual supply systems was made under a range of demand and climate scenarios, including those prescribed in the Urban Water Strategy Guidelines.

This U&R WS provides demand projections which also form inputs to GWMWater strategic business planning and are used in assessing the potential need for augmentation of supply.

3.1 Purpose, Objective and Policy Context

3.1.1 Purpose

Victoria's water planning framework requires the development of Urban Water Strategies by those water corporations providing urban services.

The purpose of Urban Water Strategies is to identify the best mix of measures to provide water services in our towns and cities now and into the future. Urban Water Strategies have a long-term outlook of 50 years; and contain actions which:

- consider the total water cycle, consistent with the principles of integrated urban water management;
- support the development of resilient and liveable communities;
- balance social, environmental and economic costs and benefits; and
- take account of the consequences and uncertainty associated with population growth and climate change and climate variability.

This U & R WS comprises of the publically available Strategy document, supported by three background technical reports.

3.1.2 Objectives

GWMWater's U&R WS has the following objectives:

- To assess the expected long term water demand of current and future customers under a range of climate change scenarios.
- To determine anticipated available water to meet these demands, and
- Propose recommendations for the Corporation to deliver on this strategy.

3.1.3 Policy Context

Water for Victoria (2016) outlines the water management opportunities and challenges facing Victoria over the coming decades. It builds on the planning framework established in Our Water, Our Future (2004), while incorporating lessons from the millennium drought and the 2010-11 floods. Among these lessons is a recognition that resilient and liveable cities and towns are fundamental to economic prosperity, social and environmental needs, and community identity and wellbeing. Water has an essential role in supporting these outcomes through more integrated and strategic approaches to urban water service provisions and urban land use planning.

The Urban Water Strategy Guidelines are written for metropolitan and regional urban water authorities. GWMWater has developed its U&R WS, encompassing both urban and rural pipeline supplied customers.

3.2 GWMWater Region

3.2.1 *History of Water Supply*

The history of the settlement of the Wimmera Mallee is largely linked with the provision of adequate water supplies. It is quite obvious that without an assured supply, the existing development would not have been possible.

In 1878, the Shires of Dunmunkle and St Arnaud constructed a timber weir in the Wimmera River near Glenorchy, turning water into the Dunmunkle and Swedes Creeks. The Shire of Wimmera constructed a similar structure near Longerenong to facilitate diversion of water into Yarriambiack Creek. Both these structures were severely damaged by floodwaters on several occasions and eventually abandoned.

The dry years following 1882 led to the construction of Lake Wartook Reservoir in 1887 by the Wimmera United Waterworks Trust. The natural watercourses of the Wimmera River, Yarriambiack and Dunmunkle Creeks and the Richardson River were used as the main distribution channels.

Settlement of the Northern Wimmera and Southern Mallee continued over the next few years, leading to further demands for water and many kilometres of new channels were constructed. In the dry period culminating in the 1902 drought the water supply scheme partially failed, leading to the construction of Lake Lonsdale in 1903.

The State Rivers and Water Supply Commission took control of the scheme in 1906 and was the responsible Authority until July 1984. Government restructuring then led to the formation of successor bodies the Rural Water Commission and later the Rural Water Corporation which existed until June 1994. Wimmera Mallee Water was the region's rural and bulk water authority until the creation of GWMWater in 2004.

After the 1914 drought, reservoirs were constructed at Lake Fyans and Taylors Lake and, in 1919 (also a dry year) Pine Lake was authorised. During the dry period 1927 to 1930, the Waranga Western Main Channel, which brings water from the Goulburn and Loddon River systems to the east, was extended 208 kilometres west of the Loddon River to supply the northern part of the system. Moora Reservoir, Green and Dock Lakes were added to the system in 1934 and 1935.

After the construction of Rocklands and Toolondo Reservoirs, which were both completed in 1953, arrangements were made to supply the whole of the system from the Grampians reservoirs, thereby removing the heavy dependence on the Waranga Western Main Channel from 1962 onwards. It was not until the 1967/68 drought that it was again found necessary to open the channel to supplement supplies to the Wimmera-Mallee. The Waranga Channel remained an essential component of the system until the completion of Northern Mallee &

Wimmera Mallee Pipeline projects, and at present only provides water supply for the township of Quambatook via the Normanville Pipeline.

The last and most recent reservoir to be constructed as part of the headworks was Lake Bellfield, completed in 1966.

To minimise system losses, a program to replace channels with pipelines commenced in 1994 with the Northern Mallee Pipeline Project. Completed in 2004, the project has saved an average 50,000 ML per year in the Wimmera and Glenelg catchments to improve reliability to existing customers, improve environmental flows and to provide water for growth. The Northern Mallee Pipeline is now sourced from the Murray River, rather than the Grampians headworks.

Construction of the Wimmera Mallee Pipeline commenced in 2006 to replace the 18,000 km of earthen channels with 9,159 km of pressurised pipeline and associated structures. One of Australia's largest infrastructure projects, the pipeline was completed in April 2010, four years ahead of schedule and within the \$688 million project budget.

Since 2010 there have been various augmentations to the system to provide water supply to areas adjoining the WMP area and water treatment upgrades to towns in the region.

3.2.2. GWMWater Overview

Grampians Wimmera Mallee Water Corporation (trading as GWMWater) is a government-owned Statutory Corporation established on 1 July 2004 under the Water Act 1989. GWMWater was the water corporation that was created from the former rural and urban water authorities to deliver and manage water supply and sewerage services.

GWMWater has one of the largest geographic footprints of all Victorian water businesses, covering some 62,000 square kilometres or 25 percent of regional Victoria. The service includes thirteen municipalities in full or in part. We service approximately 72,000 people living either on farms or in one of 71 urban centres.

Our large service area presents a major challenge to provide water and wastewater services. We harvest water in the Grampians or extract water from the Murray River and from these points store, treat, transfer and distribute water and wastewater, often over long distances, to meet our customer service obligations. To deliver these services we manage an extraordinary number of assets including bulk water supply reservoirs, hundreds of smaller storages, tanks, water towers and approximately 14,000km of pipes.

Our water services are provided for use in and around homes, in business, on farms, for environmental purposes and for recreational and sporting uses for community benefit.

4. Our Water Resources

GWMWater owns and operates a number of water supply systems which comprise of headworks reservoirs, bulk water supply assets and distribution assets (e.g. pipelines). These supply systems are broadly categorised as the:

- a) Murray supplied systems,
- b) Grampians supplied systems,
- c) Goulburn supplied systems,
- d) Pyrenees and Eastern Grampians systems, and
- e) Groundwater supplied towns.

These supply systems are very different to each other. GWMWater holds entitlements totalling 6,409 ML which are used in supplying its Murray pipeline systems. This volume is equivalent to approximately 0.04% of total Victorian River Murray high reliability entitlements. The Grampians reservoir system, which comprises of nine water supply reservoirs, associated channels and regulating structures supplies GWMWater's urban and rural entitlement of 32,720 ML (excluding supply by agreement users). This volume represents 26% of all entitlements in this system. In terms of both geographic area supplied and volumetric demand, Groundwater supplied towns and the Pyrenees and Eastern Grampians systems are relatively small systems compared to the Grampians and Murray supplied systems.

Each of these systems is described in more detail in the following sections. A summary of GWMWater's entitlements can also be found in **Appendix 3 – GWMWater Entitlements**.

4.1 Murray Supply System Description

GWMWater operates four pump stations on the River Murray located at Swan Hill, Piangil, Nyah and Liparoo. These pump stations supply bulk water to urban storages and rural customers through the Northern Mallee Pipeline (NMP) and Supply System 5 of the Wimmera Mallee Pipeline (WMP) (refer to *Figure 1*). GWMWater holds 6,409 ML of high reliability entitlements to support demands in its Murray supplied systems. GWMWater's entitlement holdings in the Goulburn system can also be accessed from its River Murray pumps through water trading mechanisms.

The 6,409 ML of entitlement provides water for urban, rural and industrial customers, as well as for recreation supply. *Table 1* provides an overview of the NMP and WMP Supply System 5 user groups and the towns supplied from the respective systems.

Figure 1 – Northern Mallee Pipeline

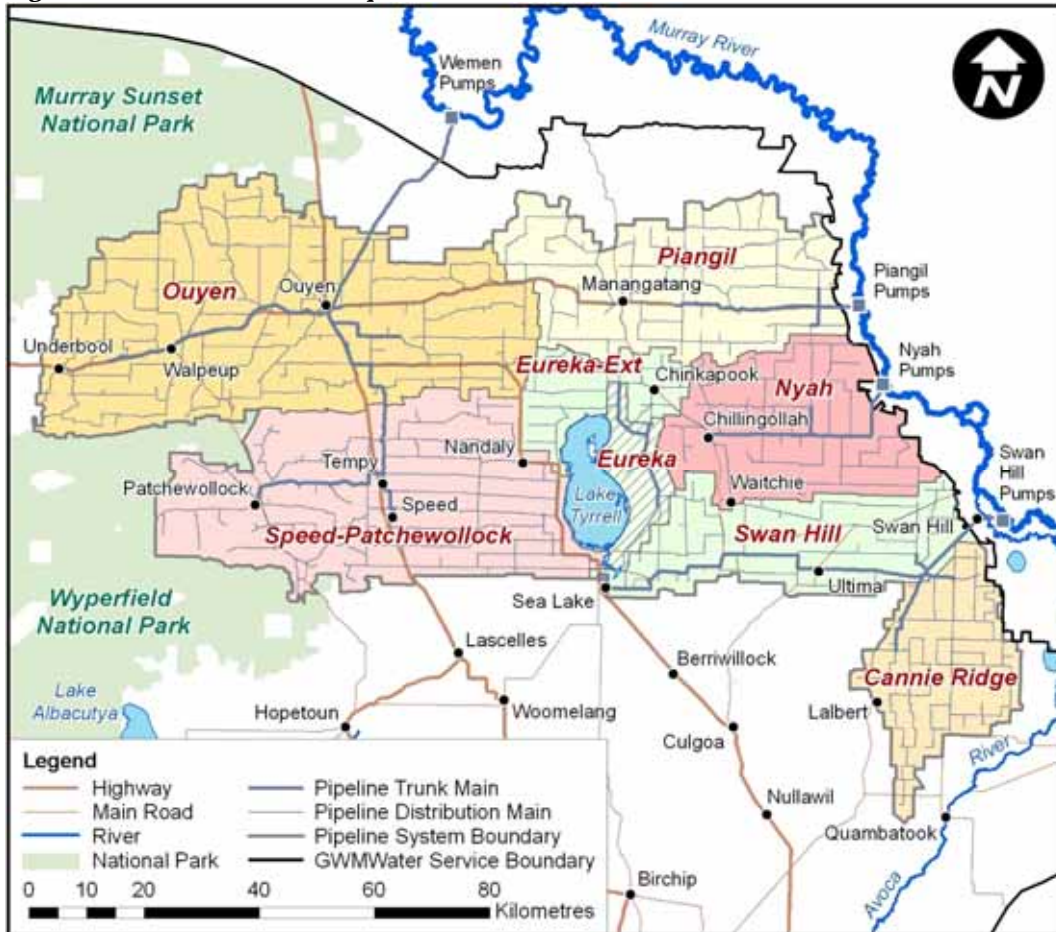


Table 1 – Murray River supplied systems and customer user groups

Pipeline System	User Group	Towns or Area Supplied
Northern Mallee Pipeline	Urban	Ouyen, Underbool, Manangatang, Nullawil, Sea Lake, Ultima, Walpeup, Chillingollah, Chinkingook, Nandaly, Patchewollock, Speed, Tempy, Waitchie
	Rural Pipeline	See <i>Figure 1</i>
	Recreation Lakes	Ouyen Lake (Ouyen township)
WMP Supply System 5	Urban	Berrwillock, Culgoa, Lalbert, Nullawil
	Rural Pipeline	Area west of Cannie Ridge NMP supply area.
	Recreation Lakes	Green Lake (near Sea Lake township)
Private Pipeline	Rural	North of Piangil, outside NMP footprint.

4.2 Grampians Supply Systems Description

GWMWater owns and operates nine bulk water supply reservoirs and a number of other headworks assets as part of the Grampians reservoir system, under direction of the Storage Manager. The reservoirs are Lake Bellfield, Lake Fyans, Mt Cole Reservoir, Lake Lonsdale, Lake Wartook, Moora Reservoir, Rocklands Reservoir, Toolondo Reservoir and Taylors Lake.

Green Lake near Horsham is no longer used for water supply, but provides valued recreation opportunities. Pine Lake and Dock Lake are no longer used for water storage or supply, and are considered to be off-line.

GWMWater has a 44,720 ML entitlement (36% of total entitlements) from the Grampians Reservoir system for supplying its urban, rural and large 'supply by agreement' commercial customers. Coliban Water, Wannon Water and the Victorian Environmental Water Holder also hold bulk entitlements in this system. Only the urban and rural component of GWMWater's entitlement (32,720 ML) used in supplying urban and rural pipeline customers is considered in this Strategy. Supply by agreement users (12,000 ML) receive a bulk water allocation and have the ability to manage their own water security through carryover. Bulk water allocations are determined by the Storage Manager.

The Grampians reservoirs support supply systems 1,2,3,4,6,7 of the Wimmera-Mallee Pipeline (refer to *Figure 2*). *Table 2* identifies the reservoirs which are typically used to supply particular towns and rural areas

The Mt Zero area near Horsham was identified as a suitable groundwater source due to its proximity to existing water supply infrastructure and evidence of a good groundwater resource. Three production bores were developed, and during the 1996-2010 drought, reduced demand on Lake Wartook from the Horsham urban system by approximately 30%. The bore field provides an ongoing contingency during periods of critically low surface water availability.

Figure 2: Wimmera-Mallee Pipeline Supply Area

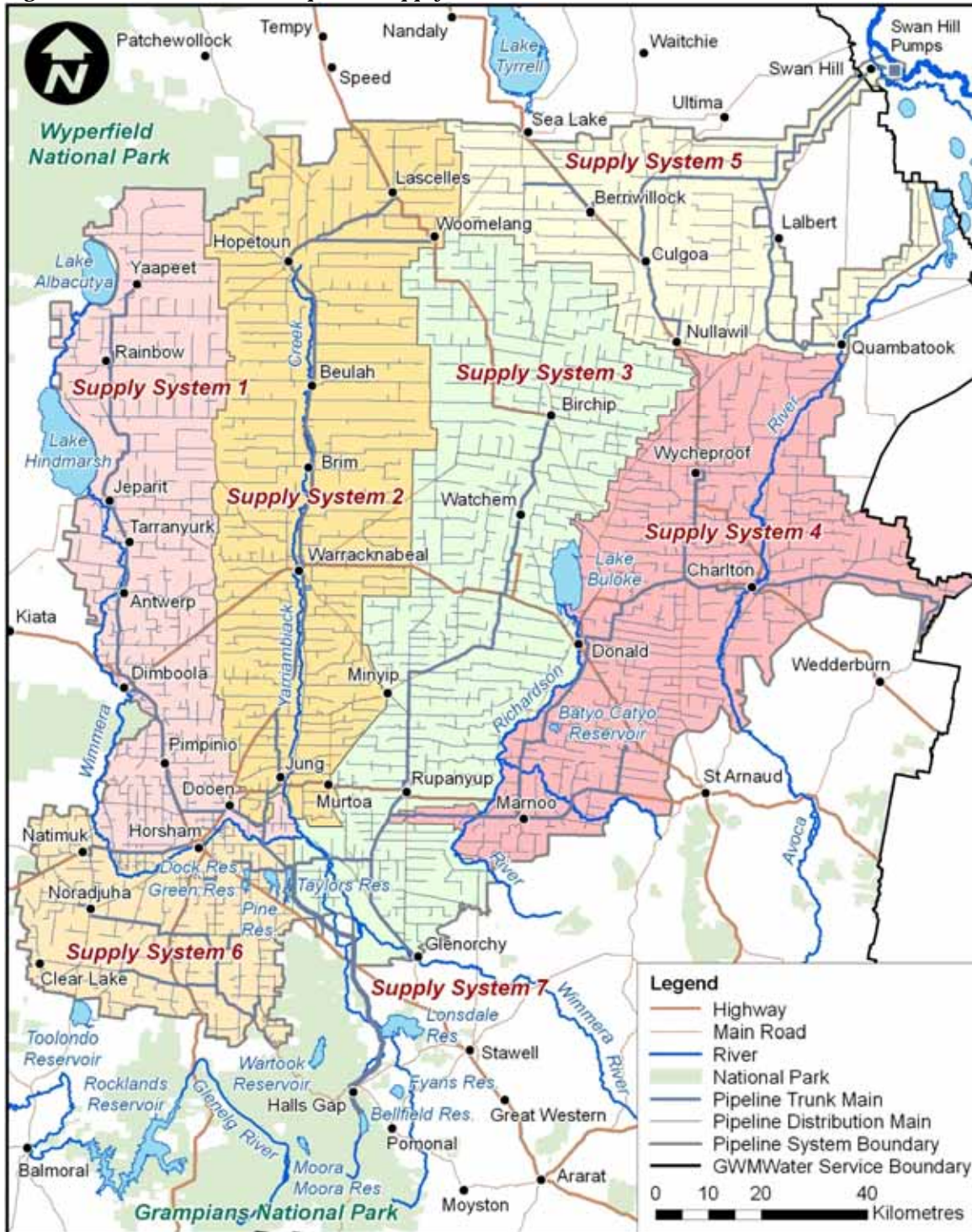


Table 2 – Grampians supplied systems and customer user groups

Reservoir/ Delivery System	User Group	Town or Area supplied
Lake Bellfield & Taylors Lake	Urban via WMP	Birchip, Charlton, Dimboola, Hopetoun, Murtoa, Rainbow, St Arnaud, Warracknabeal, Beulah, Brim, Donald, Jung, Minyip, Rupanyup, Woomelang, Wycheproof, Antwerp, Dooen, Glenorchy, Jeparit, Lascelles, Marnoo, Pimpinio Tarranyurk, Watchem and Yaapeet
	Urban from Lake Bellfield	Halls Gap, Pomonal
	Rural	Wimmera-Mallee Pipeline (see Figure 2) Supply System 1, 2, 3, 4, 7 North east part of SS 6
	Industrial from Headworks	Users supplied by agreement.
	<i>Environment</i>	<i>Environmental demand from Taylors Lake is not directly considered in this Strategy.</i>
Lake Wartook	Urban	Horsham, Natimuk
	Rural	Wimmera-Mallee Pipeline Supply System 6
	<i>Environment</i>	<i>Environmental demand from Lake Wartook is not directly considered in this Strategy.</i>
Moora Reservoir	Rural	Wimmera-Mallee Pipeline Supply System 6, including Clear Lake and Noradjuha area
Lake Fyans	Urban	Ararat, Great Western, Stawell.
	Rural	Landsborough Valley Pipeline. Rural users supplied from Lake Fyans to Stawell/Ararat raw water pipeline.
Mt Cole Reservoir	Urban	Ararat.
	Rural	Rural users supplied from Mt Cole to Ararat raw water pipeline.

Note: Some other reservoirs within the headworks system (not listed in this table) are able to support GWMWater’s demands through water transfers (e.g. Rocklands Reservoir to Taylors Lake). All reservoirs in the Grampians headworks system have been included in GWMWater’s assessment of its water security.

4.3 Pyrenees and Eastern Grampians Supply Systems Description

GWMWater operates a number of smaller systems which supply the towns of Elmhurst, Willaura, Moyston, Wickcliffe, Lake Bolac, and Buangor, located in the far south and east of GWMWater’s operational area. GWMWater also provides bulk water from the Eastern Grampians system to Wannon Water which supplements its supply to Glenthompson township.

Table 3 describes the areas and towns serviced by GWMWater from the Eastern Grampians and Pyrenees system. The entitlement volumes for supply to these areas are also shown against the supply source.

Table 3 – Pyrenees and Eastern Grampians supplied systems and customer user groups

Supply System	Supply Source	User Group	Town or Area Supplied
Pyrenees	Hickmans Creek (48 ML)	Urban	Elmhurst
	McLeods Creek (28 ML)	Urban	Buangor
Eastern Grampians	Mount William Creek, Stoney Creek, Masons Creek, (390ML)	Urban	Lake Bolac, Moyston, Wickcliffe, Willaura
		Rural	Rural users supplied from raw water pipeline.
	Groundwater (220 ML)	Bulk Water	Transfer to Glenthompson system (<i>Glenthompson BE volume (58 ML)</i>)

4.4 Groundwater Urban Supply Systems Description

GWMWater operates a number of groundwater bores that supply or supplement water to thirteen towns in the south-east and western parts of GWMWater’s operational area (refer *Figure 3*). Where groundwater is provided as a supplementary source to surface water supplies, such as the Eastern Grampians system, or as a drought contingency such as for Horsham then these supplies are also discussed in the respective surface water sections.

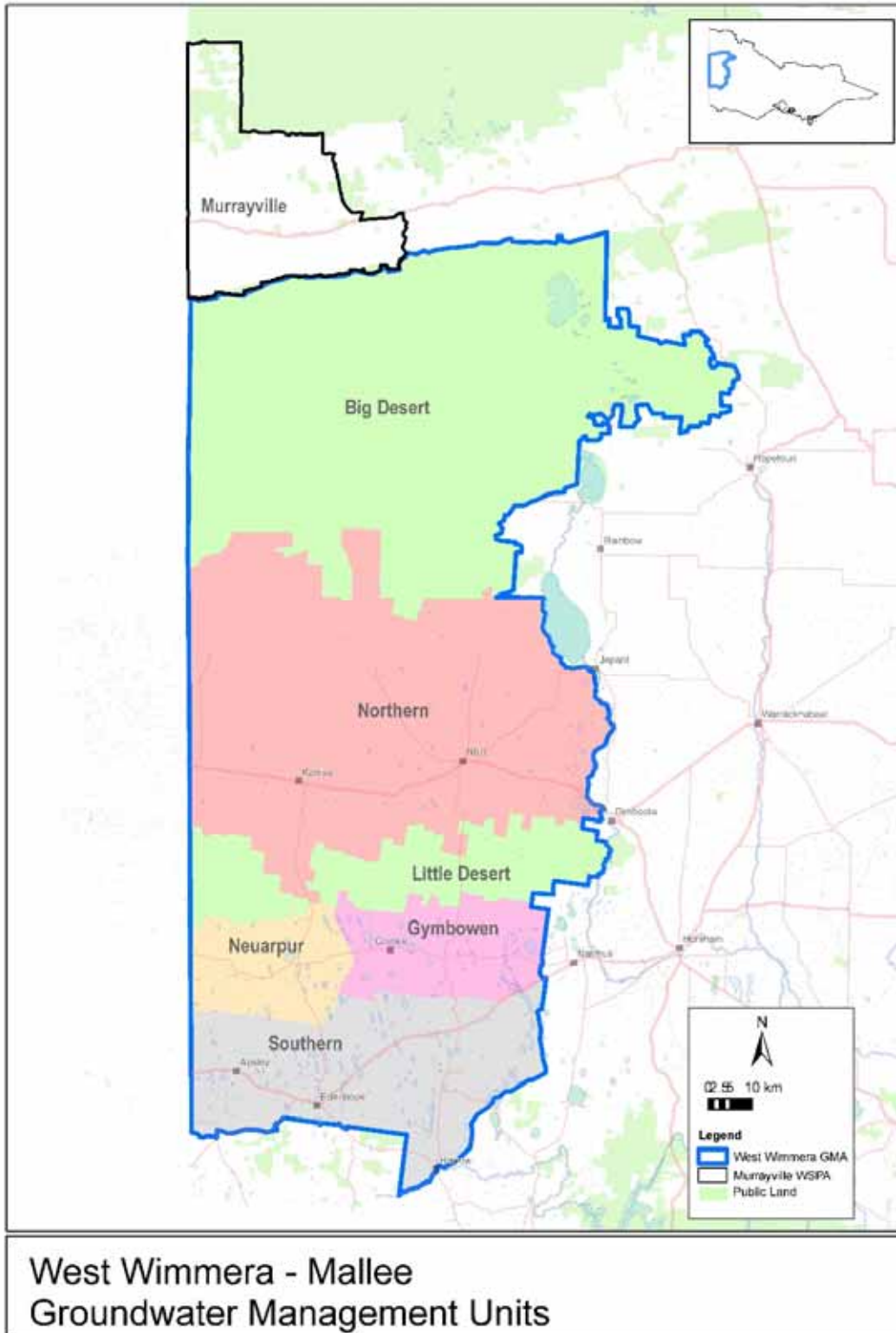
Table 4 – Groundwater supplied systems, customer user groups and licenced entitlement volumes

Groundwater area	User Group	Towns Supplied	Licence Volume (ML)
West Wimmera: Northern	Urban	Kaniva	600
		Kiata	40
		Lillimur	32
		Miram	7
		Serviceton	25
West Wimmera: Southern	Urban	Apsley	40
		Edenhope	250
		Harrow	29
West Wimmera: Gymbowen	Urban	Goroke	86
Murrayville	Urban	Cowangie	40
		Murrayville	475
Eastern Grampians	Urban (supplementary)	Streatham	30
		Westmere	30
		Willaura	220
Western Grampians	Urban (contingency)	Horsham/Natimuk	1200
			Total: 3,104

GWMWater has a 1,200 ML groundwater entitlement from the Mt Zero borefield to supplement Horsham urban system during periods of low surface water availability. This licence permits GWMWater to extract up to 1,200 ML a year from the wellfield, on the condition that a volume no greater than 2,400 ML is extracted in any consecutive 5-year period.

In addition to urban groundwater supplies, GWMWater also manages all licenced groundwater use in the groundwater management units shown in *Figure 3*. Licenced groundwater use other than for GWMWater’s towns does not form part of this Strategy. Water extracted for commercial use in groundwater areas is managed under a cap (permissible consumptive volume) and take and use licenses are managed according to Section 40 and licensed under section 51 of the *Water Act 1989*. Domestic and stock water use is a private right under Section 8 of the *Water Act 1989*.

Figure 3 – West Wimmera and Murrayville Groundwater Management Areas



4.5 Goulburn Supplied System (Quambatook) Description

The Quambatook township is supplied from the Goulburn System via the Normanville pipeline. GWMWater has a 100ML Bulk Entitlement to supply Quambatook. Supply to Quambatook can be supplemented through water trade from GWMWater's other Goulburn and Murray system entitlements.

GWMWater's South-West Loddon pipeline scheme (currently under construction) will also source a part supply from the Goulburn System via the Waranga Western Channel. It is anticipated that GWMWater's existing Goulburn entitlements will be used to support demand from this system. Information on GWMWater's Goulburn system entitlements can be found in **Appendix 3 – GWMWater Entitlements**

4.6 Other Water Supplies

4.6.1 Recycled Water

State Government policies recognise the benefits of using recycled water to improve the reliability of other water supplies.

Reclaimed water management is not governed by provisions of the *Water Act 1989*, but is regulated by the Environment Protection Authority and supplied by water corporations in accordance with EPA guidelines, principally Publication 464.2 '*Guidelines on the Use of Reclaimed Water*'.

For more than thirty years GWMWater has supplied reclaimed water for community benefit and regional development. GWMWater operates twenty-eight wastewater treatment plants, with reclaimed water supplies generated from nine of these sites supplied to thirty-nine customers. Reclaimed water is treated to a Class C standard at all wastewater treatment plants. The level of service for reclaimed water customers is based on Class C effluent quality under the relevant environmental management guidelines.

Most of GWMWater's wastewater facilities have integrated on-site reuse or alternately, reclaimed water is supplied for re-use under commercial agreement. At six of the twenty-eight sites including Ararat, Edenhope, Horsham and Warracknabeal, 100% of the scheme capacity is allocated under agreements.

GWMWater has 2,233 ML committed to third parties through reclaimed water agreements. Typically, 2,171 ML/year is produced for reuse, although the actual volume may vary.

GWMWater typically recycles around 98% of available reclaimed water, with noteworthy schemes in operation at Horsham, Ararat and Warracknabeal.

Opportunities for beneficial reuse also exist at Murtoa, Birchip, Charlton, Dimboola, Murtoa, Sea Lake, St Arnaud and Ouyen. It is recognised, however, that scope exists to improve the value achieved from reclaimed water within the region.

4.6.2. *Stormwater*

The 1996–2009 drought was a key driver for local government and their local communities develop systems to utilise stormwater for watering sports grounds and community gardens. Examples of stormwater harvesting include the Racecourse Wetlands in Horsham and parks and sports grounds in Stawell including Cato Lake Park, Cemetery Gardens, Central Park, Federation Park, North Park and Taylors Gully Park.

Future stormwater harvesting projects need to be assessed within current government policy and rules for allocating stormwater in urban areas as stated in the Central, Northern and Western Sustainable Water Strategies:

“The Government adopts the following allocation rules for storm water in urban areas:

- if stormwater is flowing to the sea via a drain, all of the storm water may be harvested; and
- if stormwater is flowing to a stream from an existing development, assume up to 50 per cent of existing stormwater can be harvested for consumptive use and 50 per cent is reserved for the environment. If there is a scheme to harvest more than 50 per cent of the resource a study is required to assess the implications for the environment “

GWMWater considers stormwater an alternative water source with the ability to support local government and local community uses, within relevant State Government policies.

4.7 Water Quality

In some cases, the water resource may not be fit for purpose use due to water quality issues such as blue green algae. The GWMWater Algae Management System provides a framework for the management of blue-green algae (BGA) blooms in GWMWater’s source waters and supply systems. The management system was developed out of experience in managing the 2016 BGA outbreak in the Murray River System, and has since been extended to include other water sources managed by GWMWater.

Information regarding the exposure guidelines to BGA, coordinated approach within Victoria, risk management plan and biovolume calculator can be found on the [Blue-green algae resources](#) page of the Department of Environment, Land, Water and Planning (DELWP) website.

5. Strategy Development Process

5.1 Learnings from recent experience, including outcomes of implementing the GWMWater Water Supply Demand Strategy 2012

The WSDS (2012) was developed in accordance with Department guidelines and GWMWater business and customer needs. GWMWater has both urban and rural water corporation responsibilities, with the WSDS taking a whole of business approach to water planning.

Key Outcomes from review of GWMWater WSDS 2012:

- The scope of U&R WS will focus on those customer groups serviced by GWMWater's urban and rural pipeline systems. Issues pertaining to other entitlement holders are the domain of the Storage Manager.
- Refine understanding of how different parts of the region's rural water requirements change due to climate change and climate variability.
- Urban demand forecasts require a thorough review. Using the last 5 years' metered customer usage data will incorporate water use across a series average to dry years.
- The Victoria In Future (VIF) 2016 data should be analysed to establish population trends based on total households for future demand projections.
- Revised GWMWater business growth water sales will be used for industry projections.
- DELWP will undertake modelling of prescribed U&R WS scenarios. GWMWater Water Resources Staff will model these against current baseline and also the forecast 2040 and 2065 demands.

5.2 Customer & Stakeholder Consultation

GWMWater continues to consult extensively with its customers and stakeholders on issues including water security, water quality and capital investment opportunities.

Stakeholder Workshop

At GWMWater's March 2017 Stakeholder Workshop, outcomes from the U&R WS were discussed including securing supply to Buangor, Edenhope and Harrow. Stakeholder feedback strongly supported GWMWater considering options to secure long-term supply for these particular towns. Suggestions also included undertaking augmentation planning in the near future, which could then be delivered when required, or delivered once a particular 'trigger' point is reached.

The Stakeholder Workshop group also considered GWMWater using its consumptive allocation to support Wimmera-Mallee Pipeline supplied recreation lakes during dry times. Feedback showed strong support for GWMWater using consumptive allocation for supply to recreation lakes, but there was an expectation that GWMWater must ensure no impact on short to medium term security of urban and rural users occurs by doing this.

Customer Newsletter

Our quarterly customer newsletter 'Tapping In' is circulated to 32,000 urban and rural customers with their accounts, providing a regular engagement opportunity with our customers, and an opportunity to provide information on current issues. Paid 'infotorials' in the region's major newspapers provide timely information on a range of water related topics. GWMWater is a regular participant at regional field days, agricultural shows and other major events throughout the region.

Consultation with Traditional Owners.

GWMWater is currently developing a Reconciliation Action Plan to promote cultural awareness and inclusion of Traditional Owner Groups. GWMWater has also signed a memorandum of Understanding with Dja Dja Wurrung Clans Aboriginal Corporation to promote co-operation and consultation for South West Loddon Water Supply project.

GWMWater consults with Traditional Owners and/or Registered Aboriginal Parties (RAP) on capital works, major projects and various planning activities as part of its standard business practice. Capital works projects are assessed against the Aboriginal Heritage Act and where a Cultural Heritage Management Plan is required, this plan is developed in consultation with the RAP and Traditional Owners.

Community Engagement

Our comprehensive Community Engagement and Marketing Strategy ensures that GWMWater has a detailed understanding of the expectations of our customers and supply and demand issues across the region. The community will have the opportunity for further input through the engagement processes available during development of the GWMWater's upcoming pricing submission and Water Plan development.

The GWMWater U&R WS is available at www.gwmwater.org.au.

5.3 Aspirational Level of Service

The objective of the U&R WS is to balance the demand for water with water availability in order to provide an appropriate level of service to customers. For the purpose of this strategy, aspirational levels of service will only be prescribed for urban customers.

The aspirational level of service is described in terms of the frequency of years that some level of restriction needs to be imposed as a direct result of constrained water availability.

The GWMWater aspirational level of service is that the unrestricted urban demand (at Permanent Water Savings level of demand) can be met in 93 years out of 100 (93% reliability). While GWMWater aspires to provide the highest possible level of service, this target means that 7% of years could have some level of water restriction, while still meeting the aspirational target (i.e. water restrictions in less than 1 year in 10).

6. Our Water Demands

6.1 Background

Historical water demands (2011-2016), combined with recent trends have informed the baseline demand forecast for the 2017 U&R WS. The baseline demand forecast compared against the 9 prescribed climate change scenarios will identify where demand is projected to exceed supply in the next 50 years, or where there is a low level of confidence in a key factor impacting upon demands. Of particular interest is the 'new baseline' climate scenario recommended by *DELWP (2016)* which is 1975 to current (refer to **Appendix 2 – Climate Modelling Scenarios** for further detail of climate scenarios considered in this Strategy).

Baseline urban demand forecasts have been developed with consideration of the following distinct user groups supplied from urban reticulation systems:

- Commercial/Industrial (e.g. food processing, general businesses, hotel/motel)
- Non-Residential (e.g. halls, municipal buildings, toilets blocks, cemetery, schools)
- Residential (e.g. houses, flats, units, vacant residential land)
- Municipal – Public Space (e.g. public parks, roadside reserve, public gardens, ovals)
- Recreation Asset (e.g. racecourse, golf clubs, tennis courts, swimming pools).

The average annual volume metered to urban customers between 2011-2012 and 2015-2016 was used to form a 'baseline' demand, as this was viewed to capture a range of climatic situations (further discussed in section 6.1) Urbans demands over the last 5 water years were analysed using the user groups listed above. From this, a baseline demand volume was developed for each customer sector within each urban town.

As per DELWP guidelines, Victoria in Future (VIF) projections have been used assess how population changes across GWMWater's towns may affect future urban demand

Key observations from developing demand projections were that:

- Small town populations are projected to decline, while larger centres are projected to grow slowly.
- 2040 urban demand is near identical to current demand due to decline in small towns offset by growth in larger centres.
- A 2% increase in urban demand is projected between current baseline and 2065. This is equivalent to a 270 ML/yr increase in bulk water to service this demand.

Rural demand baseline for the Wimmera-Mallee Pipeline (WMP) and Northern Mallee Pipeline (NMP) systems has been based on the average end user demand over the last 5 years, which was viewed to capture a range of climatic and situations. Climatic factors are the most prominent driver of rural pipeline demand.

6.2 Murray System Demand Forecast

GWMWater operates four pump stations on the River Murray located at Swan Hill, Piangil, Nyah and Liparoo. These pump stations supply bulk water to urban storages and rural customers through the Northern Mallee pipeline and supply system 5 of the Wimmera Mallee Pipeline. GWMWater has 6,409 ML of entitlements held in both the Murray and Goulburn systems. The 6,409 ML entitlement volume provides water for urban, rural, industry and recreation (refer to **Appendix 3 – GWMWater Entitlements** for details of GWMWater’s entitlements).

Summary of Murray demand:

- Current baseline annual demand in the NMP system is: urban 930 ML and rural 1530 ML.
- Current baseline annual urban demand in the WMP supply system 5 (SS5) is 65 ML, with baseline annual rural demand being 240 ML.
- Planned recreation lake average annual demand is 390 ML a year for Green Lake, Sea Lake and 350 ML for the proposed Ouyen Lake.
- Private pipeline system administered through GWMWater, which has an average annual demand of 180 ML.
- Population forecasts for the NMP area indicate that the population is declining by 0.66% per annum.

6.3 Grampians System Demand Forecast

There are nine bulk water supply reservoirs and a number of other headworks assets as part of the Grampians water supply system. The reservoirs are Lake Bellfield, Lake Fyans, Mt Cole Reservoir, Lake Lonsdale, Lake Wartook, Moora Reservoir, Rocklands Reservoir, Toolondo Reservoir and Taylors Lake.

A pool of 20,000 ML Growth Water for regional development and farm diversification was generated from water savings resulting from the Wimmera-Mallee Pipeline project. This growth water is included in GWMWater’s bulk entitlement. After several growth water sales since completion of the pipeline project, there remains approximately 8,700 ML of growth water entitlement which is uncommitted (i.e. is held by GWMWater, but has not been purchased by a customer).

Summary of Grampians demand:

- For total Grampians system, the current average annual urban demand is 9,100 ML and the current average annual rural demand is 3,955 ML
- The sale of Growth Water is expected to be the main driver of increased rural pipeline demand until a point at which all remaining growth water is committed.
- GWMWater business growth water sales projections have been used for the purpose of projecting future demand as a result of growth water sales. This assumes a 380 ML/yr

annual increase in rural demand to 2040, then assumes full rural demand is occurring by 2065.

- There are several extensions to existing pipeline systems that are in different stages of completion. These projects will primarily source their water supply from growth water sales, or alternatively purchasing water from other customers within the system.

6.3.1. Lake Bellfield Supplied

Water is supplied from **Lake Bellfield** to the north and northeast Wimmera through WMP Supply Systems 1, 2, 3 and 4.

- Current baseline annual urban demand is 3,320ML and the baseline annual rural demand is 3,525 ML.
- Population forecasts across this region indicate that the population is decreasing by approximately -0.57 % per annum.

6.3.2. Lake Wartook and Moora Supplied

The **Lake Wartook and Moora Reservoir** system provides urban supplies to Horsham and Natimuk and rural supply to south of Horsham via WMP Supply System 6. During periods of water shortage, the Mt Zero borefield has provided a supplementary supply to Horsham and Natimuk.

- The baseline annual urban demand in this system is 2,910 ML. The baseline annual rural demand is 430 ML.
- Annual population forecasts across this area indicate 0.85% growth for Horsham and Natimuk.

6.3.3. Lake Fyans Supplied

Lake Fyans provides urban supplies to Ararat, Stawell and Great Western. Its inflows are regulated with transfers from Lake Bellfield. Having only a small catchment area, Lake Fyans receives relatively small natural catchment inflows.

- The baseline annual urban demand in this system is 2,870 ML.
- Population forecasts across this region indicate that the population is increasing by approximately 0.2% per annum.

6.4 Eastern Grampians and Pyrenees System Demand Forecast

The Eastern Grampians and Pyrenees supply systems comprise the Willaura, (Eastern Grampians) Elmhurst and Buangor supply systems.

The East Grampians pipeline (Willaura system) is supplied by six weirs on small streams, with two each located on Stoney Creek, Mt. William Creek and Masons Creek. During summer the supply is supplemented by groundwater sourced from four bores near Mt William. The system services the towns of Willaura, Moyston, Lake Bolac and Wickliffe and provides bulk water to the Wannon Water township of Glenthompson under its Willaura system bulk entitlement. The system also supplies a number of rural connections who draw water from pipelines between the towns. The system services approximately 1,000 GWMWater connections.

GWMWater currently has a 220 ML/year groundwater extraction licence for the Mt William bore field. Although this aquifer is shallow, with a water table at 20 metres below ground surface, the climate risks to this groundwater supply are low based on a consistent seasonal recovery in the standing water level. This level of recovery shows that the aquifer is currently able to replenish at a rate, at least equal to, the annual extraction.

- Current baseline total demand for the Willaura System towns and rural connections is 325 ML/year.
- Baseline annual supply to Wannon Water for Glenthompson is 28 ML/year, although this volume can vary from year to year.
- Of this total baseline demand of 353 ML/year, 236 ML/year is sourced from the diversion weirs and 89 ML/year from the groundwater bores.

The Elmhurst water supply system comprises a weir which diverts water from Hickmans Creek to the Elmhurst Service Basin (via a small sedimentation and strainer tank). The Buangor water supply system comprises a weir which diverts water from McLeods Creek to the Buangor Service Basin (via a small sedimentation and strainer tank). There are a small number of rural customers between the weir and the storage basin. Both creeks are tributaries of the Wimmera River.

- Baseline annual demand for Elmhurst is 25.2 ML/year.
- Baseline annual demand for Buangor is 22.9 ML/year.
- Rural City of Ararat population projections of approximately 0.11% increase per annum were used for Elmhurst, Buangor and the four towns in the Willaura system.

The storage levels and bulk town meter are monitored weekly for each system, however there is no stream flow data collected for Hickmans Creek, McLeods Creek or Mount William, Stoney and Masons Creeks.

6.5 Groundwater Towns Demand Forecast

GWMWater supplies 10 towns from the Murray Group Limestone Aquifer in the west of the region. Irrigation and stock and domestic are the major groundwater users, however they have not been considered as part of this U&R WS.

The West Wimmera Groundwater Management Strategy (2011) addresses the strategic groundwater management directions for all groundwater uses. The strategy has identified six management zones within the West Wimmera (Northern, Southern, Neuarcurr, Gymbowen, Little Desert and Big Desert). Baseline bulk water demand for urban use over the past five years (2012-2016) is approximately 912 ML. Groundwater use in the Murrayville area is managed under a management plan, with the average urban water extraction in this area being 136 ML/yr.

Urban use in the West Wimmera and Murrayville areas make up less than 2% of the total permissible annual volume that can be extracted from this resource. In general, urban allocations are comfortably in excess of current demand, with West Wimmera groundwater towns using only 63% of licensed entitlement and Murrayville towns using 29% of licensed entitlement.

The urban groundwater demand at Nhill has decreased significantly as the town has been connected to the Wimmera Mallee Pipeline since 2012/13. Groundwater has continued to be used on identified sports grounds and municipal gardens. Nhill Lake is also now supplied from groundwater, with supplementary supply from town stormwater.

Population in the groundwater area is decreasing at approximately 0.7 – 1.2% per annum.

Groundwater is a supplementary supply annually for the Willaura System. The baseline annual use for the eastern Grampians is 89 ML/year.

The groundwater supply to the townships of Streatham and Westmere is from two production bores located north of Streatham. Both towns are within the Rural City of Ararat. These towns are currently using 21% of the 60 ML urban groundwater licence entitlement, partly due to the quality of supply only being suitable for some outdoor use (4,000 EC).

Groundwater is a supplementary supply which is utilised for the Horsham urban system during periods of surface water shortage. The average demand over last 5 years is 18 ML/year, which has been used for testing of bore operation and water quality. This supply source has not been used to supplement Horsham urban system during the past 5 years (baseline period).

6.6 Goulburn System Demand Forecast

The Quambatook township is supplied from the Goulburn System via the Normanville pipeline.

- The baseline annual urban demand in this system is 110 ML.
- Annual population forecasts across this area indicate a decline of -0.37% .

The South West Loddon Pipeline water supply project is currently under construction and will require a supply from the Goulburn Supply System. This will be a dual supply system, fed from both The Wimmera-Mallee Pipeline system (Grampians) and Waranga Western Channel (Goulburn). Demand from the Waranga Western Channel has not yet been confirmed, but total South West Loddon demand is expected to be in the order of 1,000 ML.

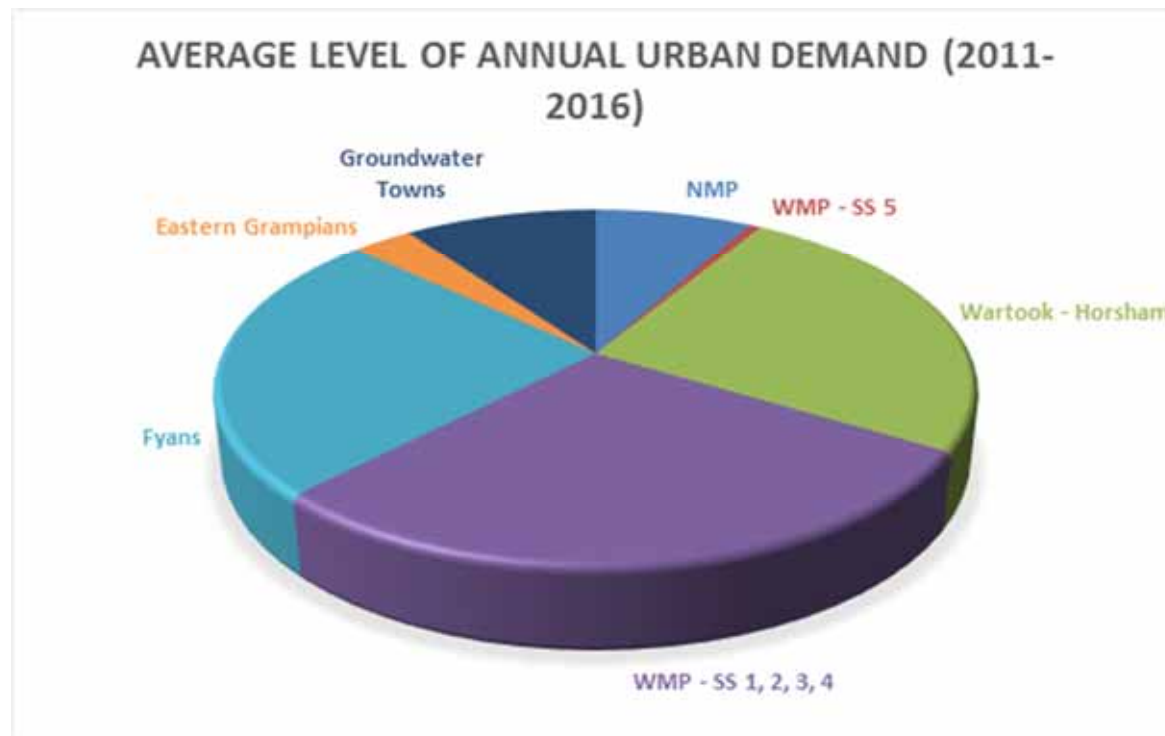
6.7 Summary of Current Urban and Rural Demand

6.7.1. Water Use in Urban Systems

Table 5: Water use in urban systems

Supply System	Average level of annual urban demand (ML) between 2011-2016
NMP	930
WMP - SS 5	65
Wartook - Horsham	2,910
WMP - SS 1, 2, 3, 4	3,320
Fyans	2,870
Eastern Grampians	361
Groundwater Towns	1,141
Total	11,597

Figure 4: Average Annual Urban Demand (2011-2016)

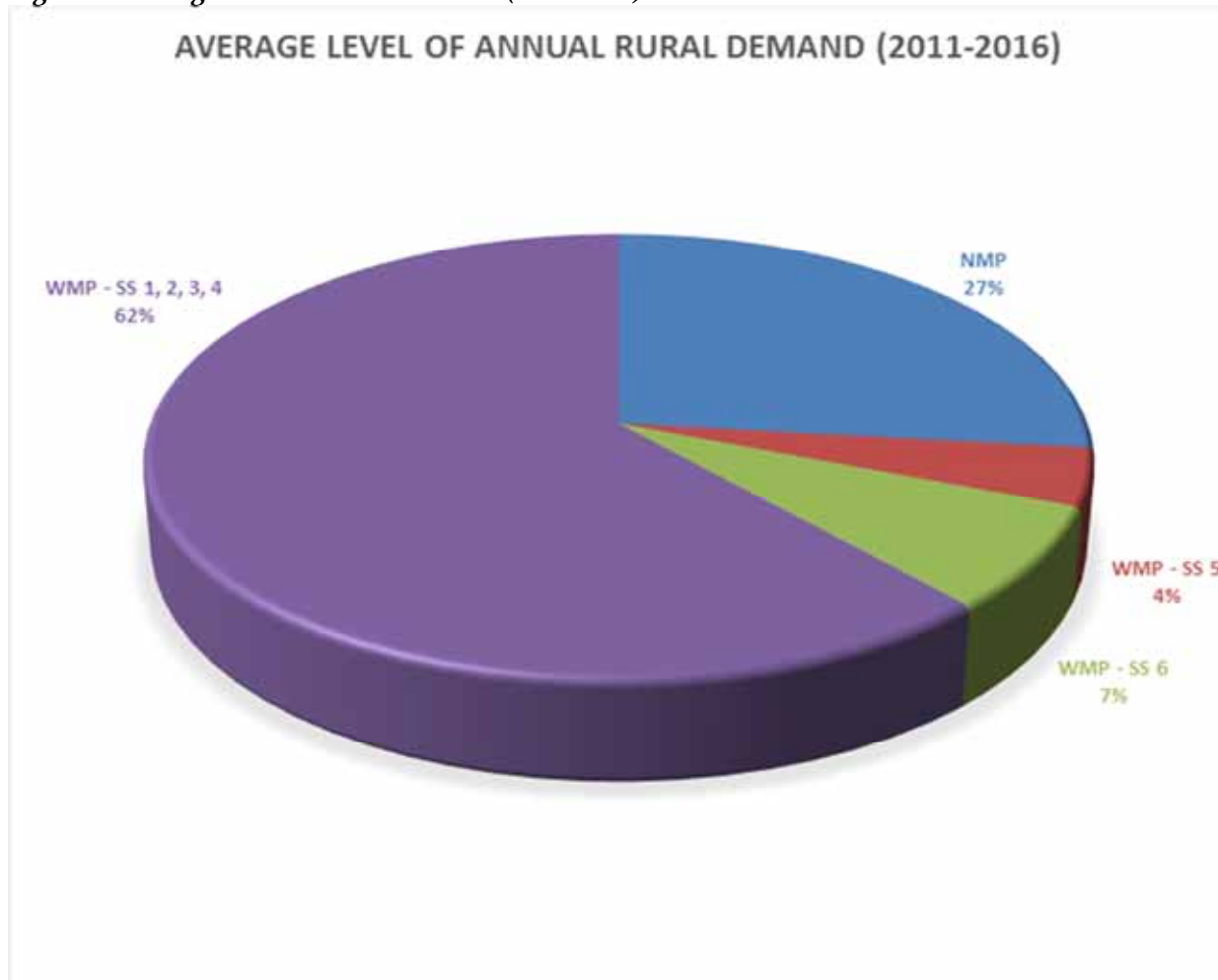


6.7.2. *Water Use in Rural Systems*

Table 6: Water use in rural systems

Supply System	Average level of annual rural demand (ML) between 2011-2016
NMP	1,530
WMP - SS 5	240
WMP - SS 6	430
WMP - SS 1, 2, 3, 4	3,525
Total	5,725

Figure 5: Average Annual Rural Demand (2011-2016)



7. Assessing System Performance

Supply –demand assessments have been undertaken for each of GWMWater’s supply systems. The level of assessment undertaken varies from spreadsheet models for the Eastern Grampians, Murray and Groundwater town systems, to detailed REALM modelling for the complex Grampians supply system. An overview of the system performance can be found in Appendix 4. For further detail on modelling assessments and methodology refer to U&R WS Modelling Report 2017

The baseline demand and 2040 and 2065 demand forecasts are discussed in summary in section 6 of this Strategy and further detail in the U&R WS Demands Background Report, 2017.

The Guidelines for Assessing the Impact of Climate Change have been applied in modelling work for GWMWater’s Urban and Rural Water Strategy, to determine future water availability under a range of plausible climate futures. These plausible climate futures range from the “bookends” - historic to the very dry (post 1997 step climate change). There are a range of low, medium and high impact (on water availability from climate dependent sources) scenarios at 2040 and 2065 which are also considered. The climate scenario - 1975 to current is recommended as the new baseline for Water Corporation future water resource planning (*DELWP, 2016*). This scenario has involved scaling of historic inflow data between 1891 and 1974 to reflect the climate observed between 1975 and present, using a flow duration curve decile method.

The security or reliability of supply under each modelled scenario provides an indication of the number of years in 100 the combined allocation and carryover available to GWMWater would be expected to meet the nominated level of demand.

7.1 Murray Supply System Performance

GWMWater entitlements in the Murray and Goulburn system support the Northern Mallee Pipeline, Wimmera Mallee Pipeline (Supply System 5) and three private schemes. Historically, demand in this system has been far less than water available under GWMWater’s entitlements. GWMWater may enter the market periodically to buy or sell small volumes of water allocation.

Key findings from the supply-demand assessments are summarised below:

- Demand is relatively stable due to population trends (slow decline).
- Demands from Green Lake (Sea Lake) and new demands from Ouyen Lake and South West Loddon scheme will reduce the security of supply to existing users by placing greater demand on existing entitlements.
- Security of supply is dependent on the level of carryover maintained to balance supply and demand in dry years.
 - With 50% (of current demand) carryover maintained in each year, unrestricted demand can be met under post 1975 (new baseline) climate in all demand

- scenarios (current, 2040 and 2065 demand scenarios). Security of supply falls to 94% of years under high impact climate change.
- With no carryover, unrestricted demand can be met in 99% of years under post 1975 (new baseline) climate, but the ability to meet unrestricted demand reduces to between 78% of years (2065 demand) and 82% of years (current demand) under high impact climate change.

An overview of Murray system performance under various climate and demand scenarios is presented in Appendix 4 – Summary of Security of Supply under modelled scenarios (Grampians & Murray).

Recommendation 1: GWMWater to undertake further detailed assessments to determine the desired level of security GWMWater will maintain for Murray supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.

7.2 Grampians Supply System Performance

The Grampians water supply system consists of nine bulk water supply reservoirs, associated transfer channels and regulating structures. The Supply System performance has been assessed that both a total Grampians Supply System and also at individual Reservoir Supply System with use of a REALM hydrologic model, and further spreadsheet analysis of model outputs.

7.2.1 Total Grampians Supply System

For the total Grampians system, analysis of model outputs showed GWMWater Wimmera-Mallee Pipeline product (urban, rural) demand:

- can be met in 100% of years with current demand for all climate scenarios.
- can be met in greater than 97% of years with 2040 & 2065 full demands for post 1975 baseline climate scenario.
- cannot be met under 2065 medium & high climate change scenario & 2065 demand (demand met in 87% and 49% of years, respectively).
- cannot be met under post 1997 climate change (step change) & 2040 & 2065 demand (demand met in 85% and 70% of years, respectively).

The analysis conducted highlighted the importance of ‘unlimited’ carryover in the Grampians headworks system as a tool to manage multi-year security by continual carryover of unused allocation to meet demands in dry years. These existing carryover rules provide an effective tool for GWMWater to manage its security of supply to its urban and rural customers. If carryover rules were to change in future, then long-term security of supply to GWMWater urban and rural users could be affected.

Approximately 8-9,000 ML of Growth Water generated through water savings from the Wimmera-Mallee Pipeline Project remains to be sold. The current GWMWater business strategy is to sell all remaining (uncommitted) growth water. This is supported by the sensitivity analysis undertaken for the U&R WS, which showed only a 1-3% variance in the number of years in which unrestricted demands could be met between 50%, 75% and full remaining growth water sale under post 1975 climate and medium impact climate change. This variance is equivalent to between 1 and 2 additional years in every 100 years where some level of restriction would be required. This is not considered significant enough to limit growth water sales for the purpose eliminating restrictions for 1-2 years in 100. Future augmentation may be best placed to manage such infrequent shortfalls in supply.

In the Grampians reservoir system, the calculation of water allocations considers all water in the headworks system, but not specifically where the water sits in the headworks system. This means there may be allocation and carryover available in the headworks to satisfy all demand, but some reservoirs could be empty or unable to supply demand dependent on them due to variability in inflows between reservoirs, demand from a reservoir relative to its storage volume and reservoir efficiency. For example, under a particular modelled scenario for post 1975 (new baseline) climate scenario and current demand, the reliability of supply from Wartook Reservoir and Bellfield Reservoir is very different. Lake Wartook draws down to critically low levels in around 50% of years, and only fills in 20% of years, whereas Lake Bellfield never falls below 50% of capacity and fills to capacity in around 55% of years

7.2.2. Individual Reservoir Supply System

Key findings at an individual reservoir scale are summarised below.

Key findings for the Wartook & Moora Reservoir supply system

- Significant shortfalls in supply to Horsham can be observed under relatively moderate climate scenarios i.e. shortfalls of greater than 500 ML in 20% of years under current demand and post 1975 baseline climate.
- Significant failure in ability to meet demand is observed under extreme climate scenarios.
- In scenarios where Wartook fails, supply system 6 rural supply is also at risk as Moora Reservoir is generally depleted and Wartook cannot provide supplementary supply.
- The Wartook Reservoir supply issue is not a resource availability one. Current entitlement rules state the sharing of water resources between entitlement holders within the headworks system. However, the rules do not specify how, or in what proportion from each storage that allocation will be supplied to entitlement holders. Where environmental demands are proportionately greater than consumptive demand over time, modelling suggests that storages such as Lake Wartook could draw down to very low levels during consecutive dry seasons and under extreme climate scenarios, resulting in a failure to meet demand for all entitlement holders supplied from that reservoir.

GWMWater views supplementary groundwater supply from the Mt Zero bore field as an emergency contingency rather than a normal part of its supply mix. GWMWater's extraction

licence allows for up to 2,400 ML to be extracted over any 5 year period. This is less than Horsham's average annual demand, and could support stage 4 demand for 12 to 16 months.

With modelling suggesting GWMWater's security could be compromised as a result of other water users' demand in some situations, GWMWater would support the development of a framework which ensures the fair and equitable access to headworks reservoirs by all water users. The Wimmera-Glenelg Storage Manager has responsibility for progressing such work.

Recommendation 2: GWMWater to work with the Storage Manager to investigate options or a framework which provides rules-based equitable access to reservoirs.

Key findings for the Lake Bellfield and Taylors Lake system:

- Supply to WMP remains secure except under climate change scenarios with increased level of demand (i.e. 2040 and 2065 demands).
- Security in this system is provided by the large storage capacity in Lake Bellfield and Taylors Lake relative to demand, and storage characteristics which make Lake Bellfield a very efficient water storage.
- Under extreme climate scenarios, reduced long-term inflows and increased demand under 2040 & 2065 scenarios result in the depletion and subsequent failure of reservoirs across the headworks system during extended dry periods.

Key findings from the Lake Fyans Supply System

- Sufficient resource is available between Lake Fyans Supply System to meet to Stawell, Ararat and Great Western demands in all but extreme climate scenarios.
- The combination of reduced inflow and increased WMP demand under climate change and 2040/2065 demand scenarios reduces the volume available in Lake Bellfield for transfer to Lake Fyans, subsequently creating shortfalls in the supply systems dependent on Lake Fyans.
- Additional demands on the Stawell Water Supply System from the Landsborough Pipeline have highlighted the need to address capacity constraints in the pipeline to Stawell and also maximizing levels in the Stawell Urban Reservoirs to meet demands. Operating rules for the urban storages will maximise system performance and enable optimisation of supply between diversion weirs and pumped supply from Lake Fyans.

Recommendation 3: Stawell Urban Reservoir operating rules are to be developed.

- The physical pipeline supply constraints on the Stawell supply pipeline are not explicitly considered through modelling (note: capital works are currently being undertaken to address capacity constraints in the Stawell system. Phase 2 works will be undertaken if and when future demand require the phase 2 upgrade to proceed).

7.3 Eastern Grampians and Pyrenees Supply System Performance

7.3.1 Eastern Grampians Supply System Performance

The Eastern Grampians system was assessed by way of spreadsheet calculation model. The model made a comparison of the demand from the system by urban and rural users and the physical capacity of the supply system. As there is not currently continuous streamflow monitoring in the catchments above the East Grampians diversion weirs, very limited information is available in relation to the volume and duration of streamflow under various climatic conditions. For the purpose of this assessment it was assumed that reduced surface water availability is able to be adequately supplemented by groundwater supply.

Recommendation 4: Continuous streamflow monitoring should be installed upstream of Eastern Grampians diversion weirs to build understanding of water availability.

Operating rules for the Eastern Grampians urban storages will maximise system performance and enable optimisation of supply between diversion weirs and groundwater bores.

Recommendation 5: Develop Storage Operating Rules for Eastern Grampians Urban Storages.

Key findings for the Eastern Grampians system:

- During dry years, a combination of limited surface water availability, high demand, and physical pipeline constraints within the Eastern Grampians system in particular, presents risks to the security of supply.
- Physical capacity of the pipeline between the headworks (weirs and bores) and Willaura storages poses a constraint in the volume of water able to be supplied into this system.
- Limitations in flow which can be achieved into the Moyston system poses a risk to the security of this branch of the overall Willaura system.
- Present operating practice of shutting off supply to GWMWater storages to increase pressure for Glenthompson supply compromises harvesting (lost harvesting opportunity).
Note: that obligation to supply Glenthompson entitlement is at the offtake from GWMWater pipeline, not to supply water into Glenthompson storage. Wannon Water have indicated that it will propose a booster pump station for Glenthompson supply in their Urban Water Strategy.
- Rural demand increased significantly in response to dry conditions (e.g. 25 ML/yr average 2010-2014 increasing to >50 ML in 2015/16).

GWMWater is currently assessing options to improve water security for the Willaura system. The *East Grampians Water Supply System - Strategic Assessment, GWMWater (December 2016)* report identified a range potential options to improve water security, including major works, minor works, operational/resource changes and administration changes. The next step with this work is to assess which combination of options will best improve water security in the East Grampians water supply system. Improving the security of supply to Eastern Grampians

towns is also being considered within the Eastern Grampians Rural Water Supply feasibility project.

Recommendation 6: GWMWater to undertake further assessment on which combination of options will best improve water security in the East Grampians water supply system.

7.3.2. Pyrenees Supply System Performance

Key findings for the Elmhurst and Buangor systems:

- Elmhurst and Buangor systems are isolated and could become at risk in very dry periods. There is currently no stream monitoring to understand what percentage of flow is harvested for consumptive use. Given the absence of streamflow data for Hickmans Creek and McLeods Creek, further investigation following installation of monitoring equipment is required to assess impacts of climate scenarios on the Pyrenees systems.
- The potential impacts of climate change on streamflow in these systems is uncertain.

Recommendation 7: Continuous streamflow monitoring should be installed on Hickmans and McLeods Creeks to build understanding of water availability.

Recommendation 8: Develop Storage Operating Rules for Elmhurst and Buangor Urban Storages.

- Diversion permitted under the Buangor bulk entitlement may no longer be sufficient during dry periods due to improvements in metering methods. An increase to the bulk entitlement volume may be required to reflect updated bulk metering.

Recommendation 9: Investigate an increase to the Buangor Bulk Entitlement volume to reflect improvements in bulk metering of diversions.

7.4 Groundwater Towns Supply System Performance

GWMWater's groundwater supplied towns span a range of groundwater areas with differing levels of security. In most cases, the existing groundwater resource provides a long term supply option which is influenced little by climatic factors.

The response of groundwater to climate change scenarios was discussed in the West Wimmera Groundwater Management Strategy (2011) which states that "as most of the groundwater resource is understood to be an ancient resource and the modern recharge rate is very small, the volume of water in store is thought to be not significantly impacted by climate change or climate variability in the planning horizon". Droughts will have limited impact on the volume

of groundwater in store apart from influencing the volume pumped for irrigation and some reduction in the recharge volume via sinkholes.

Areas in which security or supply issues have been identified are summarised below:

Edenhope

- Current supply is tapping an area of low salinity groundwater and is acknowledged as a finite groundwater resource (5-8 years).
- Main risks including increased drawdown (resulting in reduced extraction rates and reduced supply volume), and increasing salinity due to groundwater pumping inducing movement of higher salinity water towards the production bores.

Recommendation 10: Continue current Edenhope groundwater monitoring regime and undertake a technical assessment 'health check' of the current supply to determine expected remaining life and identify triggers as to when resource is becoming stressed.

The outcome of *Recommendation 10* will inform future augmentation planning and any necessary communication and engagement strategy.

The South West Wimmera Water Supply feasibility study is also acknowledged as an opportunity to develop alternate supply options for Edenhope.

Harrow

- The licence volume for Harrow is insufficient to meet current levels of demand and requires annual trades from GWMWater's other urban licences.
- The groundwater resource in this area remains secure.

Recommendation 11: GWMWater to commence work to apply for an increase in licence volume for Harrow.

The South West Wimmera Water Supply feasibility study is also acknowledged as an opportunity to develop alternate supply options for Harrow.

7.5 Goulburn Supply System Performance

Quambatook water demand is projected to decline, with forecast reduction in population for this town. Any shortfall in water allocation available for Quambatook will be secured through water trading from GWMWater's Goulburn or Murray entitlements, or accessing the temporary water market if necessary.

The South West Loddon pipeline demand from the Goulburn system is still to be confirmed. Once confirmed, further detailed work will be required to assess the new demand from the South West Loddon system in the context of the existing demand supported by GWMWater's combined Murray and Goulburn entitlements.

Recommendation 12: GWMWater to undertake further detailed assessments in conjunction with the Murray assessments (*Recommendation 1*) to determine the desired level of security GWMWater will maintain for Goulburn supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.

7.6 Priority Actions - Summary

7.6.1. Priority Actions over next 5 years

Table 7: Priority Actions over next 5 years

Action	Recommendation
1	GWMWater to undertake further detailed assessments to determine the level of security GWMWater wishes to maintain for Murray/Goulburn supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.
2	GWMWater to work with the Storage Manager to investigate options or a framework which provides rules-based equitable access to reservoirs.
3	Stawell Urban Reservoir operating rules are to be developed.
4	Continuous streamflow monitoring should be installed upstream of Eastern Grampians diversion weirs to build understanding of water availability..
5	Develop Storage Operating Rules for Eastern Grampians Urban Storages.
6	GWMWater to undertake further assessment on which combination of options will best improve water security in the East Grampians water supply system.
7	Continuous streamflow monitoring should be installed on Hickmans and McCleods Creeks to build understanding of water availability.
8	Develop Storage Operating Rules for Elmhurst and Buangor Urban Storages.
9	Investigate an increase to the Buangor Bulk Entitlement volume to reflect improvements in bulk metering of diversions.
10	Continue current Edenhope groundwater monitoring regime and undertake a technical assessment 'health check' of the current supply to determine expected remaining life and identify triggers as to when resource is becoming stressed.
11	GWMWater to commence work to apply for an increase in licence volume for Harrow.
12	GWMWater to undertake further detailed assessments in conjunction with the Murray assessment (Recommendation 1) to determine the desired level of security GWMWater will maintain for Goulburn supplied systems, and the appetite for exposure to the temporary water market to make up shortfalls in dry years.

Refer to sections 7.1, 7.2, 7.3, 7.4 of this report the context for these actions following actions are GWMWater commitment to fulfil the requirements of the Urban Water Strategy Guidelines (2016).

There are several requirements in the Urban Water Strategy Guidelines, 2016 which are new requirements upon Water Corporations. *Table 8* has a list of actions to address these requirements.

Table 8: Actions arising from Urban Water Strategy Guidelines (2016)

Action	Recommendation
13	Develop Water Atlas, GIS based mapping layers to assist to tell the Water Strategy Story from catchment to customer.
14	Develop Drought Preparedness Plan as an attachment to U&R WS by November 2017.
15	Continue to facilitate projects with customer groups to water sporting fields, schools & public green spaces with non-urban water supplies.
16	Provide demands assessments, modelling outputs, and alternative water supply assessments to inform Integrated Water Management Forums and Integrated Water Planning initiatives.
17	Priorities for future integrated water management plans include Murtoa, Edenhope and Horsham.

7.6.2. Water Efficiency Actions

GWMWater is currently involved in a range of water efficiency and water conservation programs with our customers. These include:

Victorian Government Regional Showerhead Exchange Program

Customers were able to swap their old showerhead for a new, more efficient showerhead that saves nine litres of water per minute. Two types of water saving showerheads are available for exchange (wall mounted and hand held) with 35 customers exchanging their showerheads in 2015/16.

Community Rebate Program

The Community Rebate Program was a joint initiative of GWMWater and the Victorian Government. The program aimed at reducing water bills through a free water audit and the repair or replacement of inefficient water fittings for eligible hardship customers.

The total number of eligible customer was 148, the program was taken up by 30 customers with \$16,400 being claimed for water audits and subsequent repairs and replacement of inefficient water fittings.

Water Tariff Reduction

A 15 percent tariff reduction is provided to not-for-profit organisations that conserve water by watering at night via dedicated timed sprinkler systems. There are currently 29 organisations benefiting from this initiative.

Target Your Water Use

GWMWater is part of this state-wide water efficiency program that educates and encourages regional Victorians to use their water wisely. The program is a partner to the successful 'Target 155' program operating across metropolitan Melbourne.

Action	Recommendation
18	GWMWater to continue to support water efficiency programs.

7.6.3. Actions that may need to be progressed for next 50 years

Should medium to high impact climate scenarios eventuate in the Grampians Supply System there are a range of supply augmentation options which could be considered following further investigation. These include options to improve the efficiency of the Horsham and Natimuk supply such as replacing the Mt Zero channel with pipe from Dad and Dave Weir to the Mt Zero Water Treatment Plant to reduce transmission losses and risks to water quality. Linking the Lake Bellfield pipeline trunk main (SS7) to the Mt Zero Water Treatment Plant could be considered to provide an alternative supply to Lake Wartook under a return to dry climate scenario.

Actions for Murray, eastern Grampians and Groundwater towns will be informed by investigations and assessments undertaken over next 5 years.

8. Monitoring, Reporting and Investigations

8.1 Monitoring

Essential to this Strategy is an ongoing commitment by GWMWater to monitor implementation of the actions:

- Review water availability and demand compared to U&R WS forecasts
- Review prioritised list of actions for the next five years to determine relevance, appropriateness and any need to bring actions forward or delay them
- update the Annual Water Outlook
- update the status of priority actions.

8.2 Reporting

Water Corporations must make available to its customers and DELWP an Annual Water Outlook by 1 December of each year, although they may be updated progressively throughout the year. This should be developed with advice from DELWP to ensure that it includes consistent information on probable inflow scenarios and other matters.

The Annual Water Outlook should include information on:

- the current water resource position;
- climate outlook information from the Bureau of Meteorology;
- a forward outlook over the coming year at a minimum, and five years if possible, under a range of plausible climate scenarios;
- the likelihood of restrictions;
- whether agreed levels of service will be able to be met under these scenarios; and
- if not, action/s proposed to improve system performance so that agreed levels of service can be met.

As part of the Annual Water Outlook process water corporations should forecast the likelihood for restrictions, or other actions, within the next 12 months. This information does not have to be provided in AWOs. Instead this information should be provided using the Template supplied with these guidelines.

8.3 Reviewing the Strategy

The U&R WS will be reviewed and updated every five years to ensure that its actions remain appropriate to changing conditions i.e. climate variability, customer awareness, etc.

9. References

Algae Management System (GWMWater, 2016)

East Grampians Water Supply System – Strategic Assessment, (GWMWater, 2016)

Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy, (DELWP, 2016)

Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria, (DELWP, 2016)

Statement of Obligations (General) *as applicable to Grampians Wimmera Mallee Water*, (Minister for Environment, Climate Change and Water, 2016)

Victoria In Future 2016 (DELWP, 2016)

Water Supply Demand Strategy (GWMWater, 2012)

West Wimmera Groundwater Management Strategy (GWMWater, 2011)

Western Region Sustainable Water Strategy (Department of Sustainability & Environment, 2011)

10. Appendices

10.1 Appendix 1 - Acronyms

AGL	Agreed Service Level
BE	Bulk Entitlement
BGA	Blue-Green Algae
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
EC	Electrical Conductivity in microSiemens/cm
ESC	Essential Services Commission
GL	Gigalitre
GMA	Groundwater management area
GMU	Groundwater management unit
GWMWater	Grampians Wimmera Mallee Water Corporation
MDB	Murray-Darling Basin
ML	Megalitre
NMP	Northern Mallee Pipeline
PWSR	Permanent Water Saving Rules
REALM	Resource Allocation Model (hydrologic model)
SLA	Local Government Statistical Local Area
SoO	Statement of Obligations
TCSA	Tertiary Confined Sand Aquifer
U&R WS	Urban and Rural Water Strategy
VEWH	Victorian Environmental Water Holder
VIF 2016	Victorian in Future, population projections 2015
WMP	Wimmera Mallee Pipeline
WMP SS	Wimmera Mallee Pipeline Supply System
WSDS	Water Supply Demand Strategy
WSPA	Water Supply Protection Area

10.2 Appendix 2 – Climate Modelling Scenarios

The nine modelling scenarios as described in Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria (DELWP 2016b) were run for GWMWater’s Urban and Rural Water Strategy. These were used to assess the potential impacts to water availability across a range of possible future climates for the Grampians and Murray/Goulburn systems.

The nine climate scenarios are:

- 1) Historic hydro-climatic sequence;
- 2) Current baseline climate (post 1975);
- 3) 2040 low (10th percentile factors);
- 4) 2040 medium (50th percentile factors);
- 5) 2040 high (90th percentile factors);
- 6) 2065 low (10th percentile factors);
- 7) 2065 medium (50th percentile factors);
- 8) 2065 high (90th percentile factors);
- 9) Post-1997 step climate change; and

The climate scenario ‘post 1975’ is recommended as the new baseline for Water Corporation future water resource planning (DELWP, 2016). This scenario has involved scaling of historic data between 1891 and 1974 to reflect the climate observed between 1975 and present, using a flow duration curve decile method.

10.3 Appendix 3 – GWMWater Entitlements

Murray System: Northern Mallee Pipeline Wimmera-Mallee Pipeline SS5, Private Pipelines

Entitlement Type	Volume (ML)	Reliability
Murray Bulk Entitlement	3,485.8	High
Murray Water Share	1,874	High
Goulburn Water Share	1,049	High
Total	6,408.8	

Grampians System: Wimmera-Mallee Pipeline (SS 1,2,3,4,6,7), urban towns direct from headworks.

Entitlement Type	Volume (ML)	Reliability
Wimmera-Glenelg Bulk Entitlement (Urban & Rural)	32,720	High
Wimmera-Glenelg Bulk Entitlement (SBA – not considered in this Strategy)	12,000	High
Total	44,720	

Eastern Grampians and Pyrenees System

Entitlement Type	Volume (ML)	Reliability
Bulk Entitlement (Willaura System)	390	Not defined
Bulk Entitlement (Elmhurst)	48	Not defined
Bulk Entitlement (Buangor)	28	Not defined
Total	466	

Goulburn System: Quambatook

Entitlement Type	Volume (ML)	Reliability
Bulk Entitlement (Quambatook)	100	Very High

Groundwater Towns

Entitlement Type	Volume (ML)	Reliability
S51 Licence (Goroke)	86	Not defined
S51 Licence (Kiata)	40	Not defined
S51 Licence (Nhill)	1,000	Not defined
S51 Licence (Mt William - Willaura)	220	Not defined
S51 Licence (Kaniva)	600	Not defined
S51 Licence (Serviceton)	25	Not defined
S51 Licence (Edenhope)	250	Not defined
S51 Licence (Harrow)	29	Not defined
S51 Licence (Murrayville)	475	Not defined
S51 Licence (Lillimur)	32	Not defined
S51 Licence (Cowangie)	40	Not defined
S51 Licence (Mt Zero - Horsham)	1,200	Not defined
S51 Licence (Apsley)	40	Not defined
S51 Licence (Miram)	7	Not defined
Total	4,044	

10.4 Appendix 4 – Summary of Security of Supply under modelled scenarios (Grampians & Murray)

Figure 6: Grampians system modelled security of supply (summary)

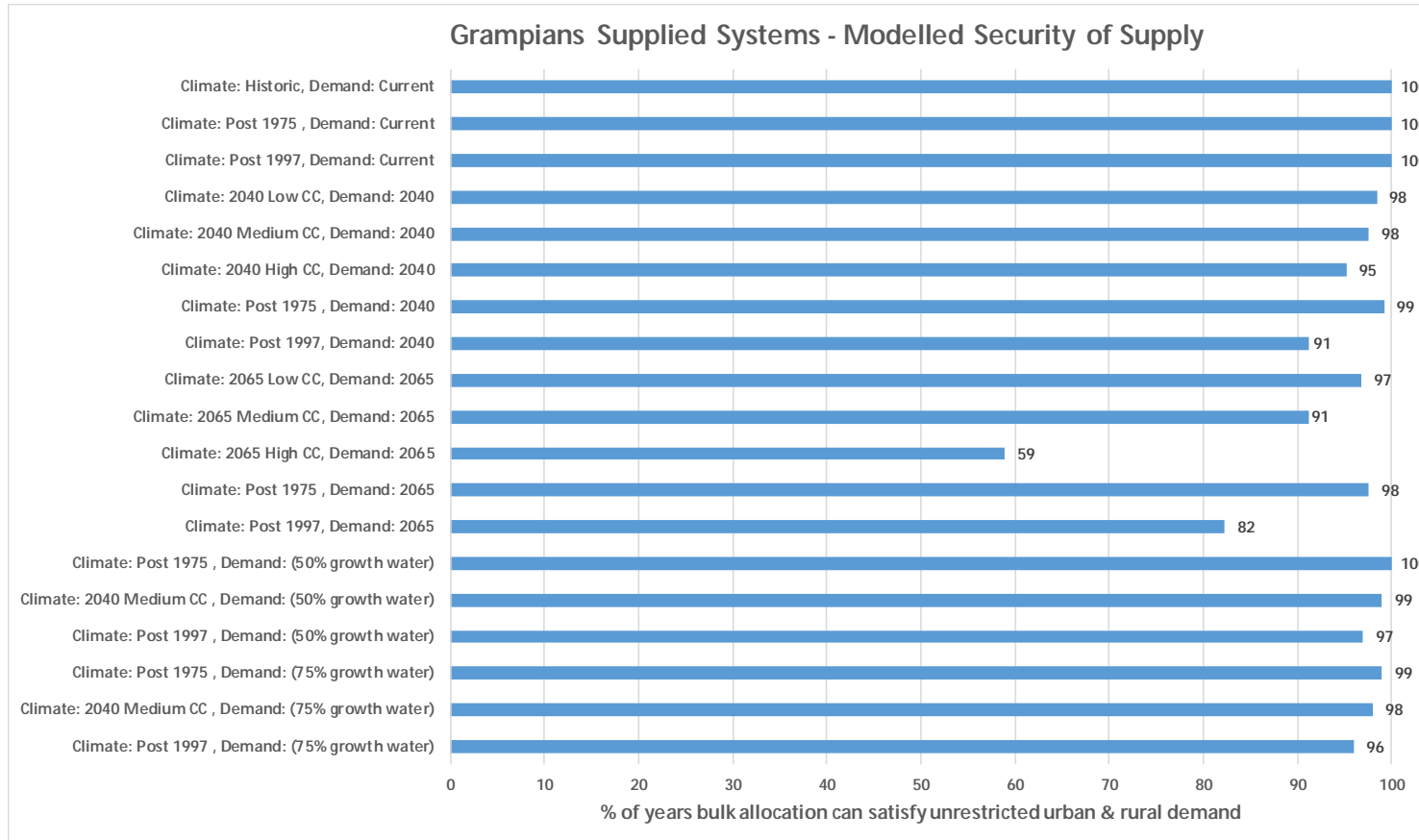


Figure 7 outlines whether each particular scenario met the GWMWater aspirational target of 93% of years or better in which demand can be satisfied under Permanent Water Savings Rules. This assessment considers water available at the whole Grampians reservoir system scale.

Figure 7: Summary of Grampians system performance against aspirational target (demand met in 93% of years at PWSR)

		Climate Scenario							
		Post 1975 baseline	2040 Low Impact Climate Change	2040 Med Impact Climate Change	2040 High Impact Climate Change	2065 Low Impact Climate Change	2065 Med Impact Climate Change	2065 High Impact Climate Change	Post 1997 step change
Demand Scenario	Current	Pass	Pass	N/A	N/A	N/A	N/A	N/A	Pass
	2040	Pass	Pass	Pass	Pass	N/A	N/A	N/A	Fail
	2065	Pass	Pass	Fail	Fail	Pass	Fail	Fail	Fail
	2040 / 50% growth water	Pass	N/A	Pass	N/A	N/A	N/A	N/A	Pass
	2040 / 75% growth water	Pass	N/A	Pass	N/A	N/A	N/A	N/A	Fail

N/A = Scenario not modelled.

Figure 8: Murray system modelled security of supply at 2040 demand (summary)

