DROUGHT RESPONSE PLAN 2005

Executive Summary

This document is Western Water's Drought Response Plan. It sets out how Western Water will provide for efficient and effective management of water supply security to its customers consistent with:

- Customer needs;
- Projected future growth;
- The practices of neighbouring water companies; and
- Best practice in water supply management during drought periods.

This plan has been updated to take into account the low reservoir inflows experienced during the ongoing drought, experience with the implementation of water restrictions and especially the introduction of new infrastructure which has enabled water to be drawn from Melbourne Water's supply system. The major improvements made to the previous plan are that the updated plan now includes for the following issues:

- The drought response curves have been revised and include for the drought experienced up to the end of July 2003;
- The revised drought response curves have been developed allowing for forecast demands for the year 2008;
- Response curves have been developed for the Rosslynne and Merrimu systems to indicate the manner in which supplies drawn through the recently constructed links to Melbourne Water's supply system should be stepped up during prolonged dry spells.

This Plan covers towns that receive their water supplies from Western Water. These towns are covered by two main systems as follows:

<u>Maribyrnong System:</u>

- Romsey;
- Lancefield;
- Woodend;
- Diggers Rest;
- Bulla;
- Gisborne;
- Riddells Creek;
- Macedon;
- Mt Macedon; and
- Sunbury.

<u>Werribee System:</u>

- Melton;
- Bacchus Marsh;
- Rockbank;
- Toolern Vale; and
- Myrniong.

A brief summary of each of Western Water's supply systems servicing these towns is provided, including a concise physical description and an outline of the historic drought experience of each township. A review of available options for augmenting supply to each system during drought is also provided, as well as a sequential plan of action for responding to drought. Finally, pre and post drought actions to ensure preparedness for drought are presented.

The major tools the Drought Response Plan utilises for drought management of Western Water supply systems is the application of water restrictions and increased reliance on supplies drawn from the Melbourne Water system. These are designed to achieve an appropriate level of reduction in demand on the supply systems such that the security of supply to customers is adequately protected through periods of drought. Western Water has adopted a four stage restriction policy that is consistent with that adopted by the Melbourne metropolitan water companies. It is anticipated that, shortly, this will be supported by the introduction of "permanent water savings measures". The four restriction stages are linked to definitions of various stages of drought that are determined by the application of a set of drought response triggers developed for each supply system.

Based on this approach, the Plan:

- Identifies key actions that should be taken to effectively manage Western Water's water resources during various stages of drought;
- Sets out the stages of drought and the corresponding four stages of restrictions on the use of water (consistent with those set out in the Drought Response Plan for Melbourne Retail Water Companies);
- Sets out the clear triggers at which increased supplies should be drawn from the Melbourne water supply system;
- Defines clear triggers for drought stages that can be used to help ensure Western Water's customers are well informed in relation to drought status and that may lead to each stage of restrictions being imposed; and
- Outlines principles to be used for deciding when restrictions should be lifted.

The introduction of "permanent water savings measures" is anticipated for which allowance
The drought response triggers, through their links to implementing various stages of restrictions, are designed to provide protection to Western Water's customers by:

- Ensuring that the water supply system should not run out of water by providing for the maintenance of a minimum level of reserve storage (appropriate to each system) remains at the end of a prolonged drought period -
  - For large systems (Rosslynne and Merrimu) a reserve storage equivalent to approximately one year's restricted supply is used; and
  - For small systems (Romsey and Woodend) a reserve storage equivalent to approximately one month's restricted supply is used;

and

- Ensuring a minimum period of demand (appropriate to each system) can be supplied during drought -
  - For the Rosslynne supply systems, which has capacity to store multiple years' demand, and offload a substantial proportion of its demand to the Melbourne system, this period is 18 months of stage one restrictions;

- For the Merrimu supply systems), which has capacity to store multiple years' demand, and can offload its entire demand to the Melbourne system, this period is 6 months of unrestricted demand; and
- For small systems (the Romsey and Woodend supply systems), with storage capacity less than one year's demand, this period is 12 months of restricted demands.

The connections to Melbourne Water's supply system, for both Sunbury (March 2000), and Bacchus Marsh and Melton (April 2004), and Gisborne, Riddells Creek and Macedon and Mt Macedon (May 2004) have allowed increased flexibility in operation, as well as providing a greater security of supply for both supply systems. The potential to reduce the load on the Rosslynne Reservoir, which now only services a portion of Sunbury demands, has made it feasible to connect Gisborne, Riddells Creek and Macedon and Mt Macedon to the Rosslynne supply. This in turn has enabled supplies previously used to supply Riddells Creek to be used to augment supplies to Romsey and those for Macedon and Mt Macedon to be diverted to Woodend or into Rosslynne Reservoir. The recent installation of pumps which can deliver water sourced from Melbourne to the towns of Gisborne, Riddells Creek and Macedon and Mt Macedon have introduced further flexibility and security to the supply system.

Triggers have also been developed to indicate how the supplies taken from the Melbourne system may be increased in order to reduce the risk of restrictions, and protect the emergency buffer storage during periods of low reservoir inflow.

The drought response triggers for each supply system and associated townships are clearly outlined in Section 4.2 of the Plan. For most of the townships, these triggers relate to the levels of available storage in the surface water storage systems from which they are supplied. The exceptions are:

- Lancefield – with the primary supply being derived from two groundwater bores, the implementation of restrictions for Lancefield would only be expected to be required in the case of bore failure of a permanent nature; short term disruptions to the bores may not require restrictions (due to the availability of back-up surface water storage), but longer term disruptions (more than two months) would require restrictions if the back-up storage volume were low.
- Myrniong – the triggers for restrictions at Myrniong relate to a coefficient calculated based on the ratio of observed Pykes Creek Reservoir inflows over 9, 12, 15 and 18 month durations to estimates of the inflows for those durations that would provide a 97% security of supplying an annual volume of 58ML/year to Myrniong.

A copy of the Western Water By-Law that sets out the details of each stage of restriction referred to by the restriction triggers for all supply systems is included in Appendix A.

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1. INTRODUCTION

There are two main components involved in planning water supply systems for periods of drought, these are:

- the provision of a supply system that satisfies current and future demands ensuring that shortfalls in supply are within defined, acceptable levels; and
- ensuring that when shortfalls in supply occur, a range of appropriate response mechanisms are available.

The first component represents the long term planning actions that result in a certain level of infrastructure development and are typically planned for in a Water Resources Management Plan. The second component relates to short term management actions that are required to minimise the impacts of drought and are also covered in a Drought Response Plan. This document represents a Drought Response Plan (DRP) for Western Water and has been designed to comply with the principles of DRPs as set out by the Department of Sustainability and Environment (DSE).

A Drought Response Plan is designed for use by water resource managers and provides a mechanism by which drought may be responded to systematically and rationally thereby minimising the social, economic and environmental impacts of drought. A Drought Response Plan considers all aspects of drought response planning including pre and post drought actions, identification of supply augmentation, demand reduction options and a sequential action plan to be followed during periods of drought.

This plan was updated to take into account the low reservoir inflows experienced during the ongoing drought, experience with the implementation of water restrictions and especially the introduction of new infrastructure which has enabled water to be drawn from Melbourne Water's supply system. The major improvements made to the previous plan are that the updated plan now includes for the following issues:

- The drought response curves have been revised and include for the drought experienced up to the end of July 2003;
- The revised drought response curves have been developed allowing for forecast demands for the year 2008;
- Response curves have been developed for the Rosslynne and Merrimu systems to indicate the manner in which supplies drawn through the recently constructed links to Melbourne Water's supply system should be stepped up during prolonged dry spells.

The Drought Response Plan for Western Water covers two main systems as follows:

- Maribyrnong System: consisting of all the Western Water urban water supply systems in the Maribyrnong Basin and Woodend (which is in the Campaspe Basin). The townships included in the Maribyrnong system are Romsey, Lancefield, Woodend, Sunbury, Diggers Rest, Bulla, Gisborne, Riddells Creek, Macedon and Mt Macedon.

  The first three towns (Romsey, Lancefield and Woodend) all have independent water supply systems and are therefore discussed separately in the following sections. Macedon, Mt Macedon, Gisborne and Riddells Creek are all supplied primarily from the Rosslynne Reservoir and so will be considered together (as the 'Rosslynne' system) throughout this report.

  Although Sunbury, (including Diggers Rest and Bulla) is also supplied from the Rosslynne system, the supply to these these towns is now augmented and backed up from the metropolitan water supply system managed by Melbourne Water. This supply

is taken from the Melbourne Water supply system. Due to the two separate supply systems, drought response for Sunbury is considered as a separate case dependent on the prevailing conditions in both systems.

- Werribee System: consisting of the urban water supply systems in the Werribee Basin that are managed by Western Water. The townships included in the Werribee system are Melton, Bacchus Marsh, Rockbank, Toolern Vale and Myrniong. From April 2004 Melton and Bacchus Marsh became connected to a pipeline from the Melbourne Water supply network. This has significantly enhanced the supply security of this system.

This Drought Response Plan includes:

- A summary of each system (including a physical description, the current security of supply and the historic drought experience of each township) in Section 2.0;
- A review of the options for augmenting supply in each system during drought in Section 3.0;
- A sequential plan of action for responding to drought (Section 4.0); and
- Pre and post drought actions to ensure preparedness for drought in Section 5.0.

In order to provide a clear focus for each of these components of the Drought Response Plan, the objectives of the plan first need to be defined.

1.1 Objectives of Drought Response Plan

The major objective of this drought Response Plan is to provide for efficient and effective management of water supply security to Western Water's customers consistent with:

- Customer needs;
- Projected future growth;
- The practices of neighbouring water companies; and
- Best practice in water supply management during drought periods.

To deliver this objective, the Plan specifically:

- Identifies key actions that should be taken to effectively manage Western Water's water resources during various stages of drought;
- Sets out the stages of drought and the corresponding four stages of restrictions on the use of water (consistent with those set out in the Drought Response Plan for Melbourne Retail Water Companies);
- Defines clear triggers for drought stages at which the supplies drawn from Melbourne Water should be increased;
- Defines clear triggers for drought stages that can be used to help ensure Western Water's customers are well informed in relation to drought status and that may lead to each stage of restrictions being imposed; and
- Outlines principles to be used for deciding when restrictions should be lifted.

The primary mechanisms for implementing drought response for Western Water's supply systems is the application of restrictions and increasing the supplies drawn from the Melbourne water supply system. These are designed to achieve an appropriate level of reduction in demand on the supply systems such that the security of supply to customers is adequately protected through periods of drought. Western Water's four stage restriction

policy and the drought response triggers linked to their implementation for each supply system provide this protection by:

- Ensuring that the water supply system should not run out of water by providing for the maintenance of a minimum level of reserve storage (appropriate to each system) remains at the end of a prolonged drought period –
  - for large systems (Rosslynne and Merrimu) a reserve storage equivalent to approximately one year's restricted supply is used; and
  - for small systems (Romsey and Woodend) a reserve storage equivalent to approximately one month's restricted supply is used;

and

- Ensuring a minimum period of restricted demand (appropriate to each system) can be supplied during drought –
  - for the Rosslynne supply systems, which has capacity to store multiple years' demand, this period is 18 months of stage one restrictions;
  - for the Merrimu supply systems, which has capacity to store multiple years' demand, this period is 6 months of unrestricted demand; and
  - for small systems (the Romsey and Woodend supply systems), with storage capacity less than one year's demand, this period is 12 months.

The connections to Melbourne Water's supply system to Sunbury (March 2000), and Bacchus Marsh and Melton (April 2004), and Gisborne, Riddells Creek, Macedon and Mt Macedon (May 2004) have allowed increased flexibility in operation, as well as providing a greater security of supply for both supply systems. Triggers have also been developed to indicate how the supplies taken from the Melbourne system may be increased in order to reduce the risk of restrictions, and protect the emergency buffer storage, during periods of low reservoir inflow.

This plan focuses on management of drought response and does not address strategic water resources management. The latter is addressed separately in Western Water's Water Resources Plan.

2. SYSTEM CONTEXT

2.1 System Description

2.1.1 Maribyrnong System

The following sections provide a description of the current water supply systems in the Maribyrnong basin. It should be noted that the system descriptions are limited to the usual supply source for a particular township; alternative and supplementary supply sources are considered further in Section 3.0.

Romsey

Romsey is a township of approximately 3,200 people. Based on an analysis of demands and demand growth over the period 1994 to 2002, Romsey's current average annual demand is estimated to be 422ML/year. Supply to Romsey is from the Kerrie Reservoir, an offstream storage that stores inflow diverted from a weir on the upper reaches of the Bolinda Creek and water pumped from Wright's Reservoir. The diversion from Bolinda Creek will be subject to a daily diversion limit based on a sliding scale depending on the available creek flow at the weir. At the top end of this scale, the maximum daily diversion allowed will be 32ML/day when the Bolinda Creek flow is greater than 35.8ML/day. An annual diversion limit of 460ML/year will also apply under the terms of the Romsey Bulk Entitlement Order.

In addition, a drought reserve of up to 280ML may be established to supplement the allowable annual diversion from Bolinda Creek, as required, in any particular year. The drought reserve is effectively an additional entitlement to divert water in a particular year over and above the annual Bulk Entitlement. Diversion from Bolinda Creek above the annual Bulk Entitlement limit can only be made when the drought reserve volume balance (this is conceptual and does not represent a physical storage) is greater than zero, and any such diversions will be debited to that balance. On 1st July in any year, Western Water will be entitled to credit to this drought reserve an amount equal to the unused annual entitlement for the preceding year. The total volume of water diverted from Bolinda Creek in excess of its annual entitlement by Western Water in any year must not exceed the available amount in the drought reserve. It should be noted that in some circumstances, even though there may be a sufficient balance in the drought reserve, additional diversion will not be possible due to a lack of available flow in Bolinda Creek.

The water pumped from Wright's Reservoir is obtained under the Riddells Creek Bulk Entitlement and sourced originally from diversions from Main Creek. The diversion from Main Creek may be taken from April to January inclusive at a maximum rate of 1ML/day whilst ensuring the passing flow does not fall below 0.5ML/day. An annual limit of 300ML is also applicable. Diverted flow may then be stored in Forsters (capacity 18ML) and Wright (55ML) Reservoirs before being pumped to Kerrie Reservoir. The delivery capacity of the pump station and rising main is 1.6ML/day, which allows downtime for maintenance etc. as the peak capacity is 1.9ML/day.

Kerrie Reservoir was enlarged in 1983/84 to its current capacity of 295ML. Water from Kerrie Reservoir is transferred by gravity to the Glenfern Service Basin, a balancing storage basin of 45ML capacity constructed in 1979. Romsey has a high level supply zone, which is served by a pump station and a 0.45ML tank. The rest of the town is supplied by gravity. The Romsey water supply system has been disinfected and treated since mid 1998. The distribution pipeline system is generally in good condition with 90% of the system being less than 20 years old. A simple schematic of the system is shown in Figure 1-1.

Romsey is situated over a fractured basalt aquifer. The potential for groundwater supply to Romsey from this aquifer was investigated between 2000 and 2002. Despite having the potential to supply in the order of 200ML of water a year, it was found that relatively high salinity levels make this groundwater source unsuitable for incorporation into the current

supply system under normal operating conditions. In 2003 this emergency bore commenced operation, and delivered supplies at a rate of approximately 160ML/year. Although the bore has been used for prolonged periods during drought it is considered as emergency supply to the town.

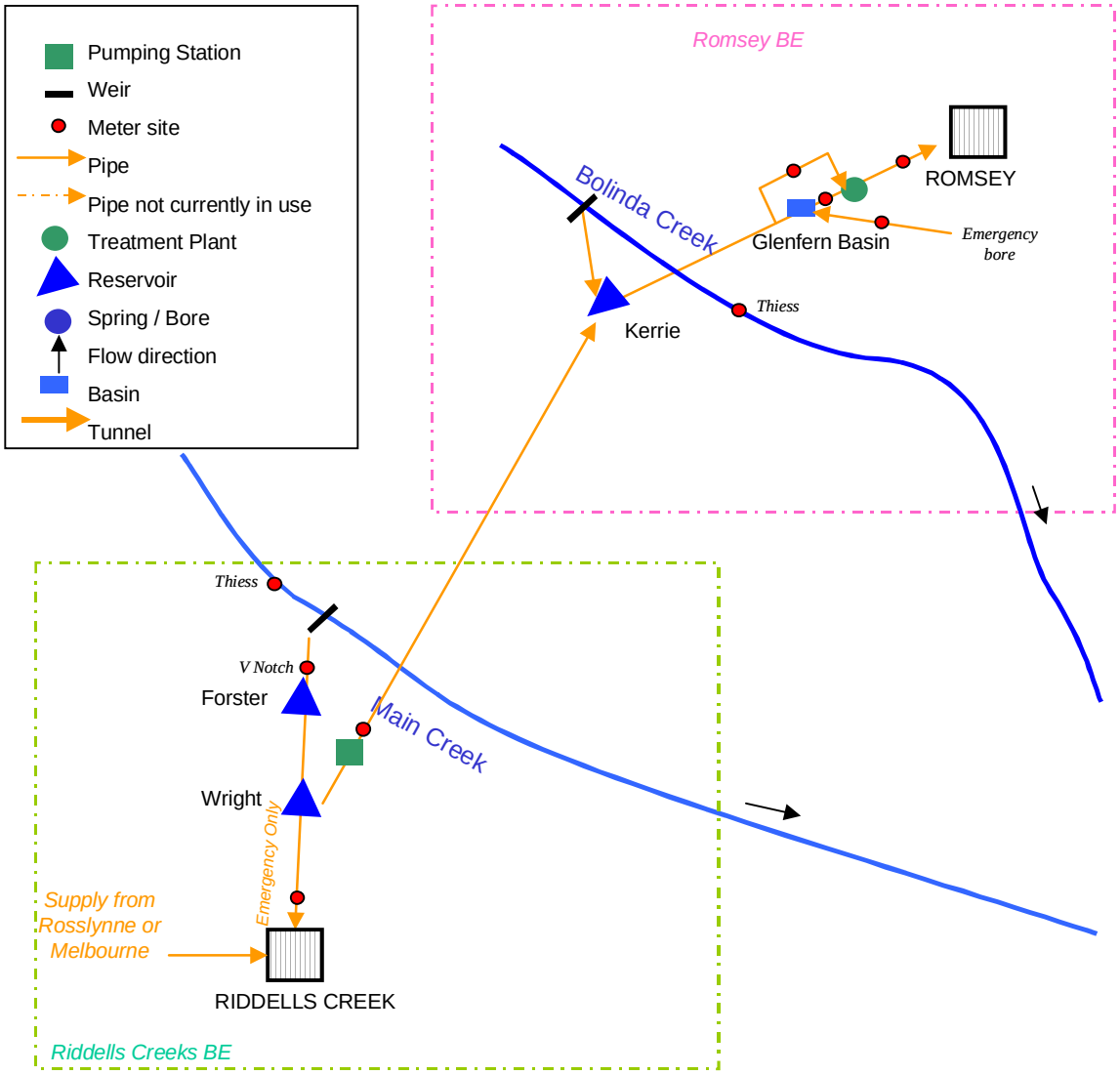


Figure 1-1: Romsey Water Supply System

Lancefield

Lancefield is a township of approximately 1,200 people to which an average annual supply of about 250ML is delivered. Water supply to Lancefield is currently via two groundwater bores (Bores No. 2 and No. 3) located near the township. Bore No. 3 was completed in February 2000 and replaced the now decommissioned Bore No. 1, which previously provided supply to Lancefield. Bore No 2 was upgraded in 2002 to improve its construction and yield. The bores are between 42 and 60 metres deep and penetrate the local fractured basalt aquifer. They produce good quality water at the following (approximate) maximum rates:

- Bore 2: 13 L/sec
- Bore 3: 10 L/sec

These rates however cannot be maintained continuously. Some allowance for aquifer recovery is required in both bores in order to maximise the system yield. Western Water's groundwater extraction from this system is currently capped at 500ML/year. Western Water may in future apply to increase this licence. Figure 1-2 shows a schematic of the system.

Although not currently used under normal operating circumstances, a back up surface water supply from the 55ML capacity Lancefield Reservoir (supplied by the 45ML capacity Garden Hut Reservoir and a diversion weir on Monument Creek) is available for Lancefield. This system, previously used as Lancefield's primary water supply source, has an associated Bulk Entitlement of 315ML/year. Plans are underway to construct a water treatment plant to enable this water to be treated, whereupon it will be reintroduced into the normal supply.

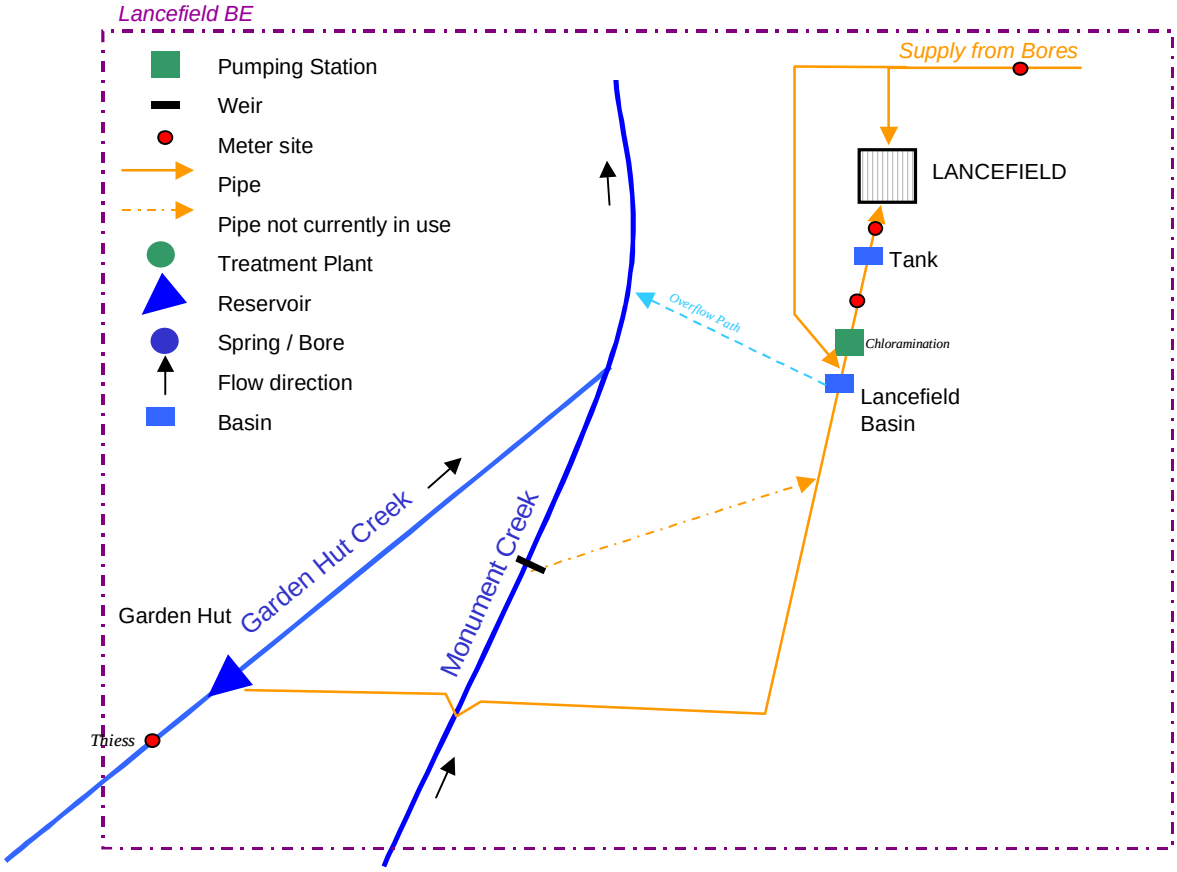


Figure 1-2: Lancefield Water Supply System

Woodend

The Woodend water supply system supports a population of approximately 3,400 people. Based on an analysis of demands and demand growth over the period 1994 to 2002, Woodend's current average annual demand is estimated to be 450ML/year. Woodend has three major sources of supply as follows:

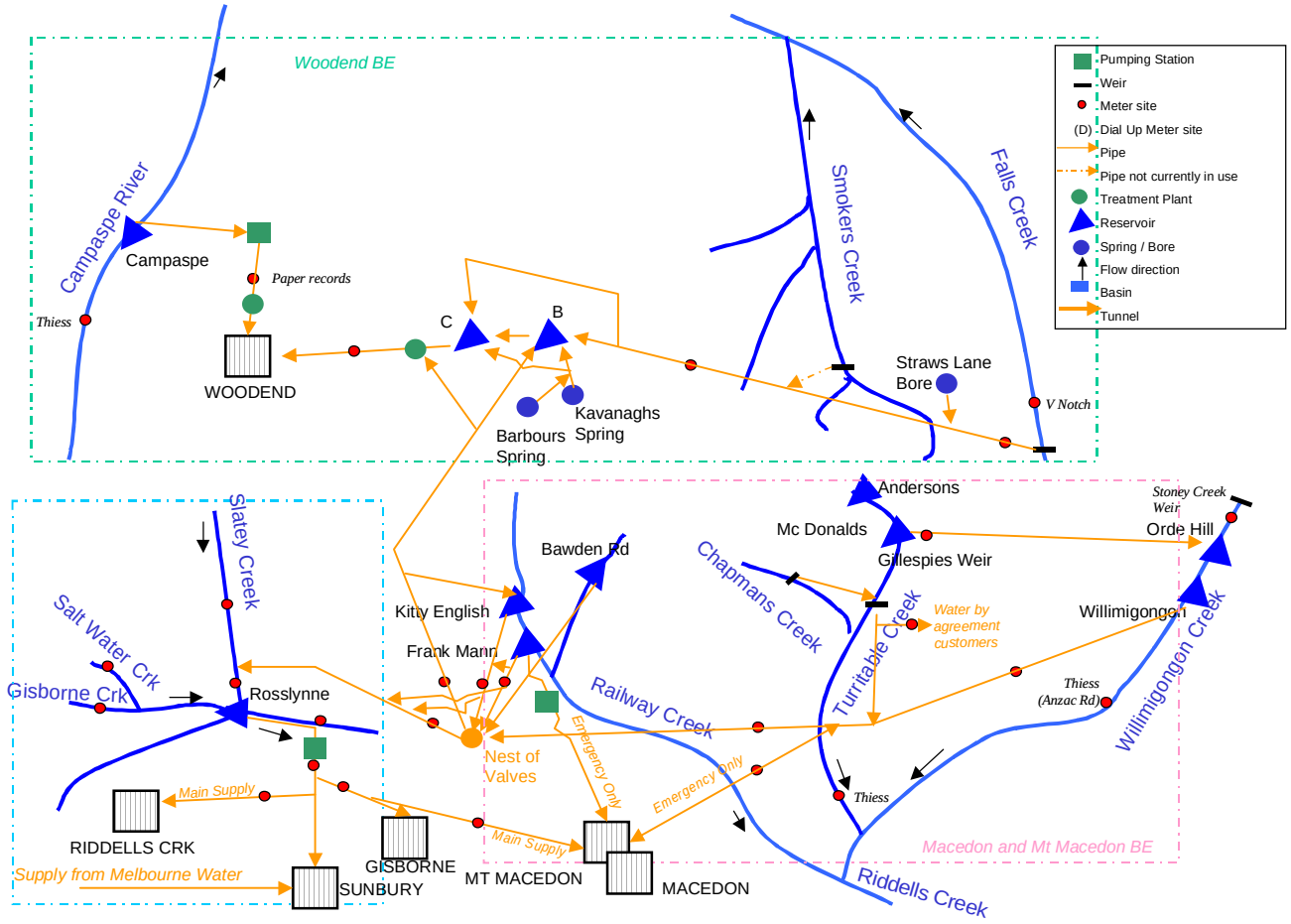
- The Campaspe Reservoir, an in stream storage on the Campaspe River, has a 245ML capacity. Water diverted for storage in the Campaspe Reservoir, under the terms of the Woodend Bulk Entitlement Order, cannot exceed 3.5ML/day. The maximum annual diversion allowed under the order is 470ML/year. Water is transferred from this storage

to the Marriages Road Basin (5ML capacity) and then to the town via a treatment plant in Donald Road. In 1993, an aeration system was installed with the aim of reducing the previously high incidence of algae. Typically the Campaspe Reservoir is used to supply winter and part summer demand to Woodend.

- Water is also harvested from diversion weirs on Falls and Smokers Creeks and from Kavanagh and Barbour Springs. A bore at Straws Lane (capacity 3l/s) can also be utilised where necessary. Water from these sources is transferred to small storages named Reservoirs B and C which have capacities of 26 and 75ML respectively. Reservoirs B and C are used to supplement the Campaspe Reservoir supply to Woodend during summer. Under the terms of the Woodend Bulk Entitlement Order, water on Falls Creek can be diverted up to a maximum of 1.2ML/day. Water on Smokers Creek can also be diverted up to a maximum of 1.2ML/day under the order. Currently the Smokers Creek Diversion is not used as Falls Creek is the better source and the single diversion pipeline cannot accept flows from both sources simultaneously. The total maximum annual diversion allowed under the order from the combined elements of this system through Reservoirs B and C is 332ML/year.
- The pipeline from Stoney Creek weir, upstream of Orde Hill, used to supply a small number of houses with raw water but, although still operational, has been disconnected as these residences are supplied with potable water. Stoney Creek Weir thus now overflows into Orde Hill Reservoir.
- Water can also be drawn from the former Mt Macedon supply system to supplement the supply to Woodend. This system comprises the 250ML capacity Orde Hill Reservoir, which is an on stream storage located on the Willimigongon Creek. As well as storing Willimigongon Creek inflows, Orde Hill Reservoir can receive diversions from Andersons and McDonalds Reservoirs (22ML and 82ML capacities respectively) on Turitable Creek. Water from Orde Hill is transferred to the downstream 15ML capacity Willimigongon Reservoir, to which water can also be diverted from Gillespies Weir on Turitable Creek downstream of McDonalds Reservoir. Water from Willimigongon Reservoir can be diverted via the Link Main into Reservoir C. This supply source is generally used at the end of the filling season in late spring to ensure Reservoir C is as full as possible prior to the start of summer. Water from Kitty English and Frank Mann Reservoirs can be pumped to Woodend. Water can also be transferred from Willimigongon Reservoir to Rosslynne Reservoir via the Macedon to Rosslynne Pipeline.

  Under the terms of the Macedon and Mt Macedon Bulk Entitlement Order, the maximum rate of extraction from Andersons and McDonalds Reservoirs is 1.7ML/day (with an annual limit of 131ML/year). The maximum rate of extraction from Gillespies Weir is 0.8ML/day up to 80ML/year. The maximum rate of extraction from Orde Hill and Willimigongon Reservoirs is 2ML/day (with an annual limit of 422ML/year). In addition, the total extraction from these sources combined with extractions from Kitty English and Frank Mann Reservoirs into the Macedon to Rosslynne Pipeline, must not exceed 873ML of water in any one year, and must not exceed 3225ML of water in any consecutive five year period.
- It is also possible to deliver water from Rosslynne to Woodend via the link main (which connects Willimogongon Reservoir to Reservoirs B or C).

Figure 1-3 shows a schematic of the Woodend supply system.



n Figure 1-3: Woodend Water Supply System

Rosslynne System

The Rosslynne system consists of the water supply system used to supply the townships of Macedon, Mt Macedon, Gisborne, Riddells Creek and Sunbury (including Diggers Rest and Bulla), and which can also supply Woodend. All of these towns except Sunbury and Woodend are supplied predominantly by Rosslynne Reservoir. Gisborne, Riddells Creek, Macedon and Mt Macedon have alternative untreated supplies available for short term emergency use in the event of a supply system failure from Rosslynne Reservoir. Table 1-1 shows the estimated population for each township and estimated average annual demand based on an analysis of demands and demand growth over the period 1996 to 2002.

Rosslynne Reservoir is operated by Southern Rural Water under the constraints of the Bulk Entitlement (Maribyrnong system – Western Water) Conversion Order. The relevant components of the BE for Western Water are:

- Rosslynne Reservoir is divided into 3 capacity shares:
  - Western Water 86%;
  - Southern Rural Water 4.5%; and
  - Melbourne Water 9.5%.

- Inflow to Rosslynne Reservoir is shared as follows:

- Western Water 86%;
- Southern Rural Water 4.5%; and
- Melbourne Water 9.5%.

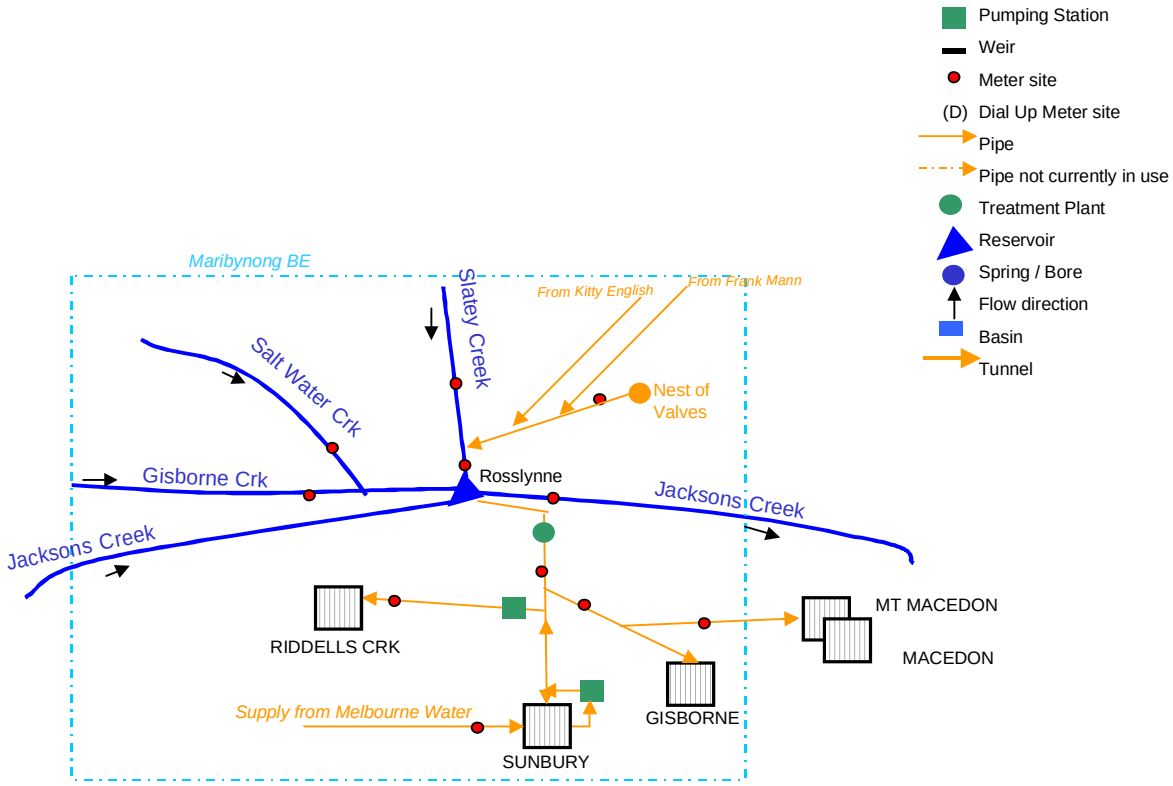
Passing flow from Rosslynne Reservoir is shared according to the capacity share arrangements. Water can be released from Rosslynne Reservoir to meet passing flow obligations at the following locations:

- Jacksons Creek at Gisborne
- Jacksons Creek at Sunbury; and
- Maribyrnong River at Keilor.

The passing flow requirement at Sunbury is 1ML/day which requires releases of up to 6ML/day from Rosslynne Reservoir. Western Water, Southern Rural Water and Melbourne Water obtained temporary amendments to their Bulk Entitlements which permits them to reduce these releases.

Table 1-1: Township populations and average demand for towns within the Rosslynne System

Town	Population (2004)	Average Annual Demand (ML)
Sunbury (including Diggers Rest and Bulla)	34,000	4,365
Gisborne	6,600	1,030
Riddells Creek	2,300	550
Macedon and Mt Macedon	2,900	480
Total	45,800	6,425



n **Figure 1-4: Rosslynne Water Supply System**

Additional security to this system is provided by a link between the Melbourne Water system and the Sunbury supply system. The pipeline has the capacity to supply at a rate of up to 17ML/day. In May 2004 a pumpstation was commissioned that allows up to 4 to 5ML/day to

be delivered from Sunbury to Gisborne, Riddells Creek, and Macedon and Mt Macedon, at times when demand in Sunbury is less than the 17ML/day supply capacity from the Melbourne system. Figure 1-4 shows a schematic of the Rosslynne system.

2.1.1 Werribee System

The Werribee system consists of the water supply networks to the townships of Melton, Bacchus Marsh, Rockbank, Toolern Vale and Myrniong. Lake Merrimu is the primary source of the vast majority of the Melton, Bacchus Marsh, Toolern Vale and Rockbank water supply. Djerriwarrah Reservoir provides up to 400ML/annum (when mixed and supplied with water from Lake Merrimu) and can act as an emergency backup supply if required. Furthermore, additional security will be afforded to the Melton and Bacchus Marsh supplies by the pipeline connection from the Melbourne Water supply system which was completed in April 2004. The capacity of this link is 41ML/day, which is sufficient to meet even peak demands in the two towns, at present.

Table 2.2 shows the estimated population for each township in the Werribee system and estimated average annual demand based on an analysis of demands and demand growth over the period 1996 to 2002.

The Myrniong water supply system utilises the water resources of the Pykes Creek Reservoir. The system comprises a pumping station immediately downstream of the Pykes Creek Reservoir and a rising main to a small service reservoir, which regulates the supply to the township of Myrniong. The system can provide up to 58ML/annum although averages around 40ML/annum. Figure 1-5 shows a schematic diagram of the Merrimu supply system.

Table 1-2: Township populations and average demand for towns within the Werribee System

Town	Population	Average Annual Demand (ML)
Melton (including Rockbank and Toolern Vale)	35,500	4,900
Bacchus Marsh	12,900	2,380
Myrniong	180	40
Total	48,580	7,320

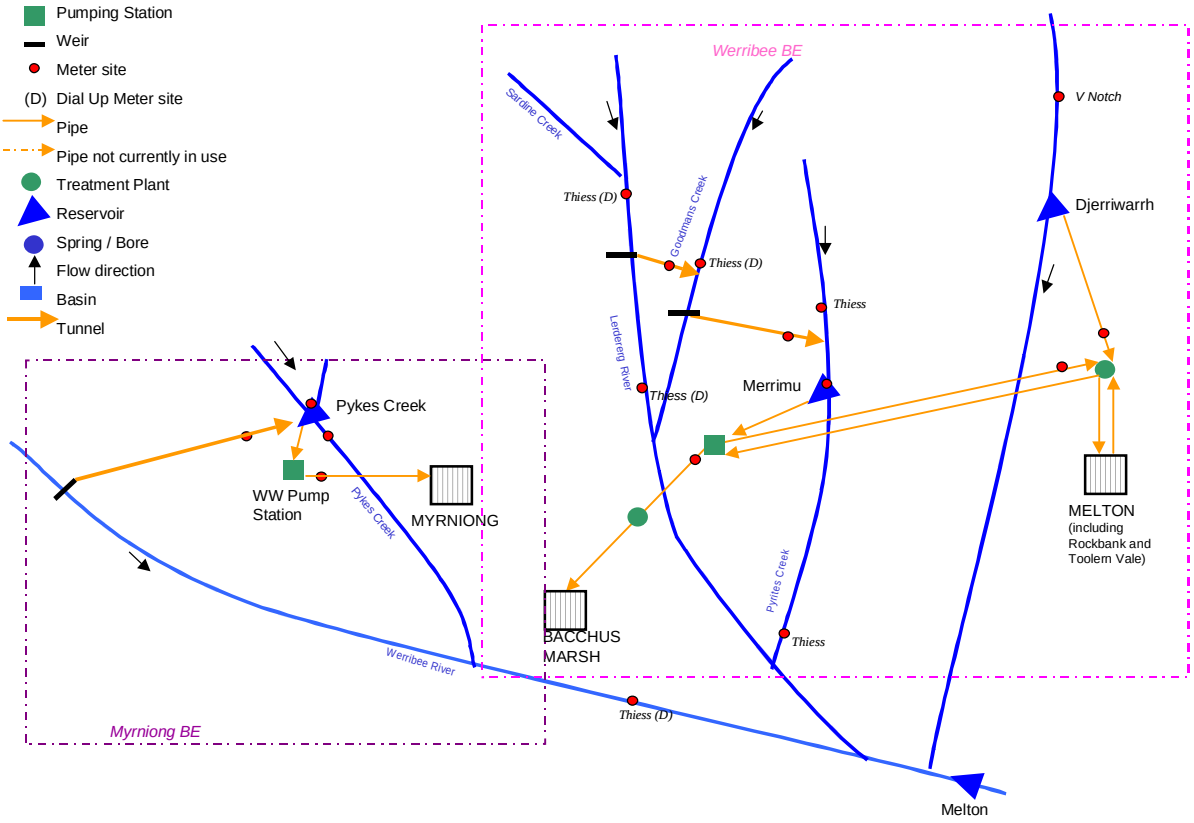
The Lake Merrimu storage serves a dual purpose of supplying both the rural irrigation needs of the Werribee district and the urban demand for Western Water. Lake Merrimu is currently operated by Southern Rural Water within the constraints of the Bulk Entitlement (Werribee system- Urban) Conversion Order for that system. The relevant components of the BE for Western Water are summarised as follows:

- Lake Merrimu is divided into 2 capacity shares:
  - Wester Water 80%
  - Southern Rural Water 20%
- Inflow to Lake Merrimu is shared as follows:
  - Western Water 70%

- Southern Rural Water 10%
- Unallocated share 20%

q Passing flow from Lake Merrimu is shared according to capacity share arrangements. Water can be released from Lake Merrimu to meet passing flow obligations at Coimadai Creek downstream of Lake Merrimu.

q Western Water provide passing flows downstream of Djerriwarrh Reservoir at the lesser of the incoming flow or 1.5ML/day.



n **Figure 1-5: Merrimu Water Supply System**

2.2 Past Drought Experience

A knowledge of the history of drought in the Maribyrnong and Werribee systems is important in ensuring that the experience of drought is progressively incorporated into future drought planning. Available information on the impact of drought on the Community and Management actions taken during drought has been collated and presented in sections 2.2.1 and.2.2.2.

In general, drought has been shown to have some of the following impacts on local communities:

q Loss of amenity for the community due to the deterioration of plants, gardens and sporting facilities.

q Financial loss to the community, incurred whilst restoring services to pre-drought conditions.

q Inconvenience to the community caused by forcing users to alter their water use practices.

q Financial loss to local businesses.

q Stress on in-stream flora and fauna.

q Reductions in revenue for water authorities caused by restrictions on consumption.

- Increased expenses for water authorities incurred in promoting and enforcing restrictions, additional system management and administration and providing emergency supplies.

2.2.1 Maribyrnong System

In the years since World War 2, Victoria and particularly the Macedon region has suffered below average rainfall or drought on a number of occasions. The estimated annual rainfall and annual inflow for the lowest 10 years on record has been summarised in Table 1-3.

Table 1-3: Summary of inflow to Western Water's capacity share and rainfall during drought in the Maribyrnong system (note that these figures are determined for the year July to June).

Year	Annual Inflow (ML)	Year	Annual Rainfall (mm)
2002-2003	287	2002-2003	477
1994-1995	376	1913-1914	481
1999-2000	383	1944-1945	521
1997-1998	389	1914-1915	526
1967-1968	500	1904-1905	552
1998-1999	784	1997-1998	554
2001-2002	869	1943-1944	573
1973-1974	1236	1907-1908	583
1914-1915	1372	1915-1916	589
1944-1945	1373	1919-1920	608

The 1967/68 drought saw relief bores sunk in the Shire of Romsey at Riddells Creek and at Monegeetta. Although these bores have since been abandoned, a number of new bores currently exist in the area, including those that supply Lancefield and the test bore at Romsey.

The drought of 1967/68 also brought hardship to the Sunbury and Gisborne areas and the Trusts of the time sank bores to try to boost their dwindling supplies. Two of these bores are still visible from the Kilmore-Gisborne Road, but they have not operated for more than 20 years and there is scant information available about them. They are the responsibility of Council.

The drought of 1967/68 served as a trigger for the construction of the Rosslynne Storage. In more recent times, consumers supplied from this source have been on low level restrictions through some summers. Drought again began to impact on the Maribyrnong system in the summer of 1997. Sunbury, Gisborne and Riddells Creek experienced stage 3 restrictions (of the then 8 stage policy) from October 1998 to November 2000. Macedon and Mt Macedon were not subjected to restrictions at the time as they were still utilising the independent Macedon storages system as a main supply source (for untreated water).
A water conservation campaign aimed at raising community awareness of water use and at encouraging responsible water use was implemented in the summer of 1999. The mascot used for this campaign was 'Sammy the Snake'.

Although Macedon and Mt Macedon are now supplied from Rosslynne Reservoir, the operational commissioning of the pipeline connecting Sunbury to Melbourne Water's supply system in March 2000 has since considerably eased the demand load on the Rosslynne system. In addition, surplus water from the Macedon storages (Orde Hill, Willimigongon, McDonalds, Andersons, Kitty English and Frank Mann Reservoirs) can now be transferred

via the Link Main, (between March and November, and based on the flows in Slatey Creek and subject to maintaining the Macedon storages at least 60% full for fire-fighting purposes) to supplement inflows to Rosslynne Reservoir.

One of the worst affected supply systems in the 1982/83 drought was Woodend. In July 1982 there was only 20ML of water in storage in the system (about 4 weeks' supply). Substantial effort was spent in searching for alternative supplies; bores were drilled, water was carted from local dams and extensive carting from outside the district was considered. At the end of November 1982 the (then) Trust asked for Governor in Council approval to restrict domestic supplies to 40L per person per day with discretion to reduce this to 20L per person per day if the situation failed to improve. The occurrence of rain deferred this decision, but later in the season the Trust was again forced to cart water to maintain supply for its customers. Records show that a total of 9,255KL of water were carted during February and March of 1983.

Macedon and Mt Macedon demands are now supplied from Rosslynne Reservoir. Consequently, surplus water in the Macedon storages can also be transferred to supplement Reservoir C in the Woodend system. Water from Kitty English and Frank Mann Reservoirs can also be pumped into Reservoir C.

Restrictions in Romsey were applied in 1982/83 due to drought and in 1983/84 during the re-construction of Kerrie Reservoir. Stage 3 restrictions (of the then 8 stage policy) were applied again from April 1998 to October 1998.

In March 1991 the (then) Romsey-Lancefield Water Board saw the need to introduce Stage 3 restrictions for the Township of Lancefield. This was due to the drawdown on its surface water storages (Lancefield and Garden Hut Reservoirs, then used as Lancefield's primary supply source) and to problems with one of its groundwater bores. The restrictions were published by the insertion of a formal notice in the Kyneton Guardian and by special notice delivered to all Lancefield householders via bulk mail. On the whole, restrictions were accepted favourably, perhaps due to the prior history of water shortage in the district. Further restrictions for Lancefield were implemented in March 1992 (Stage 2) and in December 1994 (Stage 3). Bore No 2 was upgraded in 1992.

The drought which commenced in 1998 and is still ongoing is the most severe on record. It is notable that all the years following 1997-1998 are ranked within the 10 years of lowest inflow. This drought caused a number of measures to be introduced including:

- Water restrictions to modified stage 4 in most towns in the Maribyrnong system;
- The emergency bore in Romsey was brought into operation from December 2002;
- The delivery system from Wrights Reservoir to Kerrie Reservoir was commissioned in February 2003;
- The Macedon to Rosslynne pipeline was completed in June 2001;
- The community water conservation campaign was intensified;
- Air scouring of water mains was temporarily discontinued;
- Temporary amendments were obtained to obtain relief from some of the passing flow requirements stipulated in the Bulk Entitlements;
- The program for substitution of recycled water was accelerated;
- Introduction of the supplementary supply from the Melbourne system to Sunbury, with capacity of 17ML/day, which was commissioned in March 2000; and
- Commissioning of the pump station (May 2004) to deliver water sourced from the Melbourne system, surplus to Sunbury's demands, to Gisborne, Riddells Creek, Macedon and Mt. Macedon. The delivery capacity exceeds 4ML/day.

2.2.2 Werribee System

The estimated annual rainfall and annual inflow for the lowest 10 years on record for the Werribee system have been summarised in Table 2.4.

The Township of Melton experienced Stage 4 and 5 restrictions (8 stage policy) between September 1982 and September 1983. These restrictions were necessary due to a reduction in allocation of supply from Lake Merrimu by the (then) Rural Water Commission to 75% of the previous year's consumption. Djerriwarrh Reservoir, which had been used in the previous winter, was empty during the period of restrictions.

The application of restrictions during 1982/83 appears to have worked well, with good co-operation from consumers. The progress of the drought and details of restrictions and demand targets were well advertised in local newspapers at the time. Only a few complaints were recorded on file.

Table 1-4: Summary of inflow to Western Water's capacity share and rainfall during drought in the Werribee system (note that these figures are determined for the year July to June).

Year	Annual Inflow (ML)	Year	Annual Rainfall (mm)
2002-2003	39	1996-1997	322
1982-1983	737	1926-1927	322
1997-1998	950	1944-1945	329
1926-1927	1114	1979-1980	356
1996-1997	1167	1984-1985	361
1944-1945	1306	1956-1957	374
1937-1938	2191	1961-1962	384
1943-1948	2268	1967-1968	386
2001-2002	2481	1943-1944	391
1990-1991	2712	1928-1929	405

Drought conditions again began to impact on the Werribee system in the summer of 1997. Stage 3 restrictions (8 stage policy) were in force for Melton and Bacchus Marsh from October 1998 to November 2000. In addition to implementation of the water conservation campaign referred to in Section 2.2.1, a number of other drought management options were considered. Overall, three of these options were found to be feasible for implementation at the time – these are briefly outlined as follows:

- Following negotiation with Southern Rural Water and the Department of Natural Resources and Environment, the entire volume of unallocated water (4,900ML) in Lake Merrimu was made available to Western Water as a temporary transfer.
- A total volume of 985ML of water was purchased in 1999/2000 through a temporary transfer of water right from rural irrigators being supplied from Lake Merrimu.
- Supply to the system was further supplemented with water from Djerriwarrh Reservoir, with approximately 400ML/annum being used. This water was mixed with water from Lake Merrimu prior to being passed through the treatment plant.
- The pipeline connection to the Melbourne Supply system at Sydenham as a means of supplementing the Merrimu Reservoir supply to Melton and Bacchus Marsh was also implemented by April 2004. Supplies of up to 41ML/day are drawn from this source.

The possibility of transferring water from alternative storages (including Newlyn, Colebrook and Lal Lal Reservoirs) was also investigated, but found not to be feasible and the Melbourne to Melton pipeline that was implemented does not make provision for this option. If

implemented, water was to have been delivered to Ballan via existing pipelines, transferred into the Werribee River at Ballan and finally stored at Pykes Creek Reservoir. A transfer of water right involving Southern Rural Water between the Merrimu and Pykes Creek storages would then have resulted in an increase in Western Water's capacity share of storage at Lake Merrimu. A primary difficulty with this alternative as a drought response measure was the lack of available water at Lake Merrimu to affect the water right transfer from Pykes Creek Reservoir. Difficulties associated with arranging the physical link between the alternative storages and Pykes Creek Reservoir (see Section 3.2.2 for further details) were also identified.

The drought which commenced in 1998 caused water restrictions up to modified stage 4 to be applied. The unallocated entitlement volume in Lake Merrimu was purchased on a temporary basis. However the absence of any significant inflow meant that Western Water's share of storage in Merrimu (including the unallocated share) continued to draw down and had reached approximately 1500ML by the end of April 2004. By this time however Bacchus Marsh and Melton were able to draw their whole supply from the Melbourne system as a new connection had been commissioned. The system operates under gravity and can be boosted by pumping. The gravity supply was operational from late January 2004 and the pump station was commissioned during April 2004.

2.3 Security of Supply

The term security of supply is used in describing the overall ability to supply a given quantity of water (yield). Implicit in the use of the term is an understanding that there is a risk that the specified yield will not be met. Security of supply should therefore never be interpreted as meaning the level of supply is 100% secure in all future low flow periods. Instead it should be understood that there is a probability that shortfalls in supply will occur. The expected probability and severity of shortfalls at any point in time will be dependent on a number of factors, including the level of demand relative to the water harvesting capacity of the system.
The water available in any one year to the Western Water systems is ultimately dependent upon local inflows. As is the case for most Victorian streams, streamflows in these systems are highly variable, resulting in substantial uncertainty in projections of how much water is likely to be available for supply in any one year. The availability therefore needs to be described in terms of the probability that a particular volume of water will be available for supply.
The concept of system reliability is typically used to quantify security of supply. For example, reliability of supply can be defined as the annual probability that the supply volume available over a selected period will be at least a certain value. This annual probability is generally referred to as the annual exceedence probability (AEP). A 95% AEP supply volume would provide a 95% annual reliability, i.e. a chance of only 1 in 20 of that supply volume not being available in any one year.

Computer simulation models have been used to estimate the security of supply of the Western Water systems. These models offer the advantage of being able to analyse many different interacting processes and also allow operating rules to be varied and the subsequent impacts analysed. The simulation models have been applied in previous studies to each of the Western Water systems including:

- Romsey and Lancefield: Water Resources Review.
- Mt Macedon: Future Water Resources Study.
- Development of Restriction Curves.
- Sunbury: Water Resources Review.

- Determination of Bulk Entitlements.
- Development of Drought Restriction Rule Curves.
- Melton and Bacchus Marsh Water Resources Review.
- Riddells Creek and Romsey Bulk Entitlements: Assessment of supply from Wright's Reservoir to Romsey.

The existing security of supply for each of Western Water's supply systems, and options for future augmentation to ensure continuing achievement of an appropriate level of drought security performance, is summarised in the Water Resources Strategy for Western Water.

3. OPTIONS FOR DROUGHT MANAGEMENT

Options for responding to drought can be classified into two broad categories:

- Demand reduction – reducing the volume of water consumed; and
- Supply enhancement – increasing the volume of water available for consumption.

For the purposes of a drought response plan, reducing demand and enhancing supply are only related to changes achievable in the short term. For example installation or reinstatement of groundwater bores or the introduction of water restrictions are short term options that are feasible within the timeframe of a drought. The raising of storages or systemic changes in consumer patterns of consumption would not be feasible within a limited time frame and are therefore more appropriately considered as part of strategic water resource planning.

In this section of the drought response plan, potential short term demand management and supply enhancement options for Western Water are identified and evaluated.

3.1 Demand Reduction during Drought

These are summarised in Table 1-5, which also includes an indication of their relative merit for Western Water systems. Each option is discussed further in Section 3.1.1 and 3.1.2.

Table 1-5: Demand reduction options during drought

Demand Reduction Options	Potential for Western Water Systems
Restrictions	ü
Community awareness campaigns	ü
Changed tariffs in drought	û

3.1.1 Restrictions

The use of restrictions is an accepted and effective option for reducing demand during drought. The main purpose of a restriction policy is to ensure the community does not run out of water and to conserve dwindling supplies during drought periods. Restriction policies should be based on achieving a balance between the need to reduce water consumption to protect available supplies during drought and community expectations of acceptable maximum restrictions, the frequency at which they occur and the amount the community is prepared to pay to avoid them. These expectations can be established by extensive community consultation.

Water restrictions are designed to predominantly impact on non-essential water uses (for example garden watering and the filling of pools) and minimise the impact on the use of water for commercial services, public health and essential residential use. Therefore, considering the impacts of restrictions from a conceptual point of view, demand can be thought of as comprising two components:

- a component that can be restricted (termed the ‘restrictable’ demand); and
- a component that cannot be restricted (termed the ‘unrestrictable’ demand).

Western Water may, through its By-Law No. 01/1 under the Water Act 1989, declare water restrictions where this is deemed necessary to reduce the consumption of water within its

supply systems to protect available supplies during periods of drought. This By-Law, which outlines a four stage restriction policy, with each successive stage specifying more severe water restrictions, is shown in Appendix A. This restriction policy is consistent with that applied to the Melbourne metropolitan supply system. Table 1-6 summarises the expected impacts of implementing each of the four stages of water restrictions outlined in the By-Law. The By-Law will be amended as required. The figures shown for stages 1 and 2 in Table 1-6 are based on recent experience in the Western Water system. These figures show a lower reduction in low level restriction periods than had occurred in previous times. This is most likely due to people generally using less water since the introduction of two part tariffs.

Table 1-6: Expected Impacts of Restrictions on Restrictable Demand (note this does not include the unrestrictable component of demand) and Total Demand

Level of Restriction	Effect on Restrictable Demand (% reduction)	Effect on Total Demand* (% reduction)
Stage 1	0-10	2.5
Stage 2	10-40	8
Stage 3	40-75	12
Stage 4	75-90	17.4

* The % reduction in total demand is an estimated figure based on Schedule 1 in the Water Restriction By-Law 05/01 attached.

Conventionally it is assumed that Stage 4 restrictions will achieve complete (100%) reduction of restrictable demand. For Western Water the recognition of the importance that their customers attach to their gardens and the great lengths that customers will go to in order to keep parts of their garden alive has led to reducing this assumed impact to 90%.

It is anticipated that "permanent water savings measures" will be introduced similar to detailed in the Victorian Government White Paper: *Securing our Water Future Together.* These measures may impact on the assumptions in Table 1-6. The impact cannot be quantified at present but should be evaluated when this Drought Response Plan is next updated.

For Western Water, the following target standards of service have been adopted as appropriate given the nature of its various supply systems:

Frequency of restriction events: Restrictions should occur no more frequently than once every 10 years on average.

Severity of water restrictions: Stage Four restrictions should occur no more frequently than once every 50 years on average.

Frequency of emergency events: Emergency events, that is infringement of the emergency buffer zone, should not occur more frequently than once every 100 years on average.

The standards of service applied to the Melbourne metropolitan supply system specify that application of restrictions should be no more frequent than once every 20 years on average, that more than 12 consecutive months of restrictions should never be imposed and that stage 4 restrictions should never be imposed.

Achievement of these target standards, particularly in relation to the severity of restrictions, is more difficult for Western Water's smaller supply systems (for example, the Romsey, and Woodend supply systems) that are isolated from access to resources from the larger supply

systems. Given their size and isolation, they are less able to provide supply security for droughts exceeding a year in duration. This is due to both limitations in their capacities to store sufficient water volumes and on constraints in their flexibility to access water from alternative sources. Western Water's Water Resources Strategy considers these issues in the context of a structured approach to achieving an appropriate level of drought security performance in each of its supply systems.

During a drought, an assessment of the appropriate timing for implementation of restrictions, and of the appropriate stage to be applied, must be made by Western Water. To assist in this process, the restriction policy for Western Water is reliant on a set of restriction triggers for each of its storage supply systems. For systems supplied from surface water storages, the activation of restriction stages defined in a Drought Response Plan is generally based on total storage volume falling below a set of defined volume triggers. Each trigger corresponds to a specific restriction stage. These storage triggers vary from month to month within the year based on the seasonal pattern of storage drawdown and replenishment. This pattern is specific to each particular supply system and depends on the patterns of inflow to and supply from the storage.

Development of the restriction rule triggers is based on protecting a specified volume of useable storage (as a supply buffer) in the system, or on preventing the storage system from emptying, following the occurrence of a drought over a critical period. The duration of this period is dependent on the system concerned – in particular, on the storage capacity relative to the average annual inflows and average annual demand on the system.

Where storage capacity in a system is less than average annual demand, the storage system can completely fill or completely empty within a one year period. The Romsey and Woodend supply systems fall into this category. For these systems, a 1 year critical drought period is used as the basis for defining the restriction triggers. The trigger sets are developed such that the imposition of restrictions provides 12 months of restricted supply and prevents the overall storage volume being drawn below the desired buffer storage level at the end of that 12 month period. For these systems, a desired buffer storage equivalent to about one month's restricted supply is used. This allows some buffer for implementing emergency supplies (in addition to the planning and actions that would be undertaken over the preceding 12 months during which restrictions were in force).

Where storage capacity in a system is greater than average annual demand, the storage system will not completely fill or completely empty within a one year period. The Rosslynne and Merrimu Reservoir supply systems fall into this category. These systems also can now be supported with supplies from the Melbourne's water supply system. Operating rules have been worked out as outlined in Sections 4.2.1 and 4.2.2 which take account of the extent to which demands on these supply systems can be relieved by substituting water supplied from Melbourne. For these systems, a desired buffer storage equivalent to one year's restricted supply is used. This is appropriate given the size of these systems and allows sufficient buffer for implementing alternative measures and emergency supplies (if required).

The drought response triggers for each of Western Water's supply systems are set out and discussed in Section 4.

3.1.2 Community Awareness Campaigns

It is important that the community is aware of the need to conserve water, particularly during periods of drought. Whilst this will naturally occur at the onset of restrictions, the community should be aware of the possibility of drought before the need for restrictions and

the material used to target the community should be more accessible and easily remembered than the message that comes directly from the By-Law.

The following are some suggestions as to ways of targeting the awareness of the community:

- Publication of storage volumes and/or recent rainfall data indicating water availability in the local newspapers, council newsletters, radio or television programs.
- Delivering information on water conservation methods via leaflets in water accounts, directly to letterboxes or in prominent locations (such as the town hall, general store or post office).
- Use of slogans and mascots. Some examples include:
  - 'Don't be a Wally with Water' (Melbourne Water);
  - 'Our water is as precious as gold' (Central Highlands Water); and
  - 'Don't be a snake in the grass – save water' (Western Water);
- School campaigns and competitions;

Western Water has an ongoing communications strategy, which is measured by the Balanced Scorecard and approved by the Board.

An integral part of the communications strategy is Western Water's education campaign, which has been designed to:

- Promote water conservation messages
- Change community attitudes to water usage habits
- Raise awareness that we live in a drought continent
- Increase appreciation that water is a precious resource
- To promote water saving messages before during and after restrictions
- To increase customers' confidence that Western Water is a responsible manager of their water supplies

When restrictions are in place Western Water aims to ensure that all customers are aware of their responsibilities during restrictions. A detailed restrictions communications strategy was developed and implemented to raise community awareness of restrictions and water conservation measures.

As part of the strategy, in order to ensure all customers are fully informed about restrictions Western Water has:

- Devised and implemented a direct mailing program to all Western Water customers regarding restrictions. Follow up promotions to individual residents occur when restrictions are escalated/deescalated or introduced in a newly affected area.
- Regular media updates to promote water conservation message and keep customers informed of current water levels, storage volumes.
- Developed a series of customer Q&A information sheets to specifically address the different restriction issues of individual townships.
- Devised 'Speakers Forum' to present water wise message to local community groups, such as Rotary, Probus, and University of the Third Age, schools groups, etc.
- Developed a children's water wise club to promote water conservation to our younger customers
- Worked with Councils and Schools to assist them to reduce their water usage
- Developed a water restrictions hotline
- Ensured website was constantly updated with latest restriction information

- Developed a comprehensive media policy and advertising campaign
- Developed a community newsletter which is mail out to customers with their water account.

3.2 Supply Augmentation During Drought

In general, there is a range of options open to augment supply during drought. The feasibility of each option depends to a large extent on the size of the population, the physical characteristics of the local supply and, ultimately, on the severity of the drought. Table 1-7 indicates a range of options and the potential of each for the Western Water systems.

As Table 3.3 indicates, although potentially important in the context of overall medium to long term water resource planning, options such as rainwater collection tanks, reducing network losses, water cartage and wastewater or stormwater use have all been considered as impractical short term drought response measures for most Western Water systems (limited potential exists in the smaller townships). A discussion of these options and the reasons they are considered impractical is given in Section 3.2.3. Sections 3.2.1 and 3.2.2 discuss the options that do have potential and their relative merit for each system.

n Table 1-7: Options for augmenting supply

Augmentation Option	Maribyrnong System	Lake Merrimu System
Groundwater	ü	ü
Alternative surface water	ü	ü
Transfer of water right	ü	ü
Rainwater tanks	û	û
Loss reduction	û	û
Water cartage	û	û
Wastewater and/or stormwater	û	û

3.2.1 Maribyrnong System

Romsey

Medium to long term options for permanently supplementing the existing supply to Romsey from Bolinda Creek have been considered as part of Western Water's Water Resources Strategy. Supplying Riddells Creek with water from Rosslynne Reservoir has freed up the local supply from Main Creek and this supply now has been redirected and forms part of the supply to Romsey.

The "emergency" bore has been fully operational since December 2002, but will return to standby mode as restrictions are lifted. It is also possible to further boost supplies by delivering any water, that is surplus to Riddells Creek requirements, supplied from Rosslynne Reservoir into the Sandy Creek Road tank at Riddells Creek, and then on to Wright's Reservoir, for delivery into Kerrie Reservoir. This option, however, requires extensive pumping and retreatment as treated water from Rosslynne must be mixed with untreated water of Wright and Kerrie Reservoirs. In general, the other available surface water options, such as raising of Kerrie Reservoir, would not be suitable for implementation as short term responses to existing drought, due to the implementation times required.

During times of severe drought, it may also be possible to negotiate a temporary amendment to the Bulk Entitlement for the Romsey system with the Department of Sustainability and Environment, to allow additional harvesting from Bolinda Creek. It should be noted however that this option would be subject to intense scrutiny, would be dependent upon the prevailing political climate and may not be feasible within the time frame of a drought. It would also depend on sufficient flow availability in Bolinda Creek, which would be unlikely during a period of severe drought.

Lancefield

As discussed in Section 2.3, the availability of both groundwater and surface water supply systems means that the security of supply to Lancefield is currently very high. Factors that could influence this position include lack of normal seasonal recharge, over-use of the bores, over-use of adjacent bores (both options resulting in rapid depletion of the aquifer), failure of a bore and poor water quality. Records show that prolonged pumping during dry spells does cause the water table level to draw down. Should any of these situations arise, the Lancefield Service Basin and the Garden Hut storage would both be available to supply the township.

Two of the town supply bores (Bores 1 and 2) are located in the Lancefield Groundwater Management Area (GMA) and the third bore (Bore 3) is immediately to the north of the GMA. Prior to the construction of Bore 3, Bores 1 and 2 were being pumped to their full allocation of 208ML/year with minimal or no interference with each other. Following the construction and testing of Bore 3 in 1999, excessive interference with (drawdown of) Bore 1 was observed. Since this time bore 1 has not been accessed as part o f the town water supply network.

Groundwater allocations in the GMA are at the level of estimated sustainable yield of the aquifer (referred to as the Permissible Annual Volume) and the area has been proclaimed a Water Supply Protection Area. The Department of Sustainability and Environment (DSE) and Southern Rural Water (SRW) have embarked on a program of installing monitoring bores in the GMAs. Water level monitoring (and quality monitoring will substantially improve the understanding of the groundwater resource including supply security.

Historically, Lancefield was supplied by the Garden Hut storage (45ML) and the Lancefield Service Basin (55ML). These basins are replenished by diversions on Garden Hut Creek and Monument Creek, although the Monument Creek Diversion has not been operated for a number of years. Garden Hut Creek will be limited under the terms of the Lancefield Bulk Entitlement to a maximum diversion rate of 1.1ML/day; similarly, Monument Creek will be limited to 0.85ML/day.

The construction of groundwater supply bores has seen the successive transfer of water supply from the surface water source to the groundwater source to the present condition where the township is almost totally dependent upon groundwater. Currently plans are underway to construct a water treatment plant, either locally or at Romsey, and restore the surface water supply. Regular maintenance of these reservoirs should be undertaken to ensure their continued functionality and their availability in times of drought.

Woodend

Woodend currently draws upon the resources of the Campaspe, B, C and the Macedon Storages. Whilst Campaspe, B and C Reservoirs are allocated purely to the supply of Woodend, the Macedon Storages are shared with water transfers to Rosslynne Reservoir.

The Macedon Storages are no longer used as the primary direct supply source for Mt Macedon, which is now supplied from Rosslynne Reservoir.

Water from Kitty English and Frank Mann Reservoirs, part of the former supply to Macedon, can also be pumped to Reservoir B or C for supply to Woodend. This practice is not usually followed as this water is instead delivered to Rosslynne Reservoir through the Macedon to Rosslynne Main.

With the addition of the Melbourne Water link for supply to Sunbury, Gisborne, Riddells Creek, Macedon and Mt Macedon now have a higher security of supply through Rosslynne. It is also possible, albeit unlikely, for water from Rosslynne Reservoir, or Melbourne, to be utilised to supply Woodend through the Link Main.

Additional emergency supply could potentially be obtained from the North Woodend Borefield. These bores were drilled at the end of the 1982/83 drought and are located in Boundary Road north of the Woodend/Lancefield Road. The bores have been tested and can supply up to 5 to 8L/sec each over short periods. The nearest bore is 1,750 metres via road from the nearest reticulation. Bore water would need treatment to remove suspended solids and iron but would be suitable for emergency purposes. There is no power near the bore site and there are currently no pumps or pipes connecting the bore to the reticulation system.

Rosslynne System

Under the Water Act, it is now possible to transfer water rights from Southern Rural Water and Melbourne Water to Western Water. This could be negotiated either directly with Melbourne Water and Southern Rural Water or by approaching irrigators downstream of Rosslynne. It should be noted however that, due to the relative volumes of water held by Southern Rural Water, Melbourne Water and Western Water (1110, 2344 and 21216ML respectively at full supply level), the advantages of Western Water negotiating a temporary transfer of water right are minimal.

An additional source of supply both for normal supply but especially in drought is from the Melbourne Water Supply system Reservoir (operated by Melbourne Water) to which Sunbury was connected in March 2000. The original agreement with Melbourne Water provided for lower cost water purchases between March and November, with the possibility of negotiating for additional supply through December to February (at a considerably increased cost).

This agreement was renegotiated to provide a uniform water cost throughout the year, and effectively there is no ceiling on the annual volume which may be purchased. The supply link provides the possibility of buying additional water from Melbourne Water during periods of drought.

It should be remembered that during drought, nearly all operators would be under pressure to deliver the maximum volume available to their consumers. It will therefore be difficult to buy (or transfer) large volumes of water right. Western Water experienced this problem during the 1997-2000 drought in the Melton system.

The smaller townships (of Macedon, Mt Macedon, Gisborne, Riddells Creek) have historically been supplied by their own small reservoirs and have only relatively recently been connected to Rosslynne Reservoir. With the increased security of Rosslynne Reservoir produced by the link from Melbourne to Sunbury, it is unlikely that the original supply

sources of the smaller townships would be required for emergency use. However, in severe drought, these storages would potentially be available. It should be noted that for the Macedon storages, it is more likely that these would be either needed to augment Woodend's supply or, to be transferred via the Macedon to Rosslynne main to augment supply in Rosslynne.

The agreement made with the Department of Sustainability and Environment regarding transfers through the Macedon to Rosslynne main is that:

- The annual average transfer over any five consecutive years should not exceed 645ML with an upper limit in any year of 873ML (July to June);
- Transfers may occur from Orde Hill, Willimogongon, Kitty English, Frank Mann, Andersons, McDonalds Reservoirs and the Bawben Road Reservoir;
- The daily transfer rate should not exceed 5ML/day;
- Transfers may occur from May to November (inclusive) only. In May and November transfers may only occur if the flow at Riddells Creek gauge (230204) exceeds the 20th percentile (10ML/d and 30ML/d respectively for May and November)
- The following minimum storages must be retained for fire fighting purposes:

Reservoir	Minimum storage volume
Orde Hill and Willimogongon	60%
Kitty English and Frank Mann	0%
Andersons and Mcdonalds	60%
Bawden Road	60%

Table 3.4 summarises the storage capacities of the smaller, operational storages in the Maribyrnong system that could potentially be used for short term drought supply augmentation.

It should be noted that many of these systems would have water quality problems requiring treatment at the outlet (expensive and unlikely) or boiling for consumption in the household. The following summarises the supply links from the smaller reservoirs to the townships they once supplied.

- Mt Macedon Township can be supplied by the Andersons and McDonalds Reservoirs. These storages have capacities of 22 and 82ML respectively with Andersons storage having the capacity to supply directly into the reticulation system or via McDonalds reservoir. This supply would be activated, for example if a fire fighting situation caused a large drop in reticulation system pressure, which would trigger automatic pressure valves and direct supply into the reticulation network zone above Douglas Road from Andersons Reservoir. A similar connection to Orde Hill Reservoir can feed the zone below Douglas Road. A diversion weir on Stoney Creek can also be used to supply consumers in the Mt Macedon system. In 1997/98 the Willimogongon Supply to lower Mt Macedon was partially decommissioned.

- Emergency supply to Macedon could come from the Kitty English Reservoir, Frank Mann storage, Bawden Service Basin (capacity 3ML) and Orde Hill Reservoir. Under the terms of the Bulk Entitlement order for Macedon and Mt Macedon, diversions from the streams supplying the Macedon storages are limited by the capacity of the diversion and storage network.

Table 1-8: Summary of Storage Capacities

STORAGE	TOWNSHIPS SUPPLIED	CAPACITY (ML)
Pierce Reservoir	Gisborne (emergency only)	60
Forster Reservoir	Riddells Creek (emergency only)	18
Wright Reservoir	Riddells Creek (emergency only)	55
Orde Hill Reservoir	Woodend via Reservoir C Macedon (emergency only)	250
Willimigongon Reservoir	Woodend via Reservoir C Macedon (emergency only)	15
Andersons Reservoir	Macedon (emergency only)	22
McDonalds Reservoir	Macedon (emergency only)	82
Frank Mann Reservoir	Macedon (emergency only)	65
Kitty English Reservoir	Macedon (emergency only)	65
	TOTAL	**662**

- Emergency supply to Gisborne is available from Pierce Storage. This storage is filled from a gravity diversion on Barringo Creek. The diversion on Barringo Creek is subject to the following limitations:
  - 1st June to 31st October 2/3 of flow in excess of 0.4ML/d;
  - 1st November to 31st May 2/3 of flow in excess of 2.4ML/d;
  - Maximum average abstraction of 320ML/year based on five year rolling average; and
  - Maximum of 585ML in any single year.

- Riddells Creek was originally supplied from the Forster and Wright storages, which could again be utilised in times of drought. Diversion to the Forster and Wright Storages is from Main Creek and is subject to a maximum daily diversion rate of 1ML/day (with an annual maximum of 300ML).

Under the Water Act 1989, scope exists for temporary or permanent transfer of bulk entitlements and also for the sale and transfer (permanent or temporary) of licences to take and use water. In the Rosslynne system, potential exists for such a temporary transfer between the users of Rosslynne Reservoir listed as follows:

- Western Water (urban);
- Southern Rural Water (irrigation); and
- Melbourne Water (irrigation).

The potential for use of the groundwater resource in the Rosslynne supply area is limited as groundwater salinity is generally above potable levels. At Mt Macedon, the salinity is at potable levels but bore yields are limited to 1-2L/sec.

3.2.2 Merrimu System

The three principal storages in the Werribee Basin are Pykes Creek, Merrimu and Melton Reservoirs, all of which are managed by Southern Rural Water. There is also Djerriwarrh Reservoir, which has a capacity of 983ML and is operated by Western Water.

Pykes Creek Reservoir is used primarily for irrigation in the Bacchus Marsh district. This storage can also supply the Werribee irrigation system but generally, it is kept as full as possible for the Bacchus Marsh irrigators. The small township of Myrniong is also supplied from this storage.

Melton storage serves the Werribee irrigators. Water to these irrigators can be supplemented from Merrimu or Pykes Creek storage if required. As Melton Reservoir is downstream of all demand centres supplied by Western Water, it is not a feasible option for augmenting supply, particularly during drought.

The Djerriwarrh Reservoir is owned and operated by Western Water and was the first permanent water supply for Melton. Built in 1963 with a capacity of 983ML, its current yield has been estimated as 700ML/annum. Water quality is poor and is expensive to treat and the maximum rate of supply limited to 5-15ML/d. For these reasons supply from the Djerriwarrh Reservoir is currently limited to approximately 400ML/annum and is used in conjunction with water from Lake Merrimu. Additionally, Djerriwarrh Reservoir can be used for emergency supply in the event that drought, water quality issues, incident or maintenance works prevented supply from Lake Merrimu. Note that this option was utilised during the 1997/2000 drought.

Under the Water Act 1989, scope exists for temporary or permanent transfer of bulk entitlements and also for the sale and transfer (permanent or temporary) of licences to take and use water. In the Werribee system, potential exists for such temporary transfer between the three users of Lake Merrimu:

- Western Water (urban);
- Southern Rural Water (irrigators); and
- Unallocated portion (currently managed by DSE).

Under the Water Act 1989, it is now possible to transfer water from Southern Rural Water to Western Water and from the unallocated portion to either Southern Rural Water or to Western Water. In addition to direct negotiation with the water authorities, Western Water could approach irrigators dependent upon Merrimu supply seeking a temporary transfer of their water right. The price of this water is subject to market forces and would be at the discretion of Western Water to negotiate.

Western Water successfully purchased water from downstream irrigators and was granted the unallocated portion of Merrimu (as a temporary transfer) during the 1997-2000 drought. In 2003 it purchased the unallocated portion of Merrimu, as a temporary transfer.

It is recommended that Western Water negotiate with DSE to permanently purchase the unallocated share of Lake Merrimu.

An additional augmentation option for the Werribee system is the importing of water from either the Central Highlands Water system or from Newlyn Reservoir. The former option would require the water to be pumped along the existing link between Lal Lal or Colebrook Reservoirs to Ballan and then into the Werribee River at Ballan. It should be noted that, at present, there is no direct link to the Werribee River and therefore, if this option were to be implemented, some connection would need to be made. The water could then be transferred to Pykes Creek Reservoir. Once in Pykes Creek Reservoir, Western Water would need to negotiate a transfer of entitlement with Southern Rural Water from Pykes Creek to Lake Merrimu. During discussions in January 2000, SRW indicated that losses of 20% would need to be deducted from any transfer from CHW to Pykes Creek Reservoir. It is important to note that this option would need to be considered early in drought planning to ensure sufficient Southern Rural Water storage in Lake Merrimu for transfer (a problem which arose in the 1999/2000 drought). Following the construction of the Melbourne to Melton pipeline this option has less current relevance.

Supply from Newlyn Reservoir is similar to that from the Central Highlands system except supply to Ballan would be via the Wombat pipeline, constructed in 1960. This pipeline has only been used once since construction. Some doubt therefore exists as to the potential to use this as a ready supply source. A review of the system by Southern Rural Water (in the mid 1990s) found it to be in good condition, the primary obstacle being that the transformers had been removed from the pumping stations. Some resources would also need to be allocated for testing the pipeline. SRW also indicated that they would anticipate losses of up to 50% of volumes leaving Newlyn Reservoir.

A review of the Newlyn system by SRW and Western Water in 1999 concluded that in addition to the condition of the infrastructure, this option would require the purchase of water right from existing entitlement holders in the Goulburn Murray system. Therefore, given the small volume of water that was available, anticipated losses of up to 50%, the unknown condition of the infrastructure and the requirement to purchase water rights, this option was discarded.

It should be noted that although Bacchus Marsh was originally supplied via the Bacchus Marsh irrigation channels, the pump station enabling this to occur was removed in 2000. Additionally, the treatment plant treating water to Bacchus Marsh has been decommissioned due to capacity, safety and public liability issues associated with this plant.

Myrniong is currently supplied from Pykes Creek Reservoir. In extreme drought circumstances additional supply could be obtained by pumping the dead storage of the Pykes Creek Reservoir. The current demand of Myrniong is about 40ML/annum, so it is expected that the Pykes Creek dead storage volume (of approximately 1005ML) would be ample to supply urban demands in emergency situations.

However the high turbidity of the water at very low storage levels has rendered the water unfit for use and water has had to be trucked into Myrniong. Other options, including connections to Ballan or Bacchus Marsh are currently being investigated.

Generally in this system, groundwater offers poor potential for emergency supply as groundwater salinity is generally high and bore yields are low.

3.2.3 Options Regarded as Having Less Potential

Rainwater Tanks

Rainwater tanks are generally used in isolated rural communities where no reticulated supply is available. In planning a reliable water supply, reliance cannot be placed on widespread use of tanks that are installed and operated at the discretion of householders. Rainwater tanks may, however, have some merit as a back-up supply in severe droughts. Although the installation of rainwater tanks as a drought response measure (as opposed to installation prior to the occurrence of drought) is likely to be of limited value in supplementing household supplies (the tanks would be expected to fill slowly if at all during drought), they would give owners the option of purchasing and storing carted water during very dry periods.

Loss Reduction

Metered water consumption across the whole water supply system accounts for 83% of the total treated water entering the system. The remaining 17% comprises unmetered

consumption, inaccurate meters (estimated at 4-8%), routine flushing of mains (estimated at 1-2%), bursts, firefighting, illegal connections and leakage.

The individual percentages of the unmetered components cannot accurately be determined. Overall, it is expected that leakage from the system would be minor and perhaps constitute only 2% to 3% of total water consumption. The potential for loss reduction is therefore unlikely to be easily realised as an effective short term drought response action, but rather is a long term strategy.

Water Cartage

The viability of water cartage as a supply option is dependent upon the size of the town and the severity of the drought. Costs have previously been estimated at around $10-$25/KL. Clearly, on a purely economic basis, this type of action is an emergency measure only.

Water cartage was used to supply parts of Woodend during the 1982-1983 drought. Records show that a total of 9,255KL were carted during February and March of 1983. Water is currently being carted to Myrniong due to water quality problems in Pykes Creek Reservoir. Water was also carted to Romsey following technical problems at the water treatment plant. Water has also been carted to Lancefield, and this is problematic due to the difficulties encountered with access to the tanker filling positions.

The use of water cartage to supplement water supply to even a portion of townships the size of Melton and Bacchus Marsh is not practical. Melton alone has an average demand of 10ML/d. To provide even 10% of this (or 1ML/d) by carting water would involve 100 tanker loads at 10,000L capacity. Clearly, this is not feasible.
In addition to the requirements regarding water cartage set out in the By-Law (refer Appendix A), the following provisions will also apply:

- Mobile tankers should not be filled in any supply zone, for the purpose of supplying water to customers in another supply zone where less stringent water restrictions are applicable;
- For filling of tankers in supply zones subject to stages 3 and 4 restrictions prior written approval for all tanker filling is required from Western Water who may prescribe the water source.

4. SEQUENTIAL PLAN OF ACTION FOR RESPONDING TO DROUGHT

When drought is forecast as imminent, a range of actions can be taken. A sequential plan of action is needed to implement these actions in a structured and objective fashion. This section of the Drought Response Plan develops the action plan for each system. Initially, early warning signs are considered (Section 4.1). Triggers for different drought phases are then presented (Section 4.2) and finally, the appropriate management response for each phase (Section 4.3).

4.1 Monitoring Early Warning Signs of Drought

Antecedent rainfall is often used as a measure or warning of drought. A drought is assumed to occur when the total rainfall for a period of three months or more is in the first decile range (the lowest 10% of recorded rainfalls). The Bureau of Meteorology has used the following definitions for severe and serious droughts:

- a severe rainfall deficiency exists for the period in question when the rainfall is among the lowest five percent of the recorded rainfalls;
- a serious rainfall deficiency exists when the rainfall lies above the lowest five percent of recorded rainfalls for the period in question but is less than the first decile value.

The Bureau of Meteorology provides a number of services and publishes information booklets, which have the potential to assist in the preparation for drought. These include the following monthly publications:

"Drought Review" - highlights areas of the continent experiencing significant rainfall deficiencies during the current month and areas having cumulative deficiencies over previous periods.

"Seasonal Climate Outlook" - provides three month forecasts of likely rainfall conditions expected over Australia;

"Monthly Weather Review" - provides a detailed review of Victorian weather patterns for each month including information on departures of temperature and rainfall from "normal".

More detailed information on rainfall is also available in the form of a Weekly Rain Bulletin which provides a review of weekly rainfall for major rainfall stations throughout Victoria.

In addition to rainfall deficiencies, another early warning sign of drought is low streamflow. For streams that are gauged, low streamflow can be objectively assessed by comparison with historical records (or through extension of the historical record using a rainfall/runoff model). For ungauged systems, anecdotal evidence and observation are the only indicators of low streamflow.

4.2 Identifying the Severity of Drought

As drought progresses it is important to have objective means of assessing when different actions are required. To assist in this process, drought response triggers have been developed. The trigger used depends to a large extent on the type of system; triggers for surface water supply systems are typically based on the level of water in storage or the flows in the supply creek.

The following sections present the drought response triggers that have been developed for each system. All triggers have been developed through analysis of the simulation models for each system.

4.2.1 Maribyrnong System

Romsey

The severity of a water shortage in Romsey is a function of the combined volume in Kerrie Reservoir, Glenfern Basin and Forster and Wright Reservoirs. As such, the timing and implementation of each level of drought response can be expressed as a combined storage volume trigger against time of year. These drought response triggers for the Romsey supply system are shown in Table 4.1. The total combined capacity of these storages at FSL is 377ML.

Table 1-9: Restriction level triggers for the Romsey water supply system – expressed as total combined volume of Kerrie Reservoir, Glenfern Basin and Forster and Wright Reservoirs (ML).

Month	Stage 1	Stage 2	Stage 3	Stage 4
January	275	240	205	170
February	261	228	195	162
March	239	209	179	149
April	222	194	167	139
May	207	181	156	130
June	197	173	148	124
July	192	168	145	121
August	204	179	153	128
September	220	193	165	138
October	240	210	180	149
November	261	228	195	162
December	275	240	205	170

Lancefield

Simulation modelling of the Lancefield system has shown that the existing system, which is supplied totally from groundwater bores, is very secure. The maximum capacity of the combined bores is about 2ML/d (60ML/month). Based on previous modelling, and providing the extraction from the groundwater bores is not continually sustained at this rate, drought security for Lancefield is assessed as high.

Additionally, Lancefield has access to two small surface water reservoirs (the 45ML Garden Hut Basin and the 55ML Lancefield Reservoir). Combined, these have the capacity to supply all Lancefield's water supply needs for a period of 3-4 months (albeit with reduced water

quality) pending completion of the planned water treatment plant at either Lancefield or Romsey.

Restrictions in Lancefield would therefore only be applied if there was bore failure of a permanent nature (diminishing yield, change in salinity, contamination etc.) and if there were no opportunity to drill a replacement bore. Currently available information on the groundwater aquifer supplying Lancefield indicates the source is being exploited within sustainable limits and the groundwater levels did not draw down significantly even during the recent drought. However local drawdown was experienced during peak withdrawal periods over summer which limited the pumping hours which could be achieved and hence the available supply at these times.

Decisions on restrictions for Lancefield should therefore be based on the expected time delay for restoration of any interrupted supply from the groundwater bores as follows:

Short Delays: If the yield from the bores can confidently be restored within one or two months, no restrictions would be required.

Longer Delays: If longer time delays are expected, severe restrictions should be applied when the combined backup surface water storage volume drops below 81ML. Storage levels in the two surface water reservoirs should be monitored carefully.

Woodend

Given that Woodend receives its primary water supply from both the Campaspe Reservoir and the Reservoir C systems, the severity of a water shortage in Woodend can be expressed as a function of the combined volume of water held in the storages of both systems:

- Campaspe Reservoir and Marriages Road Basin; and
- Reservoir B and Reservoir C.

The total combined capacity of these storages at FSL is 406ML.

The timing and implementation of each stage of drought response can be expressed as a combined storage volume trigger against time of year. These drought response triggers for the Woodend supply system are shown in Table 1-10.

Table 1-10: Restriction level triggers for the Woodend water supply system – expressed as total combined volume of Campaspe Reservoir, Marriages Road Basin, Reservoir C and Reservoir B (ML).

Month	Stage 1	Stage 2	Stage 3	Stage 4

January	173	145	117	90
February	147	123	100	76
March	140	117	94	71
April	161	135	109	84
May	208	175	142	110
June	248	210	171	133
July	260	221	181	142
August	265	225	185	145
September	259	220	180	141
October	245	207	170	132
November	230	194	158	122
December	200	169	137	106

Rosslynne System - Sunbury, Macedon, Mt Macedon, Gisborne and Riddells Creek

The connection of Melbourne Water's supply to Sunbury has allowed increased flexibility in the operation of the Sunbury supply system, as well as providing a greater security of supply for Sunbury. Supplying Sunbury demands from the Melbourne Water supply system also results in a greater security of supply for Macedon, Mt Macedon, Gisborne and Riddells Creek due to the reduced draw on Rosslynne Reservoir. This situation has been enhanced by the construction of the Riddells Road pumpstation at the Sunbury 20ML Reservoir which enables the delivery pipeline connected to the water treatment plant at Rosslynne to operate in reverse. In this way it is possible for water from Melbourne's system to be delivered to Riddells Creek, Macedon and Mt. Macedon and Gisborne. The planned duplication of the Melbourne to Sunbury pipeline, due for completion in December 2005, will relieve limitations on the transfer system from Sunbury to Rosslynne which is presently limited to "off peak months", approximately April to October. The capacity of the Riddells Road pumpstation is also to be increased from December 2005 to augment the overall capacity of this transfer system.

The various modes of operation of this augmented (eg: post December 2005) supply system are summarised in Table 4-3 and described in greater detail below.

Table 4-3: Assumptions regarding operational supply modes

Supply mode	Approx proportion of supply met from		Supply Zone	Supply source			
				Rosslynne system		Melbourne system	
	Rosslynne system	Melbourne system		non-summer	summer	non-summer	summer
Normal	80%	20%	Sunbury	85%	30%	15%	70%
			Gisborne, Riddells Creek & Macedon	100%	100%	0%	0%
A	65%	35%	Sunbury	70%	0%	30%	100%
			Gisborne, Riddells Creek & Macedon	100%	100%	0%	0%
B	20%	80%	Sunbury	0%	0%	100%	100%
			Gisborne, Riddells Creek & Macedon	70%	50%	30%	50%
C	5%	95%	Sunbury	0%	0%	100%	100%
			Gisborne, Riddells Creek & Macedon	0%	20%	100%	80%

Notes: Summer = December, January, February

Normal mode of operation

Under normal operating conditions, approximately 60 to 80 percent of Sunbury demands over the summer period (December to February inclusive) are supplied from the Melbourne supply system, with 10 to 20 percent of Sunbury demands being supplied from this source for the remainder of the year (March to November inclusive). The balance of the demand is met from Rosslynne Reservoir. This means that on an annual basis approximately 20% of the total (Sunbury, Gisborne, Riddells Creek, Macedon and Mt. Macedon) demand will be met from the Melbourne system and 80% from Rosslynne Reservoir.

However, if low inflows to Rosslynne Reservoir and low reservoir levels are experienced, supplies from Melbourne would be increased with the aim of averting stage one restrictions, and not requiring restrictions exceeding stage one throughout the system, and protecting the emergency buffer storage. Two sets of Rosslynne Reservoir storage level triggers for progressively increasing supplies from the Melbourne system have been derived to satisfy this criterion.

Operating Mode A

- Supplies from the Melbourne system, to Sunbury, would be increased to 30 percent (from 15 percent) between March to November inclusive; and summer supplies increased from 70 to 100 percent. The trigger is based on there being just sufficient storage to prevent falling below the trigger at which mode B operation would start within the next 3 months, assuming average demands, 10 percentile inflows and 90 percentile evaporation conditions.

Operating Mode B

- Supplies from the Melbourne system to Sunbury would be increased so that the whole of Sunbury demands are supplied from the Melbourne system. This trigger also activates a further increase in the supplies drawn from the Melbourne system by initiating the operation of the Riddells Road pumpstation to deliver water that is surplus to Sunbury's requirements to Gisborne, Riddells Creek and Macedon and Mt. Macedon. The trigger is based on there being just sufficient storage to prevent falling below the emergency storage buffer within the next 3 months, assuming average demands, 10 percentile inflows and 90 percentile evaporation conditions.

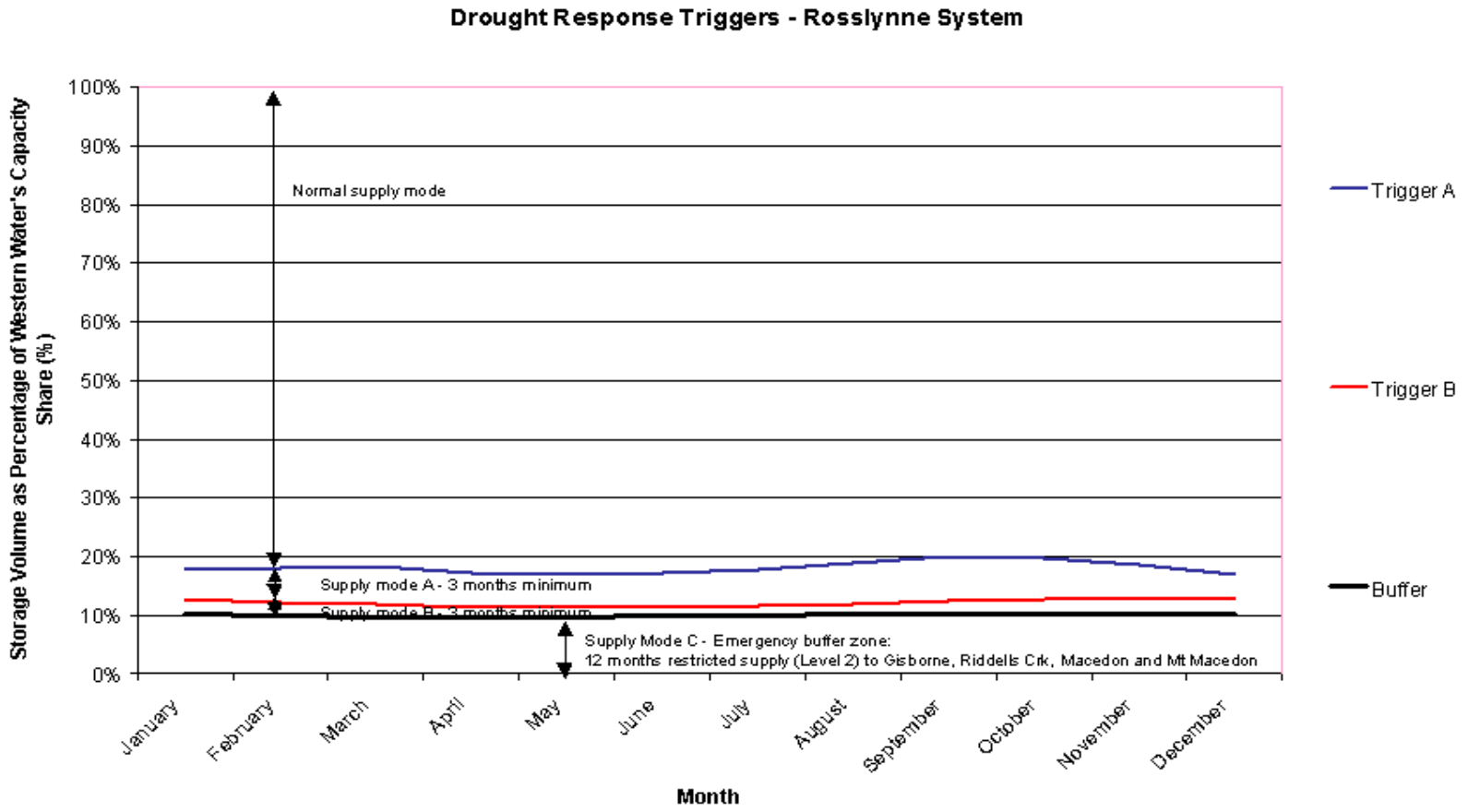
These triggers are shown in Table 4-4. In normal circumstances, that is when 70 percent of Sunbury's summer demand, and 15 percent of Sunbury's non-summer demand is met from

the Melbourne system this corresponds to approximately 40 percent of Sunbury's total annual demand. The two triggers discussed above would activate increases to 60 percent and 100 percent of total Sunbury demand being met from the Melbourne system, or approximately 35 and 80 percent respectively of total system demand (Sunbury, Gisborne, Riddells Creek, Macedon and Mt. Macedon).

A diagram representing the operation of the system is shown in Figure 4-1.

Operating Mode C

- Operating mode C would be introduced when the storage trace breaches the buffer zone storage. This level provides sufficient storage for 12 months of restricted supply (level 2) to Gisborne, Riddells Creek, Macedon and Mt. Macedon, assuming average demands and 10 percentile inflows, and 90 percentile evaporation conditions. Trigger C activates a further increase in supplies drawn from the Melbourne system by increasing the operation of the Riddells Road pumpstation located at the Sunbury 20ML reservoir. In this situation approximately 95 percent of the total system demand would be met from the Melbourne system.



- **Figure 4-1: Schematic Representation of operation of the Rosslynne system**

Table 4-4: Rosslynne Reservoir storage level triggers (ML) for increasing supply from Melbourne Water

Month	Trigger A: Increase to approx 35% of total demand	Trigger B: increase to approx 80% of total demand	Trigger C (Emergency Buffer Zone): increase to approx 95% of total demand
January	3772	2681	2145
February	3814	2593	2105
March	3870	2511	2077
April	3640	2416	2065
May	3579	2380	2070
June	3661	2403	2089
July	3800	2449	2117
August	4006	2527	2140
September	4235	2631	2172
October	4161	2691	2185
November	3957	2726	2189
December	3593	2689	2173

Assuming the triggers in Table 4-4 are implemented, Sunbury, Gisborne, Riddells Creek, Macedon and Mt. Macedon would receive its water supply in all months of the year from Melbourne whenever extended periods of low inflow conditions have caused water levels in Rosslynne Reservoir to drop below about the 13% storage level, that is in times of drought. As such, the imposition of drought restrictions for the Sunbury, Gisborne, Riddells Creek, Macedon and Mt. Macedon supply system are, in general, directly linked to imposition of restrictions on the Melbourne metropolitan supply system, rather than to the Rosslynne Reservoir restriction triggers. This supply system will therefore generally be subject to restrictions when the Melbourne metropolitan supply system is subjected to restrictions.

One exception would apply to this however if the Melbourne system was under restriction at times of "normal" operation. In this situation restrictions would not be imposed, and although water supplies drawn from Melbourne would be curtailed, to match restricted conditions, the balance of the unrestricted demand would be made up from Rosslynne.

As outlined in Section 2.1.1, the maximum rate of supply to Sunbury from the Melbourne supply is 35ML/day. When Sunbury supply is sourced from Melbourne, any daily Sunbury water demand in excess of this supply rate would need to be supplied from Rosslynne Reservoir to avoid a shortfall in supply. In the case where the Melbourne supply system (and hence Sunbury, Gisborne, Riddells Creek, Macedon and Mt. Macedon) is not on restrictions but supplies from Rosslynne have been curtailed as Rosslynne supply levels have dropped below the Trigger C level, the application of restrictions would be considered.

A summary of the drought restriction triggers for the water supply system is shown in Table 4-5.

Table 4-5: Restriction level triggers for Sunbury, and Gisborne, Riddells Creek, Macedon and Mt Macedon

System Context	Trigger	Restriction Level Imposed on Sunbury, Gisborne, Riddells Creek, Macedon and Mt Macedon
Melbourne Metropolitan supply System on Restrictions Western Water's **Rosslynne** Supply System is **Normal** zone	**Melbourne** on **Level 1** Restrictions **Melbourne** on **Level 2** Restrictions **Melbourne** on **Level 3** Restrictions **Melbourne** on **Level 4** Restrictions	NO restrictions NO restrictions NO restrictions NO restrictions
Melbourne Metropolitan Supply System on Restrictions Western Water's **Rosslynne** Supply System in zones **A,B or C**	**Melbourne** on **Level 1** Restrictions **Melbourne** on **Level 2** Restrictions **Melbourne** on **Level 3** Restrictions **Melbourne** on **Level 4** Restrictions	1 2 3 4
Melbourne Metropolitan Supply System NOT on Restrictions Western Water's **Rosslynne** Supply System is **Normal, A or B** zones Western Water's **Rosslynne** Supply System in zone **C**		NO restrictions Consider implementation of Stage 1 or 2
Emergency operation Either WW system or MWC system supply failure Or Western Water's **Rosslynne** Supply System is critically low in Zone **C**		2 2

4.2.2 Merrimu System

Melton, Toolern Vale, Rockbank and Bacchus Marsh

The connection of Melbourne Water's supply system to Bacchus Marsh and Melton has allowed increased flexibility in the operation of the supply system for those towns, as well as providing a greater security of supply for those towns. Western Water's own sources are however more economical to use so it is proposed, in normal operation, to draw most of the water for Melton and Bacchus Marsh from the Western Water system, and draw more heavily on the Melbourne supplies if storage levels in Merrimu and Djerriwarrh become depleted. The following modes of operation are proposed.

Normal operating mode

- Under normal operating conditions, approximately 10 to 20 percent of the combined Melton and Bacchus Marsh demands are supplied from the Melbourne system. This corresponds to supplying 20% of the Melton low level water supply zone. The balance of the demand is met from Merrimu and Djerriwarrh Reservoirs.

However, if low inflows to Merrimu Reservoir and low reservoir levels are experienced, it is desirable to increase the supply from the Melbourne system to protect the storage buffer in Lake Merrimu. The volume of this buffer storage should be sufficient to enable restricted demands (stage 2) to continue to be met, without support from the Melbourne Supply system, for a period of 12 months under zero inflow conditions. This buffer storage is to be protected by progressively increasing the percentage of supply drawn from the Melbourne system. Two sets of Merrimu Reservoir storage level triggers for progressively increasing supplies from the Melbourne system have been derived for this purpose.

Operating Mode A

- Supplies from the Melbourne system to Melton and Bacchus Marsh would be increased so that approximately 35 percent of combined Melton and Bacchus

Marsh demands are supplied from the Melbourne system. The trigger is based on there being just sufficient storage to prevent falling below the trigger at which mode B operation would start within the next 3 months, assuming average demands, 10 percentile inflows and 90 percentile evaporation conditions.

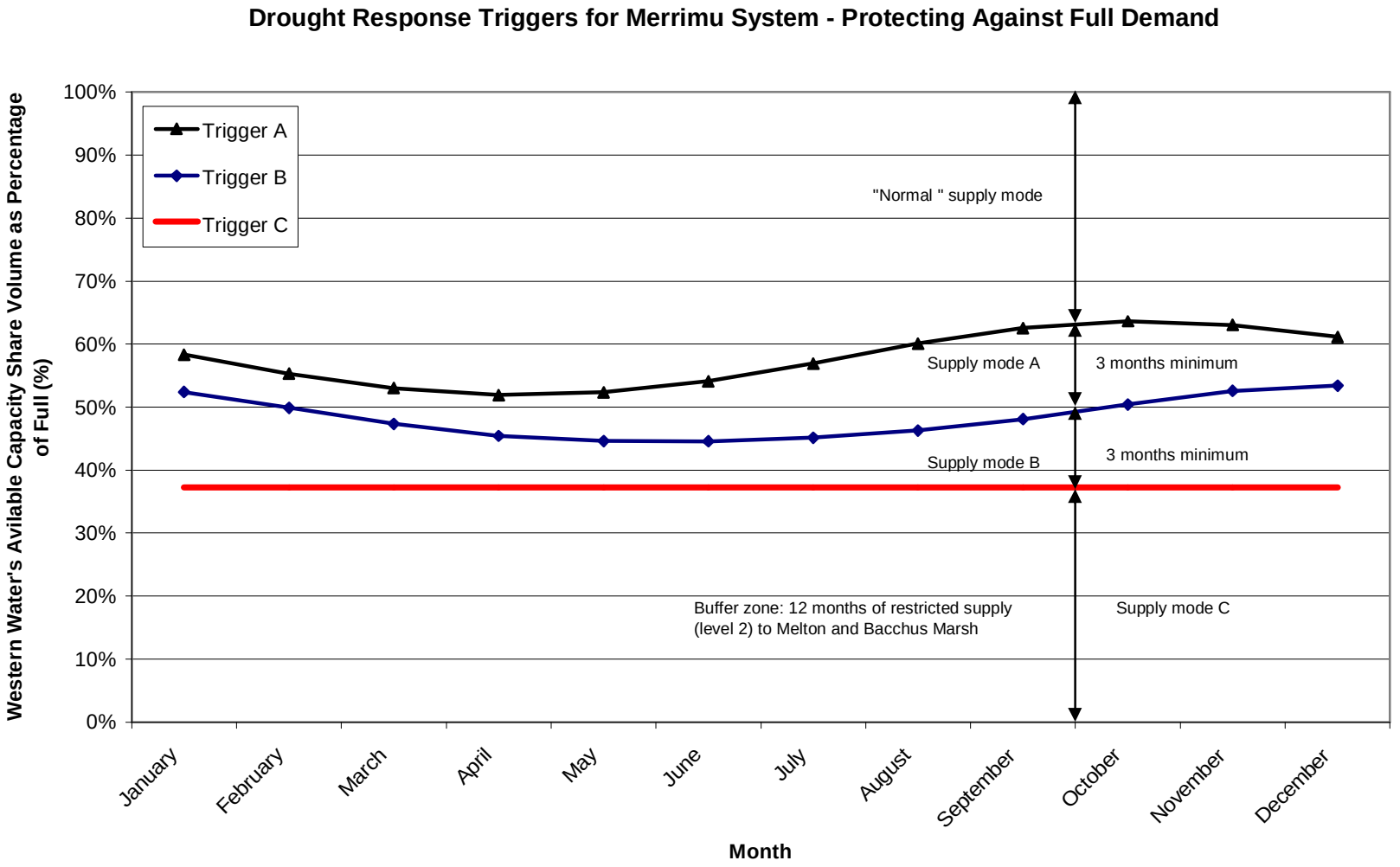
Operating Mode B

- Supplies from the Melbourne system to Melton and Bacchus Marsh would be increased so that approximately 70 percent of combined Melton and Bacchus Marsh demands are supplied from the Melbourne system. The trigger is based on there being just sufficient storage to prevent falling below the emergency storage buffer within the next 3 months, assuming average demands, 10 percentile inflows and 90 percentile evaporation conditions.

Operating Mode C

- Operating Mode C is to be introduced if the storage trace enters the buffer storage. It assumes approximately 98 percent of the combined Melton and Bacchus Marsh demands are supplied from the Melbourne system.

A schematic diagram representing the operation of the system is shown in Figure 1-2.



n Figure 1-2 Schematic representation of Operation of the Merrimu system

The supply regimes described above are based on the assumptions set out in Table 1-7.

n Table 1-7 Assumptions regarding supply regimes

Supply regime	Approx proportion of supply met from		Supply Zone		Supply source			
			Description	% of Melton demand	Merrimu system		Melbourne system	
	Melbourne system	Merrimu system			non-summer	summer	non-summer	summer
Normal	10 to 20%	80 to 90%	Melton high level	15%	100%	100%	0%	0%
			Melton low level	85%	70%	70%	30%	30%
			Bacchus Marsh	NA	100%	100%	0%	0%
A	35%	65%	Melton high level	15%	100%	100%	0%	0%
			Melton low level	85%	50%	0%	50%	100%
			Bacchus Marsh	NA	100%	100%	0%	0%
B	70%	30%	Melton high level	15%	50%	100%	50%	0%
			Melton low level	85%	0%	0%	100%	100%
			Bacchus Marsh	NA	50%	100%	50%	0%
C	98%	2%	Melton high level	15%	5%	5%	95%	95%
			Melton low level	85%	0%	0%	100%	100%
			Bacchus Marsh	NA	5%	5%	95%	95%

Notes: NA = not applicable
Summer = December, January, February
The Merrimu system includes Djerriwarrh Reservoir

These triggers at which supply regimes A, B and C should be activated are shown in Table 1-8.

n Table 1-8: Storage level triggers (ML) for increasing Melton and Bacchus Marsh supply from the Melbourne system – expressed as Western Water's capacity share volume of Merrimu Reservoir.

Month	Trigger A: Increase to approx 35% of total demand	Trigger B: increase to 70% of total demand	Trigger C: increase to 98% of total demand
January	12250	11005	7825
February	11617	10480	7825
March	11133	9940	7825
April	10903	9540	7825
May	10996	9370	7825
June	11358	9355	7825
July	11954	9480	7825
August	12625	9725	7825
September	13139	10100	7825
October	13361	10585	7825
November	13235	11040	7825
December	12839	11215	7825

The imposition of drought restrictions for Melton and Bacchus Marsh would generally be linked to imposition of restrictions on the Melbourne metropolitan system, and the stage of restrictions imposed for Melton and Bacchus Marsh will be the same as those for Melbourne. One exception would apply to this however if the Melbourne system was under restrictions at times of "normal" operation, (storage levels in Merrimu and Djerriwarrh high). In this situation, restrictions would not be imposed, and although supplies drawn from Melbourne Water would be curtailed, to match restricted conditions, the balance of the unrestricted demand would be made up from Merrimu and Djerriwarrh.

The maximum rate of supply to Melton and Bacchus Marsh from the Melbourne Water system is 41ML/day. Any daily water demand in excess of this capacity would need to be

supplied from the Merrimu system to avoid a shortfall in supply. In the case where the Melbourne supply system (and hence Melton and Bacchus Marsh) is not on restrictions but supplies from Merrimu have been curtailed as Merrimu system storage levels have dropped below the Level C trigger, the application of restrictions would be considered.

A summary of the drought restriction triggers for Melton and Bacchus Marsh is shown in Table 4-9

n Table 1-9: Restriction level triggers for the Melton and Bacchus Marsh water supply system

System Context	Trigger	Restriction Level Imposed on Sunbury, Gisborne, Riddells Creek, Macedon and Mt Macedon
Melbourne Metropolitan supply System on Restrictions Western Water's **Merrimu** Supply System is **Normal** zone	**Melbourne** on **Level 1** Restrictions **Melbourne** on **Level 2** Restrictions **Melbourne** on **Level 3** Restrictions **Melbourne** on **Level 4** Restrictions	NO restrictions NO restrictions NO restrictions NO restrictions
Melbourne Metropolitan Supply System on Restrictions Western Water's **Merrimu** Supply System in zones **A,B or C**	**Melbourne** on **Level 1** Restrictions **Melbourne** on **Level 2** Restrictions **Melbourne** on **Level 3** Restrictions **Melbourne** on **Level 4** Restrictions	1 2 3 4
Melbourne Metropolitan Supply System NOT on Restrictions Western Water's **Merrimu** Supply System is **Normal, A or B** zones Western Water's **Merrimu** Supply System in zone **C**		NO restrictions Consider implementation of Stage 1 or 2
Emergency operation Either WW system or MWC system supply failure Or Western Water's **Merrimu** Supply System is critically low in Zone **C**		2 2

Note: The level of WWD restrictions will be decided according to prevailing circumstances. In general it is envisaged they will resemble level 2 restrictions. In circumstances of emergency operation the need for further restrictions on use would also be reviewed.

Myrniong

Under the proposed Bulk Entitlement for the Myrniong system, a supply of up to 58ML/year would be available from the Pykes Creek Reservoir at a security of 97%. Given that annual demand at Myrniong averages approximately 40ML/year, the security of supplying the current level of Myrniong demand would be somewhat greater.

Southern Rural Water is the Resource Manager and Operators of Pykes Creek Reservoir. Their procedure for implementing restrictions at Myrniong is based on the Myrniong restriction policy developed by the Department of Sustainability and Environment (DSE) and outlined as part of the draft Bulk Entitlement for Myrniong. Western Water's policy for introducing restrictions in Myrniong is to match the reduced allocation from Pykes Creek to the appropriate stage of restrictions according to the anticipated savings as outlined in Table 1-6.

4.3 Responding to Drought Restriction Triggers

The following describes in detail each of the suggested progressive drought actions that may be applied as a drought worsens. Each action has been tied to a specific trigger level.

Action 1: Water Conservation and Application of Voluntary Restrictions

The promotion of water conservation is an ongoing activity for Western Water, which will assume particular significance if it is perceived that a drought may be impending. If storage volumes approach the triggers for restrictions, voluntary restrictions should be considered for townships dependent upon the storage. At this stage, Western Water should implement an advertising campaign requesting voluntary demand reduction.

In the advertising campaign, it is important to promote the following messages about the nature of the problem:

- There has been low rainfall and streamflow in the preceding months and there has therefore been insufficient flow to fill the storage to a level whereby Western Water can confidently supply full demand throughout the summer. There is therefore a likelihood of restrictions;
- The encouragement of individual responsibility;
- The range of ways to conserve water and the availability of customer fact sheets that provide useful information on this topic; and
- by introducing early voluntary restrictions there will be an increase in the chance of avoiding the possibility of more severe restrictions in future months.

The messages should point out the following specific actions that can reduce demand on the supply system:

- use of water-efficient appliances.
- reduction of obvious waste (e.g. pathway hosing, long showers etc.).

The messages could be conveyed through local newspapers, either as advertisements or articles (depending on media interest). At this early stage of drought it would also be timely to issue an information kit to customers explaining methods for conserving water around the house. In dealing with the media, it is good practice to nominate a single contact person to be responsible for liaison.

Action 2: Introduction of Stage 1 to 2 Urban Restrictions and Water Watch Days

Implementation of restrictions for drought response stages 1 to 2 should be in accordance with the triggers outlined in Section 4.2. Throughout these stages of restriction, consumers should be updated on drought status and kept aware of likely future scenarios. This can be achieved with regular articles in local newspapers and with reports on rates of water consumption and graphs of the state of the volume in storage. For the Merrimu system, Triggers A and B should trigger similar responses to the Stage 1 and 2 triggers for the other systems, other than the imposition of restrictions.

Steps should be taken to pursue the availability of alternative water supplies, determining the most likely sources and the barriers to their availability. Readily accessible alternative supply sources should be considered at this stage (such as the use of water from Djerriwarrh Reservoir). It would also be worth considering the economics of transferring water from the rural sector to the urban sector (either on a temporary or permanent basis).

Work in other urban centres in Victoria has shown that consumers are often unaware of the impact of restrictions. A summary sheet of what each restriction is and how consumers will

be affected by each successive stage of restriction is a useful way to take some of the apprehension out of future restrictions for consumers. This information could be printed in local newspapers or distributed to customers via direct mail, and published on Western Water's website. It is suggested that this information be distributed after any stage of restrictions is introduced.

Action 3: Introduction of Stage 3 Urban Restrictions

If the total volume in storage drops to levels below Stage 3 as defined in Section 4.2, Western Water should announce Stage 3 restrictions.

A significant reduction in total demand is expected following the implementation of Stage 3 restrictions. The media campaign should continue as per Action 2. Forecasts should also be printed in the local newspapers, and consumers could be made aware of how the restrictions are reducing consumption.

At this stage of restriction, it is likely that there will be major inconvenience to consumers and Western Water should make a public statement on the seriousness of what may lie ahead. One way that Western Water shows the gravity of the situation is to prosecute offenders who violate restriction policy rules and to ensure that the prosecutions are given media attention.

At this stage of the drought, alternative sources of supply are a serious consideration and Western Water should have a strategy in place for enabling such supplies to be accessed. If weather forecasts anticipate continued drought conditions, consideration should be given to accessing alternative supply sources in the most vulnerable systems and a strategy for the introduction of emergency measures should be developed.

Action 4: Introduction of Stage 4 Restrictions

If the volume in storage falls below the Stage 4 restrictions target, Western Water should introduce the highest stage of urban restrictions. At this stage of a drought, all water use should be restricted to essential functions only. Offenders should be prosecuted and possibly their supply restricted by flow restricting devices on their meters. All available sources of alternative supply should be implemented.

Action 5: Introduction of Emergency Measures

In very extreme events emergency measures may have to be implemented. For this system restrictions would be increased so that a minimum delivery of 60l/d would be supplied to all consumers. This minimum complies with health regulation standards.

The implementation of emergency measures is outside the current Western Water restriction By-Law and therefore would require Ministerial approval.

4.3.1 Updating Restriction Curves during Drought

The current restriction triggers are based on the best information available. However, it is possible that the impacts of the various response measures proposed will be different than expected. Western Water will therefore require an efficient and flexible drought management team to be able to decide on the appropriate action, implement it and assess its effectiveness. Additionally, whilst the DRP as written provides a framework for making decisions, it may need to be adjusted as a drought develops and more information becomes available.

As drought conditions develop the effectiveness of drought actions needs to be closely monitored. As a minimum, the following data should be collected:

- Demand for each township affected;
- Inflow to each major storage system;
- Transfers between storages (as relevant);
- Rainfall;
- Evaporation; and
- Storage level.

Careful attention should be paid to the results of monitoring, particularly the impacts of the restrictions applied. The timing of the implementation of more severe restrictions will be based on the results of this monitoring. The Bureau of Meteorology's *Seasonal Forecasts* could also be considered in deciding on the nature and timing of the implementation of the various emergency measures for extreme drought conditions (Action 5).

All information collected and all decisions made (and subsequent outcomes) should be well documented so that they will be of use in guiding future drought planning and drought response.

Monitoring of the timing and effectiveness of the restriction policy will allow an assessment of its ability to meet the Drought Response Plan objectives and therefore whether more drastic action will need to be taken. For example, if monitoring and estimates indicate that Stage 2 restrictions result in less than approximately a 15% reduction in total demand, then it may be necessary to revise the nature of the water use activities restricted and/or to bring forward implementation of the next stage of restrictions so that the required reduction in water demand is achieved. The monthly reductions which may be anticipated according to the stage of restrictions and the month are shown in Appendix B. Adjustments based on these results can then be made to defer or bring forward the next stage of restriction as required.

4.3.2 Lifting of Restrictions and Restriction Levels

During drought periods in which restrictions have been imposed by Western Water under this Drought Response Plan, Western Water may:

- Lift a prevailing restriction level and substitute a lower stage of restriction; or
- Lift restrictions.

These decisions will be made at the discretion of Western Water based on an assessment of the likelihood of relevant circumstances requiring the reimposition of restrictions. As part of this assessment, Western Water will determine whether the change in drought circumstances is likely to be so temporary that the benefits to its customers of lifting a stage of restriction would be outweighed by the inconvenience they experience through the subsequent reimposition of the same stage of restriction within a short timeframe.

The following guidelines may be used for lifting restrictions:

- Restrictions should generally be lifted one stage at a time;
- the stage of restriction would be lifted where Western Water can reasonably conclude that the same stage of restriction is not likely to be reimposed:
  - Within the next 12 months for the Rosslynne systems; and

- Within the next season (or at least 3 months) for the smaller systems (including the Romsey and Woodend systems).

- For the smaller systems complete lifting of restrictions should only be implemented at the end of the summer high demand period ie: the end of February.

5. PRE AND POST DROUGHT EVALUATION

5.1 Preparing for Drought

The ability to respond to drought conditions is largely dependent upon the preparedness of the managing organisation (Western Water). This section discusses issues requiring attention during the intervening periods between droughts.

5.1.1 Availability of Alternative Supply

The timing of the actions proposed in Section 4.0 is very much dependent on the availability of some of the resources proposed. On this basis, it would be advisable for Western Water to carefully evaluate the actions proposed and to determine which will require early action (either well before a drought or as part of an action in preparation for the drought situation worsening). For example, if groundwater has been identified as a suitable alternative, the need for licences to access the water (or prevent it being otherwise utilised) may need consideration. It would also be advisable to contact suitable drillers, water carters etc. in the pre-drought period to discuss potential requirements for drought times. Detailed arrangements regarding drilling, pump availability and water cartage etc. could be made as a drought develops.

5.1.2 Consumer Education and Publicity Material

The development of publicity material for both the media and consumers on issues such as voluntary demand reduction, Permanent Water Saving Rules, restrictions etc requires ongoing review. Furthermore, this information should be examined with consumer groups and modified according to their feedback.

5.1.3 Watching Brief

The long term operational objective of ensuring that Western Water is kept informed of changes to total levels of service and patterns of demand and of consumer expectations in relation to desirable levels of service needs to be addressed. A watching brief therefore needs to be maintained in relation to population growth and acceptable standards of supply. An awareness of issues and requirements in relation to environmental flows should also be maintained.

5.1.4 Monitoring the Effects of Bore Pumping

Ideally, a drought relief bore or borefield should be constructed with monitoring bores to enable the evaluation of drawdown effects; operating policies for drought relief bores would ideally be developed from pumping test data. Given the likelihood that new emergency bores will not be drilled until they are actually needed, other short term methods to monitor groundwater levels and assess yield and impacts will be required. This would involve a performance test on the bore itself from which aquifer properties could be determined and enable regular monitoring of the drawdown of the pumping well(s).

For short term pumping, the immediate concern relates to over-pumping from the well, resulting in the water level dropping to below the pump intake. If longer pumping is considered, a borefield operation plan will be required, incorporating the calculation of long

term sustainable yields and associated impacts of drawdown such as drying up of nearby creeks. It would be wise for Western Water to have a full understanding of the operation of their emergency supply bores before the onset of drought.

5.1.5 Training and Education

It is important for Western Water to present an informed and consistent image to its customers. To this end, all staff should be aware of the current status of restrictions, perhaps by reading a regular staff newsletter with updates on the drought. Customer service staff would require more detailed training on the specifics of restrictions.

Training will also need to be given to selected Western Water personnel in relation to the responsibilities identified in the Drought Response Plan and to be able to interpret the drought warning signals that are available from the various Bureau of Meteorology publications.

5.1.6 Proposed Funding Strategy

Completion of a Drought Response Plan requires identification of the budget and staffing resources necessary to maintain the program during all phases of its operation. Western Water will need to review the adequacy of its reserve funds to cover extraordinary expenses that are identified and consider the appropriateness of all other funding options at its disposal. Ongoing drought response development and maintenance costs will need to be programmed into Western Water's business plan.

5.1.7 Revision

Drought Response Plans are dynamic in nature and will only be appropriate for a particular system for a short period of time unless a static status is reached. For Western Water there is an expectation of continued growth and system change; the Drought Response Plan therefore needs constant revision to keep it up-to-date with changes. The revisions should be based on the results of the evaluations referred to above and carried out in a regular and disciplined manner.

5.2 Post Drought Phase – Evaluation and Revision

Following a drought period, it is important to review the response of Western Water to ensure that areas of best practice and areas requiring attention are identified and documented for future reference. The following sections discuss actions requiring attention immediately following a drought.

5.2.1 Evaluation of Objectives

The first part of the review process should be to assess the suitability of the objectives. There are three components to the objectives (i.e. strategic, planning and operational) and each of these needs to be critically reviewed to determine if the objectives were appropriate and

achievable. If they were not, some comment needs to be made as to why not and new objectives set for the next drought.

5.2.2 Evaluation of Water Supply Management Actions

There have been a range of actions identified (Section 3.0) for staged demand reduction and supply augmentation. In most droughts, only a few of the actions will need to be implemented. The timing and effectiveness of each action needs to be assessed and documented at the end of a drought period. If, for example, the introduction of Stage 2 restrictions led to a greater reduction in demand than anticipated then a decision needs to be made as to whether this restriction is too severe or whether it should be implemented at a later date when more serious conditions have developed.

Comparisons between historic deliveries and drought deliveries will have been made as part of the monitoring process during the drought and can be used to assess the effectiveness of drought response options. It is important in the immediate post drought phase that as much available data on the system during the drought is collated and reported upon. As a minimum, the following should be collected:

- Demand for each township affected
- Inflow to each major storage system
- Transfers between storages (as relevant)
- Rainfall
- Evaporation
- Storage level

Demand modelling procedures should also be used to further aid in the estimation of the effects of restrictions on demand. From this, an assessment of the effectiveness of a current stage of restriction (relative to current expectations as summarised in Table B1 in 0) can be made and, if necessary, adjustments made to defer or bring forward the next stage of restriction.

5.2.3 Impact of Restrictions on the Community

Community response to the imposition of restrictions should be sought through contact with representatives of the major water user groups. These groups can help identify additional actions that could have been taken to reduce consumption. The following provides a guide to the type of information that should be sought in such a survey:

- Were there other things that could have been done to help reduce demand for water?
- Was there enough warning that restrictions were to be imposed?
- Was the right mix of media used to disseminate information on when the restrictions were to begin and what was and was not allowed to be done?
- Were the restrictions too severe?
- Did they last too long?
- Were people confused by the number of restrictions?
- What attitude did people have during the drought?
- Was there any significant plant loss?
- Was there any major inconvenience caused by the lower stages of restrictions?
- Were there any particular sectors of the community that were adversely affected by drought?

5.2.4 Impact on Western Water Staff

Staff from Western Water should also be interviewed to determine how they coped with the additional burden of drought. In particular, it will be important to identify any issues that came up that were not identified prior to the drought and were not taken into account in the Drought Response Plan. The following issues should be addressed:

- Were the restrictions easy to enforce?
- Were the limited watering times causing problems for supervision?
- Did the staff feel alienated from the community?
- Was the additional workload reasonable?
- Do staff have any suggestions for improvements for the Drought Response Plan?

5.2.5 Updating of the Drought Response Plan

This plan has been developed based on the assessed availability of water resources using the available hydrological records up to June 2003, and makes allowance for forecast growth in demands up to 2008. The plan should be fully reviewed and updated again in 2007. Prior to 2007 the plan should be reviewed on an annual basis to confirm whether or not there have been any significant changes in conditions that would indicate a need to update the plan earlier. Such changes may include:

- Significant changes to water supply infrastructure;
- Growth in water demand well in excess of that envisaged; and
- Any assessed change in hydrological conditions based on additional hydrological records.

5.3 Knowledge Gaps

As indicated above, a Drought Response Plan should be seen as a dynamic instrument for guiding drought management; new or additional information and knowledge will continually become available, and their implications for good drought management should be incorporated (as appropriate) in the Drought Response Plan through a process of ongoing review. It is particularly important, in this context, to be aware of key gaps in the available knowledge base. The main area where knowledge is lacking is in relation to the likely impact of restrictions on reducing levels of demand. Sections 5.2.2 and 5.2.3 presents a summary of the key monitoring needs to improve the knowledge base and hence Western Water's preparedness for drought.