

Loddon Highlands

Water Supply Protection Area

Groundwater Management Plan



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Department of
Sustainability and Environment

Loddon Highlands

Water Supply Protection Area

Groundwater Management Plan

November 2012

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Approval

I, Peter Walsh, Minister for Water, approve this management plan in accordance with section 32A(6) of the Water Act 1989.

Signed – 21 November 2012

A handwritten signature in blue ink, appearing to read 'Peter Walsh'.

Peter Walsh MLA

Minister for Water

Date *21-11-2012*

Foreword

Groundwater in the Upper Loddon Catchment is highly valued. It is shared between the environment, domestic and stock users, irrigated agriculture and growing urban communities. Groundwater levels dropped across the region in response to the dry conditions experienced in the late 1990s and 2000s. In some local areas, the fall in groundwater levels was greater due to the concentration of groundwater pumping.

A review of the Spring Hill Groundwater Supply Protection Area (GSPA) Groundwater Management Plan and concern for falling groundwater levels in other parts of the upper Loddon Catchment resulted in the declaration of the Loddon Highlands Water Supply Protection Area (WSPA) and the appointment of a consultative committee to draft a groundwater management plan. The Loddon Highlands WSPA covers a large area, incorporating the former Spring Hill GSPA and Upper Loddon WSPA and surrounding areas, which better represents the extent of the aquifer system.

The committee believe this Plan will provide groundwater users with a good understanding of the aquifer systems and operational guidelines that will help licence holders best utilise their groundwater entitlement. The Plan provides protection for existing users and the environment through supporting a cap on licence entitlement; restricting the extraction of groundwater when triggered; and placing limits on the concentration of groundwater pumping. The Plan also provides licence holders with the opportunity to better manage their entitlements through the introduction of carryover and permanent trade.

The consultative committee recognises that there is a need for more work to be undertaken to better understand the impact of groundwater pumping on creeks and determine the water needs of any high value groundwater dependent ecosystems. The Plan includes a review process that enables it to be refined as more information about the impacts of groundwater pumping becomes available.

The ongoing costs to groundwater licence holders was of primary concern to the committee who believe the costs for the implementation of this Plan are already recovered through licence fees.

I would like to thank the members of the consultative committee for their passion and dedication. Their contribution has ensured that there is a balance between the various users of groundwater resources in the upper Loddon Catchment.



Jock Leishman

Chairman

Loddon Highlands Water Supply Protection Area Consultative Committee

Preface

The preparation of the Loddon Highlands Water Supply Protection Area Groundwater Management Plan commenced in November 2010 following the appointment of a consultative committee in accordance with the Victorian *Water Act 1989*.

The consultative committee has developed this Plan following extensive discussions, consideration of technical work and public consultation.

The voting members of the Loddon Highlands Water Supply Protection Area consultative committee are:

Jock Leishman Landholder (Chair)

Richard Carter Landholder

Lea Chibnall Landholder

Ian Esmore Landholder

Elizabeth Hak Landholder

Russell McKay Landholder

Norm Suckling Landholder

Tom Toose Landholder

Patrick Russell Central Highlands Water

James Williams Environment Victoria (replaced Malcolm Brown)

Rodney May Hepburn Shire Council

Shannon Lancaster Goulburn-Murray Water

Rohan Hogan North Central Catchment Management Authority

Acknowledgements

The consultative committee would like to thank members of the community who provided input to the development of the groundwater management plan through discussions at public meetings, the groundwater user survey and written submissions.

The consultative committee would like to thank the technical working group for its commitment to providing the best available data to assist the committee's decisions. The technical working group included Dr Jon Fawcett (Sinclair Knight Merz); Brendan Cossens and Bob Knowles (Goulburn-Murray Water); Rob Rendell (RMCG consulting), Simon Baker (Department of Sustainability and Environment); and Rohan Hogan (North Central Catchment Management Authority). Elizabeth Zajc and Greg Williams from the Department of Sustainability and Environment are acknowledged for advice provided to the consultative committee.

Glossary of terms

This section defines the terms used throughout the document.

Term/Acronym	Description
Act	Victorian Water Act 1989
AHD	The Australian Height Datum is used as a reference for groundwater level measurement where the mean sea level for 1966-68 is assigned a value of zero
Allocation	A percentage of licence entitlement that may be extracted in a given season
Corporation	Goulburn-Murray Water Rural Water Corporation
DSE	Department of Sustainability and Environment
Entitlement	Licensed volume of groundwater
GDE	Groundwater dependent ecosystem
GL	Gigalitre or one thousand megalitres
GMA	Groundwater management area
G-MW	Goulburn-Murray Water Rural Water Corporation
GSPA	Groundwater Supply Protection Area
km	kilometre
Licence	Licence issued under section 51 of the Water Act 1989 to take and use groundwater
m	metre
ML	Megalitre or one million litres
Plan	Loddon Highlands Water Supply Protection Area Groundwater Management Plan
Prescription	A function, power or duty of the Corporation that has the obligation or responsibility of administering and enforcing the Plan.
Season	Period of 12 calendar months beginning on 1 July in any year and ending on 30 June in the following year
WSPA	Water Supply Protection Area
Zone	A defined part of the water supply protection area

1 Introduction

1.1 Groundwater management

Groundwater resources in the Loddon Highlands Water Supply Protection Area (WSPA) provide an important source of water for domestic and stock use, irrigation, commercial and industrial purposes, reticulated urban supply and the environment.

The Loddon Highlands WSPA Groundwater Management Plan (the Plan) aims to provide security of access to authorised users and protect the environment by supporting a cap on licence entitlement and placing restrictions on groundwater extractions when triggered.

The Plan also enables licensed groundwater users to better manage their entitlement by providing trading opportunities and describing how carryover can be utilised.

Goulburn-Murray Water (the Corporation) is responsible for administering and enforcing the Loddon Highlands WSPA Groundwater Management Plan under section 32A(5) of the *Water Act 1989* (the Act) (Victorian Government, 1989).

A number of technical studies were undertaken to support the development of the groundwater management plan. These are listed in Chapter 6 of this Plan.



1.2 Loddon Highlands WSPA

The Loddon Highlands WSPA extends from Newlyn and Learmonth in the south to Dunolly in the north, and incorporates the townships of Creswick, Waubra, Clunes, Talbot and Maryborough (Central Plan Office, 2009). It covers an area of approximately 2,882 km² (Figure 1).

The Loddon Highlands WSPA applies to the management of aquifers to all depths.

1.3 Development of groundwater resources

Gold mining during the late 19th and early 20th centuries required considerable localised dewatering of mines. The vast amounts of groundwater, particularly in the Deep Lead deposits, caused significant issues for the early miners. The decline in mining activity can be partly attributed to the cost of dewatering the mines.

Development of groundwater resources for agricultural purposes grew steadily from the 1970s with sharp increases in dry periods, particularly during the 1990s.

Groundwater resources have also been developed to meet the demand from growing urban communities around Newlyn, Kingston, Learmonth, Clunes, Waubra, Avoca, and Maryborough.



In response to declining groundwater levels and high licence entitlement the Spring Hill Groundwater Supply Protection Area (GSPA) and the Upper Loddon WSPA were declared in 1999 and 2001 respectively.

In 2002 a Groundwater Management Plan was approved for the Spring Hill GSPA, which included the townships of Newlyn, Blampied and Smeaton (Spring Hill Groundwater Supply Protection Area Consultative Committee, 2002). Continued falling groundwater levels resulted in limits on temporary trade in 2006/07 and restrictions on extractions from 2007/08 to 2009/10. Groundwater levels continued to fall in response to the prolonged dry conditions despite restrictions, but the rate of decline was reduced.

Concerns were raised regarding the fall in groundwater levels in some areas as there were reports of reduced supply from irrigation and domestic and stock bores and decreased flow from springs (Goulburn-Murray Water, 2007).

Additionally, there was uncertainty about the impact of declining groundwater levels on the environment, including baseflow and groundwater dependent ecosystems, under dry conditions.

Goulburn-Murray Water undertook a review of the Spring Hill GSPA Groundwater Management Plan which recommended that the Spring Hill GSPA, Upper Loddon WSPA and surrounding unincorporated area be managed as a single WSPA that better represented the extent of the basalt and Deep Lead aquifers (GHD, 2010a).

The Loddon Highlands WSPA was declared in June 2010 in accordance with section 27 of the Act.

1.4 Plan objectives

The objective of the groundwater management plan, as defined in section 32A(1) of the Act, is to make sure that the water resources of the protection area are managed in an equitable manner, so as to ensure the long-term sustainability of those resources.

More specifically, the objectives of the Plan seek to balance economic, environmental and social values of groundwater use through:

1. Managing the resource to protect groundwater users and the environment, including aquifer integrity, baseflow and groundwater dependent ecosystems, by:

- managing groundwater extraction with appropriate trigger levels and restrictions;
 - ensuring the security of licenses by capping entitlement in the area: and
 - providing mechanisms to deal with different climatic scenarios.
2. Enabling equitable access of the groundwater resources to realise the potential for its use in the region by:
 - providing opportunity for licence holders to manage their entitlement through trading and carryover;
 - limiting trade within zones of intensive groundwater development; and
 - providing opportunity for new developments through groundwater trading.
 3. Effective and transparent communication of plan objectives, management rules and resource status by:
 - developing a plan that is practical and easy to communicate with transparent rules; and
 - establishing a communication strategy that will provide groundwater users and the wider community with monitoring data, groundwater usage data, seasonal allocations and any changes to groundwater management.





Figure 1 Loddon Highlands Water Supply Protection Area

2 Groundwater resources

2.1 Groundwater system

There are two main aquifers in the Loddon Highlands WSPA; the Newer Volcanic fractured basalt and the Deep Lead sand and gravel deposits (GHD, 2010b).

Basalt dominates the surface geology in the southern half of the WSPA and is the main aquifer utilised for groundwater development. Yields are variable and groundwater quality is generally good.



The Deep Lead deposits are found underlying the basalt contained within narrow trenches that have been displaced by faulting (Figure 2). The Deep Lead, although difficult to locate, can provide higher yields and the groundwater quality is generally good.

The underlying and in places outcropping sandstone, siltstone and granite bedrock aquifer is low yielding and mainly used for domestic and stock supply.

Groundwater flows north to the Mid-Loddon Groundwater Management Area. Groundwater salinity generally increases along the flow path.

2.2 Management zones

A significant amount of technical work has been undertaken in the Loddon Highlands WSPA to understand the groundwater system and develop the Plan (refer section 6). Using this knowledge the Loddon Highlands WSPA has been divided into seven management zones based on hydrogeological characteristics, location of licence entitlement, aquifer response to pumping, dominant groundwater flow path and historical management boundaries (refer Figure 3).

The management zones facilitate appropriate management through restrictions on groundwater use and the transfer of licence entitlement.

These zones can be grouped into the basalt highlands (southern zones) and the basalt plains (northern zones).

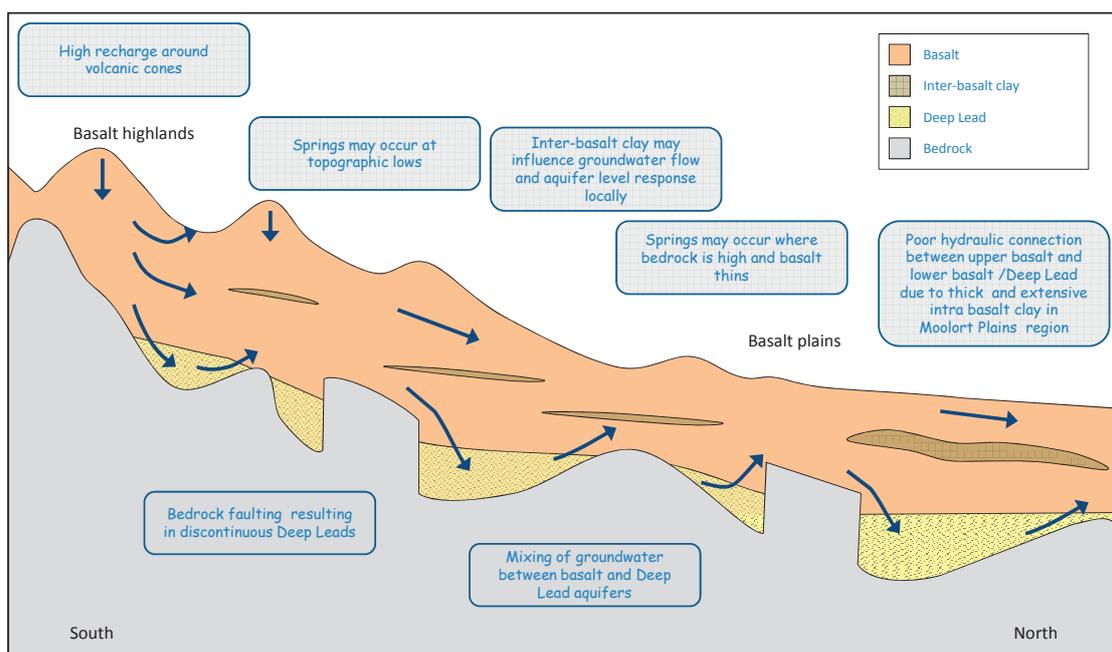
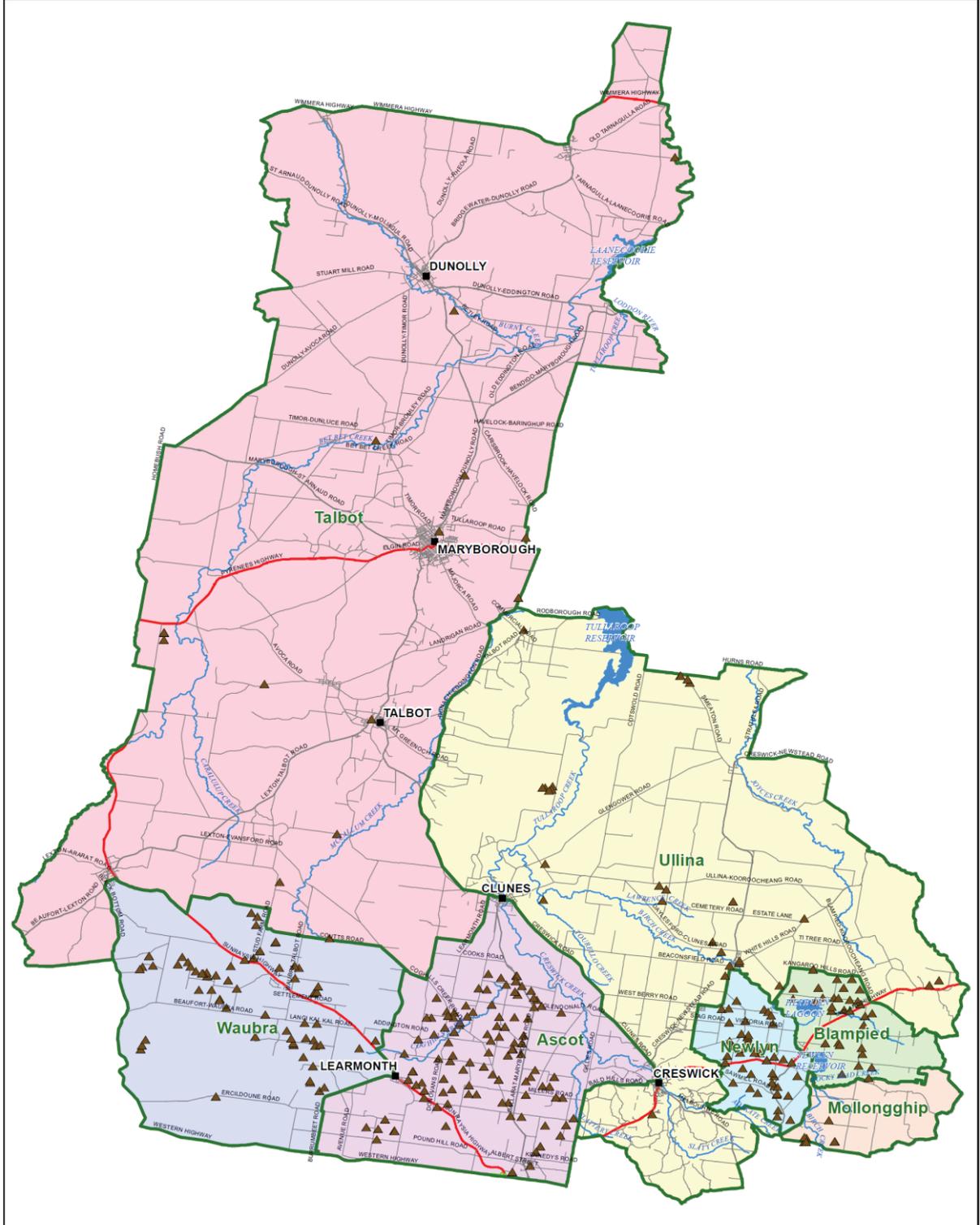


Figure 2 South to North cross section

LODDON HIGHLANDS WSPA - LICENSED BORES
GOULBURN-MURRAY WATER



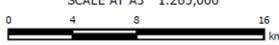
 <p>GMW-12-010 07 MAR 2012</p> <p>GOULBURN-MURRAY WATER 40 CASEY STREET (PO BOX 165) TATURA VIC 3616 Ph (03) 5833 5500 Fax (03) 58245827 gmsupport@gm-water.com.au</p>		<p>Legend</p> <ul style="list-style-type: none"> ▲ Licenced Bores ▭ Loddon Highlands Management zones — Waterway ■ Waterbody — Freeway — Highway — Major Road — Minor Road 	<p>SCALE AT A3 1:265,000</p>  <p>The content of this product is provided for information purposes only. No claim is made as to the accuracy or authenticity of the content of the product. In no event will G-MW, its agents, instrumentallities and employees be liable for the accuracy of the information contained within this product nor its use or reliance placed on it. The information used within this product is provided on the basis that all persons accessing the information undertake responsibility for assessing the relevance and accuracy of its content.</p> <p>\\Client\GIS\2012_Products\GMW-12-010\GMW-12-010_LicensedBores_all.mxd</p>
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Figure 3 Loddon Highlands Water Supply Protection Area management zones

Basalt highlands

The basalt highlands region includes the Newlyn, Blampied, Mollongghip, Ascot and Waubra Zones in the southern part of the Loddon Highlands WSPA.

The area is characterised by thick fractured basalt flows originating from the numerous volcanic cones that dominate the steep to undulating topography.

There is generally a good hydraulic connection between the basalt and the underlying Deep Lead aquifers in the basalt highlands region. As a result, groundwater pumping from the Deep Lead aquifer may impact groundwater levels in the basalt aquifer. Clay layers within the basalt may influence groundwater flow and level response locally.

Recharge is high at the volcanic cones and the groundwater quality is good.

Springs are commonly found at the base of volcanic cones, topographic lows and where basalt abuts bedrock.

The majority of licence entitlement in the Loddon Highlands WSPA is in the Ascot, Waubra and Newlyn Zones.

Intensive groundwater pumping in the Newlyn and Ascot Zones has resulted in seasonal drawdown (the difference in groundwater levels between pumping and non-pumping conditions) of up to 20 m. In these areas the rate of groundwater level decline during the recent drought was greater than in other regions with groundwater recovery levels (the level to which groundwater rises during winter/spring each year) declining by around 20 m from the early 1990s to 2010 (Figure 4).

In the Waubra Zone, groundwater levels have remained relatively steady despite dry conditions experienced over the last decade.

The Blampied Zone has experienced moderate levels of groundwater development and seasonal fluctuations of over 5 m have been observed.

The Mollongghip Zone is a region of little development extending south of the Blampied Zone to the southern boundary of the WSPA. Limited monitoring data suggests groundwater levels do not experience significant seasonal fluctuations in the Mollongghip Zone.

Basalt plains

The basalt plains region includes the Ullina and Talbot Zones. These zones cover the northern extent of the Loddon Highlands WSPA and include large areas of bedrock outcrop.

A thick and extensive clay layer is found within the basalt of the Moolort Plains in the northern area of the Ullina Zone. In this area groundwater pumping from the Deep Lead or lower basalt does not appear to impact on the watertable (Figure 4).

The Deep Leads appear to be discontinuous due to subsurface faulting. Bedrock highs force groundwater to the surface as springs as evident around Ullina.

There is little groundwater development in the Ullina Zone. Groundwater levels have remained relatively steady compared to the more intensively developed areas.

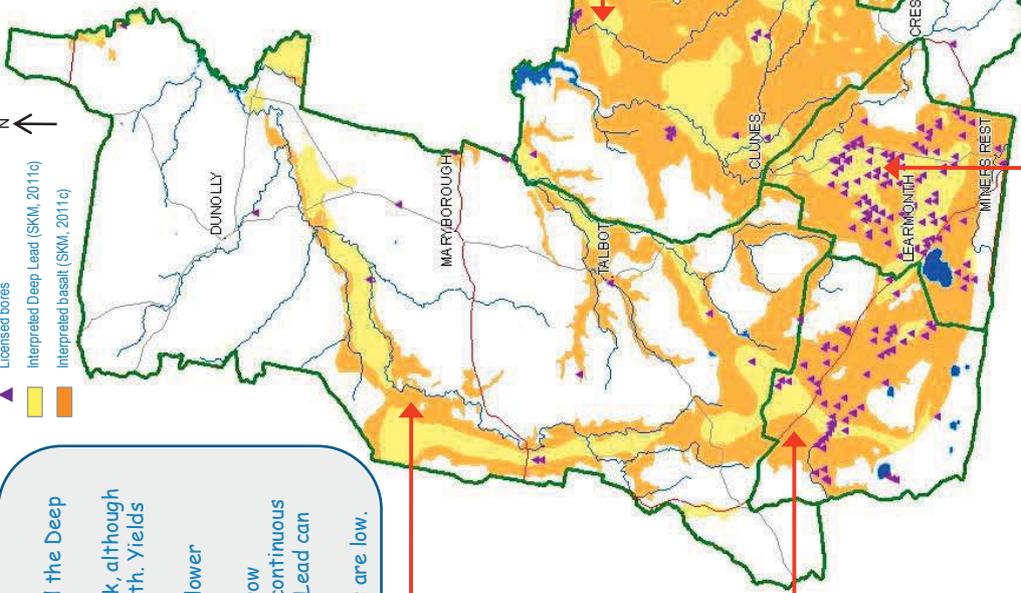
Groundwater is relatively fresh in the southern area of the Ullina Zone; however the upper basalt aquifer can be more saline.

The Talbot Zone extends from Evansford in the south to Dunolly in the north and includes the Madame Hopkins and Chalks Deep Leads.

The basalt in the Talbot Zone is narrow and bedrock outcrops over much of the area. There is little licence entitlement in the Talbot Zone and groundwater levels have remained steady, even throughout recent droughts.

Groundwater quality deteriorates in the northern parts of the Talbot Zone.

▲ Licensed bores
 ■ Interpreted Deep Lead (SKM, 2011c)
 ■ Interpreted basalt (SKM, 2011c)



Aquifers

The key aquifers in the area are the basalt and the Deep Lead.

The basalt is generally up to around 100 m thick, although it is deeper under the volcanic cones in the south. Yields are variable up to around 2 ML/day.

Intra-basalt clay separates upper basalt from lower basalt and Deep Lead on Moolort Plains.

Deep Lead deposits are found in relatively narrow trenches. Deep Lead deposits appear to be discontinuous due to bedrock faulting. Yields from the Deep Lead can be up to around 5 ML/day.

Bedrock outcrop dominates in the north. Yields are low.

Groundwater pumping

Licence volume and groundwater pumping is greatest in the upper catchment around Newlyn, Blampied, Ascot and Waubra.

Large seasonal drawdown is observed in areas of intensive groundwater pumping around Newlyn and Ascot.

Groundwater recovery levels fall at higher rates in areas of intensive pumping during dry periods.

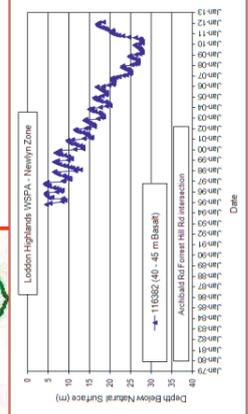
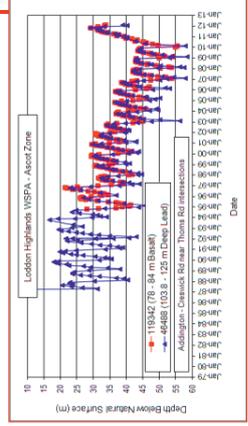
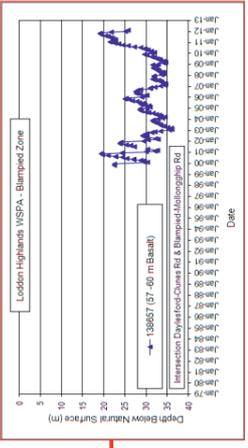
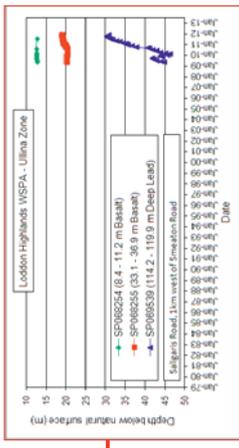
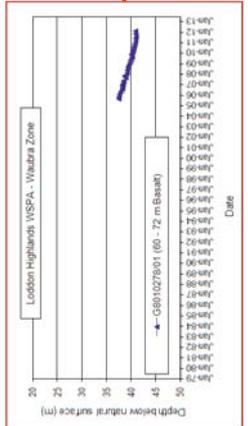
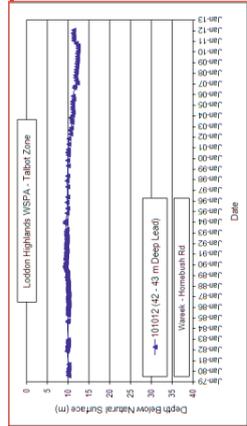
Lower in the catchment groundwater levels have remained relatively steady.

Groundwater quality

Groundwater quality is generally suitable for most purposes in the upper catchment.

Groundwater salinity increases along the flow path in the Madame Hopkins and Chalks Deep Leads.

Groundwater salinity can be higher in upper basalt on the Moolort Plains.



Groundwater recharge and flow

Groundwater recharge is high in the upper catchment, particularly around volcanic cones.

Groundwater flows radially from volcanic cones and north to the Mid-Loddon Groundwater Management Area.

Hydraulic gradients are steep in the upper catchment and flatten on the plains in the north.

Springs

Springs occur at geological contacts and topographic lows in upper catchment.

Springs around Ullima may be due to basement highs and thinning of basalt.

Groundwater discharges to creeks in the upper catchment. Creeks are variably losing and gaining downstream.

Figure 4 Groundwater system

2.3 Groundwater use

2.3.1 Licensed use

The total licence entitlement in the Loddon Highlands WSPA is 20.1 GL/year. More than one third of licence entitlement is held in the Ascot Zone (Table 1). Entitlement in the Waubra and Newlyn Zones is also high. The location of licence bores in June 2012 is shown for each zone in Appendix A.

Table 1 Number of licence holders and licence volume in June 2012

Management Zone	Number of licences	Licence volume (GL/year)
Mollonghip	3	0.3
Blampied	22	1.3
Newlyn	28	3.1
Ullina	19	2.4
Ascot	68	7.0
Waubra	35	4.7
Talbot	14	1.3
TOTAL	191	20.1

Available metered data indicates that usage has generally been around 30 to 40% of total entitlement (Figure 5). It should be noted that this does not include all usage in the former unincorporated area. Groundwater use has generally been higher in dry periods and correlates with reduced surface water availability.

Restrictions on extractions under the former Spring Hill GSPA Groundwater Management Plan were in place between 2007/08 and 2009/10. High rainfall and flooding in 2010/11 resulted in little groundwater usage.

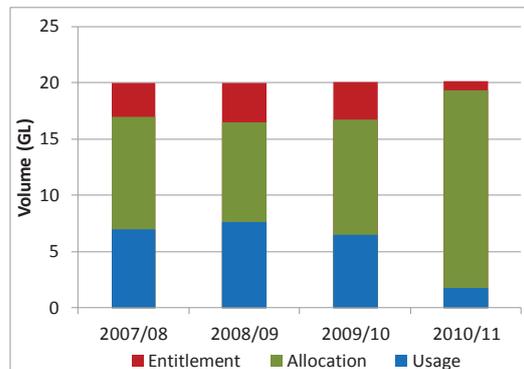


Figure 5 Entitlement and metered use

2.3.2 Domestic and stock

There are around 180 registered domestic and stock bores in the Loddon Highlands WSPA. There are also a number of older unregistered domestic and stock bores. Domestic and stock bores are registered in a state groundwater database when a works licence to construct the bore is issued. The operating status of domestic and stock bores is not monitored; however the cumulative usage is considered to be relatively small.

Domestic and stock access to groundwater is a statutory right under section 8 of the Act. Landholders can apply to the Corporation for a works licence to install a bore for domestic and stock purposes.



Domestic and stock bores should be constructed with consideration of seasonal fluctuation of groundwater levels in the local area to ensure security of supply.

Access to groundwater from domestic and stock bores will be managed by limiting the depth to which groundwater levels may fall before licensed groundwater use is restricted.

The Corporation needs to consider impacts on domestic and stock bores when making licensing decisions. For this reason domestic and stock users are encouraged to ensure that their bore is registered.

2.4 Impacts of extraction on the environment

2.4.1 Groundwater quality

Groundwater in the Loddon Highlands WSPA is generally of good quality.

The freshest groundwater is located in the basalt aquifers in the south of the WSPA where high rainfall and permeable soils associated with the volcanic cones results in greater recharge.

Groundwater salinity generally increases northwards along the groundwater flow path.

The greatest potential for change to groundwater salinity from pumping is considered to be leakage from the more saline basalt aquifer to the Deep Lead on the Moolort Plains and Bet Bet Creek regions; and lateral movement of saline groundwater from bedrock into the basalt aquifer.

The risk to groundwater quality from groundwater extraction is considered to be low because of the volume of fresh water recharging the aquifer and the low demand for groundwater in the Moolort Plains and Bet Bet Creek regions.

Monitoring of groundwater quality is to be undertaken as part of the Plan to ensure any unexpected changes are detected as early as possible (refer chapter 4.2).

2.4.2 Groundwater interaction with surface water

In the upper catchment, groundwater generally discharges to creeks providing baseflow, although in some areas surface water recharges to the groundwater system. That is, creeks can lose water to the groundwater system over some reaches, and groundwater can discharge to the creeks over other reaches.

If groundwater levels decline there can be reduced discharge to the creeks or increased leakage from the creeks to the groundwater system. This can impact on flows in the creeks.

Investigations have identified that the greatest potential for impacts to creeks from groundwater pumping are in areas of intensive groundwater development in the Newlyn Zone (e.g. Birch Creek) and Ascot Zone (e.g. Creswick Creek).

Groundwater pumping has the greatest impact on surface water features in dry

climatic conditions when groundwater levels are low and there is a reduction in surface water availability. The impact on baseflow has not been accurately determined and investigations are required to better quantify the groundwater interaction with surface water to inform the review of the Plan (refer chapter 5.4).

The groundwater discharge to creeks and the potential for increased leakage from creeks has been considered through restrictions on groundwater extractions when triggered (refer chapter 3.3). Triggers and restrictions have been set above historic groundwater level lows.

Impacts to creeks will also be considered when assessing new groundwater licensing applications in accordance with section 40 of the Act.

Monitoring will be undertaken as part of the Plan to better understand the interaction between groundwater and surface water (refer chapter 4).

The available data suggests that while there is good connection between the groundwater system and streams in some areas of the Loddon Highlands WSPA, large time lags and variable connectivity indicate that the groundwater and surface water resources should be managed independently.

2.4.3 Groundwater dependent ecosystems

Development of groundwater resources can impact on the water availability for groundwater dependent ecosystems (GDEs). GDEs are ecosystems that utilise groundwater to meet some or all of their water needs.

Satellite imagery has been used along with groundwater level data to determine the potential locations of riparian GDEs in the Loddon Highlands WSPA (SKM, 2011b). Using this information, and with assistance from landholders, springs and remnant pools have been identified that support River Blackfish (*Gadopsis marmoratus*) and Platypus (*Ornithorhynchus anatinus*).

Spring activity has been identified in the upper catchment around Mollongghip, Newlyn, Ullina, Waubra and Ascot, while remnant pools and riparian vegetation that may be groundwater dependent has been observed along Birch Creek, Coghills

Creek, Middle Creek, Joyces Creek and Lawrence Creek (Figure 6).



Mapping of GDEs is incomplete and further investigations are required to determine their level of dependence on groundwater.

There is also a need to determine the value of GDEs and their sensitivity to change.

Lowering of groundwater levels could reduce the water availability to GDEs by decreasing discharge to creeks and springs, or inducing greater leakage from creeks during dry climatic periods.

Any unacceptable impacts to GDEs from groundwater pumping is to be managed through triggers which restrict groundwater extractions (refer chapter 3.3). Triggers have been set above historic groundwater level lows.

Further, GDEs will be considered when assessing groundwater licence applications under section 40 of the Act and referred to the Catchment Management Authority (CMA) for comment if necessary.

Ongoing monitoring should be established for high value GDEs, once identified, to determine their water requirements and inform the review of the Plan (refer chapter 5.4).

The Department of Sustainability and Environment (DSE) and North Central Catchment Management Authority, in consultation with the Corporation, are working towards identifying high value GDEs.

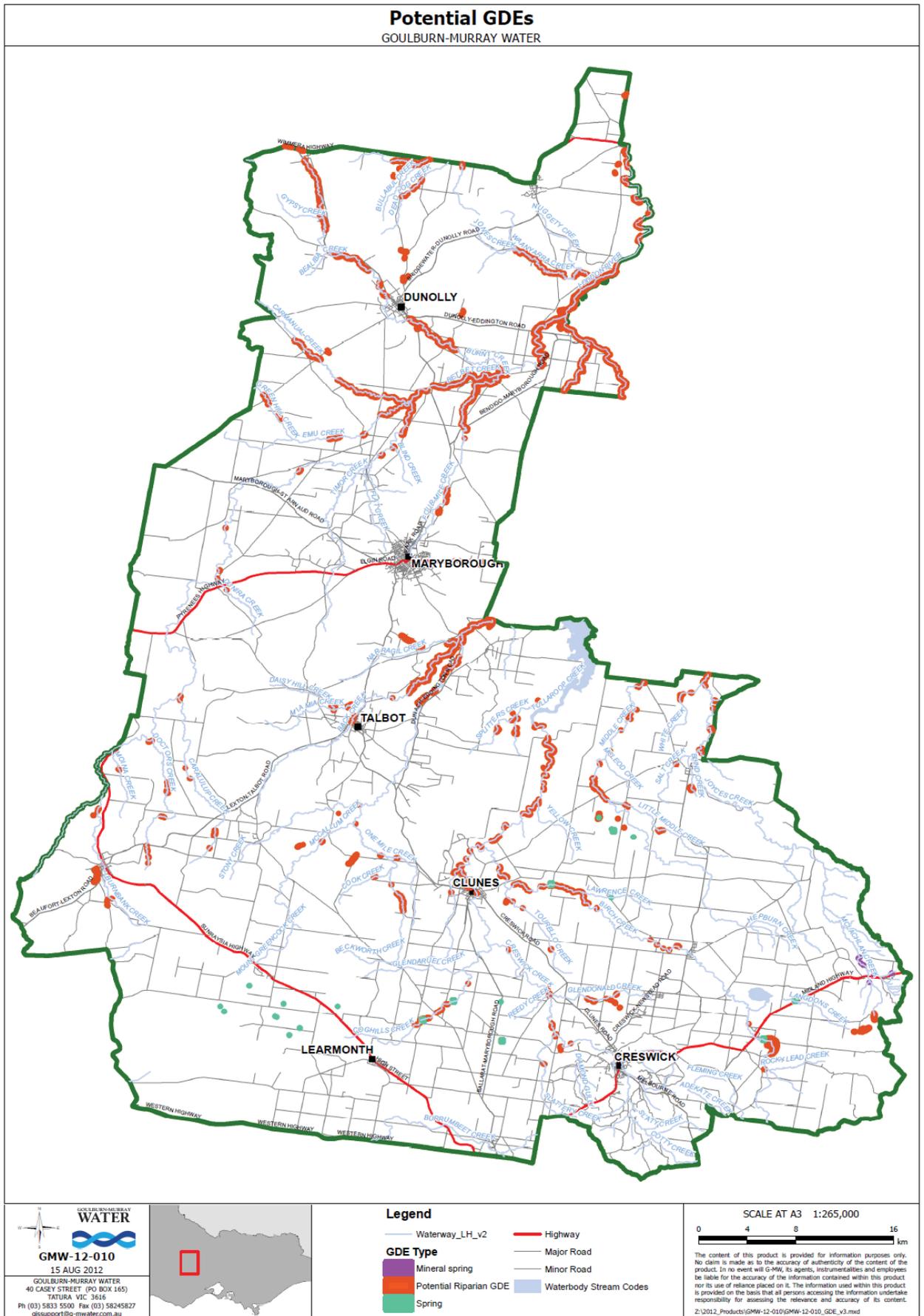


Figure 6 Known springs and potential GDEs in the Loddon Highlands WSPA

3 Resource management

3.1 Licence entitlement

Licence entitlement has been capped in the Loddon Highlands WSPA to protect authorised groundwater users and the environment and to preserve the integrity of the aquifer.

The cap is a permissible consumptive volume (PCV) of 20.5 GL/year declared by the Minister for Water under section 22A of the Act in July 2010.

A well calibrated numerical groundwater model has been developed for the Loddon Highlands WSPA (SKM, 2011a). The model indicates that groundwater levels are responsive to climatic conditions. This is supported by observed records which show that groundwater levels recovered strongly following the recent dry conditions. The model suggests that groundwater levels would remain relatively steady under average climatic conditions for usage of licensed entitlement.

Groundwater licenses may be issued for a period not exceeding 15 years in the Loddon Highlands WSPA, in accordance with section 56(3) of the Act. The licence period will be subject to assessment of the risks of extraction to surrounding users and the environment.

The transfer of licence entitlement provides the opportunity for new developments (refer chapter 3.4).

For information on obtaining a groundwater licence refer to the Corporation's website www.gmwater.com.au.

3.2 Carryover

Carryover is unused seasonal allocation that may be used in the following season. It provides groundwater users with the flexibility to use water when it is of greatest benefit to them.

Carryover also reduces the need for licence holders to pump unused allocation

to storage at the end of the irrigation season. Rather, unused allocation will remain in the aquifer.

To enable the use of carryover the Corporation will apply to the Minister for Water under section 62A of the Act to declare availability of carryover in the Loddon Highlands WSPA.

Initially, the Corporation will apply to allow carryover up to a maximum of 15% of licence entitlement in a season. This limit provides some control over the potential fall in groundwater levels when carryover is used in a dry season. It also reduces the likelihood of harsher restrictions due to carryover use.

The percentage of licence entitlement that can be carried over can be altered and the Corporation will consult with the Groundwater Reference Committee about the possibility of any changes to carryover (refer chapter 5).

Licence holders with carryover have the potential to use up to their allocation plus carryover in any season provided they are able to extract the water under their licence conditions.

Licence conditions should be sufficient to effectively manage the impacts of drawdown to existing groundwater users and the environment with the introduction of carryover. Licence conditions limit daily extraction rates and volumes to manage interference.

A licence holder may apply to the Corporation to increase their pumping rate to enable them to use carryover if their licence conditions are limiting.

Carryover volumes are not subject to restrictions and become part of the total water available to a licence holder in the following season. An example of how carryover might be used is provided in Example 1.

Example 1

A licence holder has an entitlement of 100 ML/yr and a maximum carryover of 15 ML (15% of licence entitlement).

Season	1	2	3	4	5
Entitlement (ML)	100	100	100	100	100
Allocation	100%	100%	75%	75%	50%
Carryover (ML)	0	15	10	5	10
Trade in (ML)	0	0	0	0	10
TOTAL AVAILABLE (ML)	100	115	85	80	70
Usage (ML)	80	80	80	70	70
Trade out (ML)	0	25	0	0	0
TOTAL OUT (ML)	80	105	80	70	65
BALANCE (ML)	20	10	5	10	5
Available for carryover (ML)	15	10	5	10	5

In season 1 the allocation is 100%. The licence holder uses 80 ML and has 20 ML remaining, but may only carryover a maximum of 15 ML to season 2.

In season 2 the allocation is 100% and the licence holder has carried over 15 ML, providing a total of 115 ML for the season. The licence holder uses 80 ML and trades out 25 ML. This leaves 10 ML remaining for carryover to season 3.

In season 3 allocation is 75% so the licence holder has 85 ML available for use including the 10 ML of carryover. The licence holder uses 80 ML. This leaves 5 ML for carryover to season 4.

In season 4 allocations are 75%, so the licence holder has 80 ML available for use including carryover. The licence holder uses 70 ML. This leaves 10 ML for carryover to season 5.

In season 5 allocations are 50%. The licence holder has 10 ML carryover and trades in 10 ML, providing a total of 70 ML. The licence holder uses 65 ML and can carryover 5 ML to the next season.

Prescription 1: Carryover

The Corporation shall:

- (a) Apply to the Minister for Water to declare the availability of carryover in the Loddon Highlands WSPA up to a maximum of 15% of licence entitlement that will not be subject to restriction in the form of allocations.
- (b) Consult with the Groundwater Reference Committee about the need to alter the percentage of carryover.

3.3 Managing extractions

Restrictions, when triggered will be imposed to limit groundwater extractions and manage groundwater use.

Trigger levels have been set using information gathered from State observation bores to manage the long-term sustainability of the aquifer and protect authorised groundwater users and the environment.

Trigger levels have been determined by averaging annual maximum groundwater recovery levels from key State observation bores in a particular zone (Table 2). The bores selected have a good monitoring history and are generally representative of groundwater level response in that zone. Surrounding monitoring bores will be used to verify the groundwater level response in the trigger bores.

Consideration was given to a range of factors to establish the triggers based on the risk of falling groundwater levels and available data. This included GDEs; groundwater interaction with surface water; available drawdown for existing users; groundwater salinity; watertable relief and land salinity benefits; and the current conceptual understanding of the groundwater system.

The greatest risk resulting from the development of groundwater resources was determined to be the potential to reduce groundwater discharge to creeks or induce leakage from creeks, and maintaining an acceptable level of access to existing authorised groundwater users.

Trigger levels have only been established in the Blampied, Newlyn, Ascot and

Waubra zones where there is large entitlement, considerable seasonal drawdown, and a higher rate of fall in groundwater recovery levels during recent droughts.

In other zones, the level of entitlement, observed change in groundwater levels and intensity of groundwater pumping suggests that restrictions are not required.

Staged restrictions on the use of licence entitlement will apply when the averaged maximum groundwater recovery level from key bores reaches the trigger level. The average maximum seasonal groundwater level is the sum of the maximum level recorded in each of the key bores in a given season, divided by the number of key bores (refer Example 2).

Restrictions will be introduced through the use of allocations. Allocations are a percentage of licence entitlement that may be extracted in a given season. For example, if a licence volume was 100 ML/year and a 50% allocation was announced, then up to 50 ML may be extracted in that season.

The trigger levels and corresponding restrictions are shown in Figure 7 with the calculated average maximum groundwater recovery level plotted over time. In the Newlyn Zone it can be seen that allocations would have been reduced to 75% in 2006/07 and 2007/08 and then further reduced to 50% in 2008/09 and 2009/10. In 2010/11 the groundwater levels recovered in response to the wet conditions and allocations returned to 100%.

Table 2 State observation bores used to determine seasonal allocations

Zone	State observation bore number
Blampied	138657
Newlyn	138658, 116382
Ascot	64879, 64880, 122152, 119377, 119342
Waubra	G8010278/01, WRK016266, WRK016267, WRK016269

Example 2

In the Newlyn Zone there are two key bores, 138658 and 116382.

The maximum seasonal groundwater recovery level is recorded for each key bore. The groundwater levels are recorded as meters above sea level or meters Australian Height Datum (m AHD).

The maximum seasonal groundwater recovery levels are summed ($536 + 532 = 1068$) and then divided by two (the number of trigger bores) ($1068 / 2 = 534$).

Bore	Maximum groundwater recovery level (m AHD)	Average maximum groundwater recovery level (m AHD)
138658	536	534
116382	532	

The average maximum groundwater recovery level is compared to the trigger levels to determine if restrictions are required.

In this case there would be a 75% allocation in the Newlyn Zone.

Due to the limited groundwater monitoring record in the Waubra Zone an allocation has not been determined at this time. When the average groundwater recovery level falls below the trigger the Corporation will determine the seasonal allocation based on a review of available data and consult with the Groundwater Reference Committee (refer chapter 5).

If the 50% trigger is reached in the Blampied, Newlyn or Ascot Zone, a review will be undertaken by the Corporation to determine the need for further restrictions in that zone. The Corporation will consult with the Groundwater Reference Committee during the review. If the average groundwater recovery levels continue to decline and reach the lower trigger, the Corporation will announce an allocation based on the outcomes of the review.

Allocations will be announced by 15 September each year based on the August groundwater readings compared to the trigger levels in each zone.

A 100% allocation will be announced as soon as possible from 1 July that season if the groundwater levels have recovered above the 100% trigger.

Allocations will be reviewed based on groundwater readings to November, by which time the maximum seasonal recovery level is generally seen.

Allocations may increase if the average maximum groundwater recovery level rises above the trigger level. Allocations will not be reduced from the September announcement.

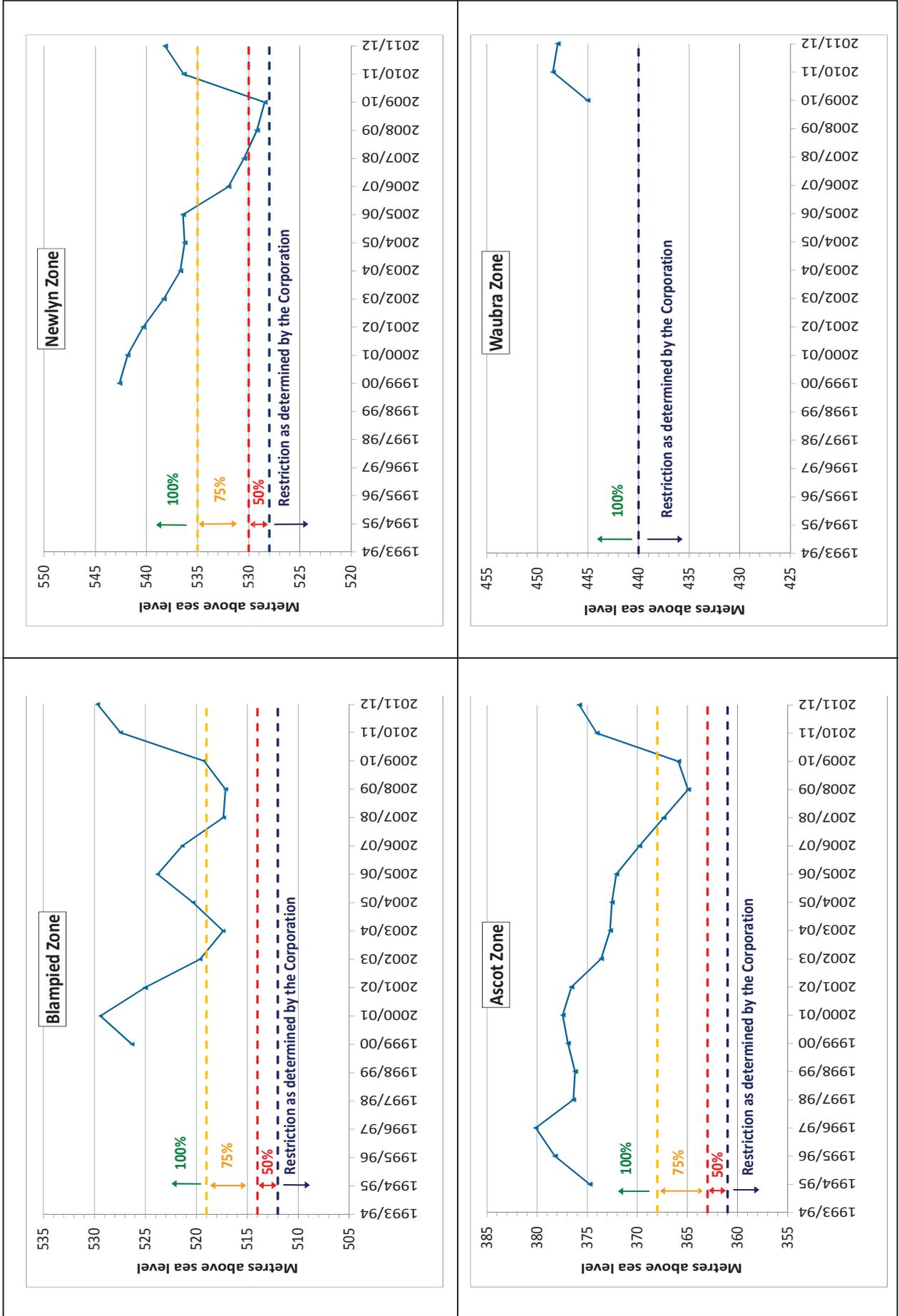


Figure 7 Trigger levels and allocations

Prescription 2: Triggers and restrictions

The Corporation shall:

- (a) By 15 September each year determine the maximum seasonal groundwater recovery level in the relevant bore/s, or its replacement, and corresponding seasonal allocation as shown below:

Blampied	
Trigger level (m AHD)	Allocation
519 and above	100%
From 514 – 518.9	75%
From 512 – 513.9	50%
Below 512	refer (b) below

Newlyn	
Trigger level (m AHD)	Allocation
535 and above	100%
From 530 – 534.9	75%
From 528 – 529.9	50%
Below 528	refer (b) below

Ascot	
Trigger level (m AHD)	Allocation
368 and above	100%
From 363 – 367.9	75%
From 361 – 362.9	50%
Below 361	refer (b) below

Waubra	
Trigger level (m AHD)	Allocation
440 and above	100%
Below 440	refer (c) below

- (b) Determine a seasonal allocation for the relevant zone based on the outcomes of a review of available data. The review will be undertaken when the 50% allocation is triggered in the Blampied, Newlyn or Ascot Zone. The Corporation shall consult with the Groundwater Reference Committee during the review.
- (c) Determine a seasonal allocation for the Waubra Zone and consult with Groundwater Reference Committee.
- (d) Announce seasonal allocations by listing them on its website; sending letters to all licence holders and placing public notices in local newspapers.
- (e) Review allocations based on groundwater level readings to November each year and announce an increase if triggered.

3.4 Transfer of licence entitlement

The transfer of licence entitlement provides opportunity for further development of groundwater resources.

The temporary and permanent transfer of licence entitlement is permitted in the Loddon Highlands WSPA subject to conditions that protect the integrity of the aquifer and reduce the potential for unacceptable impacts to authorised groundwater users and the environment.

Licence transfers may result due to the sale or conveyance of land, where the licence remains with the property or through an off-property licence transfer

where the groundwater is to be extracted and used on a different property.

When transferring entitlement consideration is to be given to:

1. Trading between zones; and
2. Groundwater level interference.

3.4.1 Trading between zones

There are seven zones in the Loddon Highlands WSPA which govern groundwater transfers: Mollongghip, Blampied, Newlyn, Ullina, Ascot, Waubra and Talbot (refer Figure 3). Permanent

and temporary trading is permitted between licenses within each zone.

No entitlement is to be traded into the Blampied, Newlyn, Ascot or Waubra Zones. This is to limit impacts to existing users in the zones and recognises that most of the licence entitlement is contained within these zones.

Permanent trading is permitted between zones along the dominant groundwater flow path (Figure 8). There is greater flexibility for temporary trading between zones.

A buffer has been applied to zone boundaries to provide an opportunity for licence holders with bores situated within 2.5 km of each other across internal zone boundaries to temporarily transfer licence entitlement (refer Example 3).

Licence entitlement can be temporarily transferred out of the Loddon Highlands WSPA. Licence entitlement can be temporarily transferred into the Loddon Highlands WSPA provided that the PCV is not exceeded.

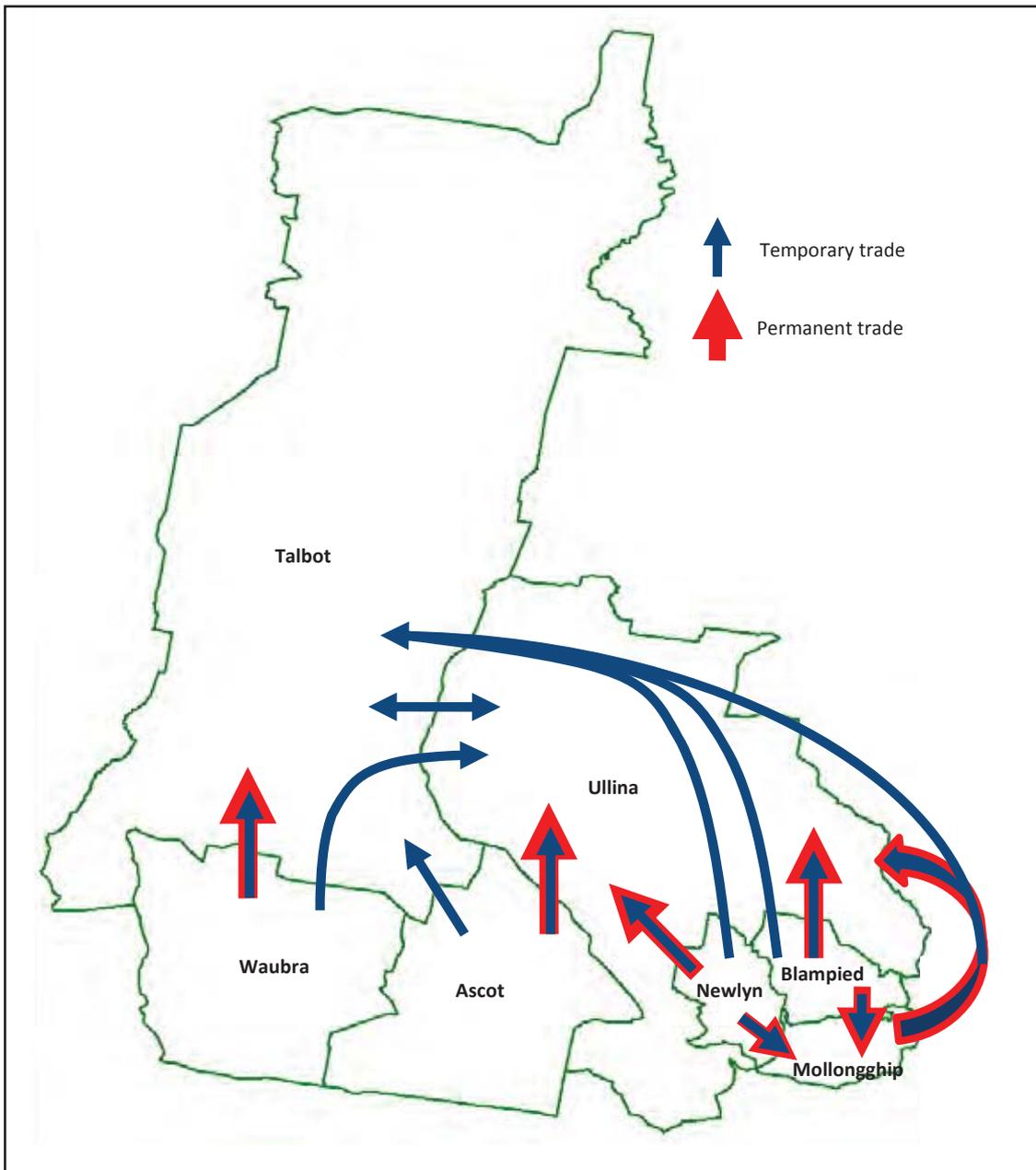


Figure 8 Trading between zones

Prescription 3: Trading between zones

The Corporation may approve a temporary or permanent transfer of groundwater licence entitlement under section 62 of the *Water Act 1989* provided section 53 matters have been considered and the following conditions are satisfied:

(a) The permanent transfer of licence entitlement is between zones as specified below:

Zone	Can trade to	Can trade from
Molongghip	Molongghip, Ullina	Blampied, Molongghip, Newlyn
Blampied	Blampied, Molongghip, Ullina	Blampied
Newlyn	Molongghip, Newlyn, Ullina	Newlyn
Ullina	Ullina	Ascot, Blampied, Molongghip, Newlyn, Ullina
Ascot	Ascot, Ullina	Ascot
Waubra	Talbot, Waubra	Waubra
Talbot	Talbot	Talbot, Waubra

(b) The temporary transfer of licence entitlement is between zones as specified below:

Zone	Can trade to	Can trade from
Molongghip	Molongghip, Talbot, Ullina	Blampied, Molongghip, Newlyn
Blampied	Blampied, Molongghip, Talbot, Ullina	Blampied
Newlyn	Molongghip, Newlyn, Talbot, Ullina	Newlyn
Ullina	Talbot, Ullina	Ascot, Blampied, Molongghip, Newlyn, Talbot, Ullina, Waubra
Ascot	Ascot, Talbot, Ullina	Ascot
Waubra	Talbot, Ullina, Waubra	Waubra
Talbot	Talbot, Ullina	Ascot, Blampied, Molongghip, Newlyn, Talbot, Ullina, Waubra

(c) Despite (b) above, a temporary transfer of licence entitlement may be considered where bores are located within 2.5 km of each other across an internal zone boundary.

(d) Licence entitlement may be temporarily traded into, or out of, the Loddon Highlands WSPA provided that the PCV is not exceeded.

Example 3

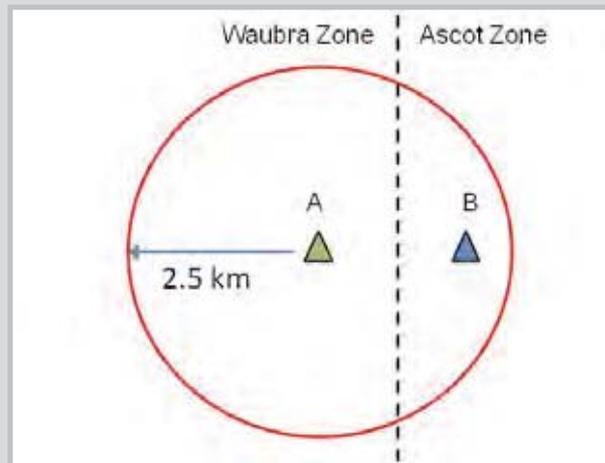
A temporary transfer may be permitted across a zone boundary provided that the bores are located within 2.5 km of each other despite limitations on trading between zones.

The triangles in the example below represent licensed bores.

The blue bore is in the Ascot Zone and the green bore is in the Waubra Zone.

Trading is not permitted between the Waubra and the Ascot Zones.

However, in this case a temporary transfer may be permitted across the zone boundary between these bores as they are within 2.5 km of each other.



3.4.2 Groundwater level interference

Groundwater pumping lowers the groundwater level around the bore being pumped. This decline in groundwater level is referred to as the drawdown cone (Figure 9).

The size and shape of the drawdown cone depends primarily on the nature of the aquifer as well as the pumping rate and duration. Drawdown decreases with distance from the bore, and the cone expands in size whilst pumping continues until steady-state conditions are reached.

Groundwater level interference can occur when the drawdown cone intersects a neighbouring bore or environmental feature such as a stream or a spring. The impacts from groundwater pumping are site specific as the pumping requirements are likely to be different and the aquifer hydraulic characteristics can vary, particularly in the fractured basalt aquifer.

Interference is considered by the Corporation when assessing groundwater licence applications. This includes the potential impacts to existing groundwater users and the environment. The matters

considered are detailed in sections 40, 53 and 68 of the Act.

When bores located in close proximity are extracting from the same aquifer it can result in intersecting drawdown cones. Unacceptable drawdown levels could be a consequence of the cumulative impacts of a number of pumps operating in a local area (intensive groundwater pumping).

In the Loddon Highlands WSPA, large seasonal drawdown and falling recovery levels have been observed in dry conditions in areas of intensive groundwater pumping.

While licence entitlement has been capped in the Loddon Highlands WSPA, the transfer of licence entitlement or amendment of an existing licence to add a bore could result in an increase in the local intensity of groundwater pumping.

To avoid new areas of intensive groundwater pumping developing in the WSPA, entitlement has been limited to 1 GL within a 2.5 km radius of a licensed bore (refer Example 4).

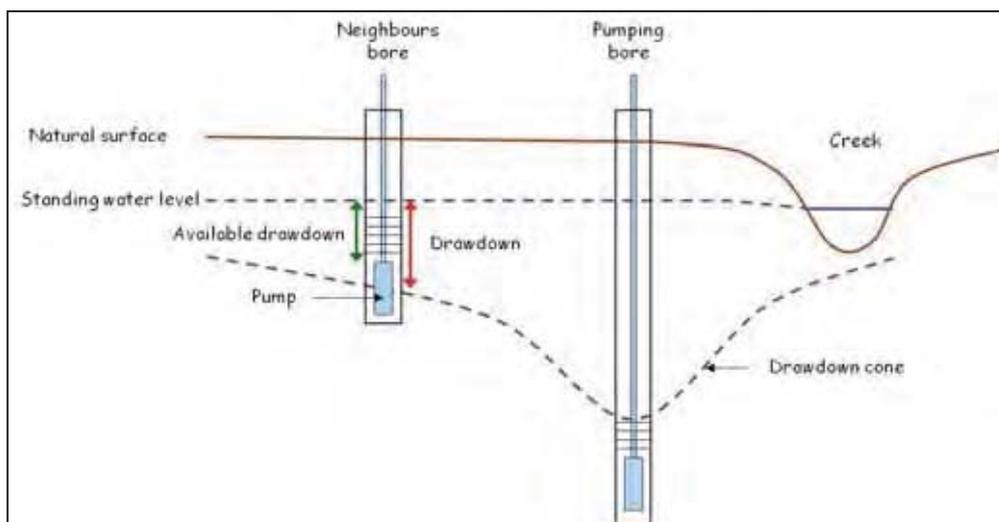


Figure 9 Drawdown cone resulting from groundwater pumping

This provides protection to authorised groundwater users and the environment from drawdown resulting from intensive groundwater pumping.

In some cases the 1 GL limit within a 2.5 km radius of a licensed bore has already been exceeded.

In these areas, a licence holder's usage is to be limited to 115% of their licence entitlement, whether it occurs through a temporary trade or carryover. This provides some flexibility for licence holders to meet seasonal water demands.

Usage may exceed 115% of licence entitlement if trading from other licence holders within a 2.5 km radius. This enables licence holders to trade in additional entitlement to meet business needs without increasing the local intensity of groundwater pumping.

It is recognised that there may be some locations within the Loddon Highlands WSPA where the limit on intensive groundwater pumping may not be appropriate. In this case the intensity limit may be exceeded where other relevant information has been considered, or the applicant has been able to clearly demonstrate to the Corporation through further investigations that there would not be any unacceptable impacts to

surrounding groundwater users or the environment.

Other relevant information to be considered by the Corporation may include local historical usage, previous transfers, proximity of the buyer and seller's bore as well as current resource position.

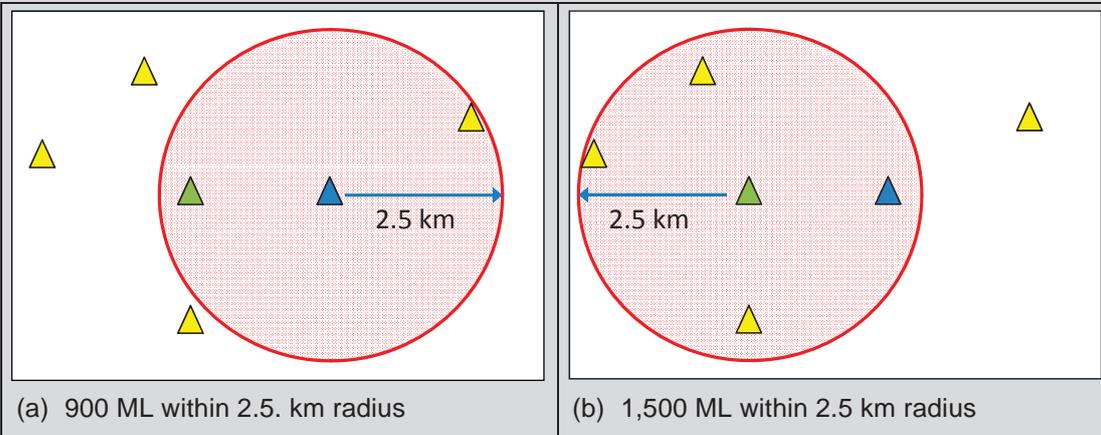
Further investigations to be undertaken by the applicant may include water chemistry analysis, a pumping test and/or groundwater modelling.

The intensity of licence entitlement within 2.5 km of each licensed bore is presented in Appendix B; however it is subject to change over time with the approval of groundwater licence applications such as subdivisions, amalgamations and transfer of entitlement.

In some cases there may be multiple bores listed on a licence. In this case a conservative approach has been adopted and it is assumed that the entire licence entitlement can be extracted from the bore nearest to the applicants bore. Any particular licence conditions that limit the volume a bore can extract will be considered by the Corporation when applying the intensity rule, for example, the maximum daily extraction volume over the season.

Example 4

In the figures below, each of the triangles represents a licensed bore with an entitlement of 300 ML.



In example (a) there are three bores within a 2.5 km radius of the blue bore (including the blue bore).

As each bore has a licence volume of 300 ML, the total licence entitlement within the 2.5 km radius of the blue bore is 900 ML.

In this case an additional 100 ML may be permanently or temporarily traded to the blue bore before the intensity limit of 1,000 ML is reached.

In example (b) there are five bores within a 2.5 km radius of the green bore (including the green bore).

As each bore has a licence volume of 300 ML, the total licence entitlement within the 2.5 km radius of the green bore is 1,500 ML.

In this case the intensity limit of 1,000 ML within a 2.5 km radius has been exceeded.

The licence holder of the green bore may use up to 115% of the licence entitlement through either carryover or a temporary transfer.

If the licence holder of the green bore required more than 115% of the licence entitlement then they would need to temporarily or permanently trade from one of the other licences within the 2.5 km radius, or undertake detailed investigations to demonstrate that no unacceptable impacts are likely to occur.

Prescription 4: Groundwater level interference

The Corporation may approve an application to take and use groundwater under section 51 or a transfer under section 62 of the *Water Act 1989* provided that section 53 matters have been considered and the following conditions are satisfied:

- a) Licence entitlement may be temporarily or permanently transferred up to 1,000 ML/yr within 2.5 km radius of a licensed bore.
- b) Where the licence entitlement within a 2.5 km radius of a licensed bore exceeds 1,000 ML/yr then:

<p>(i). For temporary transfer of licence entitlement</p>	<ol style="list-style-type: none"> 1. Trade with usage in any one season limited to 115% of entitlement, whether it occurs through trade or carryover (this could include transferring from outside the 2.5 km radius); or 2. Trade from others within 2.5 km radius of the applicant's bore for usage to exceed 115% of entitlement; or 3. Assess the application to consider other relevant information such as historical use and, if required undertake detailed investigations, when seeking to use more than 115% of your licence entitlement to demonstrate no unacceptable impacts are likely to occur. This could include transferring from outside the 2.5 km radius.
<p>(ii). For permanent transfer of licence entitlement</p>	<ol style="list-style-type: none"> 1. Trade from others within 2.5 km radius of the applicant's bore; or 2. Undertake detailed investigations to demonstrate no unacceptable impacts are likely to occur. This could include transferring from outside the 2.5 km radius.

4 Monitoring program

Monitoring, evaluation and reporting of groundwater levels and quality from a network of strategically located State observation bores over time is critical to inform effective groundwater resource management.

A groundwater monitoring program has been established under section 32A(3)(a) of the Act for metering and monitoring of, and accounting for, groundwater.

The monitoring program will inform allocations, support transfer decisions and carryover determination and assess the impact of groundwater pumping on the environment. This includes groundwater quality, baseflow, GDEs, and the long term sustainability of the resource.

Outcomes from the monitoring program will be reported annually and communicated to groundwater users. Further, the monitoring program will inform the review of this Plan (refer chapter 5).

4.1 Groundwater levels

The Loddon Highlands WSPA has an extensive network of State observation bores, with over 70 bores currently monitored and maintained by DSE on a quarterly basis in February, May, August and November of each year.

The Corporation shall obtain monthly groundwater level readings from key State observation bores identified in Schedule 1, where practicable, to support the Plan implementation and review. The State observation bores currently monitored are shown in Figure 10.

To improve the spatial coverage of the monitoring network it is recommended that

a new bore be installed in the Waubra Zone (refer Chapter 5.4).



4.2 Groundwater quality

Groundwater salinity can have significant economic impacts by reducing agricultural productivity. There is also an obligation to protect beneficial uses under Victoria's State Environment Protection Policy (Groundwaters of Victoria) (EPA, 1997).

Although the risk of groundwater salinity increasing due to pumping is considered low, monitoring groundwater quality over time is important to record any changes.

A two pronged approach has been adopted to monitor any changes in groundwater quality that will provide improved data sets for future analysis:

1. targeted sampling of licensed bores; and
2. sampling of State observation bores.

If there is a consistent trend towards increasing salinity over time then investigations should be undertaken to inform the Plan review.

LODDON HIGHLANDS WSPA - STATE OBSERVATION BORES

GOULBURN-MURRAY WATER

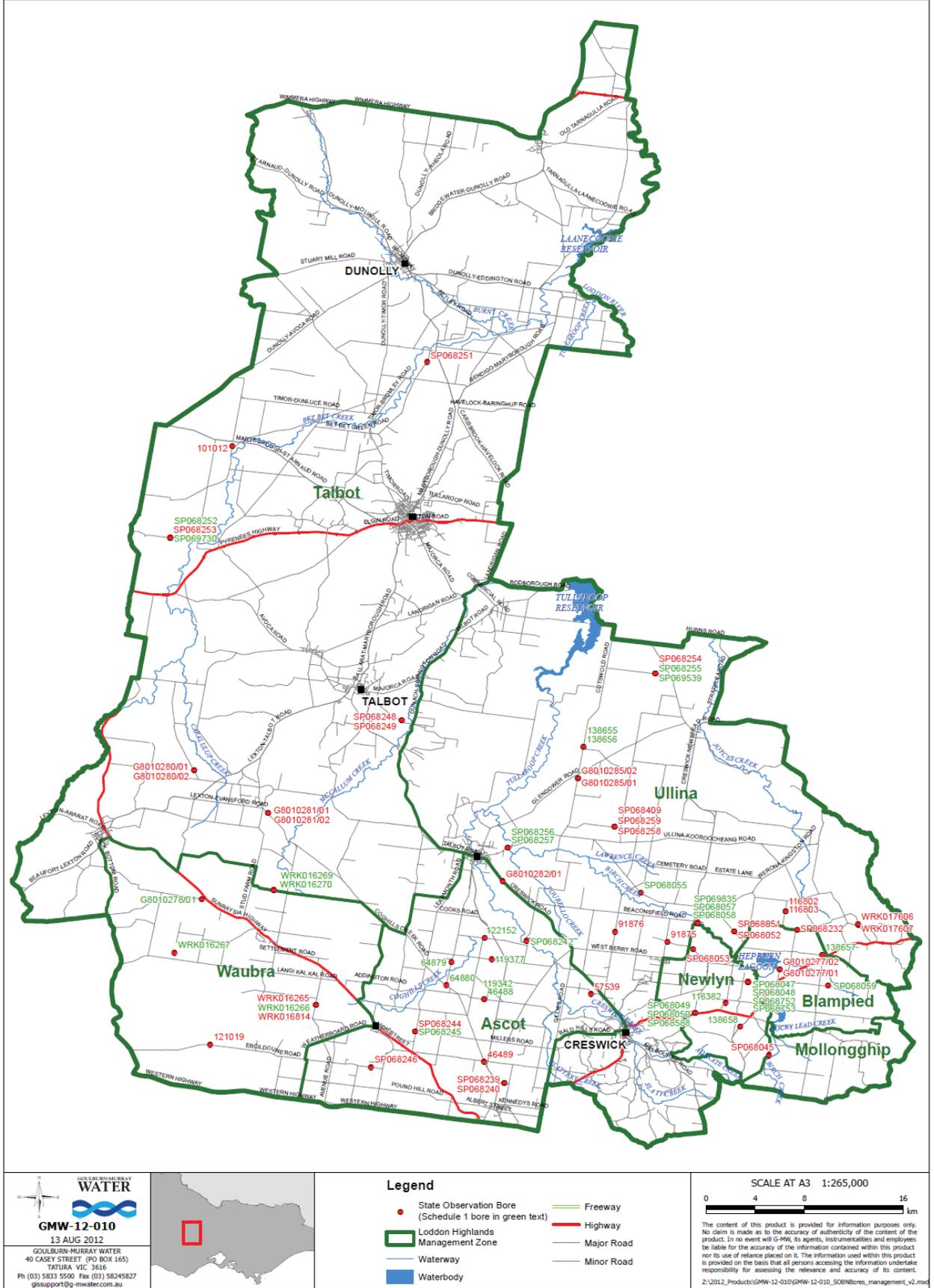


Figure 10 State observation bores

4.2.1 Targeted sampling of licensed bores

A program of targeted salinity monitoring of licensed bores is to be established.

The purpose of the program is to ensure that samples are consistently collected each year from a number of licensed bores located in strategic locations that will provide an improved data set to aid in understanding any changes in groundwater salinity.

Sampling is to be undertaken by the licence holder. The Corporation will provide training to the licence holder on groundwater sampling to provide greater confidence in the quality of the samples obtained. Samples will be tested by the Corporation.

The Corporation will invite licence holders with bores located in strategic locations to participate in the program.

4.2.2 Sampling of State observation bores

Sampling and analysis of selected nested State observation bores (screened in the basalt and Deep Lead aquifers) is to be undertaken to observe any changes in groundwater quality between aquifers on the Moolort Plains and Bet Bet Creek regions.

The bores will be sampled annually in summer and groundwater analysed at a NATA (National Association of Testing Laboratories) accredited laboratory for salinity, major ions, phosphorous and metals. The bores to be sampled are listed in Schedule 1. If it is not possible to sample the bore for any reason then an appropriate replacement bore will be sampled.

Sampling from State observation bores and analysis of the samples at a NATA accredited laboratory provides a greatest level of confidence in water quality results.

Prescription 5: Groundwater monitoring

The Corporation shall:

- (a) Obtain monthly groundwater level readings, where practicable, from State observation bores listed in Schedule 1 or their replacement (up to 288 readings per season).
- (b) Establish a targeted groundwater salinity monitoring program to collect and analyse groundwater samples from selected licensed bores each year.
- (c) Collect groundwater samples from selected State observation bores identified in Schedule 1 where practicable, or their replacement, and send them to a NATA accredited laboratory for analysis.

4.3 Accounting for metered use

Data gathered through metering licensed use is critical to understand how the groundwater system responds to groundwater extraction and to ensure that users comply with their licence conditions.

All licensed bores will be metered. Meters will be read once at the end of each season and at least once randomly during the season. In drier seasons when demand is greater they may be read more frequently.

Meter readings will be stored in the Victorian Water Register to enable reporting on usage.

It is the responsibility of the licence holder to monitor their usage. If a licence holder intends to use greater than their licence volume in a season, including any available carryover, then it is their responsibility to secure a transfer and obtain written approval from the Corporation before the water is extracted. Licence holders must apply well in advance of requiring the water as it can take a number of weeks to process an application.

Prescription 6: Metered licensed use

The Corporation shall:

- (a) Ensure that a meter is fitted to all operational licensed bores.
- (b) Read each meter at least twice each season.

5 Plan implementation

5.1 Provide effective communication

By 30 September each year the Corporation will prepare an annual report on the administration and enforcement of the Plan for the Minister for Water as required under section 32C of the Act. The annual report will cover the period 1 July to 30 June. The report will be made available for inspection at the offices of the Corporation.

The Corporation will produce an annual newsletter in September each year to provide an update on the status of groundwater resources in the Loddon Highlands WSPA and summarise outcomes from the annual report.

The Corporation will post on its website at www.g-mwater.com.au the Plan, annual reports, newsletters and groundwater level monitoring results.

Additionally, the Corporation will appoint a Groundwater Reference Committee, which will include licence holders and relevant stakeholders, to meet with at least annually to report on the implementation of the Plan.

5.2 Plan review

A review of the Plan will be undertaken after five years from approval, or sooner if warranted by any prescription contained within the Plan.

The Corporation will consult with the Groundwater Reference Committee on the Plan review.

The success of the Plan will be determined by the extent to which it achieves the management objectives specified in chapter 1.4.

The Plan review must report on the impacts of groundwater pumping on the environment, with consideration of any technical works undertaken to better understand GDEs and groundwater interaction with surface water. It may also include an update and review of the Loddon Highlands WSPA groundwater model used to determine a water balance.

Any concerns or issues regarding Plan implementation should be directed to the Corporation. For more information visit their website www.g-mwater.com.au.

Prescription 7: Plan implementation

The Corporation shall:

- (a) By 30 September each year:
 - (i). prepare an annual report on the administration and enforcement of the Plan for the Minister for Water and relevant agencies.
 - (ii). mail a newsletter to groundwater licence holders, and domestic and stock users upon request, summarising the outcomes in the annual report.
- (b) Post on its website the Plan; annual report, newsletters and groundwater level monitoring results.
- (c) Meet with a Groundwater Reference Committee at least once each year to report on the implementation of the Plan and consider the need to review the Plan.
- (d) Undertake a review of the Plan after five years from its approval, or sooner if warranted by any prescription contained within the Plan.

5.3 Implementation costs

The annual implementation costs for the Loddon Highlands WSPA Groundwater Management Plan, at the time the Plan was drafted, were estimated to be approximately \$70,000 (GST inclusive).

Implementation costs include groundwater level monitoring, groundwater salinity sampling, meter reading, annual reporting and communications, meeting with the Groundwater Reference Committee, and the review of the Plan.

Implementation costs are recovered by the Corporation through groundwater licence fees. These costs are built into the current

tariff and pricing structure for the management of the resource.

5.4 Future technical investigations

Future technical investigations that would enhance the understanding of groundwater resources in the Loddon Highlands WSPA and inform a review of the Plan and development of any future management actions are provided in Table 3.

The Corporation will work with the North Central Catchment Management Authority and the Department of Sustainability and Environment to action these investigations.

Table 3 Recommended technical investigations to inform the Plan review

Project	Description
Assess level of risk to high value GDEs	<p>Sections 32(3)(i) and (ia) of the Act enable a plan to specify any conditions necessary to protect the environment. State policy requires that high value GDEs must be protected. Falling groundwater levels could pose a risk to these ecosystems.</p> <p>While some works have been undertaken by the North Central Catchment Management Authority and Goulburn-Murray Water to identify GDEs, more work needs to be undertaken to determine their level of dependency on groundwater.</p> <p>High value GDE sites should be identified and ongoing monitoring established to determine their water requirements and any risk resulting from groundwater extraction. It is noted that the Department of Sustainability and Environment is currently developing state wide guidelines to define high value GDEs.</p>
Quantify the impacts of groundwater pumping on baseflow	<p>Sections 32(3)(i) and (ia) of the Act enable a plan to specify any conditions necessary to protect the environment. There remains some uncertainty about the impacts of groundwater pumping on baseflow.</p> <p>Lower groundwater levels can reduce discharge to the creeks or increase leakage from the creeks to the groundwater system. This could impact on reliability of supply for surface water users and the environment.</p> <p>Investigations are required to better quantify the groundwater interaction with surface water and assess the impact of groundwater extraction on baseflow. This should be undertaken with consideration of surface water management of regulated and unregulated systems.</p>
Improve spatial location of groundwater monitoring in the Waubra Zone	<p>Section 32(A)(3)(A) of the Act enable a plan to contain requirements for monitoring. This includes identifying any requirement for additional monitoring locations to improve the spatial location of monitoring points and integrity of monitoring data.</p> <p>An assessment of the spatial distribution of monitoring bores has identified a need to install a monitoring bore centred among the licensed bores near Waubra.</p> <p>The bore could then be used to support allocation decisions and inform the review of the Plan.</p>

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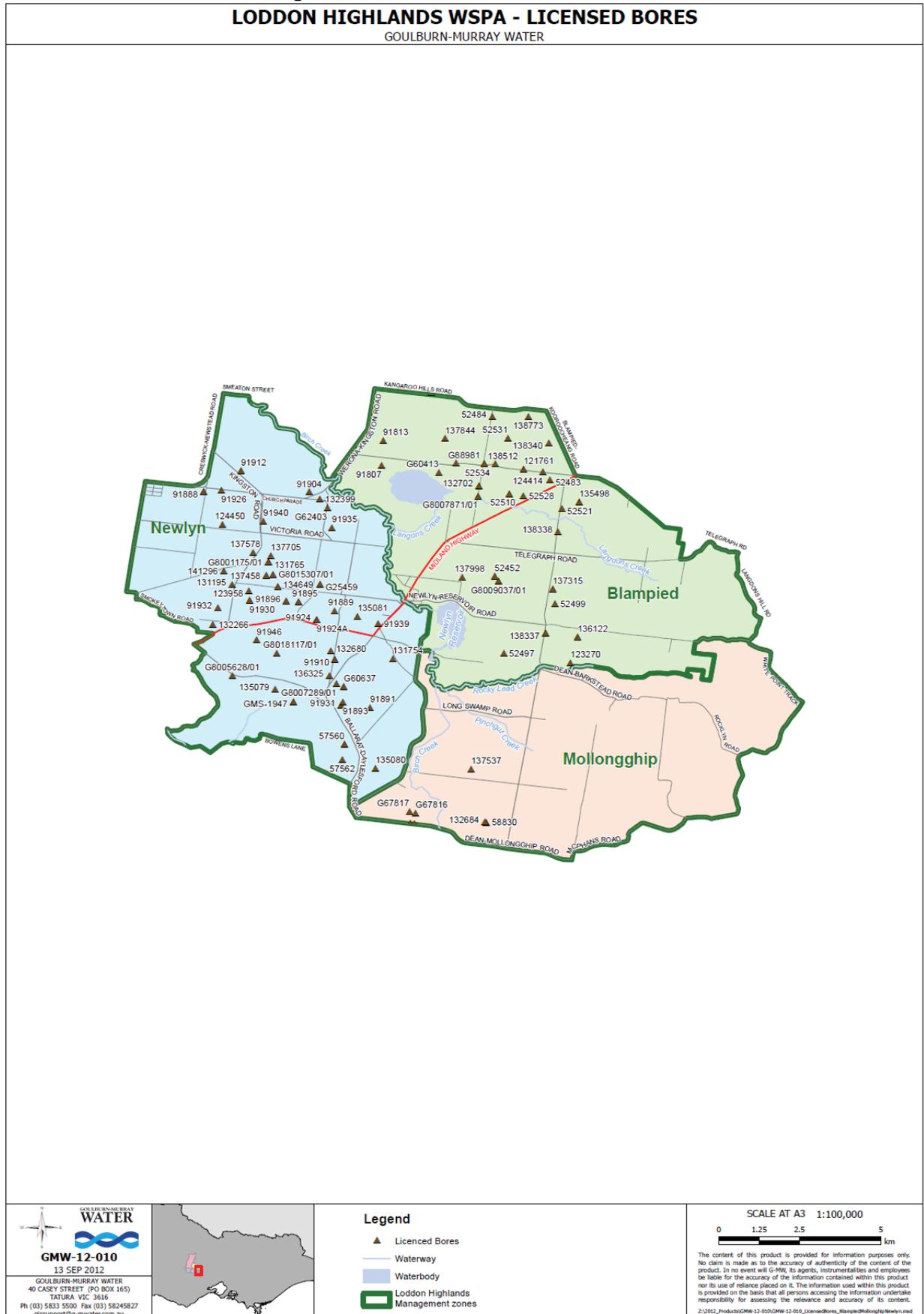
Schedule 1 – Monitoring program

Groundwater levels to be measured monthly and quality annually

Bore ID	Zone	Aquifer monitored	Monitoring purpose					
			Groundwater quality	Interaction with surface water	Groundwater dependent ecosystems	Trigger levels	Response to pumping	Aquifer interaction
138657	Blampied	Basalt				✓	✓	
SP068059	Blampied	Basalt					✓	
138658	Newlyn	Basalt				✓	✓	
116382	Newlyn	Basalt				✓	✓	
SP068047	Newlyn	Deep Lead						✓
SP068048	Newlyn	Basalt		✓	✓			✓
SP068752	Newlyn	Basalt					✓	✓
SP068753	Newlyn	Deep Lead						✓
SP068050	Newlyn	Basalt				✓	✓	✓
SP068588	Newlyn	Basalt			✓		✓	✓
SP068049	Newlyn	Bedrock				✓		✓
SP068057	Ullina	Basalt					✓	✓
SP068058	Ullina	Basalt		✓	✓		✓	✓
SP069835	Ullina	Deep Lead						✓
SP068055	Ullina	Basalt		✓	✓			
SP068256	Ullina	Basalt						✓
SP068257	Ullina	Basalt		✓	✓			✓
138655	Ullina	Basalt		✓	✓			✓
138656	Ullina	Deep Lead						✓
SP068255	Ullina	Basalt	✓	✓	✓			✓
SP069539	Ullina	Deep Lead	✓			✓	✓	✓
46488	Ascot	Deep Lead				✓	✓	✓
119342	Ascot	Basalt				✓	✓	✓
64880	Ascot	Basalt				✓	✓	
64879	Ascot	Basalt				✓	✓	
119377	Ascot	Basalt				✓	✓	
122152	Ascot	Basalt				✓	✓	
SP068242	Ascot	Basalt		✓	✓			
SP068245	Ascot	Basalt					✓	
WRK016267	Waubra	Basalt				✓	✓	
G8010278/01	Waubra	Basalt				✓	✓	
WRK016270	Waubra	Granite					✓	✓
WRK016269	Waubra	Basalt				✓	✓	✓
WRK016266	Waubra	Basalt				✓	✓	
SP068252	Talbot	Basalt	✓					
SP069730	Talbot	Deep Lead	✓					

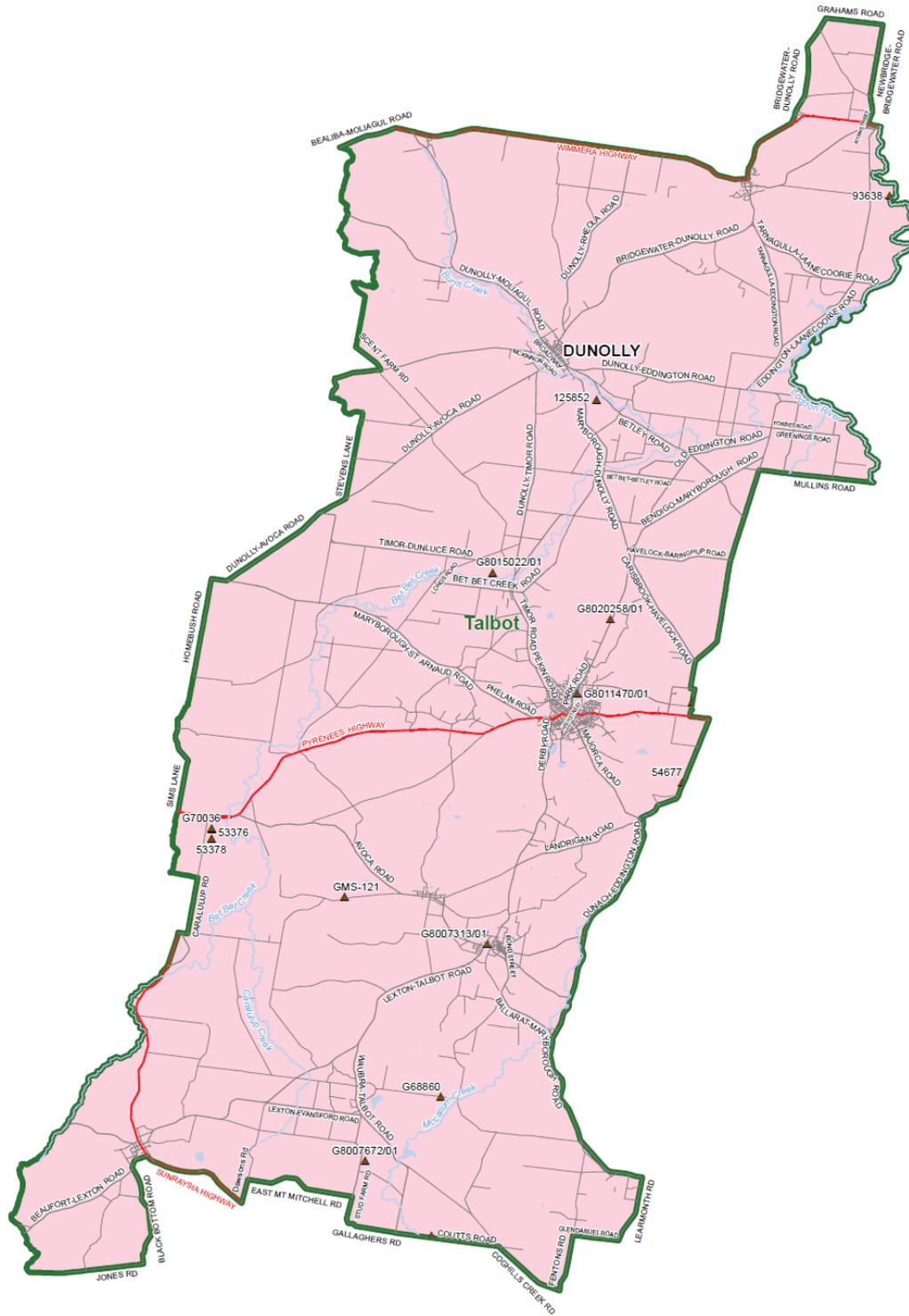
Appendix A

Licensed bores in each management zone in June 2012.



LODDON HIGHLANDS WSPA - LICENSED BORES

GOULBURN-MURRAY WATER





GMW-12-010
12 SEP 2012

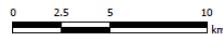
GOULBURN-MURRAY WATER
40 CASEY STREET (PO BOX 165)
TATURA VIC 3616
Ph (03) 5833 5500 Fax (03) 58245827
gissupport@gmw.com.au



Legend

- ▲ Licenced Bores
- Waterway
- Waterbody
- Loddon Highlands Management zones

SCALE AT A3 1:225,000



0 2.5 5 10
km

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Appendix B

Intensity of licence entitlement volume within 2.5 km of each licensed bore as at May 2012 (not subject to particular conditions on individual licences – these will be considered upon application)

