



Lower Campaspe Valley Water Supply Protection Area Groundwater Management Plan

Annual Report

For year ending 30 June 2015

Document History and Distribution

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Foreword

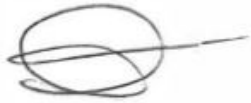
Goulburn-Murray Water (GMW) is pleased to present the annual report for the Lower Campaspe Valley Water Supply Protection Area Groundwater Management Plan (the Plan) for the 2014/15 season.

GMW is responsible for the implementation, administration and enforcement of the Plan, which was approved by the Minister for Water in October 2012.

This report has been prepared in accordance with section 32C of the *Water Act 1989*.

This report provides an overview of the groundwater management activities in the Lower Campaspe Valley Water Supply Protection Area and documents the successful operation of the Plan during the 2014/15 season.

A copy of this report is available for inspection at the GMW Tatura office, or it can be downloaded from the GMW website.



John Calleja
MANAGING DIRECTOR

Date

Executive summary

The Lower Campaspe Valley Water Supply Protection Area (WSPA) Groundwater Management Plan (the Plan) was approved by the Minister for Water in October 2012.

The 2014/15 season marks the third year of operation under the Plan.

Allocations in 2014/15 were 100% of licence entitlement in all management zones of the Lower Campaspe Valley WSPA.

Metered use in the Lower Campaspe Valley WSPA was 65% (36,057 ML) of licence entitlement, which is at the upper end of the historical range of seasonal use.

There was moderate trade activity during 2014/15. There were 22 temporary licence transfers for a total of 3,095 ML. There were also 3 permanent licence transfers for a total of 690 ML.

Licence holders in the Lower Campaspe Valley WSPA are entitled to carryover a maximum of 25% of licence entitlement. A total 13,425 ML of entitlement has been carried over to 2015/16.

Groundwater level monitoring indicates that seasonal aquifer recovery is relatively strong and levels are within observed historical ranges.

Groundwater monitoring and metering programmes continue to be successfully undertaken to support the implementation of the Plan.

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1 Introduction

1.1 Purpose

This annual report has been prepared to meet the requirements of Prescription 7 of the Lower Campaspe Valley Water Supply Protection Area (WSPA) Groundwater Management Plan (the Plan) and section 32C of the *Water Act 1989* (the Act).

This report provides an overview of groundwater management activities undertaken in accordance with the Plan from 1 July 2014 to 30 June 2015.

1.2 Water Supply Protection Area

The Lower Campaspe Valley WSPA was declared in June 2010. It extends from Lake Eppalock in the south to Echuca in the north and includes the towns of Axedale, Goornong, Elmore, Lockington and Rochester.

There are four management zones within the Lower Campaspe Valley WSPA, which are the Barnadown, Elmore-Rochester, Bamawm and Echuca Zones (Figure 1).

The WSPA includes groundwater resources to all depths except where it is overlain by the Campaspe West Salinity Management Plan Area and the region to the north of the Waranga Western Channel including the Shepparton Irrigation Region GMA. In these areas, the Plan only applies to the management of groundwater resources greater than 25 m depth.

1.3 Groundwater Management Plan

The Plan was approved by the Minister for Water in accordance with section 32A(6) of the Act on 17 October 2012.

The objective of the Plan, as defined in section 32A(1) of the Act, is to make sure that groundwater resources of the WSPA are managed in an equitable manner so as to ensure the long term sustainability of those resources. More specifically, the Plan seeks to:

1. protect existing groundwater users and the environment by managing groundwater levels and the potential for change in groundwater salinity;
2. enable equitable development of groundwater resources to realise the potential for its use in the region; and
3. communicate the Plan's objectives, management rules and resource status with stakeholders and the wider community.

Goulburn-Murray Water (GMW) is responsible for the implementation, administration and enforcement of the Plan. An assessment summary of GMW's activities in accordance with Plan prescriptions is presented in Appendix A.

A copy of the Plan can be downloaded from GMW's website at <http://www.g-mwater.com.au/>.

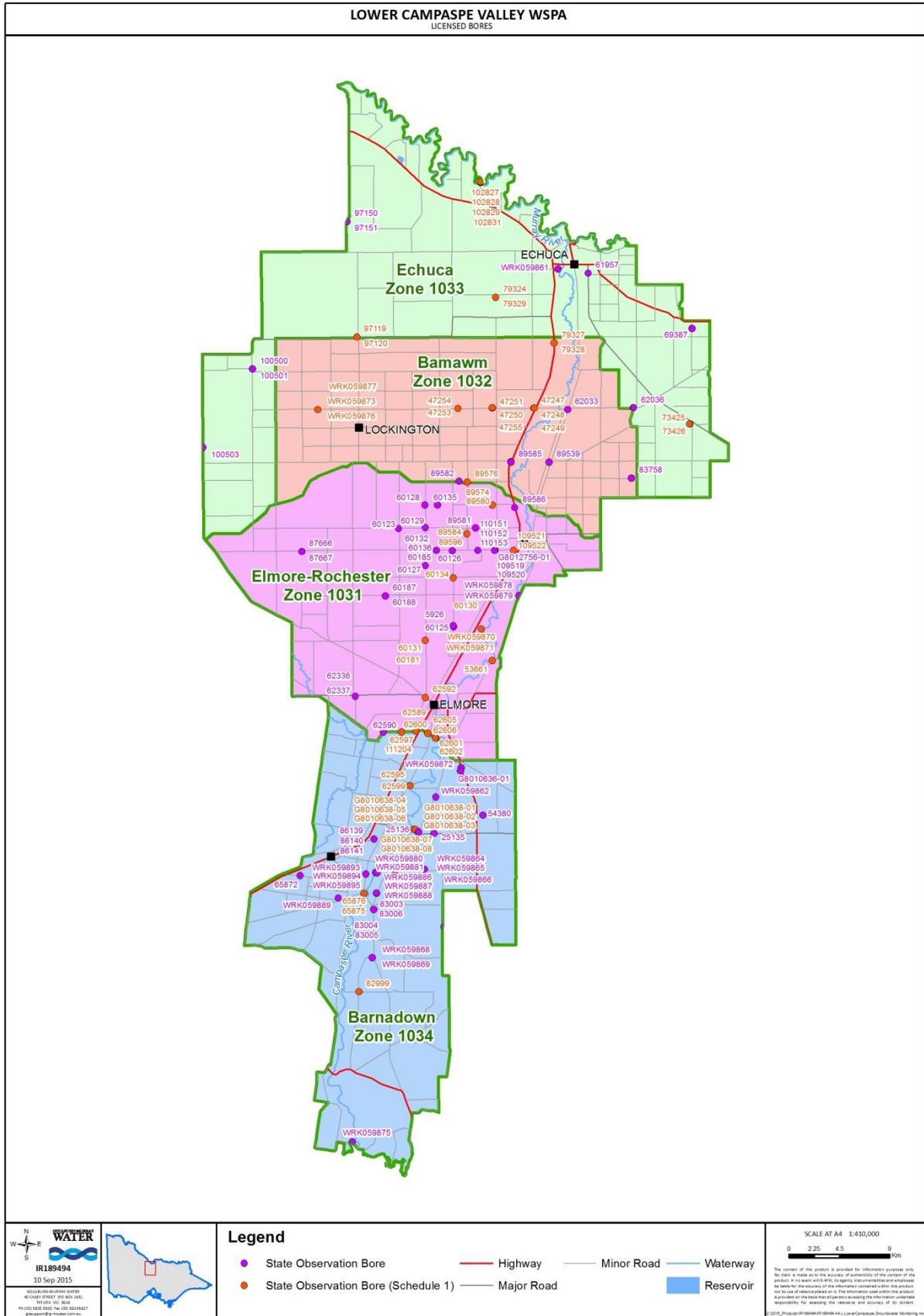


Figure 1 Lower Campaspe Valley Water Supply Protection Area

2 Groundwater management

2.1 Licence volume

The Minister for Water declared the Permissible Consumptive Volume to be 55,875 ML/year in March 2013 (Victorian Government Gazette, 2013). At 30 June 2015 the licence entitlement volume in the Lower Campaspe Valley WSPA was 55,870 ML (Table 1).

Table 1 Licence entitlement in the Lower Campaspe Valley WSPA

Zone	Number of Licences	Licensed bores	Licence volume (ML)
Barnadown	20	55	7,995.0
Elmore-Rochester	58	67	16,835.6
Bamawm	42	47	25,938.9
Echuca	18	18	5,100.9
Total	138	187	55,870.4

Note: Data extracted from the Victorian Water Register 30 June 2015 only recorded a licence volume of 54,790.4 ML/yr. A review of the data identified that some licences weren't included, perhaps due to transactions late in the season. The licence data for July 2015 is correct and these are the values reported here.

Licence entitlement as at 30 June 2014 was 55,874.4 ML/year. The 4 ML/yr reduction in licence entitlement is due to licence surrender in 2014/15.

2.2 Groundwater allocations

Allocations are a percentage of licence entitlement that may be extracted in a given season. Allocations are determined by comparing the three year rolling average of the maximum annual groundwater recovery levels in bores 62589 and 79324 with the Plan trigger levels (Figure 2 and Figure 3). Allocations of 100% were announced on 1 July 2014 for all management zones for the 2014/15 water year.

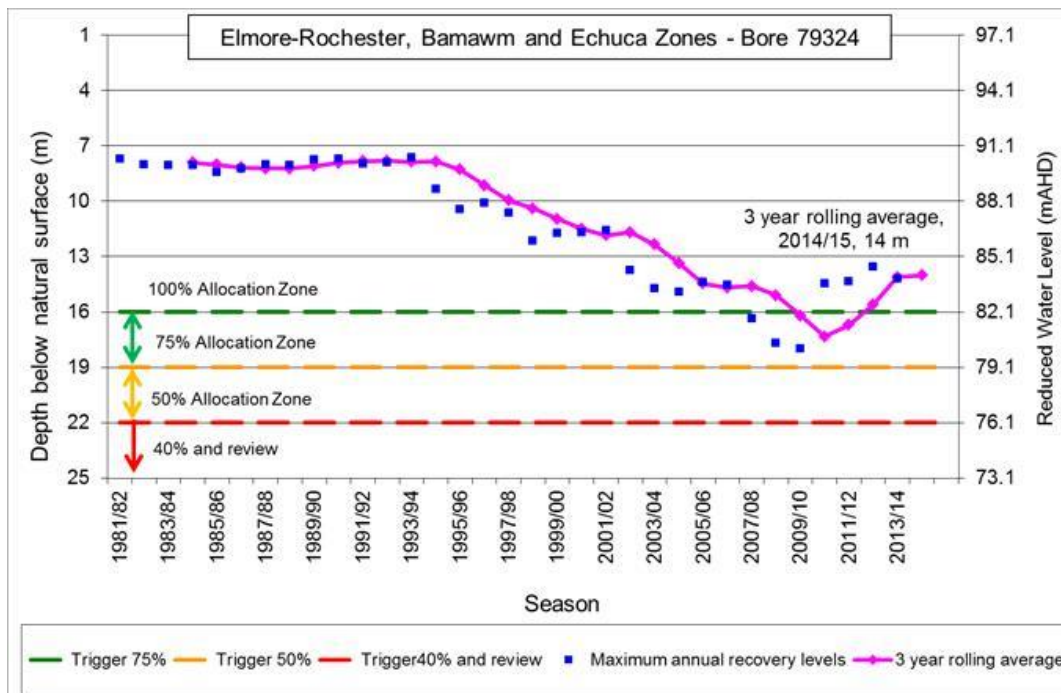


Figure 2 Trigger levels to determine allocations in the Elmore-Rochester, Bamawm and Echuca Zones

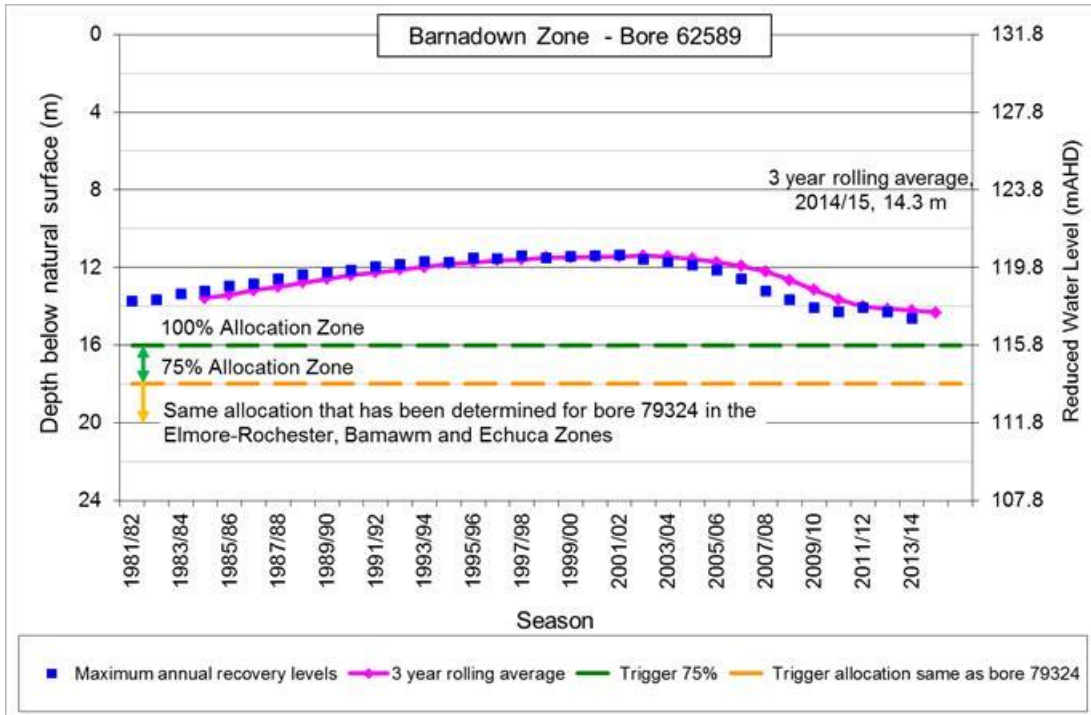


Figure 3 Trigger levels to determine allocations in the Barnadown Zone

2.3 Groundwater use

Metered use in the Lower Campaspe Valley WSPA in 2014/15 was 36,057 ML. This equates to 65% of licence entitlement, which is at the upper end of the historical range (Figure 4).

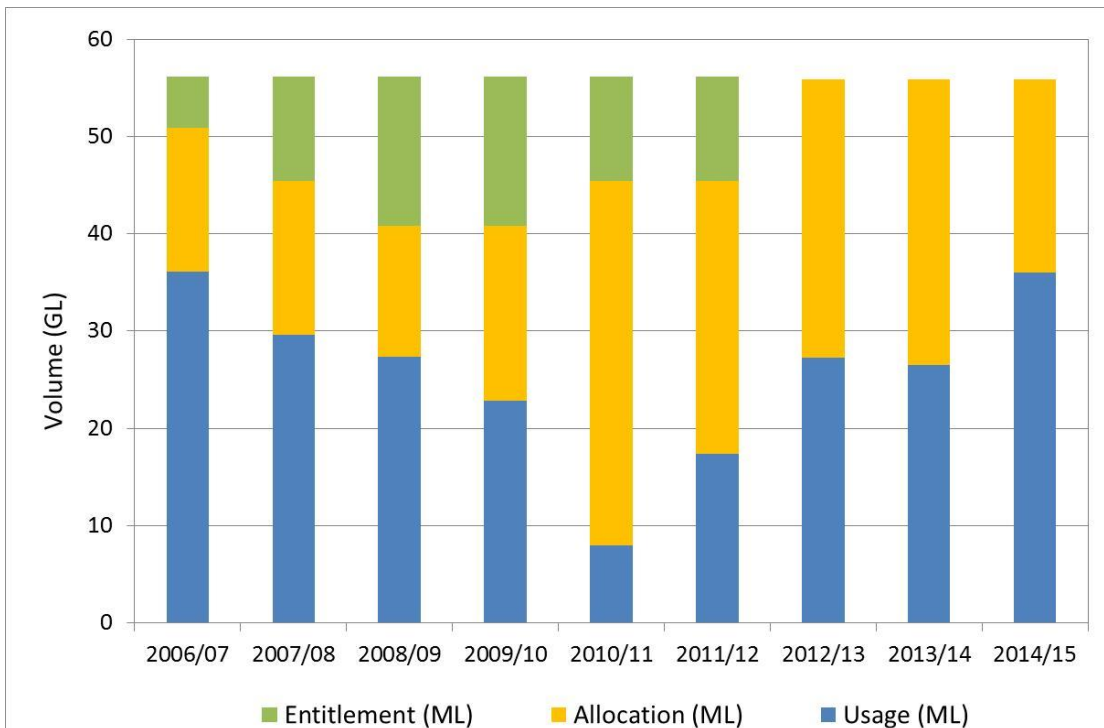


Figure 4 Metered usage in the Lower Campaspe Valley WSPA

Metered usage was highest in the Bamawm Zone (Table 2). Licence holders in the Elmore-Rochester and Echuca Zones used the greatest percentage of licence entitlement.

Table 2 Metered usage in the Lower Campaspe Valley WSPA in 2014/15

Zone	Licence volume (ML)	Metered use (ML)	% Licence entitlement
Barnadown	7,995.0	4,544.1	57%
Elmore-Rochester	16,835.6	11,727.9	68%
Bamawm	25,938.9	16,485.6	64%
Echuca	5,100.9	3,299.3	67%
Total	55,870.4	36,056.9	65%

2.4 Rainfall

Rainfall data from the Bureau of Meteorology (BoM) weather station at Rochester indicates that rainfall during 2014/15 was below average (Figure 5).

Since high rainfall events in 2010/11, the cumulative deviation from the mean monthly rainfall indicates that rainfall has mostly been below average. The drier conditions have resulted in reduced recharge to the groundwater system.

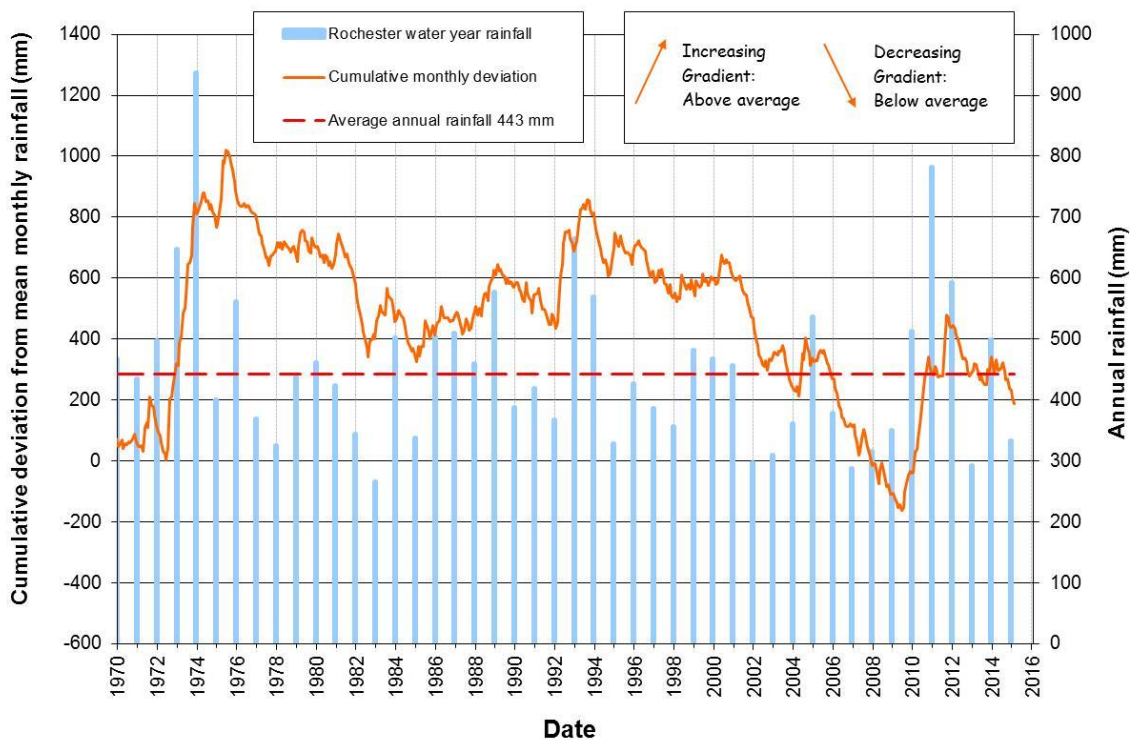


Figure 5 Rainfall at Rochester (BoM station 080049)

2.5 Transfer of entitlement

The Plan allows groundwater licence holders to temporarily or permanently transfer licence entitlement. In 2014/15 there were 22 temporary licence transfers for a total of 3,095 ML and 3 permanent transfers for a total of 690 ML. This level of licence transfer activity is similar to previous seasons (Figure 6).

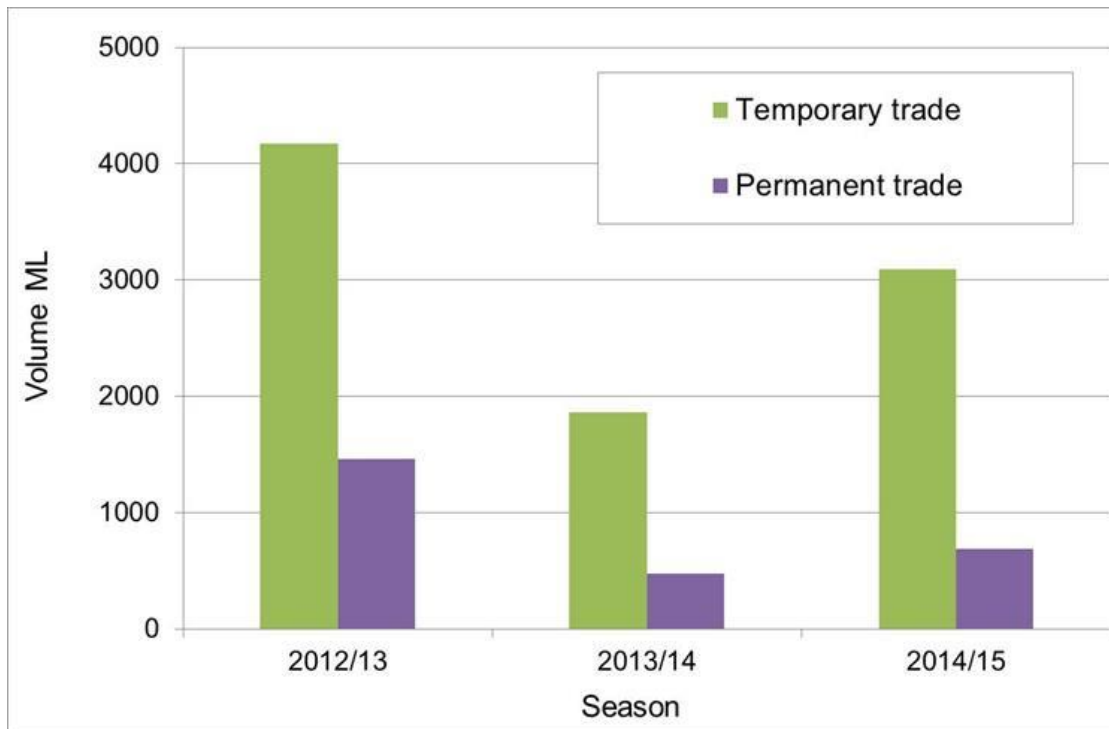


Figure 6 Total licence transfer volume traded in the Lower Campaspe Valley WSPA

The majority of temporary licence transfers occurred within the same management zone (Table 3). There were some transfers between zones with 111 ML transferred out of the Echuca Zone; 11 ML transferred into the Bamawm Zone; and 100 ML transferred into the Elmore-Rochester Zone.

There was 690 ML permanently transferred out of the Bamawm Zone, with 190 ML transferred into the Echuca Zone and 500 ML transferred into the Elmore-Rochester Zone.

Table 3 Licence transfers in the Lower Campaspe Valley WSPA in 2014/15

Zone	Temporary				Permanent			
	Transfer from		Transfer to		Transfer from		Transfer to	
	No. of transfers	Volume (ML)	No. of transfers	Volume (ML)	No. of transfers	Volume (ML)	No. of transfers	Volume (ML)
Echuca	2	148	3	37	0	0	2.0	190
Bamawm	10	1,380	8	1,391	3	690	0	0
Elmore-Rochester	7	1,042	8	1,142	0	0	1.0	500
Barnadown	3	525	3	525	0	0	0	0
Total	22	3095	22	3095	3	690	3	690

2.6 Carryover

The Minister for Water declared that groundwater licence holders in the Lower Campaspe Valley WSPA were authorised to take carryover from November 2012 (Victorian Government Gazette, 2012).

The maximum amount of entitlement that may be carried over by a licence holder in a water season is 25% of their licence volume (13,967 ML).

There was total of 13,689 ML of carryover available to licence holders in the Lower Campaspe Valley WSPA in the 2014/15 season.

At the conclusion of the 2014/15 season, groundwater licence holders in the Lower Campaspe Valley WSPA were able to carryover a total of 13,425 ML into the 2015/16 season.

2.7 Domestic and stock bores installed

GMW received 20 bore completion reports for bores constructed for domestic and stock purposes in the Lower Campaspe Valley WSPA during the 2014/15 season.

3 Monitoring program

3.1 Groundwater levels

The Department of Environment, Land, Water and Planning (DELWP) monitored 132 bores from the State Observation Bore Network on a quarterly basis in the Lower Campaspe Valley WSPA (Figure 1).

GMW conducted monthly monitoring of 60 key State observation bores identified in Schedule 1 of the Plan (Appendix B). Monitoring indicates that seasonal groundwater level recovery is strong and observation bore levels are within observed historical ranges.

In the Elmore-Rochester and Bamawm Zones, groundwater recovery levels have continued to decline by up to 6 m following the floods in 2010/11. Seasonal drawdown of up to 18 m was observed in more intensively pumped areas in 2014/15 (Figure 7).

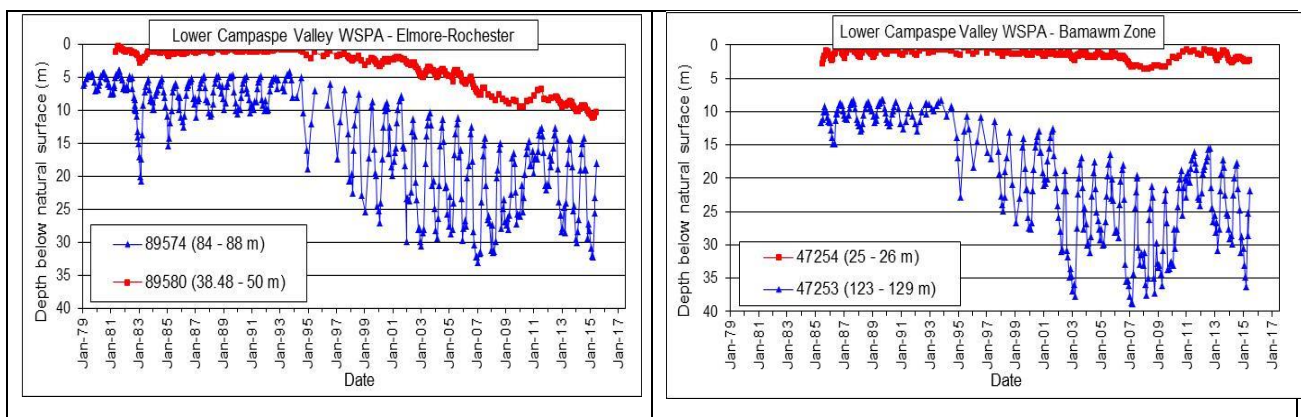


Figure 7 Groundwater levels in the Elmore-Rochester and Bamawm Zones

In comparison, in the Barnadown and Echuca Zones groundwater recovery levels have remained relatively steady and seasonal drawdown of up to around 5m is seen.

Interestingly, in the Barnadown Zone groundwater levels continued to rise through the dry period until about 2005, whereas in other areas levels were generally falling from the mid-1990s. By contrast, the groundwater levels in the Barnadown Zone did not recover strongly following the wet period in 2010/11 as they did in other areas. Rather, the groundwater levels in the Barnadown Zone appeared to steady, but are now declining (Figure 8). This response may be related to the processes and controls influencing groundwater recharge, such as the extent of the aquifer in the Barnadown Zone.

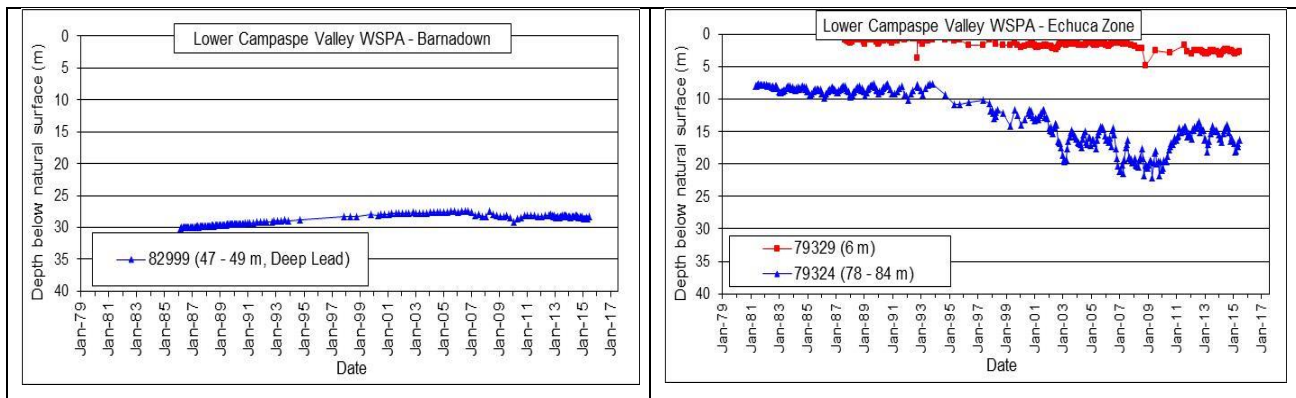


Figure 8 Groundwater levels in Barnadown and Echuca Zones

3.2 Groundwater quality

Groundwater user salinity sampling

GMW sent 164 sample bottles and a reply paid envelope to licence holders, and domestic and stock users upon request, to collect a groundwater sample from their bore for analysis. There were 42 samples returned for analysis (a return rate of 25%).

GMW measured the groundwater salinity, advised each bore owner of the result and recorded the data in the State groundwater database. The results are shown spatially in Figure 9 and show more saline groundwater in the northern parts of the Lower Campaspe Valley WSPA. Higher groundwater salinity levels west of the Campaspe River in the Barnadown zone may be influenced by groundwater from the Huntly Deep Lead.

A higher and more consistent sample return rate would assist with spatially assessing any changes in groundwater salinity over time. Groundwater users are strongly encouraged to participate in this program so that they can identify any changes in groundwater salinity; which in turn enables a greater understanding of how using groundwater from their bore might impact on their business.

Targeted sampling of licensed bores

GMW has enlisted six licence holders to participate in the targeted groundwater salinity monitoring program. The purpose of the program is to ensure that samples are consistently collected each year from private bores in strategic locations that will provide a reliable data set to aid in understanding any changes in groundwater salinity over time. The results are presented in Appendix C.

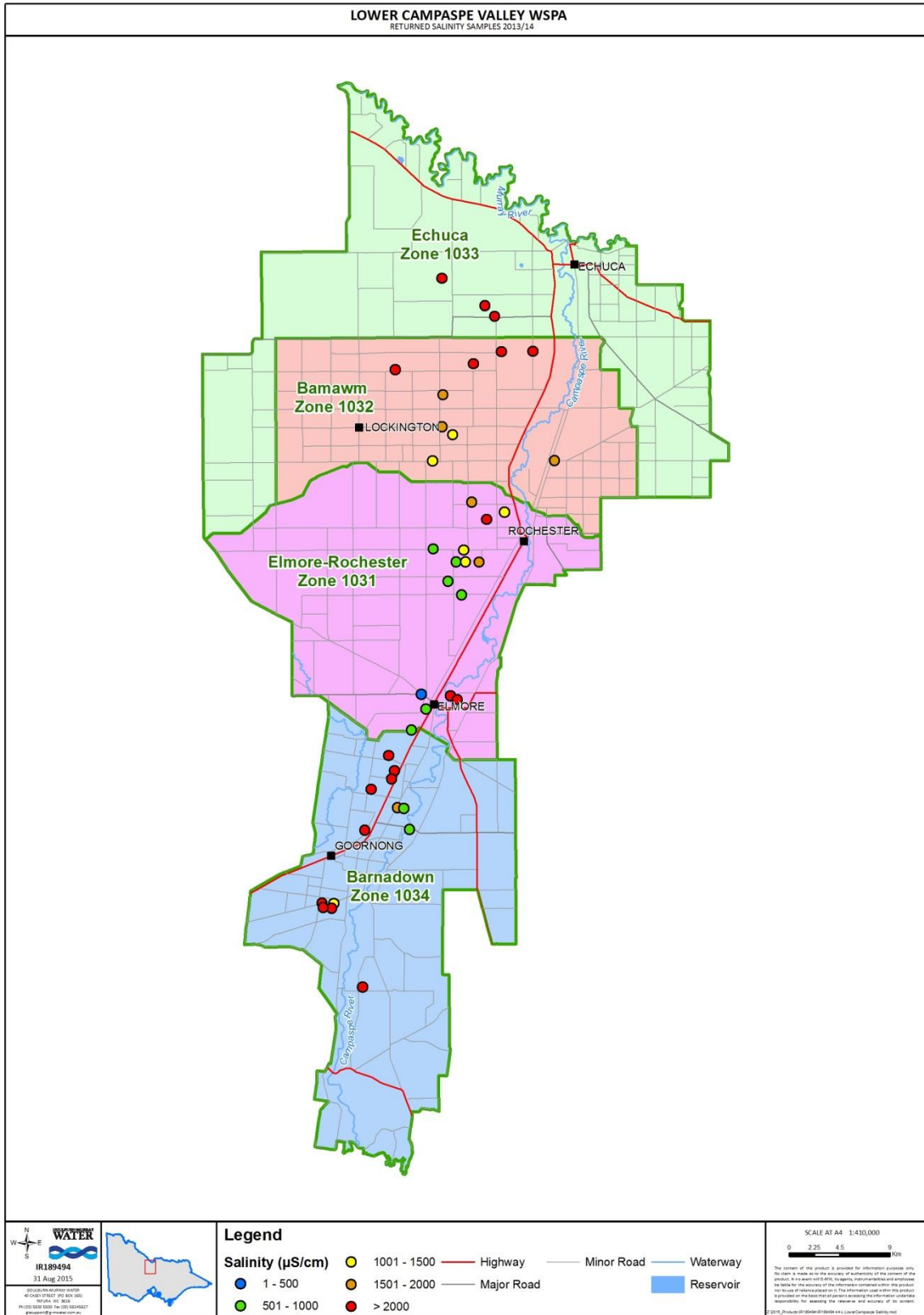


Figure 9 Location of returned samples analysed for groundwater salinity

Sampling from State observation bores

Groundwater samples from nested State observation bores were sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. Nested sites feature two or more monitoring bores in close proximity, each monitoring a different aquifer. The State observation bores used for water quality testing are located in the areas of intensive groundwater pumping west of Rochester and at the northern margins of the Lower Campaspe Valley WSPA.

Groundwater salinity results are presented in Table 4. The results have been compared to earlier measurements of groundwater salinity (Appendix C). Continued monitoring of groundwater quality will enable any trends to be identified with greater confidence.

Table 4 Groundwater salinity levels in key monitoring bores October 2014

Bore number	Zone	Screen depth below natural surface (m)	EC ($\mu\text{S}/\text{cm}$)
102827	Echuca	108 - 114	4,670
102828	Echuca	160 - 167	10,300
102829	Echuca	70 - 74	4,070
73425	Echuca	87 - 89	10,700
73426	Echuca (SIR)	6 - 18	8,730
WRK059873	Bamawm	82 - 87	3,930
WRK059876	Bamawm	91 - 97	2,900
WRK059877	Bamawm	34 - 37	4,180
47250	Bamawm	73 - 85	3,840
47251	Bamawm	22 - 27	1,740
89584	Elmore-Rochester	84 - 88	5,390
89596*	Elmore-Rochester	2 - 14	Bore dry

3.3 Metering

All operational licensed bores in the Lower Campaspe Valley WSPA were metered as of 30 June 2015. There were 9 meters that required maintenance activity in 2014/15 (Table 5).

All meters were read at least twice during the 2014/15 season.

Table 5 Metering activities

Metering activity	Year ending 30 June 2015
Number of meters installed or replaced	24
Meter maintenance events	9
Total number of meters in WSPA	169
Total number of meter reads	338

3.4 Licence compliance

There were no prosecutions or convictions relating to groundwater matters in the Lower Campaspe Valley WSPA in 2014/15.

There were six incidents of unauthorised take and use of groundwater. These incidents have been investigated and GMW has taken action in accordance with the National Framework for

Compliance and Enforcement of Systems for Water Resource Management (DSEWPC, 2012). This includes verbal and written notification not to take water without authorisation; a direction to apply to transfer entitlement to account for usage; and providing information on groundwater licence transfer options.

4 Future management considerations

4.1 Groundwater Reference Committee

The Groundwater Reference Committee, appointed in accordance with Prescription 7(c) of the Plan, met on 21 October 2014. Key actions of the meeting included requests for GMW to:

- consider the need to hold a customer meeting in August 2015;
- follow up on options to assist with facilitating groundwater trading; and
- send out salinity sample bottles before Christmas.

GMW elected not to hold a meeting in August 2015 due to the favourable groundwater resource conditions and due to the need to prioritise Water Plan 4 pricing submission consultation.

GMW continues to pursue options to assist with facilitating groundwater transfers. Consideration is currently being given to developing an on-line trading forum to assist customers find available sellers and buyers of licence entitlement.

GMW sent out salinity sample bottles in December 2014 as requested.

4.2 SOBNI review

The State Observation Bore Network (SOBN) is owned and managed by the DELWP. DELWP currently monitors around 2,300 bores across Victoria on a quarterly basis to provide valuable information on groundwater resources.

DELWP is undertaking a detailed review of the SOBNI, which aims to identify opportunities to make the network more cost effective.

GMW will seek its customers' views on future groundwater monitoring needs through its Regional Water Services Committees and the Groundwater Reference Committee.

5 References

Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2012. National Framework for Compliance and Enforcement of Systems for Water Resource Management. Viewed 28 August 2014,

<http://www.environment.gov.au/system/files/resources/d4367a3b-28a9-430d-a869-2effbda8a447/files/ris-water-compliance-enforcement.pdf>

Goulburn-Murray Water, 2013. Lower Campaspe Valley Water Supply Protection Area Groundwater Targeted licensed bore sampling. Unpublished report by Goulburn-Murray Water, Tatura. Document reference number 3503975.

Department of Sustainability and Environment, 2012. Lower Campaspe Valley Water Supply Protection Area Groundwater Management Plan October 2013. Department of Environment and Primary Industries, Melbourne

Victorian Government, 2012. Victorian Government Gazette No. G43 25 October 2012. Victoria Government, Melbourne

Victorian Government, 2013. Victorian Government Gazette No. G10 7 March 2013. Victoria Government, Melbourne

Appendix A – Assessment of activities against Plan prescriptions

Prescription	Activity	Compliant
<p>Prescription 1: Triggers and Restrictions</p> <p>By 1 July each year the Corporation will:</p> <ul style="list-style-type: none"> (a) Determine the rolling average of the maximum annual groundwater recovery levels from the preceding three seasons for the relevant bore, or its replacement, and announce a corresponding allocation for the subsequent season for zones as detailed in the Plan. (b) Announce seasonal allocations by listing them on its website; sending letters to all licence holders and placing public notices in local newspapers. (c) Not apply restrictions to any water authorised to be taken in a subsequent water season (carryover). 	<p>GMW determined the rolling average of the maximum annual groundwater recovery levels from the preceding three seasons and announced allocations of 100% in all management zones on 1 July 2014.</p> <p>GMW announced allocations by listing them on their website, sending letters to all licence holders and placing public notices in local newspapers.</p>	Yes
<p>Prescription 2: Trading rules</p> <p>The Corporation may approve a transfer of a groundwater licence under section 62 of the <i>Water Act 1989</i> provided section 53 matters have been considered and it accords with the following:</p> <ul style="list-style-type: none"> (a) Transfer of licence entitlement can occur between zones as specified in the Plan (b) Despite (a) above, if the groundwater level falls to a depth of 18 metres below the natural surface in bore 62589 a licence may be transferred between the Barnadown Zone and other zones (c) Limits on the maximum licence volume in each zone as specified in the Plan are not exceeded. 	<p>GMW processed 22 temporary transfer transactions for a total of 3,095 ML; and 3 permanent transfer transactions for a total of 690 ML in 2014/15.</p> <p>GMW processed all groundwater licence applications in accordance with Prescription 2(a) and (c).</p>	Yes
<p>Prescription 3: Intensive groundwater pumping</p> <p>The Corporation may approve an application to take and use groundwater under section 51 or a transfer under section 62 of the <i>Water Act 1989</i> provided that section 53 matters have been considered and the following conditions are satisfied:</p> <ul style="list-style-type: none"> (a) For a permanent transfer, the total licence entitlement of bores within a 4 km radius 	<p>GMW processed all groundwater licence applications in accordance with Prescription 3.</p>	Yes

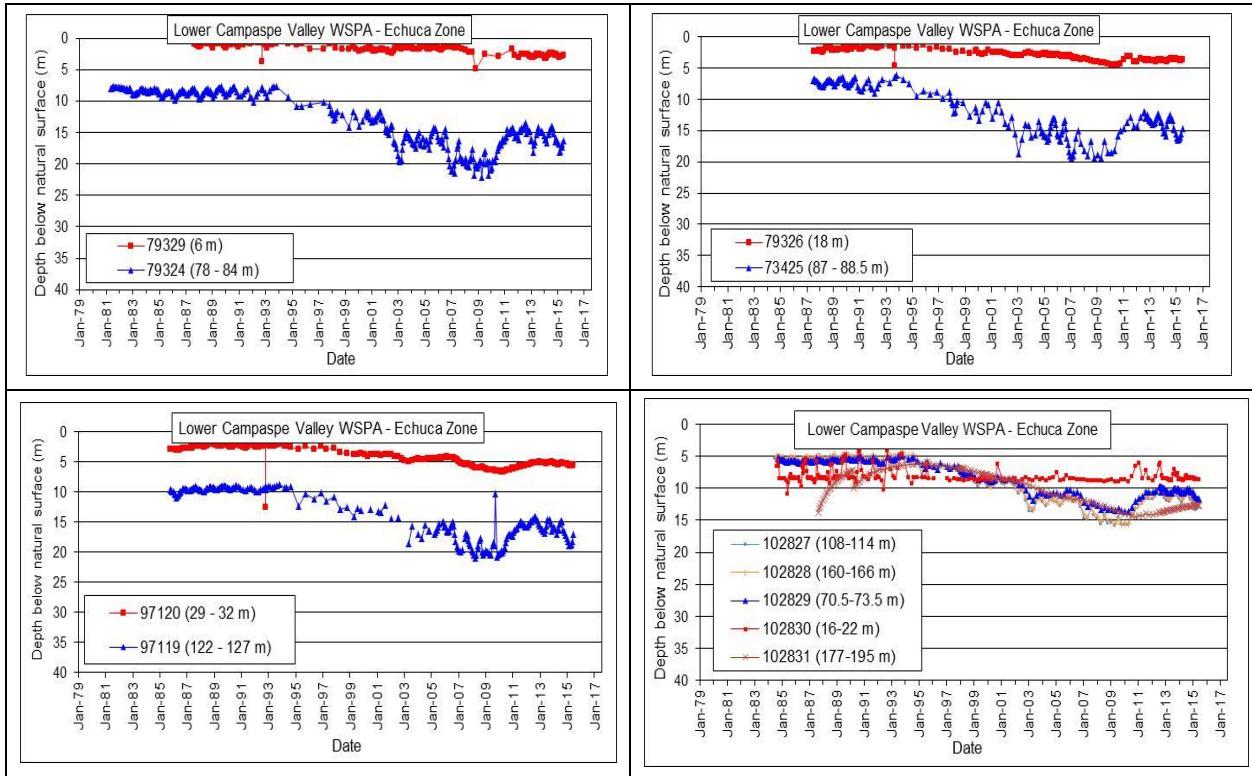
<p>of an applicant's bore is less than 7.5 GL/yr.</p> <p>(b) Where summed licence entitlement exceed the limits specified in (a) above, then a licence holder's usage is to be limited to 125% of entitlement in one water season whether it occurs through either temporary transfer of entitlement or carryover.</p> <p>(c) Usage may exceed 125% of entitlement as specified in (b) above through temporary or permanent transfer of entitlement from others within the 4 km radius.</p>		
<p>Prescription 4: Monitoring groundwater levels</p> <p>The Corporation will:</p> <p>(a) Obtain monthly groundwater level readings (up to 480 readings per season) from key State observation bores from the list in Schedule 1, or their replacement, where practicable.</p> <p>(b) Install at least one new observation bore in the Coonambidgal Formation to better inform groundwater interaction with the Campaspe River.</p>	<p>GMW obtained monthly groundwater level readings from bores listed in Schedule 1 of the Plan where practicable.</p> <p>A new observation bore is still to be installed in the Coonambidgal Formation. Consideration will be given to the installation of this bore as part of the SOBN review.</p>	Yes
<p>Prescription 5: Monitoring groundwater salinity</p> <p>The Corporation will:</p> <p>(a) Support annual groundwater user salinity sampling by:</p> <p>(i) Providing a sample bottle and a reply paid envelope to each groundwater licence holder and request that they collect a groundwater sample from all their licensed bores and return the samples to the Corporation for salinity analysis.</p> <p>(ii) Providing a sample bottle and a reply paid envelope to any domestic and stock groundwater user upon their request for them to provide a sample for salinity analysis.</p> <p>(iii) Measuring groundwater salinity in all returned sample bottles and providing the bore owner with the results.</p> <p>(iv) Entering the groundwater salinity results into the State groundwater database.</p> <p>(b) Establish a targeted groundwater salinity monitoring program to collect and analyse groundwater samples from selected licensed bores each year.</p> <p>(c) Collect groundwater samples from selected State observation bores identified in Schedule 1 where practicable, or their replacement</p>	<p>GMW provided a sample bottle to licence holders and domestic and stock users upon request. GMW measured the groundwater salinity in returned samples, advised bore owners of the result and entered the results into the State groundwater database.</p> <p>GMW engaged with the six land holders participating in the target sampling of licensed bores. A total of 10 bores were sampled in 2014/15.</p> <p>GMW collected groundwater samples from nested State observation bores identified in Schedule 1 where practicable and sent them to a NATA accredited laboratory for analysis.</p>	Yes

<p>Prescription 6: Metered licensed use</p> <p>The Corporation will:</p> <ul style="list-style-type: none"> (a) Ensure that a meter is fitted to all operational licensed bores. (b) Read each meter at least once a year and enter readings into the Water Register. 	<p>All operational licensed bores are metered.</p> <p>Meters were read in February/March and May/June 2014 and data entered into the Water Register.</p>	<p>Yes</p>
<p>Prescription 7: Plan implementation</p> <p>The Corporation will:</p> <ul style="list-style-type: none"> (a) Post on its website the Plan; annual reports and newsletters; groundwater levels; and rolling average for trigger bores. (b) Mail a newsletter in October each year to groundwater licence holders, and domestic and stock users upon request, in the Lower Campaspe Valley WSPA and relevant agencies stating the resource position and summarising outcomes in the annual report. (c) Meet with the Groundwater Reference Committee at least once each year to report on the groundwater resource status and implementation of the Plan and consider the need to review the Plan. (d) Undertake a comprehensive review of the Plan after five years from 	<p>GMW has posted on its website the Plan, annual reports, groundwater level and rolling average for trigger bores.</p> <p>GMW held a customer meeting in Rochester on October 2014 to report on Plan implementation and provide advice on groundwater licence transfers. Newsletters reporting on resource status and implementation of the Plan were made available at the meeting. The newsletters were also mailed out to customers with early advice of allocations for the 2015/16 water year.</p> <p>GMW met with the Groundwater Reference Committee in October 2014 to discuss Plan implementation.</p>	<p>Yes</p>

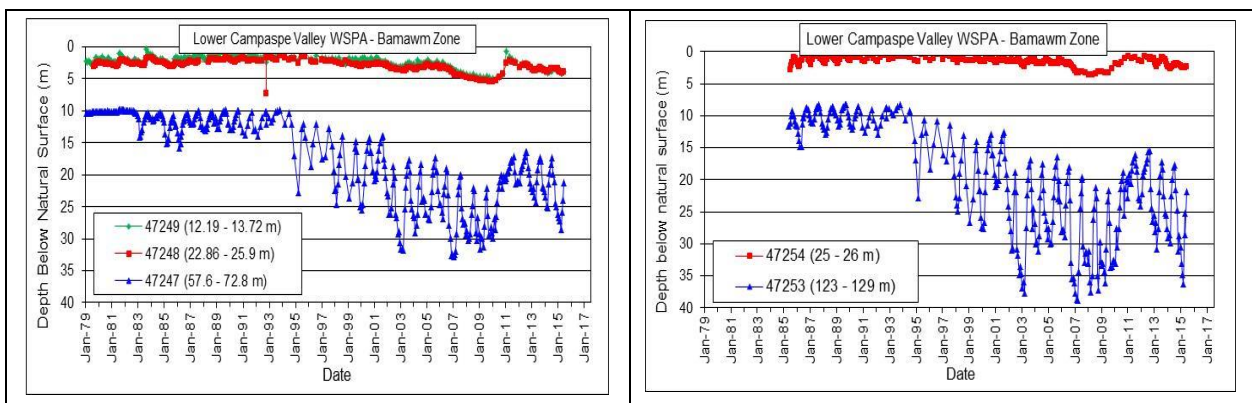
Appendix B – Hydrographs

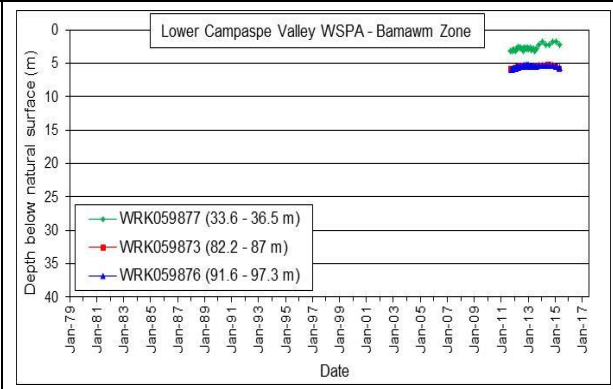
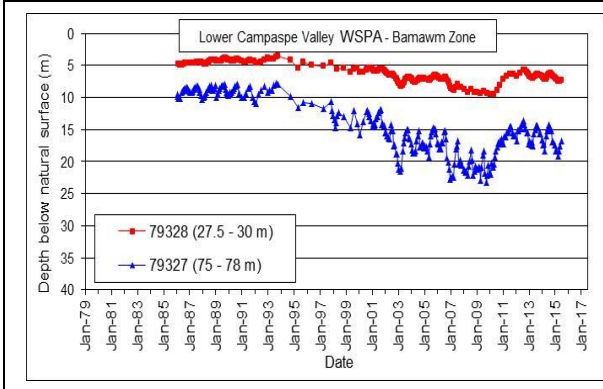
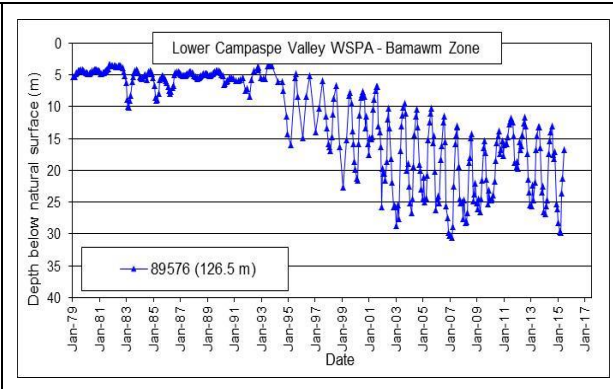
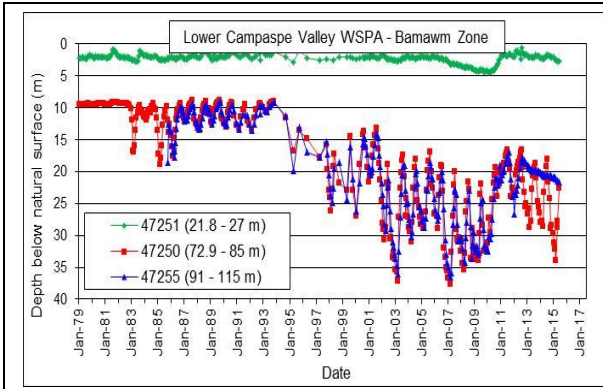
Hydrographs for key monitoring bores listed in Schedule 1 of the Plan. Further groundwater level information from other State observation bores is available on the Visualising Victoria's Groundwater website at <http://www.vvg.org.au/>.

Echuca Zone

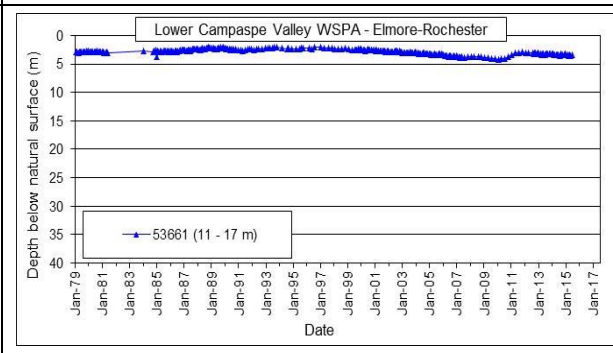
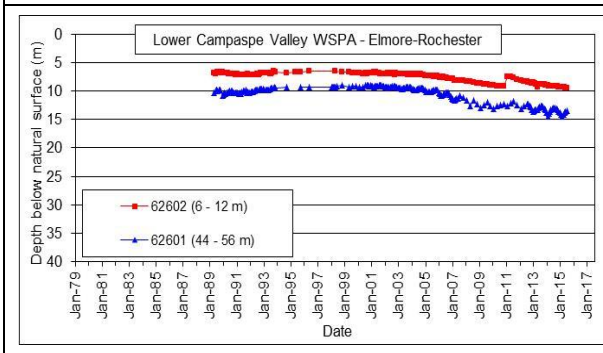
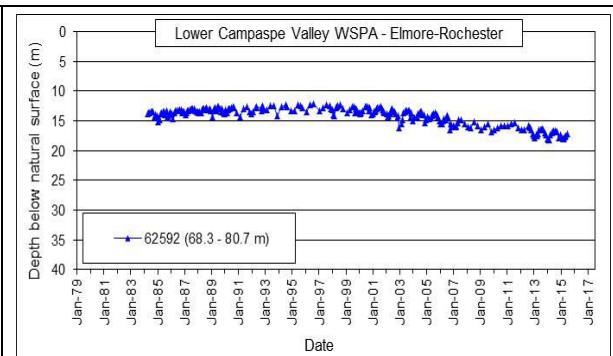
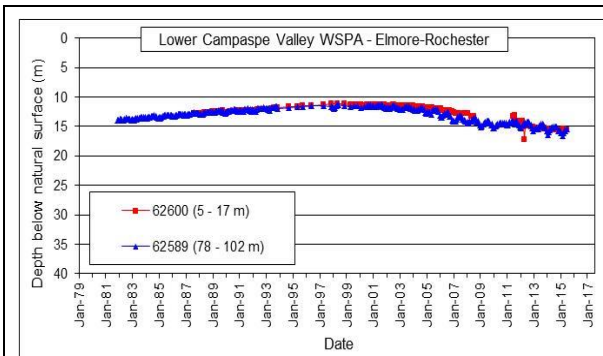


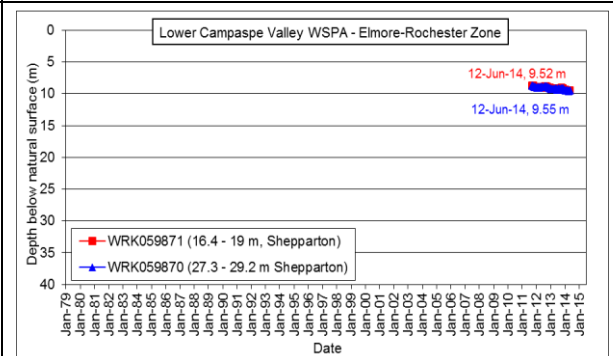
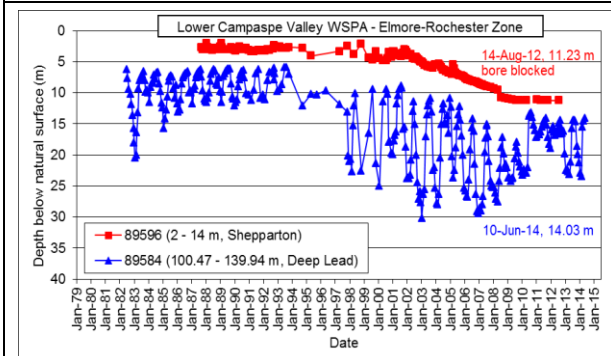
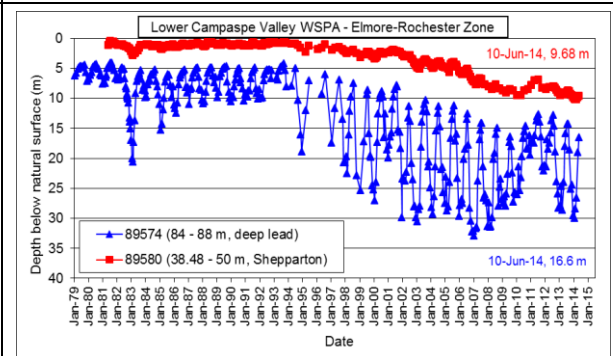
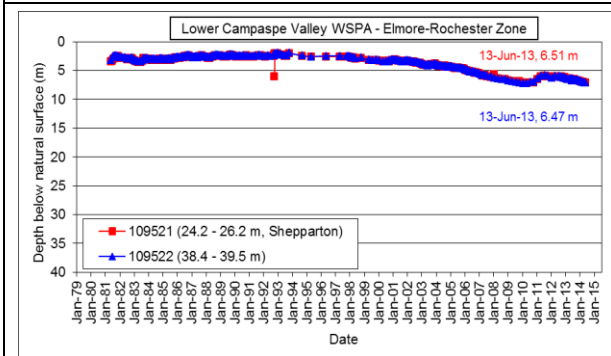
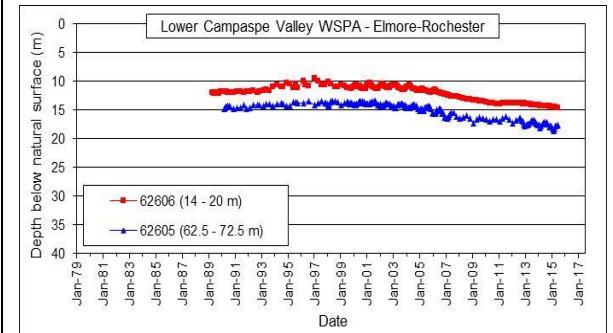
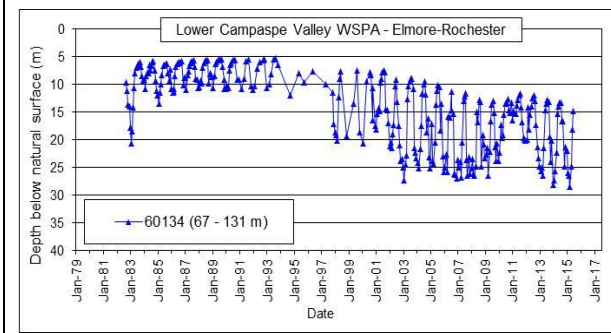
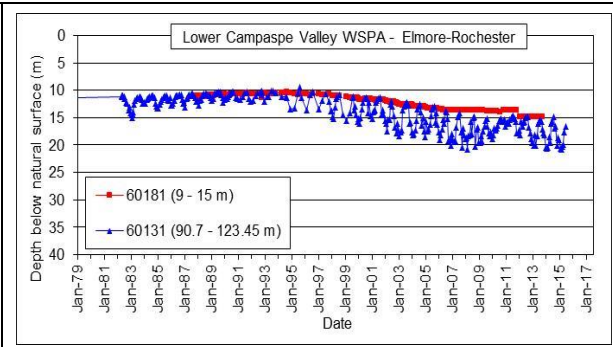
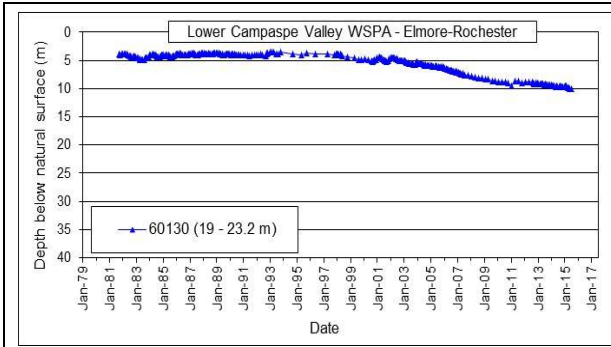
Bamawm Zone



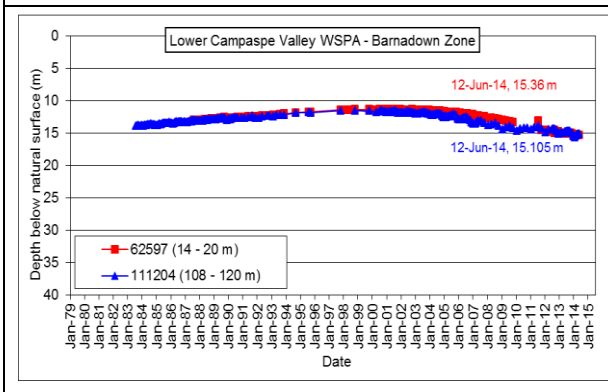
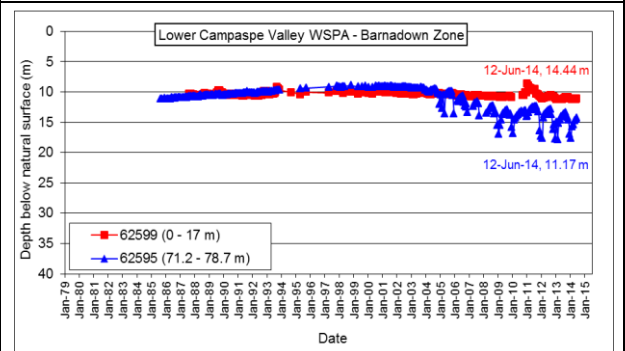
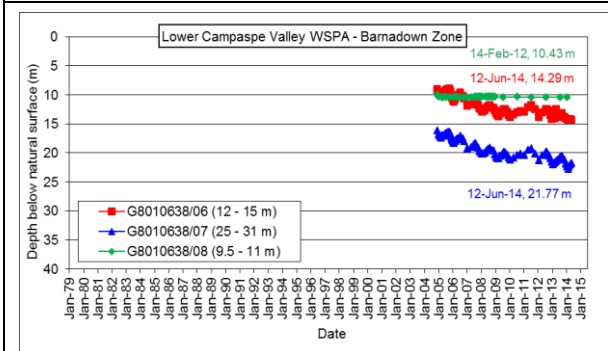
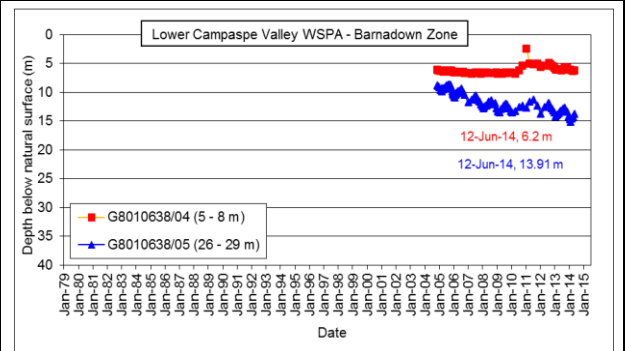
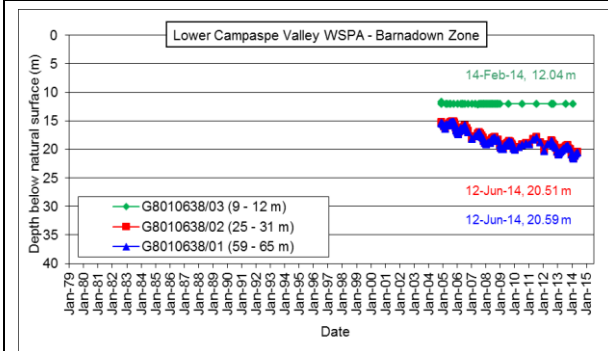
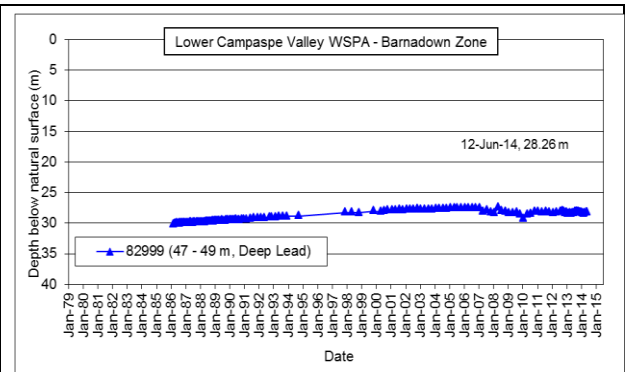
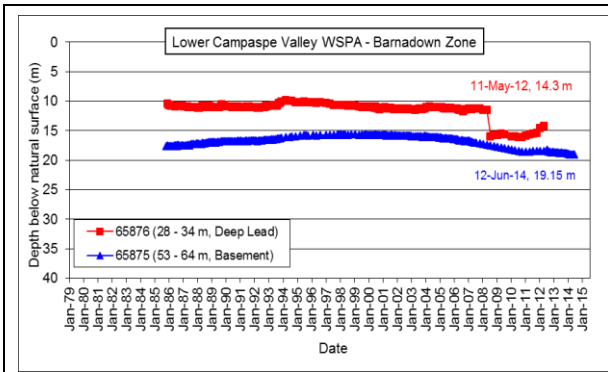


Elmore-Rochester Zone



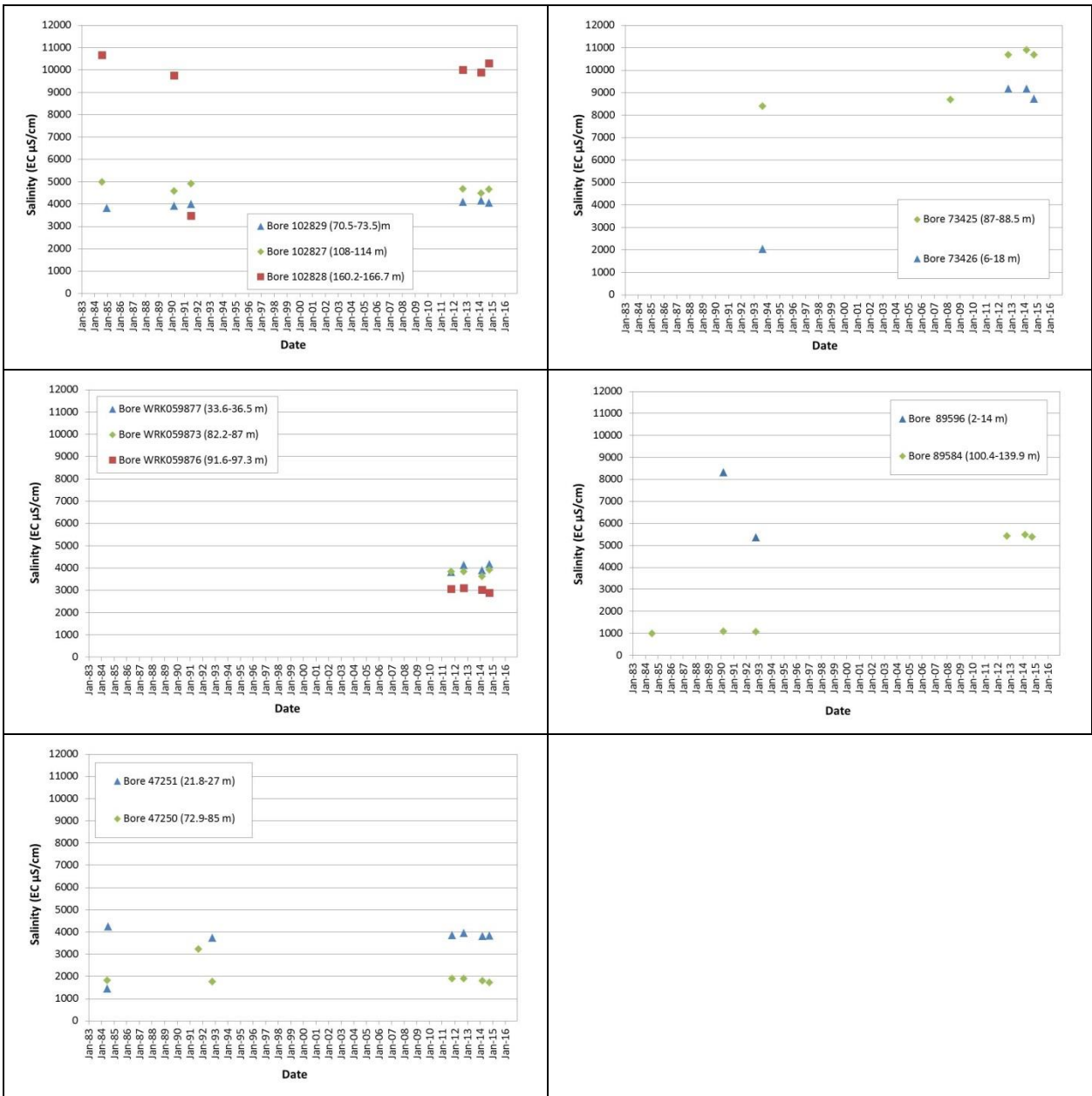


Barnadown Zone



Appendix C – Groundwater quality

Historical groundwater salinity from State observation bores listed in Schedule 1 of the Plan



Groundwater quality results from State observation bores listed in Schedule 1 of the Plan

Analyte	Bore	102828	102827	102829	WRK 059873	WRK 059876	WRK 059877	47251	47250	73425	73426	89584
		16/10/14	16/10/14	16/10/14	7/10/14	7/10/14	7/10/14	8/10/14	8/10/14	8/10/14	8/10/14	16/10/14
Electrical Conductivity @ 25°C	µS/cm	10300	4670	4070	3930	2900	4180	3840	1740	10700	8730	5390
Total Dissolved Solids @180°C	mg/L	6020	2590	2380	2040	1630	2210	1850	862	6250	5260	3430
Turbidity	NTU	26.8	47.8	34.6	12.7	82.8	1.4	29.8	103	5.6	77.1	47.4
Bicarbonate Alkalinity as CaCO3	mg/L	159	79	179	138	207	148	114	52	196	57	<1
Carbonate Alkalinity as CaCO3	mg/L	64	91	<1	<1	<1	<1	25	22	<1	<1	<1
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	mg/L	223	170	179	138	207	148	139	74	196	57	<1
Sulfate as SO4 - Turbidimetric	mg/L	251	178	273	180	<1	298	169	9	519	974	3
Chloride	mg/L	3630	1280	1040	1080	917	1110	1070	541	3770	2820	1760
Calcium	mg/L	28	4	35	72	47	60	12	6	130	116	80
Magnesium	mg/L	281	90	79	102	67	91	61	22	291	222	119
Potassium	mg/L	17	9	7	10	8	12	14	6	16	9	6
Sodium	mg/L	1670	763	662	541	447	660	686	285	1810	1560	320
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Copper	mg/L	0.001	<0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.002
Iron	mg/L	<0.05	<0.05	0.05	<0.05	5.17	<0.05	<0.05	<0.05	0.48	<0.05	556
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Manganese	mg/L	0.127	0.066	0.02	0.003	0.243	0.067	0.052	0.019	0.121	0.004	22
Nickel	mg/L	<0.001	<0.001	0.076	0.001	0.003	0.001	<0.001	<0.001	<0.001	0.003	0.001
Zinc	mg/L	<0.005	<0.005	<0.005	0.022	0.018	<0.005	<0.005	<0.005	0.018	<0.005	0.122
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Ammonia as N	mg/L	0.78	0.11	0.04	0.26	0.21	0.04	0.31	0.29	0.18	0.02	0.22
Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	<0.01	0.01	0.02	0.03	0.86	0.01	0.03	0.01	2.46	0.01
Nitrite + Nitrate as N	mg/L	0.01	<0.01	0.01	0.02	0.03	0.86	0.01	0.03	0.01	2.46	0.01
Total Kjeldahl Nitrogen as N	mg/L	0.7	0.3	<0.1	0.5	0.2	<0.1	0.3	0.3	0.2	0.5	0.3
Total Nitrogen as N	mg/L	0.7	0.3	<0.1	0.5	0.2	0.9	0.3	0.3	0.2	3	0.3
Total Phosphorus as P	mg/L	0.05	0.03	0.04	0.03	0.12	0.02	0.01	0.04	0.02	0.03	0.04
Ionic Balance	%	6.92	2.62	1.83	1.65	4.35	1.23	0.94	7.2	5	4.58	6.97
Total Anions	meq/L	112	43.2	38.6	37	30	40.5	36.5	16.9	121	101	49.7
Total Cations	meq/L	97.6	41	37.2	35.8	27.5	39.5	35.8	14.7	110	92.2	57.2
Total Organic Carbon	mg/L	2	<1	<1	1	4	<1	<1	1	1	1	2

Groundwater salinity results from targeted sampling program with available historical data

