Goulburn-Murray WATER

Lower Campaspe Valley Water Supply Protection Area Groundwater Management Plan

Annual Report

For year ending 30 June 2022

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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 2021/22 water year.

GMW is responsible for the implementation, administration and enforcement of the Plan which was approved by the Minister administering the *Water Act 1989* on 21 November 2012.

This report has been prepared in accordance with section 32C of the *Water Act 1989*. It provides an overview of the groundwater management activities administered under the Plan between 1 July 2021 and 30 June 2022.

A copy of this report is available for inspection at the Tatura office of GMW, or for download from the GMW website, www.gmwater.com.au.

Charmaine Quick

MANAGING DIRECTOR

Date: 27/09/2022

Executive summary

The *Lower Campaspe Valley Water Supply Protection Area Groundwater Management Plan* (the Plan) was approved on 17 October 2012 by the Minister for Water. The 2021/22 water year marks the tenth year of operation of the Plan.

Goulburn-Murray Water (GMW) announced an allocation of 75 per cent for all management zones of the Lower Campaspe Valley Water Supply Protection Area (the WSPA) during the 2021/22 water year. This is the second time the three northern management zones have had an allocation of less than 100% since the Plan was implemented.

Recorded use in the WSPA in 2021/22 was 25,468.2 ML, or 46 per cent of the total licence entitlement volume, which is less than the preceding three years.

Trade activity in the WSPA during the 2021/22 water year included 13 temporary licence transfers totalling 2,645.5 ML and seven permanent licence transfers totalling 640 ML/yr.

Licence holders in the WSPA are entitled to carryover up to a maximum of 25 per cent of their unused licence entitlement volume for use in the subsequent water year. A total of 12,725.7 ML was carried over for use in the 2022/23 water year.

Groundwater monitoring and metering programs continue to be successfully undertaken to support the objectives of the Plan.

Contents

1 Introduction

1.1 Purpose

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

The report provides an overview of groundwater resource status and summarises the groundwater management activities undertaken in accordance with the Plan during the 2021/22 water year (1 July 2021 to 30 June 2022).

1.2 Water Supply Protection Area

The Lower Campaspe Valley Water Supply Protection Area (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.

The WSPA includes groundwater resources to all depths, except where it is overlain by the Shepparton Irrigation Region Groundwater Management Area. In these areas, the Plan only applies to the management of groundwater resources greater than 25 metres (m) depth below the surface (DBNS).

There are four management zones within the WSPA: Elmore-Rochester Zone (1031), Bamawm Zone (1032), Echuca Zone (1033) and Barnadown Zone (1034), as shown in Figure 1.

1.3 Groundwater Management Plan

The Plan was approved on 17 October 2012 by the Minister for Water, in accordance with section 32A(6) of the *Water Act 1989*.

The objective of the Plan is to ensure that groundwater resources within the WSPA are managed in an equitable and sustainable manner. More specifically, the Plan seeks to:

- Protect existing groundwater users and the environment by managing groundwater levels and the potential for change in groundwater salinity.
- Enable equitable development of groundwater resources to realise the potential for its use in the region.
- 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. A 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: www.gmwater.com.au

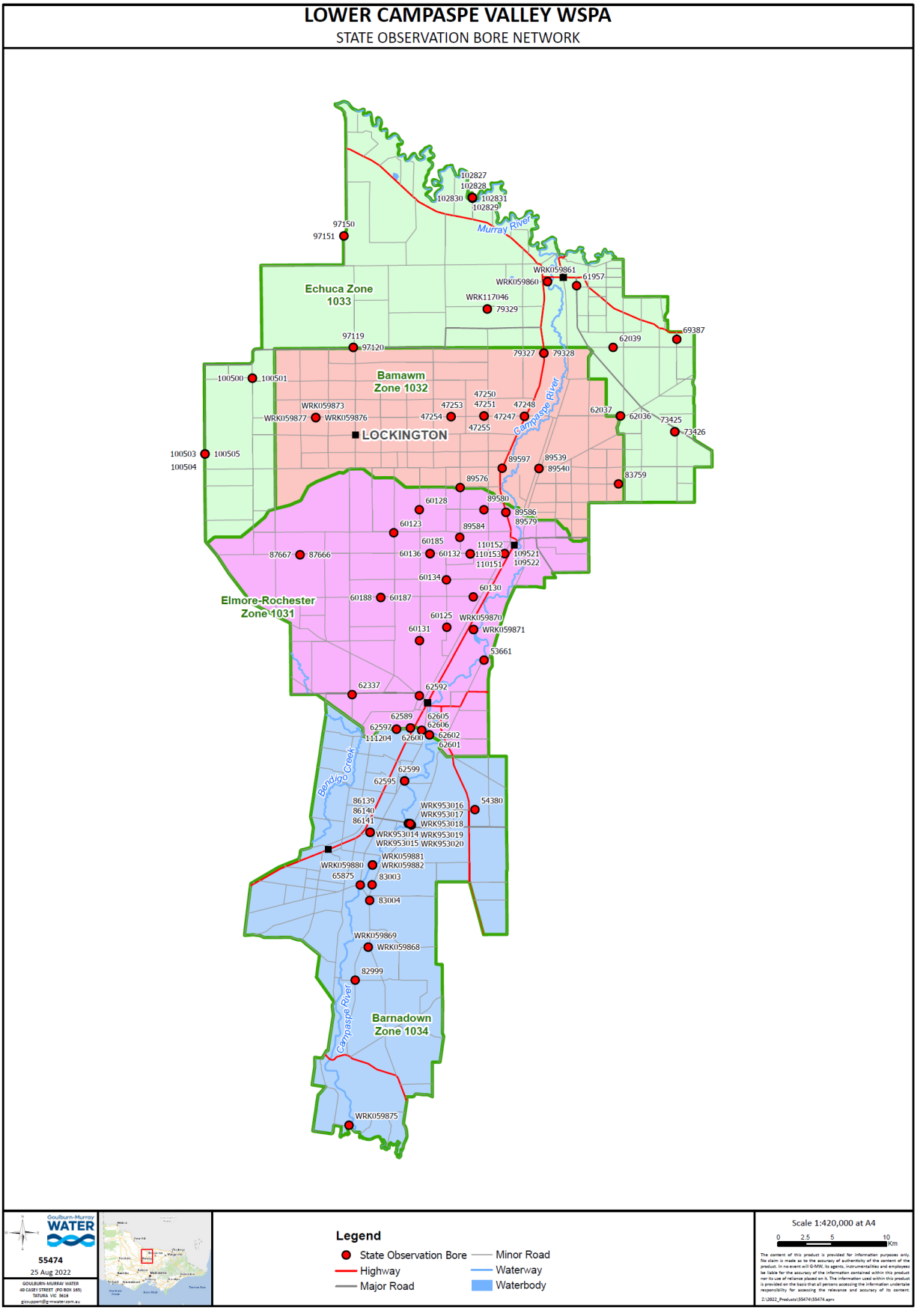

Figure 1 Lower Campaspe Valley Water Supply Protection Area

2 Groundwater Management

2.1 Licence entitlement volume

The then Minister for Water declared a Permissible Consumptive Volume of 55,875 megalitres per year (ML/yr) for the WSPA in March 2013 (Victorian Government, 2013).

At 30 June 2022, licence entitlement volume in the WSPA was 55,860.4 ML/yr (Table 1). This has not changed from 30 June 2021. The number of licences in each management zone is summarised in Table 1, as well as the total number of licensed bores and the total licence entitlement volume.

Table 1 Groundwater licences in the Lower Campaspe Valley WSPA in 2021/22

Management zone	Licences	Licensed bores	Licence entitlement volume (ML/yr)
Elmore-Rochester Zone (1031)	54	66	16,959.6
Bamawm Zone (1032)	43	49	26,065.3
Echuca Zone (1033)	16	18	4,840.5
Barnadown Zone (1034)	20	59	7,995.0
Total	**133**	**192**	**55,860.4**

Note: Data extracted from the Victorian Water Register 30 June 2022.

2.2 Groundwater allocations

Annual groundwater allocations in the WSPA are determined by comparing the average of annual maximum groundwater recovery levels recorded in key state observation bores from the previous three water years (i.e. a three-year rolling average) against trigger levels outlined in Prescription 1 of the Plan. These trigger levels are illustrated in Figure 2 for the northern management zones and in Figure 3 for the Barnadown Zone only.

2021/22 allocation

GMW determined allocations for the 2021/22 water year based on the average of maximum recovery levels recorded for the respective trigger bores over the previous three water years (i.e. 2018/19 to 2020/21). An allocation of 75 per cent was set for all management zones. This marked the second time a restriction had been placed on groundwater extraction for all management zones in the WSPA since the Plan was implemented in 2012.

2022/23 allocation

GMW announced allocations for the 2022/23 water year on 17 June 2022. An allocation of 75 per cent was set for all management zones, as the average of maximum recovery levels recorded for both trigger bores, individually, over the previous three water years (2019/20 to 2021/22), was below the 16-metre trigger level (Figure 2 and Figure 3).

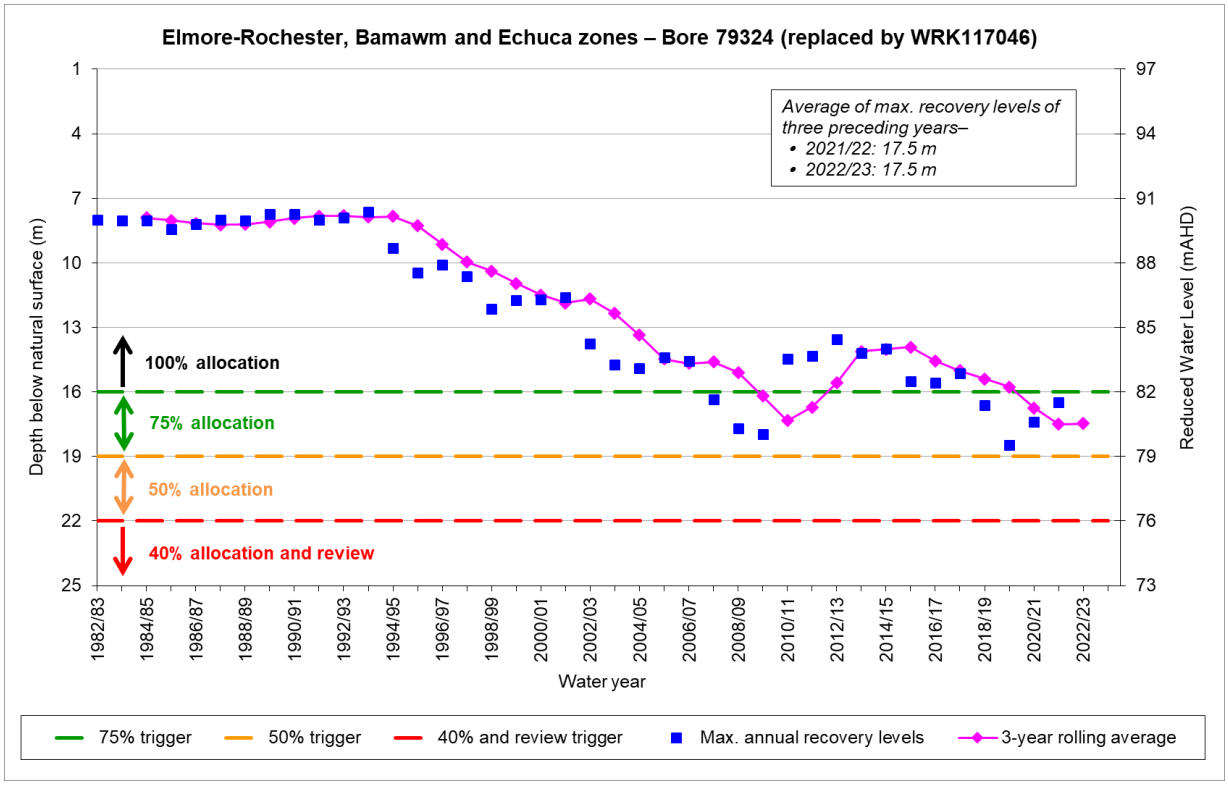

Figure 2 Trigger graph for determining allocations for the northern zones of the Lower Campaspe Valley WSPA

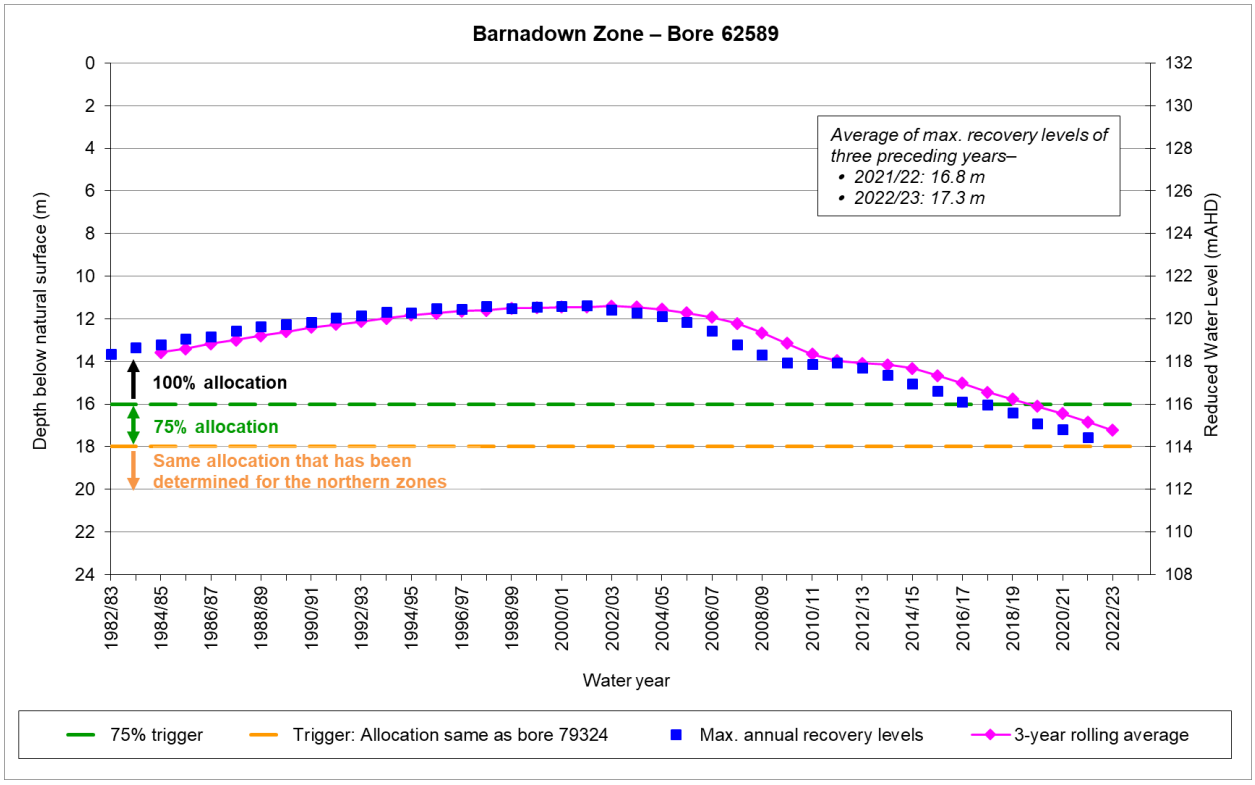

Figure 3 Trigger graph for determining allocations for the Barnadown Zone

2.3 Groundwater use

Total recorded use in the WSPA in 2021/22 was 25,468.2 ML, or 46 per cent of total licence entitlement volume (Figure 4). This is a 13 per cent decrease compared to the volume used in 2020/21.

Note: 'recorded use' refers to metered and deemed use.

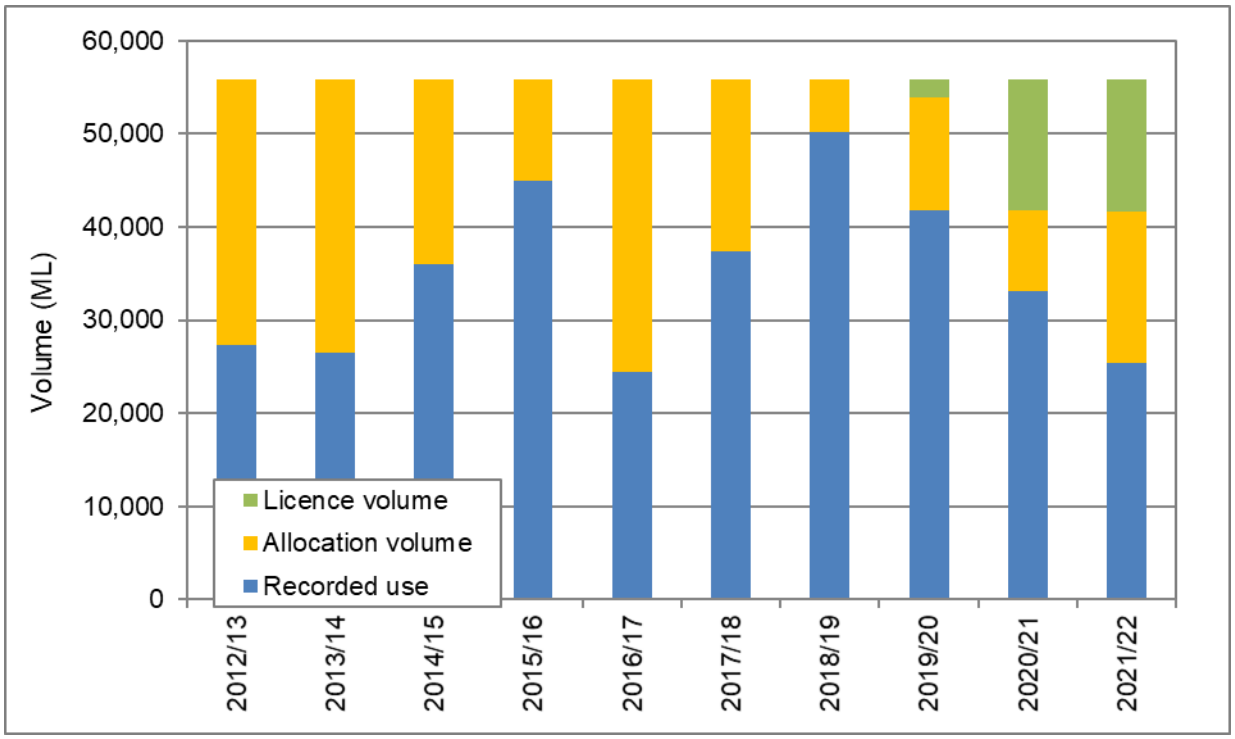

Figure 4 Entitlement, allocation and use in the Lower Campaspe Valley WSPA, since 2012/13

In 2021/22, the volume of recorded use was greatest in the Bamawm Zone, where the highest proportion of licence entitlement volume is held (Table 2). Recorded use as a proportion of total licence entitlement was highest in the Echuca Zone, at 53 per cent.

Table 2 Recorded use in the Lower Campaspe Valley WSPA in 2021/22

Management zone	Licence entitlement volume (ML/yr)	Recorded use (ML)	Proportion of total licence entitlement volume used
Elmore-Rochester Zone (1031)	16,959.6	7,145.4	42%
Bamawm Zone (1032)	26,065.3	12,272.6	47%
Echuca Zone (1033)	4,840.5	2,541.3	53%
Barnadown Zone (1034)	7,995.0	3,508.9	44%
Total	**55,860.4**	**25,468.2**	**46%**

Note: Recorded use data extracted from Irrigation Planning Module on 26 July 2021.

2.4 Rainfall

Historical rainfall data, sourced from the Bureau of Meteorology weather station at Rochester (BOM, 2022), is presented in Figure 5 as an indicator of climate trends across the WSPA.

The data show that annual rainfall was generally above the long-term average (443.7 mm) in the early 1970s and remained relatively steady through the 1980s and 1990s. Between 2001/02 and 2008/09, annual totals were below-average (i.e. during the Millennium Drought). Conditions improved in 2010.

With the exception of the 2013/14 and 2016/17 water years, annual rainfall totals have been below average since the Plan was implemented, resulting in reduced recharge to groundwater systems within the WSPA.

There was a total of 411.8 mm of rainfall recorded for Rochester during the 2021/22 water year. A higher than average rainfall occurred in April 2022, which resulted in a short-term increase in the mean monthly trend.

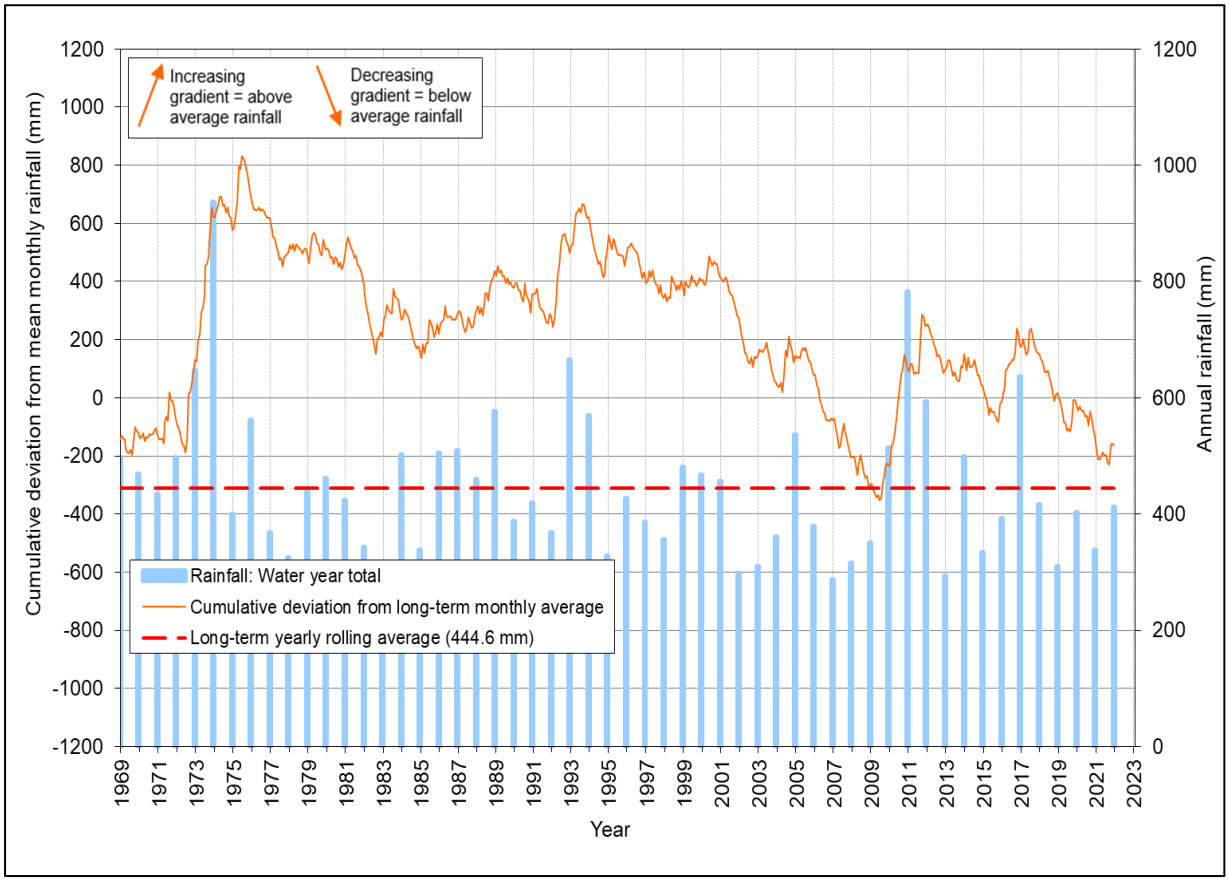

Figure 5 Rainfall recorded at Rochester in the Lower Campaspe Valley WSPA (BOM, 2022)

2.5 Licence transfers

The Plan allows groundwater licence holders to temporarily or permanently transfer licence entitlement volume. During the 2021/22 water year, there were 13 temporary licence transfer transactions for a total of 2,645.5 ML and seven permanent transfers for a total of 640.0 ML/yr (Figure 6).

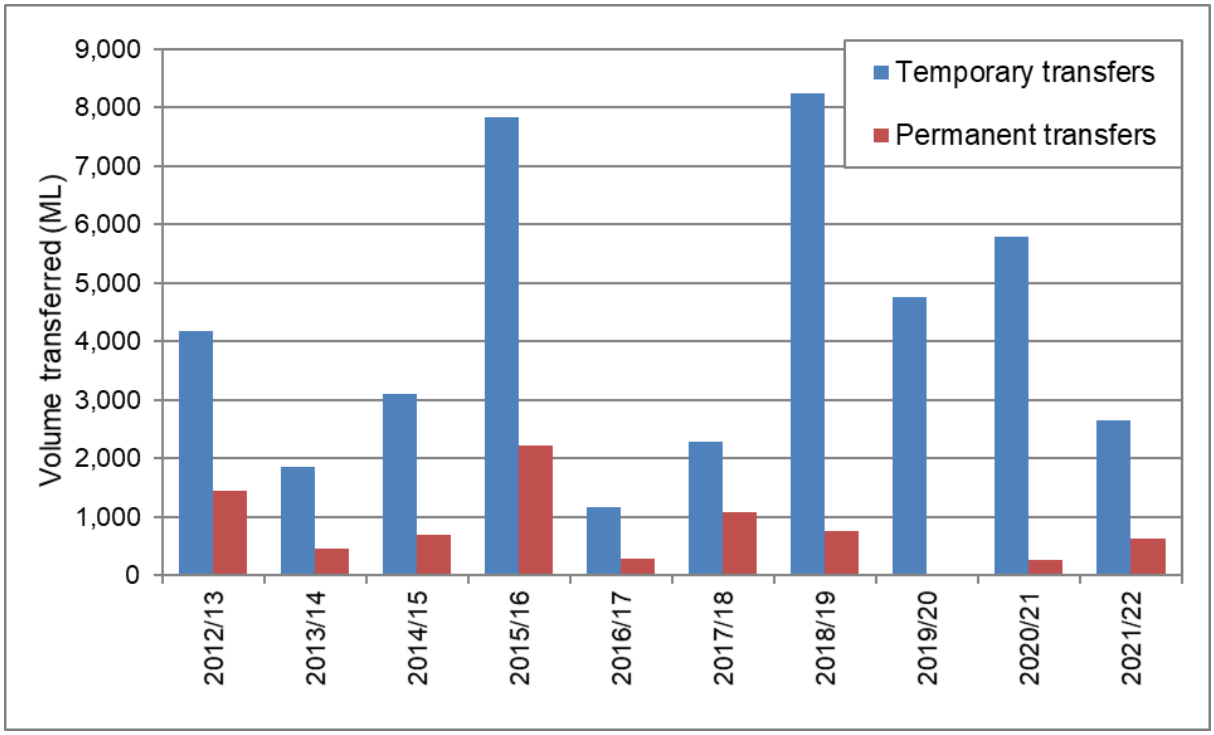

Figure 6 Licence entitlement volumes transferred in the Lower Campaspe Valley WSPA, since 2012/13

The majority of transfers occurred between licence holders within the same management zones (Table 3).

Of the 13 temporary transfers, two were between management zones resulting in a net increase of temporary licence volume in the Echuca zone of 200 ML. Of the seven permanent transfers, four were to the Bamawm Zone totalling 343 ML/yr. (Table 3).

Table 3 Licence transfers in the Lower Campaspe Valley WSPA in 2021/22

Management zone	Temporary				Permanent			
	Transfer from		Transfer to		Transfer from		Transfer to	
	No. of transfer	Volume (ML)	No. of transfer	Volume (ML)	No. of transfer	Volume (ML/yr)	No. of transfer	Volume (ML/yr)
Elmore-Rochester Zone (1031)	5	671.8	5	671.8	2	193.0	0	0.0
Bamawm Zone (1032)	3	847.7	2	647.7	3	151.0	4	343.0
Echuca Zone (1033)	1	246.0	2	446.0	1	246.0	2	247.0
Barnadown Zone (1034)	4	880.0	4	880.0	1	50.0	1	50.0
Total	**13**	**2,645.5**	**13**	**2,645.5**	**7**	**640.0**	**7**	**640.0**

2.6 Carryover

In November 2012, the Minister declared that groundwater licence holders in the WSPA were authorised to carry over up to a maximum of 25 per cent of their unused licence entitlement volume for use in the subsequent water year (Victorian Government, 2012).

There was a total of 11,623.33 ML carried over by licence holders in the WSPA for use in the 2021/22 water year. At the conclusion of 2021/22, a total of 12,725.7 ML was carried over for use in the 2022/23 water year.

2.7 Metering

There were 151 metered service points and 39 deemed service points in the WSPA as at 30 June 2022. There were 104 meter-related activities undertaken during the 2021/22 water year, including inspections, maintenance and battery replacements (Table 4).

All meters were read at least twice during the 2021/22 water year.

Table 4 Metering activities in the Lower Campaspe Valley WSPA in 2021/22

Metering activity	Year ending 30 June 2022
Total number of meters	151
Total number of meter reads	302
Meters installed or replaced	0
Meter inspection events	103
Meter maintenance events	1

2.8 Licence compliance

The Victorian Government and GMW have a zero-tolerance approach to unauthorised take of non-urban water. GMW is responsible for ensuring water users in northern Victoria comply with their licence conditions. All incidents of non-compliance are investigated by GMW and action is taken in accordance with GMW's Risk-Based Compliance and Enforcement Framework. More information can be found on GMW's website, at www.gmwater.com.au/water-resources/water-use-compliance .

There were five instances of alleged unauthorised take of water (i.e. licence entitlement volume exceedance) in the WSPA in 2021/22. There were zero prosecutions or convictions relating to groundwater matters.

2.9 Domestic and stock bore licences

The volume of groundwater taken for domestic and stock use is not required to be licensed as it is a private right under section 8 of the Act, provided that water is used in accordance with the constraints imposed by the Act.

The installation of a bore for domestic and stock use requires a bore construction licence, in accordance with section 67 of the Act. Upon completion of a bore, a bore completion report is required to be submitted to GMW and details are recorded in the Victorian state groundwater database, referred to as the Water Measurement Information System.

During the 2021/22 water year, 26 licences to construct a D&S bore were issued by GMW and the Victorian Water Register (combined) within the WSPA.

3 Monitoring Program

3.1 Groundwater levels

During the 2021/22 water year, a total of 101 state observation bores located within the WSPA were monitored by GMW and DELWP (Figure 1). This figure includes the 60 key bores listed in Schedule 1 of the Plan, where practicable. Of the 101 bores, 34 were monitored remotely using telemetry equipment, with measurements recorded hourly, and 67 were monitored manually, with measurements recorded on a monthly or quarterly basis.

Water level data for these bores are presented in Appendix B.

Monitoring indicates that seasonal groundwater recovery levels have been generally declining since the Plan was implemented in 2012. Groundwater recovery levels in the Calivil Formation Aquifer (Deep Lead) across much of the WSPA in 2021/22 were slightly higher than the 2020/21 water year. However, the amount of decline in groundwater level observed during the irrigation season (seasonal drawdown) for some locations was less than what was observed in the previous water year.

The amount that water levels rise to in the absence of irrigation extraction (maximum recovery level) in a Deep Lead observation bore (60134), located near Rochester in the Elmore-Rochester Zone, was 0.23 m higher in 2021/22 than the maximum level in 2020/21; 17.06m DBNS in July 2021, versus 16.03 m in August 2020 (Figure 7). The amount of seasonal drawdown was 12.02 m during 2020/21, recorded in the same Deep Lead bore. The amount of seasonal drawdown in 2021/22 was 11.03 m, which was less than the drawdown recorded in 2020/21.

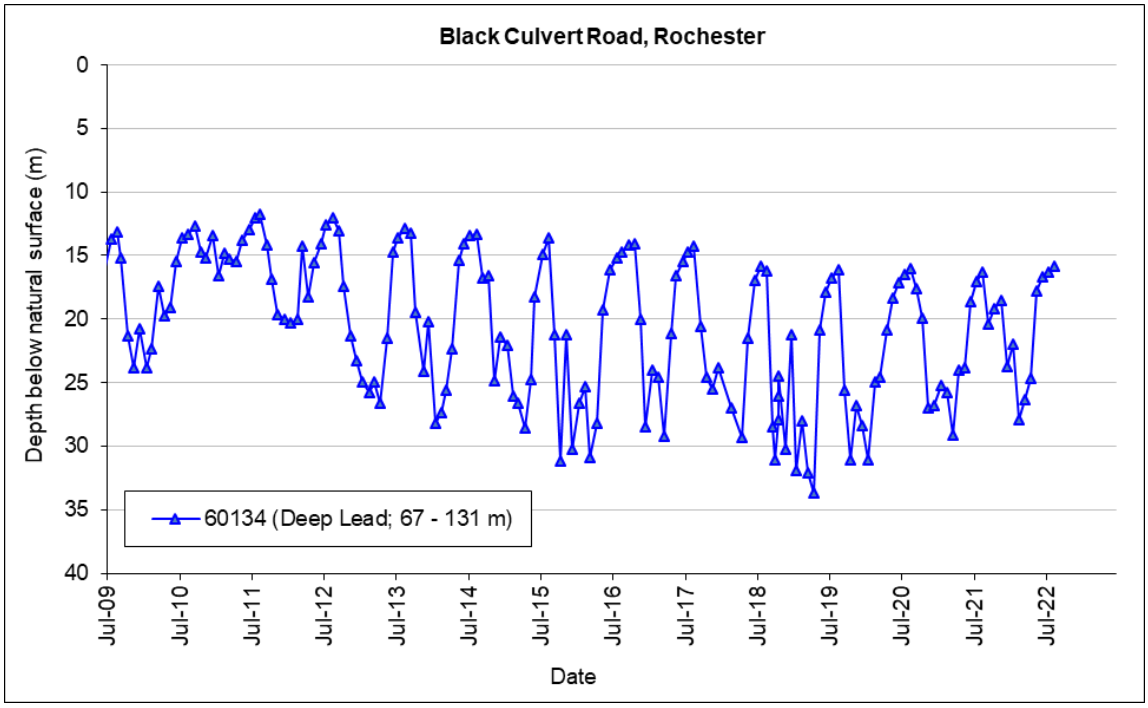

Figure 7 Groundwater level monitoring in the Elmore-Rochester Zone, at Rochester – July 2009 to June 2022 (DELWP, 2022)

In the Bamawm Zone, there was an increase in maximum recovery levels in 2021/22. In Deep Lead observation bore 47247 at Strathallan, the maximum recovery level was 19.64 m DBNS in August 2022 compared to 21.93 m in August 2021 (Figure 8). The amount of seasonal drawdown was approximately 6.78 m during 2021/22.

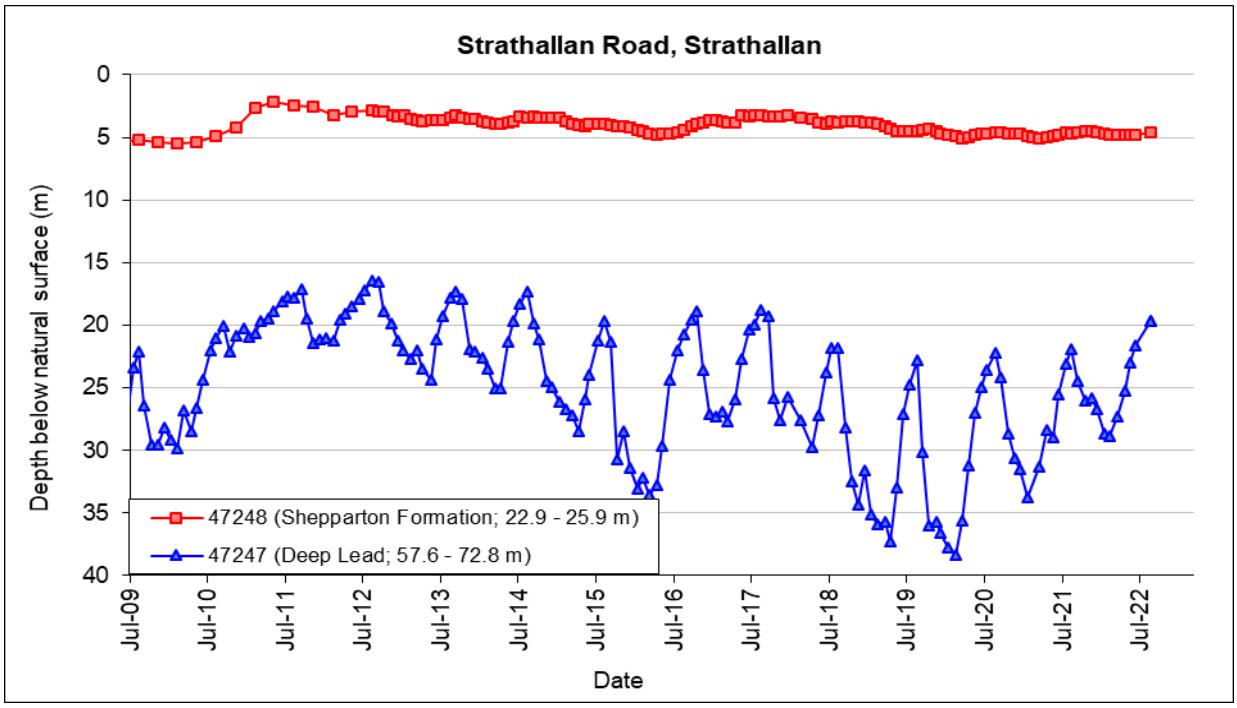

Figure 8 Groundwater level monitoring in the Bamawn Zone, at Strathallan – July 2009 to June 2022 (DELWP, 2022)

In the Echuca Zone, groundwater recovery levels increased in 2021/22. In Deep Lead observation bore 79324 at Echuca West, the maximum recovery level was 16.102 m DBNS in July 2022. That is 1.28 m higher than the maximum recovery level in 2020/21, which was 17.4 m DBNS in August 2021 (Figure 9). In the same bore, the amount of seasonal drawdown was 4.8 m during 2020/21. The amount of seasonal drawdown in 2021/22 was 1.74 m i.e. less than the drawdown recorded in 2020/21.

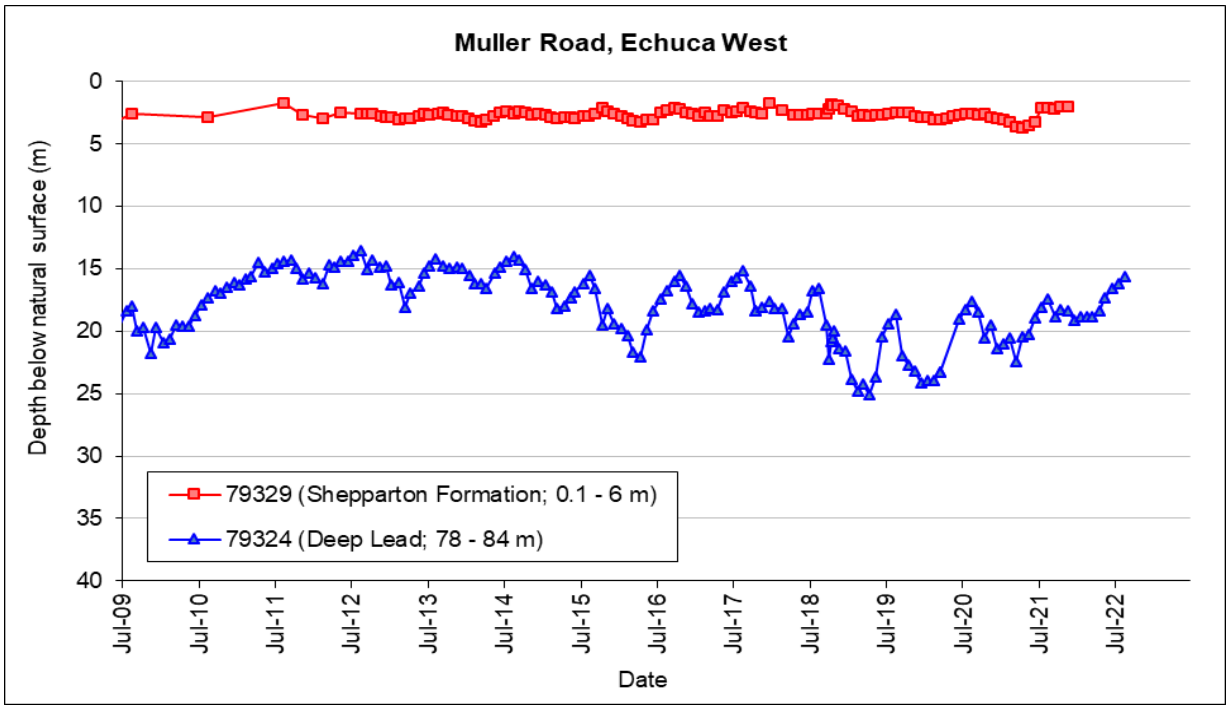

Figure 9 Groundwater level monitoring in the Echuca Zone, at Echuca West – July 2009 to June 2021 (DELWP, 2021)

In the Barnadown Zone, there is typically less seasonal variation in groundwater levels compared to the other three management zones. In a Deep Lead observation bore located adjacent to the Campaspe River at Runnymede (G8010638/07), the maximum recovery level in 2021/22 was 24.58 m DBNS compared to 24.64 m DBNS in the previous year (Figure 10). The amount of seasonal drawdown was approximately 1.23 m during 2021/22.

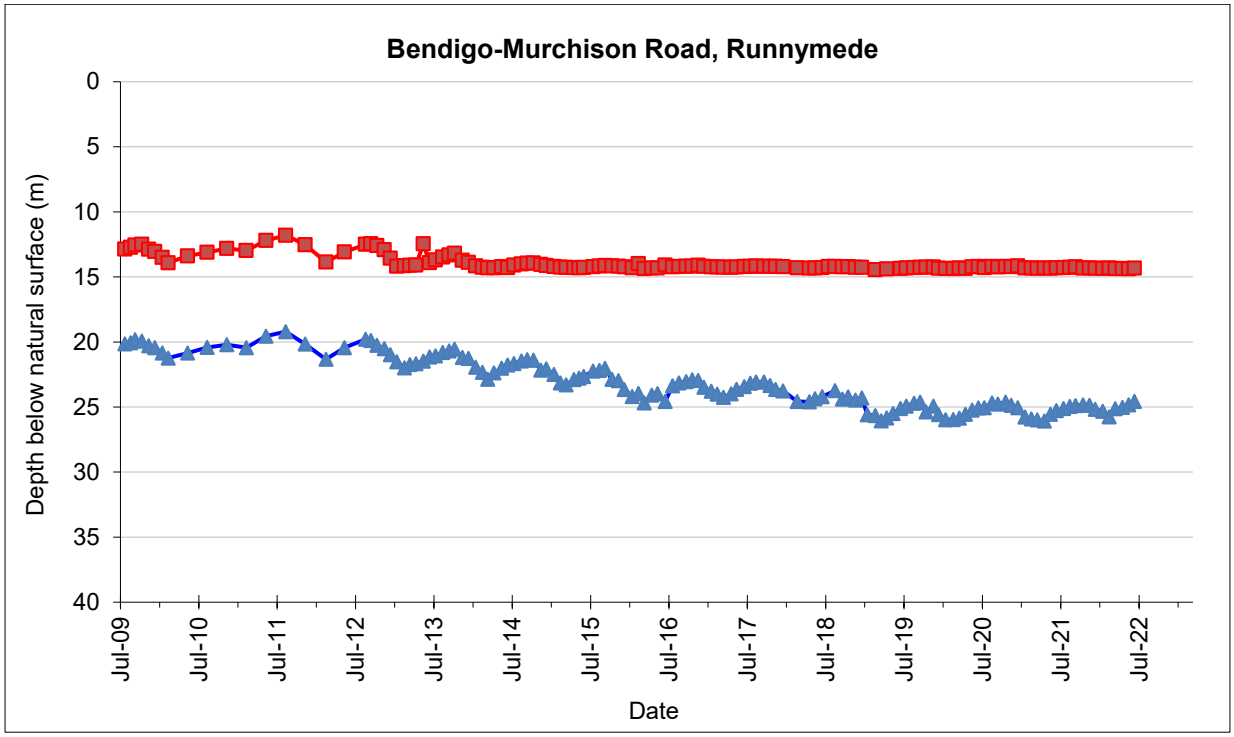

Figure 10 Groundwater level monitoring in the Barnadown Zone, at Runnymede – July 2009 to June 2022 (DELWP, 2022)

3.2 Groundwater quality

Groundwater user salinity sampling

GMW sent 166 sample bottles and reply-paid envelopes to licence holders, and domestic and stock users upon request, to collect a groundwater sample from their bore for analysis. There were 23 samples returned for analysis; a return rate of 14 per cent.

GMW measured the groundwater salinity of each sample, advised each bore owner of their result, and recorded the data in the State groundwater database (the Water Management Information System). The results are presented spatially in Figure 11 and show that less saline groundwater occurs within the Elmore-Rochester Zone. Groundwater samples collected from bores within the Echuca Zone, west of the Campaspe River, were more saline (>4,000 µS/cm). Salinity sampling in the Barnadown Zone showed the highest salinity results and upward trends in salinity.

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.

Targeted sampling of private bores

GMW has enlisted 11 licence holders to participate in a targeted groundwater salinity monitoring program. Samples are collected on an annual basis from the same set of 11 private bores which have been strategically selected based on location and bore construction details. The aim of the program is to build a reliable and consistent dataset of groundwater salinity over time to support licensing and resource management decisions. There were three samples returned for analysis; a return rate of 27 per cent.

Results from the groundwater samples collected in 2021/22 are presented in Appendix C.

Groundwater salinity varies between water years, although there has been a rising salinity trend of groundwater in some bores, notably licensed bores WRK010877 in the Barnadown Zone and WRK015989 in the Bamawm Zone. Salinity rose to 3,290 µS/cm in 2021/22 season compared to 2,650 µS/cm recorded in 2019/20. However, no salinity data was collected for Bore WRK015898 in 2020/21 so any further increase since 2019/20 is not known. Continued monitoring will enable trends to be better understood and to inform future resource management decisions.

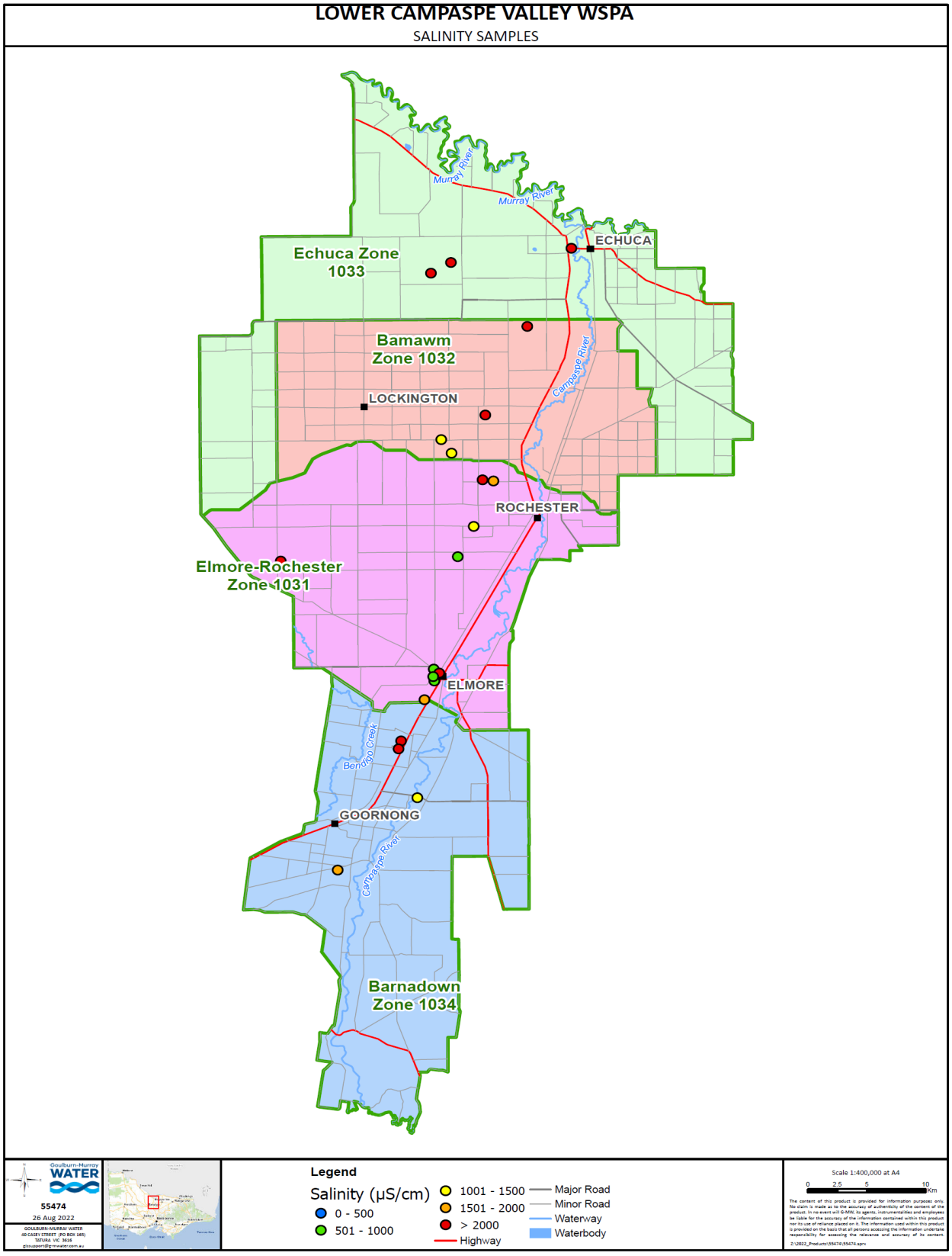

Figure 11 Salinity results of samples submitted by groundwater users during 2021/22 in the Lower Campaspe Valley WSPA

Sampling of state observation bores

Groundwater samples from nested state observation bores were sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. The full suite of results are presented in Appendix C.

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 areas of intensive groundwater pumping west of Rochester and at the northern margins of the WSPA.

Groundwater salinity results from samples collected during the 2021/22 water year are presented in Table 5. These results are compared against historical data in Appendix C.

Groundwater salinity varies between water years, but Bore 47251 in Bamawn Zone declined from a value of 4,100 µS/cm in 2020/21 to 3,800 µS/cm in 2021/22. Bore 102828 in the Echuca Zone had a significant decline from a value of 9,900 µS/cm in 2020/21 to 8,800 µS/cm in 2021/22. All other sites recorded slight increases compared to the previous water year. There were no strong trends in the data; however, salinity levels have been generally declining in some bores since 2015/16. Continued monitoring of groundwater quality will enable trends to be better understood and support future management decisions.

Table 5 Groundwater salinity results for bores sampled during 2021/22 in the Lower Campspe Valley WSPA

Management zone	Location	Bore ID	Depth of screened interval (m)	Aquifer screened	Salinity, as electrical conductivity (µS/cm)
Elmore-Rochester Zone (1031)	Lowe Road, Diggora	89584	100 – 140	Deep Lead	1,200
		89596	2 – 14	Shepparton Formation	*(Bore dry)*
Bamawm Zone (1032)	Strathallan Road, Lockington	WRK059873	82 – 87	Deep Lead	3,900
		WRK059876	92 – 97	Deep Lead	3,100
		WRK059877	34 – 37	Shepparton Formation	4,600
	Strathallan Road, Bamawm	47251	22 – 27	Shepparton Formation	3,800
		47250	73 – 85	Deep Lead	1,900
Echuca Zone (1033)	Casey Road, Wharparilla	102827	108 – 114	Deep Lead	4,800
		102828[1]	160 – 167	Deep Lead	8,800
		102829	71 – 74	Shepparton Formation	4,100
	Craig Road, Koyuga	73425	87 – 89	Deep Lead	11,000
		73426	6 – 18	Shepparton Formation	9,000

4 Administration and Engagement

4.1 Groundwater Reference Committee

The Groundwater Reference Committee, appointed in accordance with Prescription 7(c) of the Plan, met via video-conferencing on 16 March 2022.

Key points of discussion included:

- Actions from last meeting discussed and committee updated
- Plan administration and resource update, including 2022/23 allocation outlook
- Local issues – current and emerging, including:
    - Licence compliance
    - Gunbower groundwater development
    - Groundwater management planning
    - Fosterville gold mine
    - Managed Aquifer Recharge
    - Technical work to support groundwater applications
- Resource update and administration activities.

5 References

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Appendix A – Assessment of activities against Plan prescriptions

Prescription	Activity	Compliant
PRESCRIPTION 1 Triggers and Restrictions		
By 1 July each year the Corporation will: (a) Determine the rolling average of the maximum annual groundwater recovery levels from the preceding 3 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).	In June 2021, GMW determined the allocations for the 2021/22 water year based on the rolling average of the maximum annual groundwater recovery levels from the preceding three water years. Allocations were set at 75 per cent for all management zones. GMW announced the allocations by placing public notices in local newspapers, listing the allocations on its website and sending letters to all licence holders.	Yes
PRESCRIPTION 2 Trading rules		
The Corporation may approve a transfer of a groundwater licence under section 62 of the *Water Act 1989* provided section 53 matters have been considered and it accords with the following: (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.	GMW processed 13 temporary transfer transactions for a total of 2,645.5 ML/yr; and 7 permanent transfers for a total of 640 ML/yr in 2021/22. GMW processed all groundwater licence applications in accordance with Prescription 2(a) and (c).	Yes
PRESCRIPTION 3 Intensive groundwater pumping		
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) For a permanent transfer, the total licence entitlement of bores within a 4 km radius of an applicant's bore is less than 7.5 GL/yr. (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. (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.	GMW processed all groundwater licence applications in accordance with Prescription 3.	Yes

Prescription	Activity	Compliant
PRESCRIPTION 4 Monitoring groundwater levels		
The Corporation will: (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. (b) Install at least one new observation bore in the Coonambidgal Formation to better inform groundwater interaction with the Campaspe River.	GMW obtained monthly groundwater level readings from bores listed in Schedule 1 of the Plan, where practicable. GMW installed an 8.5 m bore screening the Coonambidgal Formation which was drilled and constructed on 3 September 2020 adjacent to the Campaspe River at Runnymede, just south of Elmore.	Yes
PRESCRIPTION 5 Monitoring groundwater salinity		
The Corporation will: (a) Support annual groundwater user salinity sampling by: (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. (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. (iii) Measuring groundwater salinity in all returned sample bottles and providing the bore owner with the results. (iv) Entering the groundwater salinity results into the State groundwater database. (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.	GMW provided sample bottles 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. GMW engaged with the 11 licence holders participating in the target sampling of licensed bores. A total of three bores were sampled in 2021/22. 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.	Yes
PRESCRIPTION 6 Metered licensed use		
The Corporation will: (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.	GMW ensured that use was accounted for each operational licensed bore. Meters were read in February/March and May/June 2022 and the data were entered into the Water Register.	Yes

Prescription	Activity	Compliant
PRESCRIPTION 7 Plan implementation		
The Corporation will: (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 5 years from approval, or sooner if warranted by any clause contained within the Plan.	GMW prepared an annual report on the administration and enforcement of the Plan during the 2020/21 water year for the Minister and relevant agencies. GMW also sent a newsletter to licence holders summarising the information in this report. GMW has posted on its website: the Plan; and the 2020/21 annual report and 2021 newsletter. GMW updates a selection of hydrographs of groundwater levels on its website every quarter. GMW undertook a comprehensive review of the Plan in 2018. GMW met with the Groundwater Reference Committee in December 2021 to discuss Plan implementation, resource conditions and the outlook of allocations for 2021/22 being 75% for all zones as being likely based on recovery levels to November 2021.	Yes

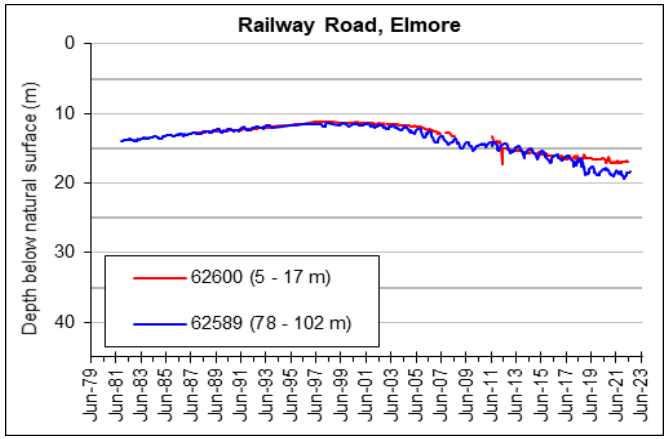
Appendix B – Groundwater level data

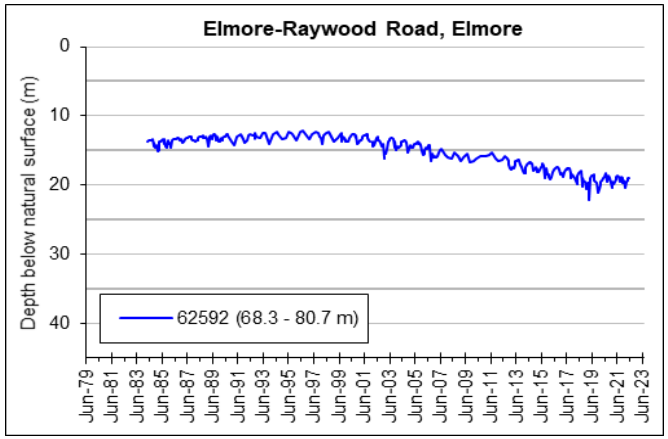
Hydrographs are provided for key monitoring bores listed in Schedule 1 of the Plan. All data is sourced from the Water Measurement Information System (DELWP, 2022).

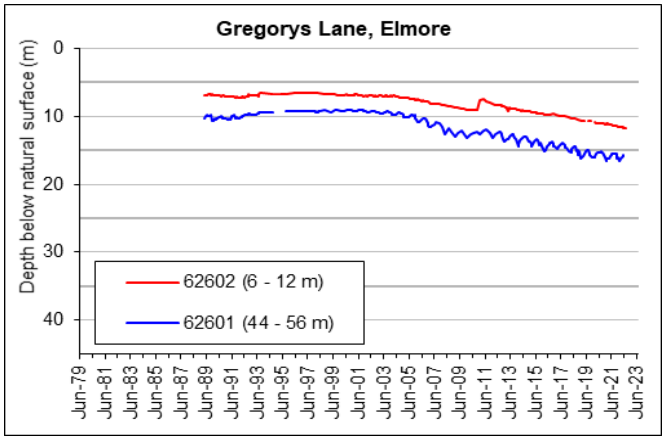
All data have been sourced from the *Water Measurement Information System* (WMIS) (DELWP, 2022). Further information is available on the WMIS website, at https://data.water.vic.gov.au.

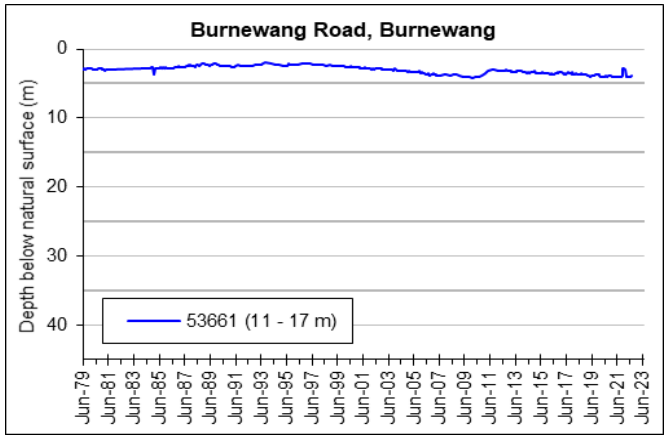
Please note that the data presented here are not continuous. Data points which make up these curves are at either monthly or quarterly intervals. Since November 2017, some sites have been converted to remote-read which has allowed for hourly levels to be recorded. For those sites, only one level per month is presented in the hydrographs – 12:00 PM on the 15th day (or closest available).

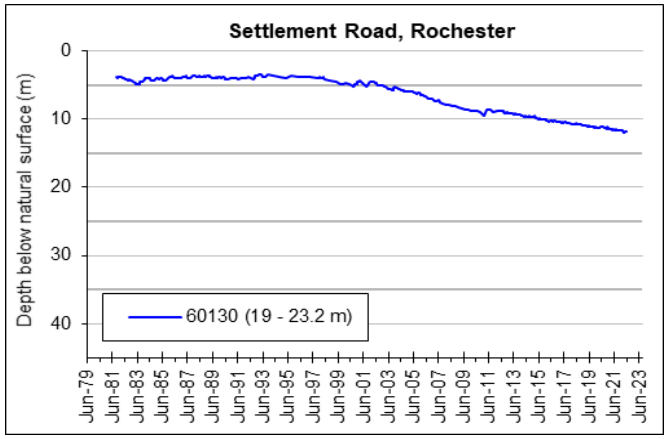
Elmore-Rochester Zone (1031)

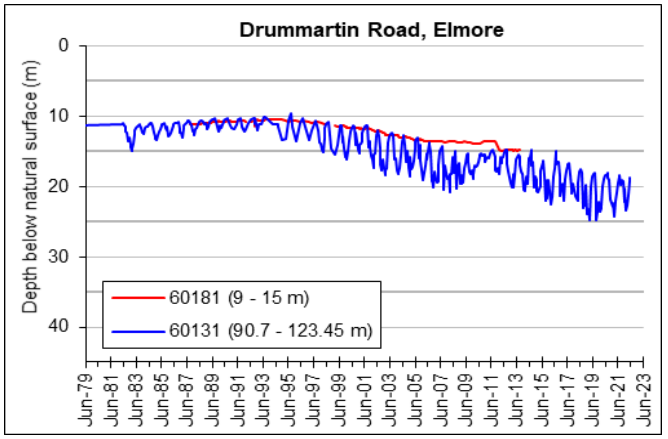


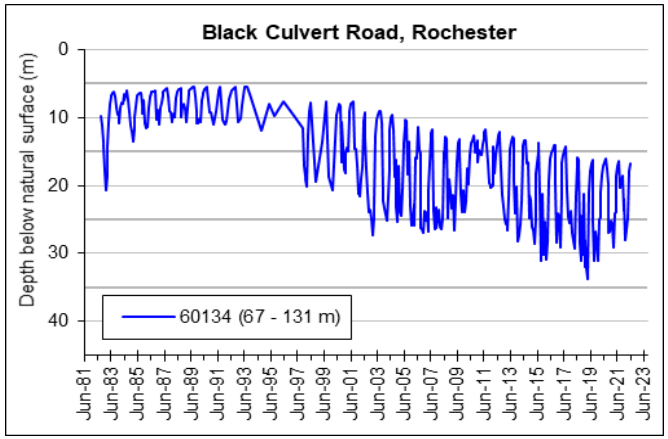


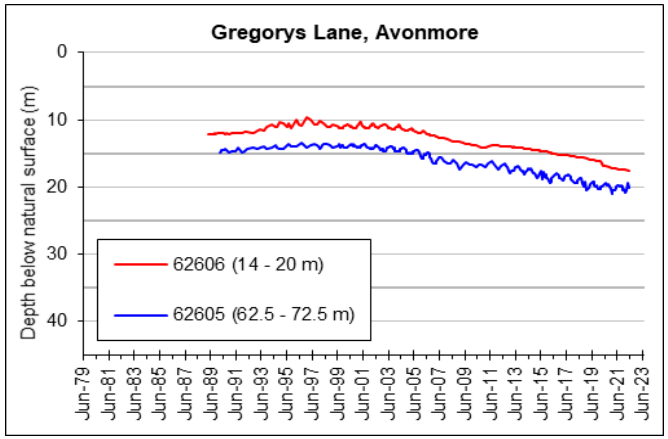


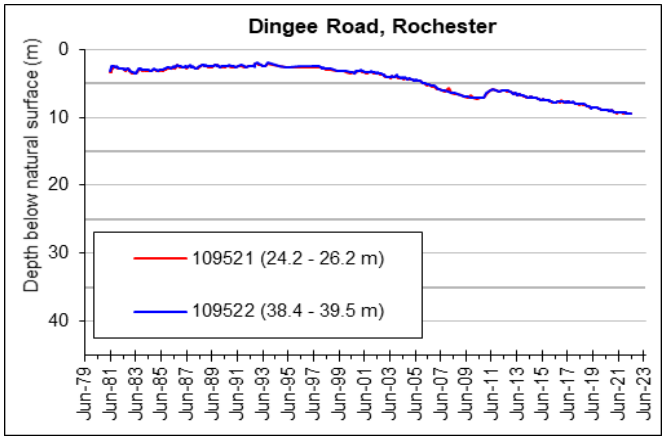

Burnewang Road, Burnewang
Depth below natural surface (m)
0
10
20
30
40
53661 (11 - 17 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23


Settlement Road, Rochester
Depth below natural surface (m)
0
10
20
30
40
60130 (19 - 23.2 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23


Drummartin Road, Elmore
Depth below natural surface (m)
0
10
20
30
40
60181 (9 - 15 m)
60131 (90.7 - 123.45 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23


Black Culvert Road, Rochester
Depth below natural surface (m)
0
10
20
30
40
60134 (67 - 131 m)
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23


Gregorys Lane, Avonmore
Depth below natural surface (m)
0
10
20
30
40
62606 (14 - 20 m)
62605 (62.5 - 72.5 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23


Dingee Road, Rochester
Depth below natural surface (m)
0
10
20
30
40
109521 (24.2 - 26.2 m)
109522 (38.4 - 39.5 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
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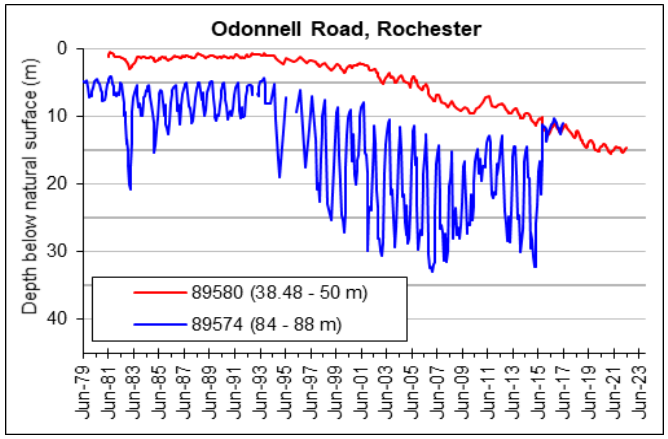
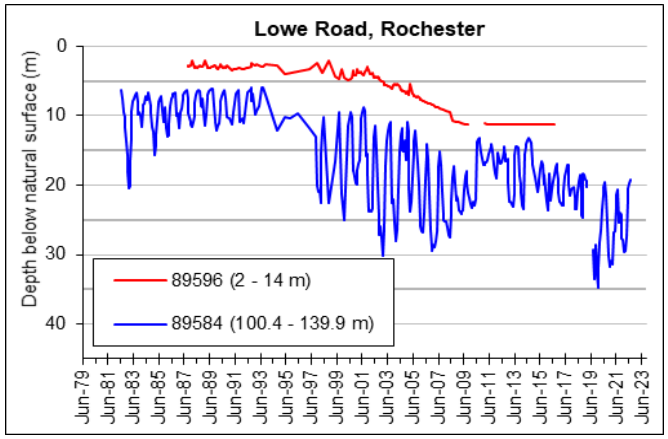
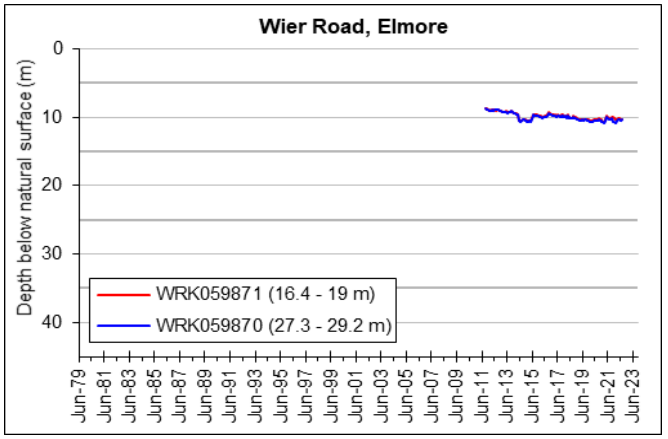
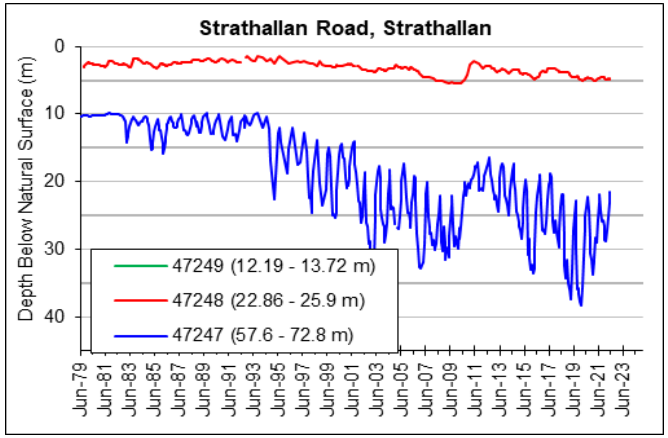
Jun-19
Jun-21
Jun-23

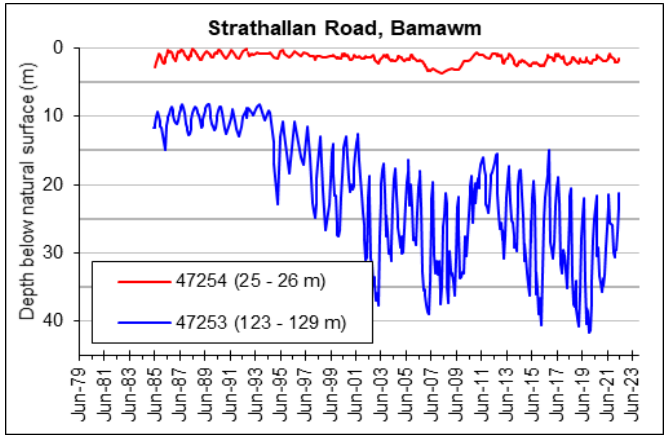


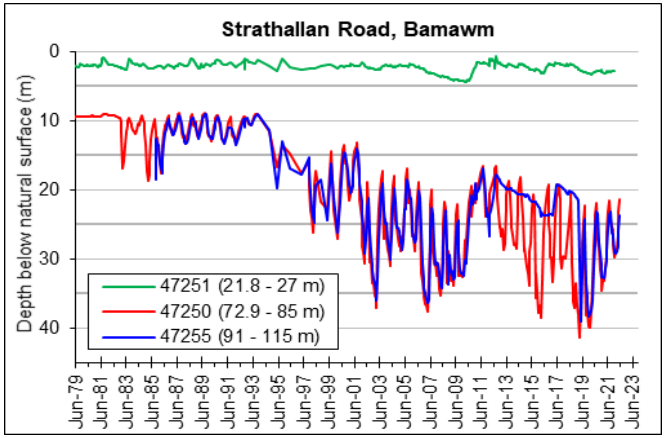


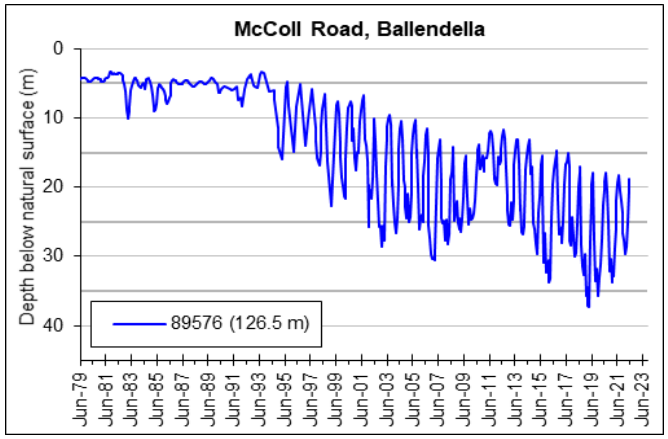


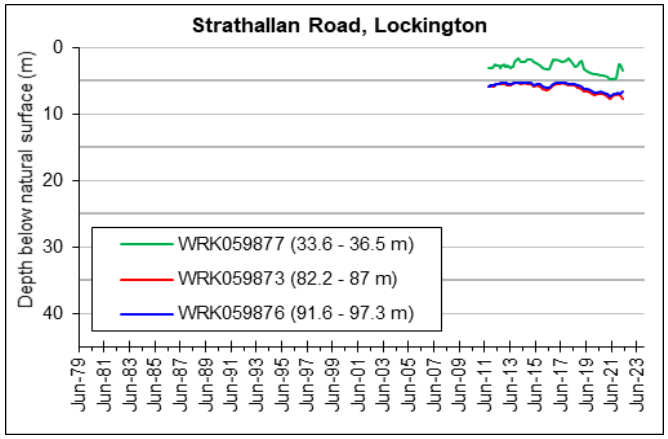
Bamawm Zone (1032)



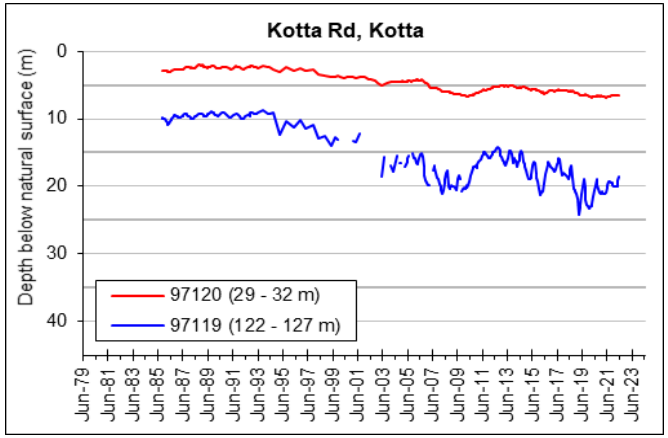


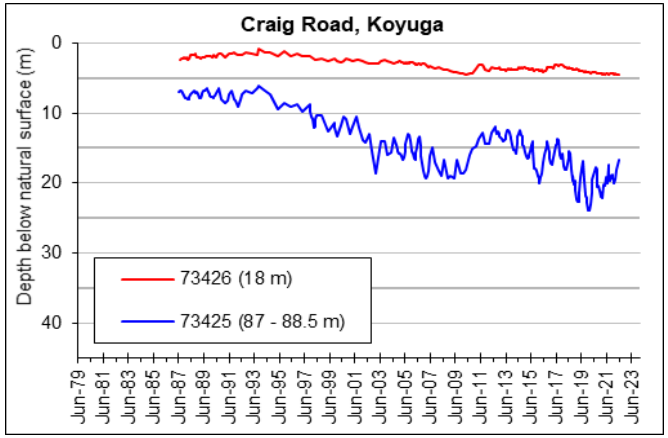


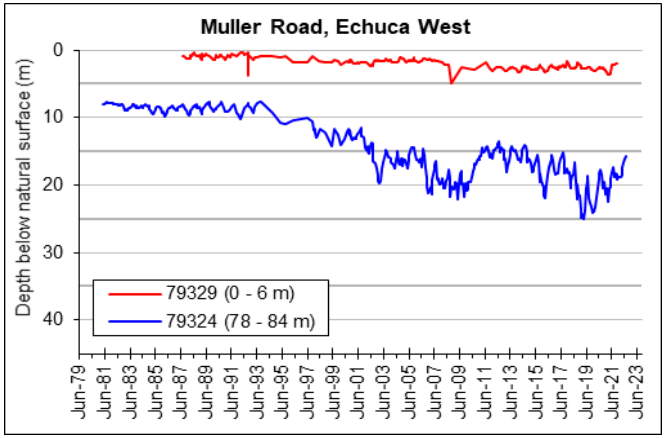


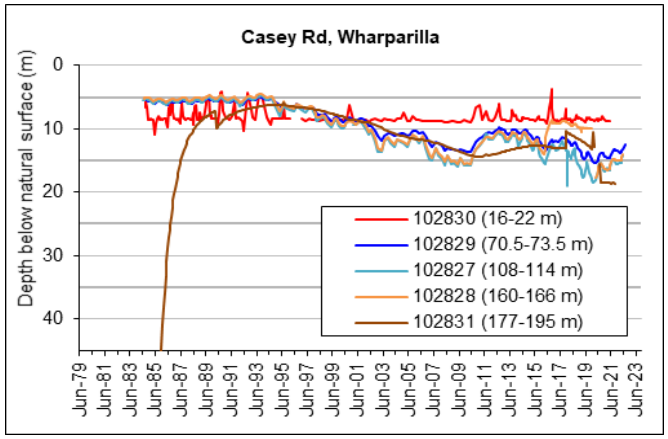


Echuca Zone (1033)

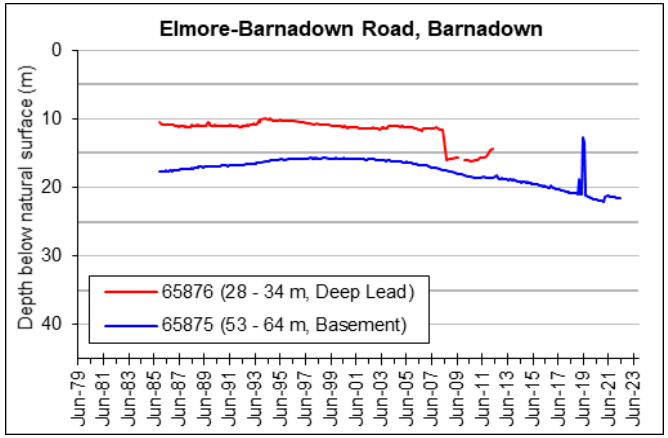


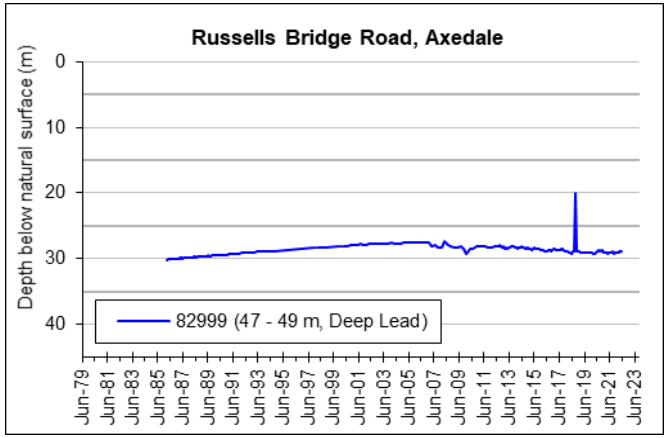


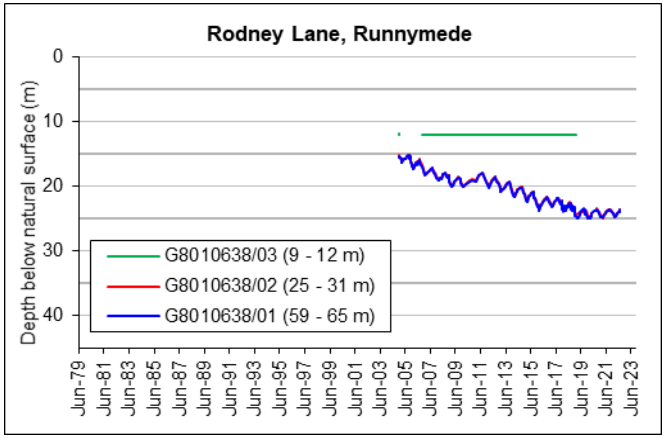


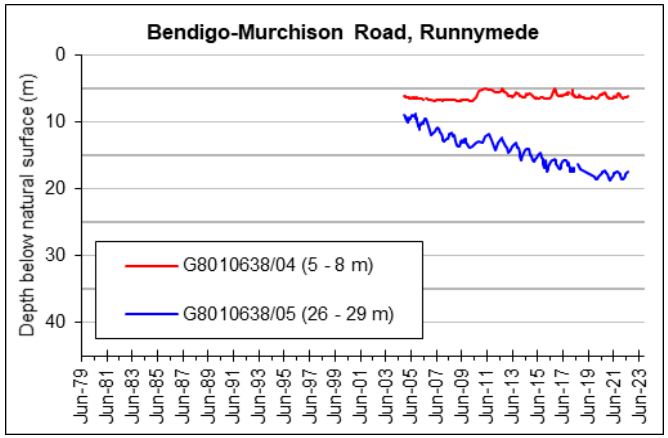


Barnadown Zone (1034)








Bendigo-Murchison Road, Runnymede
Depth below natural surface (m)
0
10
20
30
40
G8010638/04 (5 - 8 m)
G8010638/05 (26 - 29 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
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Jun-07
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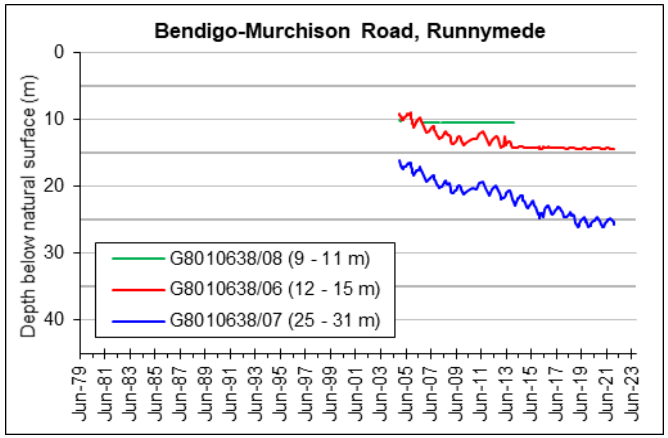
Jun-19
Jun-21
Jun-23


Bendigo-Murchison Road, Runnymede
Depth below natural surface (m)
0
10
20
30
40
G8010638/08 (9 - 11 m)
G8010638/06 (12 - 15 m)
G8010638/07 (25 - 31 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
Jun-07
Jun-09
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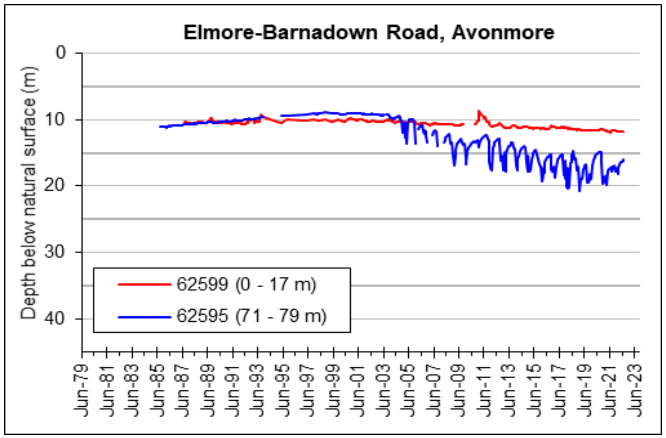
Jun-17
Jun-19
Jun-21
Jun-23


Elmore-Barnadown Road, Avonmore
Depth below natural surface (m)
0
10
20
30
40
62599 (0 - 17 m)
62595 (71 - 79 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
Jun-05
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Jun-11
Jun-13
Jun-15
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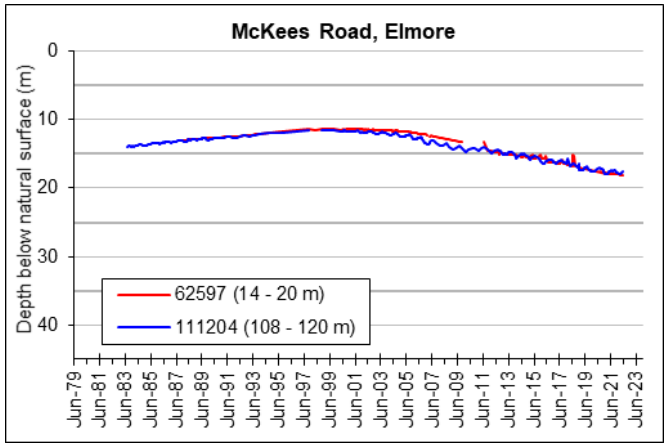
Jun-19
Jun-21
Jun-23


McKees Road, Elmore
Depth below natural surface (m)
0
10
20
30
40
62597 (14 - 20 m)
111204 (108 - 120 m)
Jun-79
Jun-81
Jun-83
Jun-85
Jun-87
Jun-89
Jun-91
Jun-93
Jun-95
Jun-97
Jun-99
Jun-01
Jun-03
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Jun-11
Jun-13
Jun-15
Jun-17
Jun-19
Jun-21
Jun-23

Appendix C – Groundwater quality results

Analytical chemistry results for 2021/22

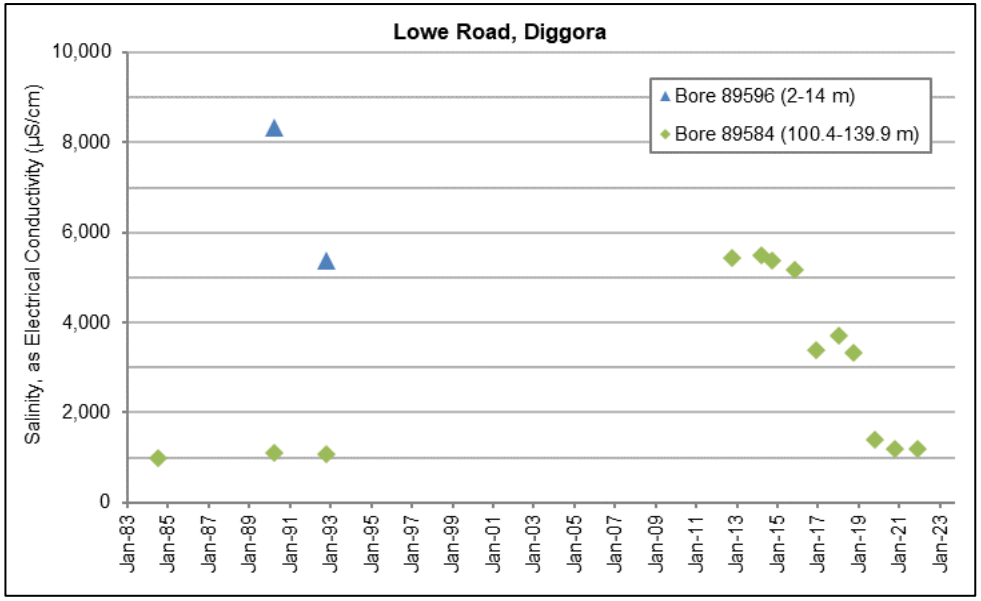
Analytical chemistry results are provided for key monitoring bores listed in Schedule 1 of the Plan.

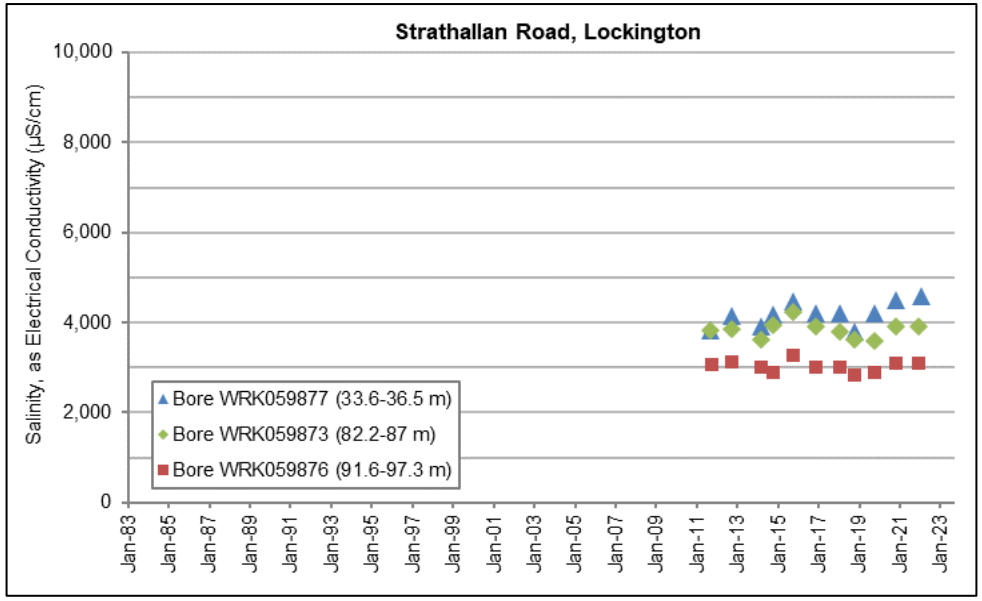
Further groundwater quality information is available on the Water Measurement Information System at https://data.water.vic.gov.au

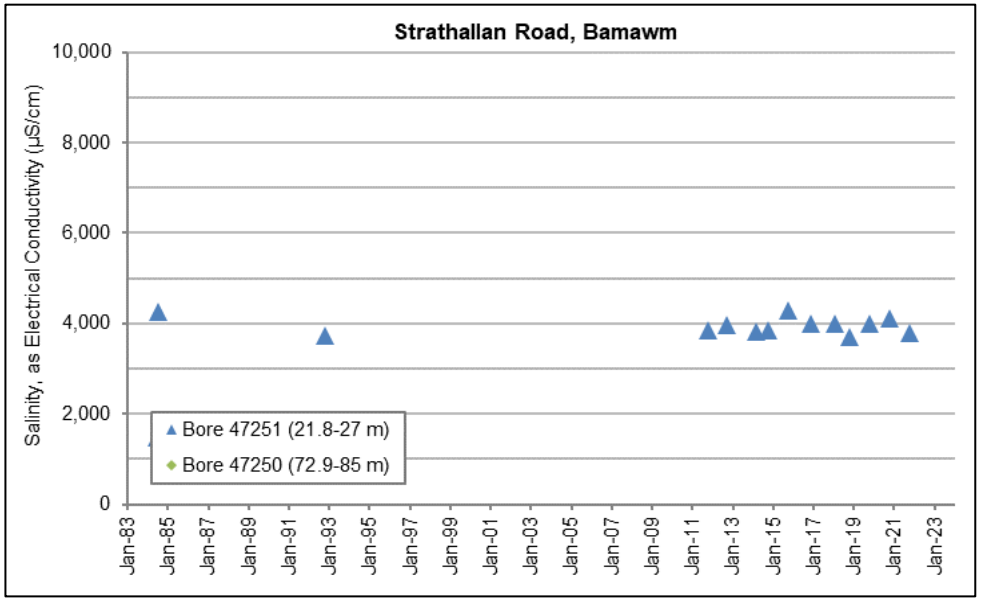
Bore:		102827	102828	102829	47250	47251	73425	73426	89584	WRK059873	WRK059877	WRK059876
Aquifer:		Deep Lead		Deep Lead	Shepparton Formation	Deep Lead	Shepparton Formation	Deep Lead	Shepparton Formation	Deep Lead	Deep Lead	Deep Lead
Date:		27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020
Analyte	**Unit**											
Conductivity (µS/cm)	µS/cm	4800	8800	4100	1900	3800	11000	9000	1200	3900	4600	3100
pH	pH	9.2	8.67	7.03	8.33	7.63	6.55	6.36	8.76	6.6	6.51	6.58
Oxidised Nitrogen	mg/l	<0.01	<0.01	0.05	0.02	0.58	0.02	2.7	<0.01	0.04	1.3	0.02
Ionic balance (%)	%	5.55	1.57	2.88	13.3	6.29	2.22	-4.68	-7.89	3.85	0.96	1.49
Total Anions (meq/l)	meq/L	47	81	41	17	37	111	96	10	40	44	30
Total Cations (meq/l)	meq/L	42	79	39	13	33	106	105	12	37	43	29
Ion Balance - TDS (EC) vs TDS	mg/l	0.6	0.6	0.6	0.5	0.5	0.5	0.7	0.4	0.5	0.6	0.6
Bicarbonate Alkalinity, CaCO3	mg/L	180	120	180	140	120	200	50	56	130	150	160
Calcium, as Ca	mg/L	14	42	38	13	23	130	140	15	75	72	50
Carbonate Alkalinity, as CaCO3	mg/L	55	11	<2	5	<2	<2	<2	9	<2	<2	<2
Chloride, as Cl	mg/L	1400	2700	1100	500	1100	3400	2700	330	1200	1200	960
Hydroxide Alkalinity, as CaCO3	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Potassium, as K	mg/L	10	12	8	5	11	13	9	5.1	11	12	9
Sodium, as Na	mg/L	780	1400	670	240	610	1700	1700	220	530	690	470

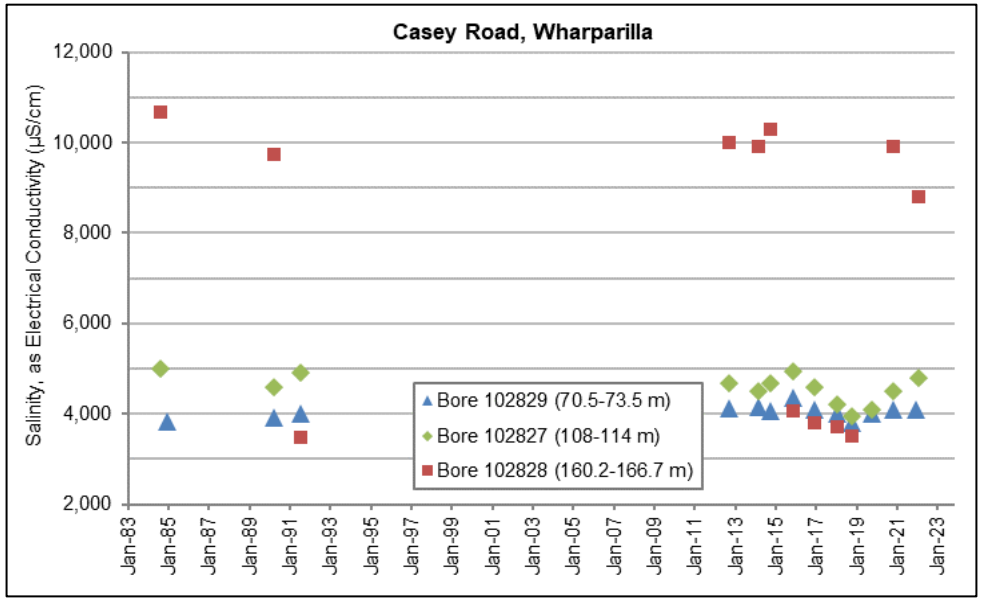
	Bore:	102827	102828	102829	47250	47251	73425	73426	89584	WRK059873	WRK059877	WRK059876
	Aquifer:	Deep Lead		Deep Lead	Shepparton Formation	Deep Lead	Shepparton Formation	Deep Lead	Shepparton Formation	Deep Lead	Deep Lead	Deep Lead
	Date:	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020	27/10/2020
Analyte	**Unit**											
Ammonia, as N	mg/L	<0.1	1.6	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
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
Nitrate, as N	mg/L	<0.01	<0.01	0.04	0.02	0.58	0.02	2.7	<0.01	0.04	1.3	0.02
Nitrate + Nitrite, as N(0.003d	mg/L	0.1	1.6	<0.1	0.4	0.9	<0.1	2.7	<0.1	0.2	1.4	0.4
Sulphate, as SO4	mg/L	210	140	300	16	190	540	880	2	170	330	2
Total Kjeldahl Nitrogen, as N	mg/L	0.1	1.6	<0.1	0.4	0.3	<0.1	<0.1	<0.1	0.1	0.2	0.4
Arsenic, as As	mg/L	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron, dissolved as Fe	mg/L	<0.01	0.07	0.03	0.01	0.16	<0.01	<0.01	0.02	1.3	<0.01	0.46
Mercury, as Hg	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Magnesium, as Mg	mg/L	92	190	89	24	61	310	290	22	120	110	76
Manganese, dissolved as Mn	mg/L	0.03	0.17	0.034	0.049	0.11	0.13	0.008	0.015	0.079	<0.001	0.087
Total Dissolved Solids, 180C	mg/L	2800	5500	2300	1000	2000	5900	6000	520	2100	2900	1800
Total Organic Carbon	mg/L	0.9	1.6	<0.5	3.1	0.7	1.2	0.7	2.1	0.9		3
Turbidity, NTU	NTU	13	20	5.1	28	6	19	9.8	6.3	36	<0.1	7.2
Phosphorus, total as	mg/L	<0.05	<0.05	<0.05	0.06	<0.05	0.05	<0.05	<0.05	0.08	<0.05	0.14
Lead, dissolved (ICP-	mg/L	0.003	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001
Nickel, dissolved	mg/L	<0.001	<0.001	0.037	<0.001	0.008	0.008	0.008	0.003	0.009	<0.001	0.007
Cadmium, dissolved	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002
Chromium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001
Copper, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	0.005	0.014	<0.001
Zinc, dissolved (ICP-	mg/L	0.001	<0.001	0.03	0.001	0.002	0.13	0.028	0.05	0.027	0.018	0.017

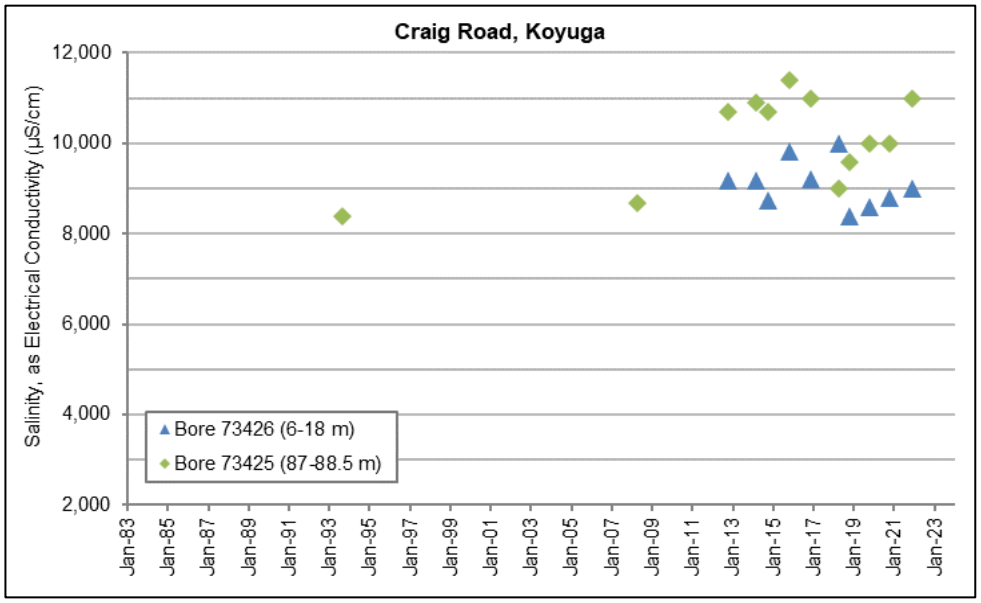
Historic groundwater salinity data for key monitoring bores listed in Schedule 1 of the Plan



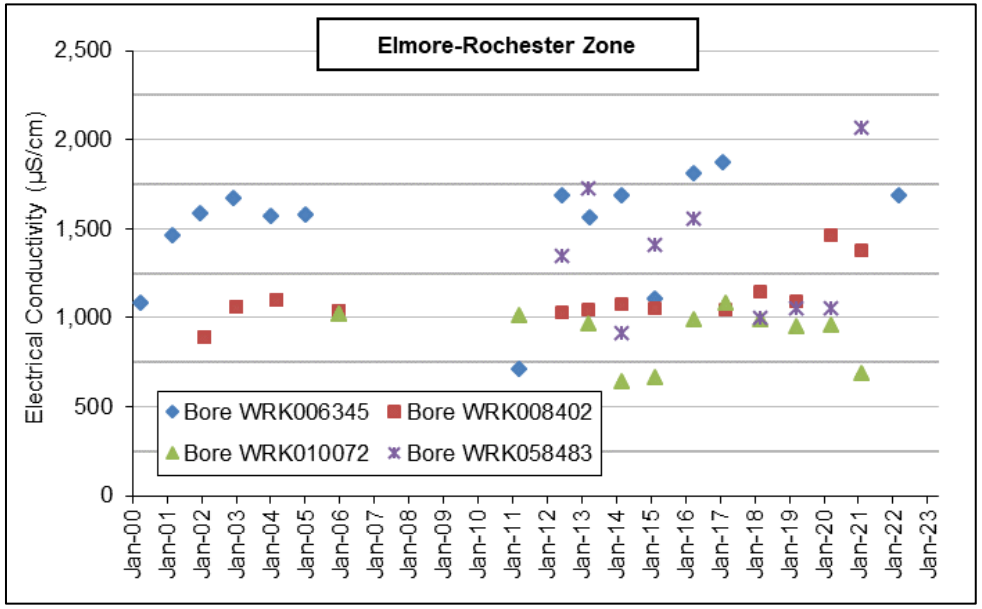


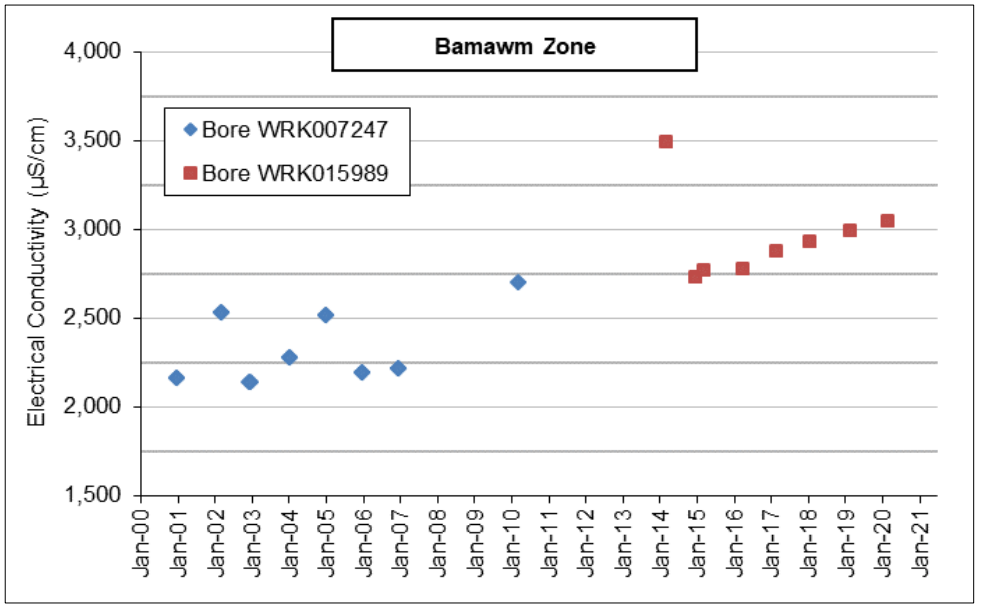

Strathallan Road, Bamawm
Salinity, as Electrical Conductivity (µS/cm)
10,000
8,000
6,000
4,000
2,000
0
Bore 47251 (21.8-27 m)
Bore 47250 (72.9-85 m)
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Jan-13
Jan-15
Jan-17
Jan-19
Jan-21
Jan-23

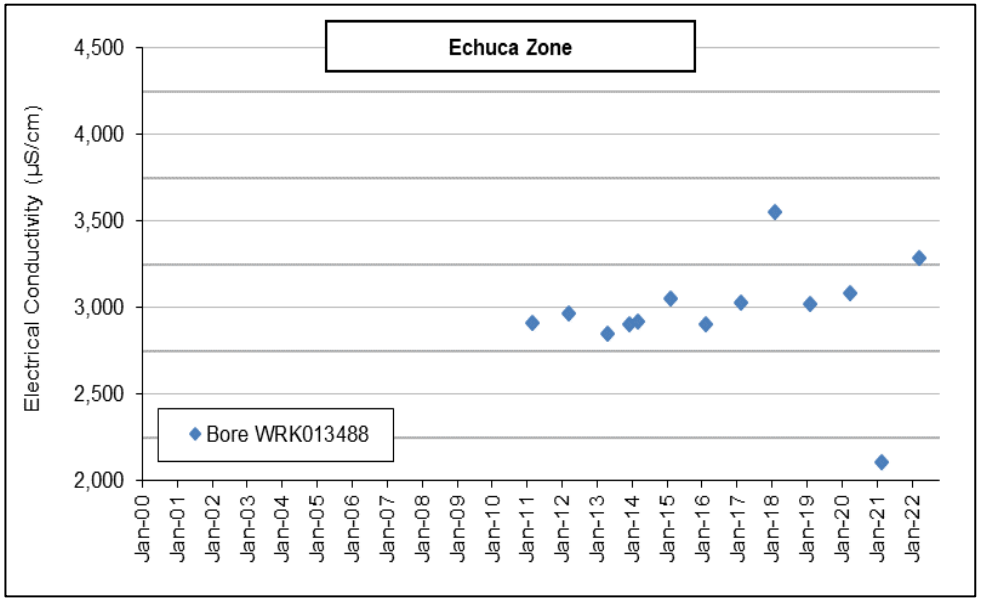

Casey Road, Wharparilla
Salinity, as Electrical Conductivity (µS/cm)
12,000
10,000
8,000
6,000
4,000
2,000
Bore 102829 (70.5-73.5 m)
Bore 102827 (108-114 m)
Bore 102828 (160.2-166.7 m)
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Jan-13
Jan-15
Jan-17
Jan-19
Jan-21
Jan-23

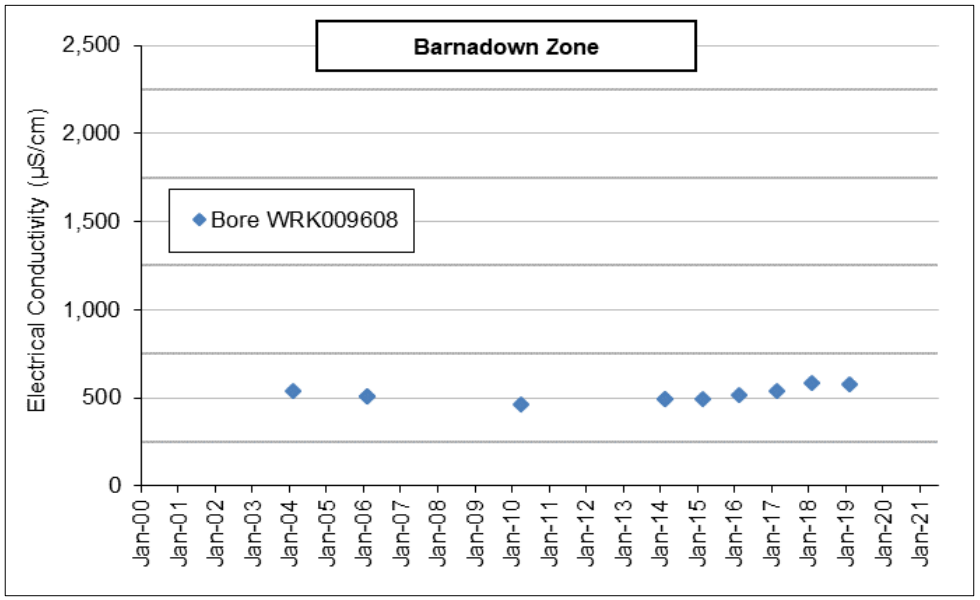

Craig Road, Koyuga
Salinity, as Electrical Conductivity (µS/cm)
12,000
10,000
8,000
6,000
4,000
2,000
Bore 73426 (6-18 m)
Bore 73425 (87-88.5 m)
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Jan-13
Jan-15
Jan-17
Jan-19
Jan-21
Jan-23

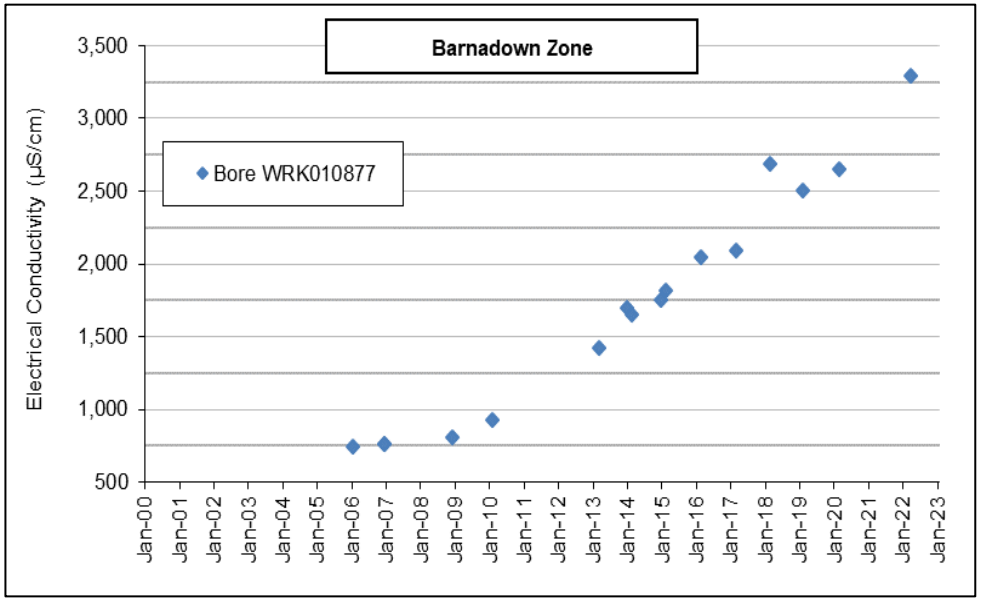
Historic groundwater salinity data for private bores sampled in the targeted sampling program






Echuca Zone
Electrical Conductivity (µS/cm)
Bore WRK013488
4,500
4,000
3,500
3,000
2,500
2,000
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22


Barnadown Zone
Electrical Conductivity (µS/cm)
Bore WRK009608
2,500
2,000
1,500
1,000
500
0
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21


Barnadown Zone
Electrical Conductivity (µS/cm)
Bore WRK010877
3,500
3,000
2,500
2,000
1,500
1,000
500
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23