South Australian–Victorian Border Groundwaters Agreement Review Committee

Thirty-Sixth Annual Report

To 30 June 2021

Adelaide and Melbourne

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PREFACE

The Border Groundwaters Agreement Review Committee's Annual Report for 2020-21 fulfils the requirement under clause 30(1) of the Border Groundwaters Agreement to report on its activities during the year to 30 June 2021. This report has been compiled with reference to reports from South Australia and Victoria.

Clause 30(2) requires the Review Committee to forward a copy of the report to the appropriate Minister in each government.

Section 11 of the Victorian *Groundwater (Border Agreement) Act 19*85, and section 13 of the South Australian *Groundwater (Border Agreement) Act 1985* provides that the relevant minister shall cause a copy of the annual report to be laid before the parliament within fourteen sitting days of the receipt of the report.

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1. The year in summary

Along the South Australian–Victorian border, groundwater is the principal source of reliable natural water. It is used extensively in both states for municipal supplies, individual domestic and livestock water supplies, industry, and irrigation of agricultural crops and recreational grounds. While groundwater supplies are relatively secure, the Border Groundwaters Agreement Review Committee (Review Committee) has sought to continually improve the technical understanding of the groundwater resources to maintain its ongoing sustainable and equitable use along the South Australian–Victorian border.

The Agreement establishes a Designated Area, extending 20 kilometres either side of the border, and from the coast to the River Murray. The Agreement applies specifically to this area. The Designated Area is divided into 22 management zones with 11 zones in each state (Figure 1).

The Review Committee undertook reviews of the groundwater resources and management prescriptions along the South Australian-Victorian border.

Province 1, where the Tertiary Limestone Aquifer in the Otway Basin is unconfined, is the southern portion of the South Australian-Victorian border Designated Area. The Review Committee has completed its initial technical assessment and is now reviewing the management implications. The Province 1 review recommendations are intended to be finalised in 2021-22.

On five occasions over the past ten years (2011 to 2021) groundwater extractions exceeded the Allowable Annual Volume in Sub-zone 1A South. Sub-zone 1A South is located along the coast in South Australia in Province 1. The groundwater resources in this area are at potential risk of seawater intrusion from excessive groundwater extraction. The Review Committee determined to alter the Allowable Annual Volume for Sub-zone 1A South to within maximum level of historic extractions, from 12 507ML to 15 000ML. This alteration to the Allowed Annual Volume in Sub-zone 1A South does not increase the Permissible Annual Volume of Zone 1A. This alteration was based on a review and risk assessment of existing licensee water requirements that found no adverse impacts had been detected from the over-use occurrences and low risk of adverse impacts from continuing extraction at historical levels for the medium-term future. There are no changes to the water share with Victoria or potential risks to groundwater users in Victoria. South Australia has committed to ongoing monitoring and analysis of potential adverse impacts including the potential for seawater intrusion. The alteration was gazetted and in effect from 1 July 2021.

Province 2, where the Tertiary Limestone Aquifer in the Murray Basin is unconfined and located in the central portion of the South Australian-Victorian border Designated Area. The Review Committee completed its review of the management prescriptions in the Tertiary Limestone Aquifer in November 2020 and found that some areas are experiencing long term decline in groundwater levels. These do not exceed the prescribed rates of decline set for the zones in the Designated Area (Table 10), however further work is required to determine an acceptable rate of decline, including the potential impacts from an increase in extraction up to the full entitlement. The Review Committee recommended to the States that investigations be undertaken to determine an acceptable level of groundwater decline. The Review Committee is consulting with the states to better understand potential adverse impacts from declines in groundwater levels and to develop management options and a common policy to mitigate any potential adverse impacts.

Province 3 where the Tertiary Limestone Aquifer in the Murray Basin is confined, is located in the northern portion of the South Australian-Victorian border Designated Area. The Province 3 review found groundwater level trends to be stable and the resource is responding as expected to groundwater extraction. No emerging risks were identified. The Review Committee determined not to alter the current management prescriptions.

The Review Committee completed a review of the Agreement in 2019. It concluded the Agreement had worked well in terms of understanding and ensuring equitable sharing of the groundwater resource. The Agreement could be improved by ensuring newer and emerging challenges such as groundwater dependent ecosystems, climate change and plantation forestry are appropriately considered and to respond to areas where groundwater resources are declining. The Review Committee will be seeking comments from government agencies on the Review of the Agreement during 2022.

2. About the Agreement and the Review Committee

The South Australian–Victorian Border Groundwaters Agreement

The groundwater resources along the South Australian–Victorian border are shared between the states. In recognition of the need to cooperatively manage these resources, both states agreed to enter into the Border Groundwaters Agreement (the Agreement) in 1985. The Agreement was amended in 2006.

The Agreement establishes a Designated Area, extending 20 kilometres either side of the border, and from the coast to the River Murray. The Agreement applies specifically to this area. The Designated Area is divided into 22 management zones with 11 zones in each state (Figure 1).

The Agreement provides that the available groundwater shall be shared equitably between both states and applies to all existing and future bores within the Designated Area. Bores that extract groundwater for domestic and livestock purposes are not subject to the Agreement.

New water extraction licences, or permits to take water, or well construction permits may not be granted or renewed within the Designated Area, other than in accordance with the management prescriptions set out in the Agreement. The prescriptions limit water extraction to a Permissible Annual Volume for total withdrawals from all aquifers, to a permissible rate of potentiometric surface lowering, and to a permissible level of salinity. The prescriptions also provide that, where appropriate, casing of new wells shall be sealed between aquifers to prevent inter-aquifer contamination.

The allocation of water is the responsibility of the licensing agencies in each state, in accordance with the relevant groundwater management plan or water allocation plan, prepared under the states' respective water resources legislation.

The approach taken by the states in developing management plans has included objectives to better quantify the resource, to establish appropriate mechanisms for allocating the resource or, if needed, to restrict the use of the resource. Plans are developed through consultative regional committees or boards to maximise community and industry involvement in making and implementing the management arrangements.

The management areas relevant to the Designated Area are set out in Table 1. The location of the zones relevant to state water administration areas are shown in Figure 2.

Table 1: Management areas relevant to the Designated Area

South Australia	Victoria
• Mallee Prescribed Wells Area • Tatiara Prescribed Wells Area • Lower Limestone Coast Prescribed Wells Area	• Murrayville Groundwater Management Area • West Wimmera Groundwater Management Area • Glenelg Water Supply Protection Area

Border Groundwaters Agreement Review Committee

The Review Committee, with membership from both states, is established under the Border Groundwaters Agreement as the operating body for the effective implementation and administration of the Agreement. [1]

The Review Committee is required, at intervals of not more than five years, to review the management prescriptions – that is, the Permissible Annual Volume of extraction, the extraction of Allowable Annual Volume for sub-zones, the permissible distance from the border for referral to the other state, the permissible rate of potentiometric surface lowering (groundwater level drawdown), and the permissible level of salinity (if any such levels have been declared).

The schedule of reviews of the management prescriptions are as follows:

- Province 1 is underway with completion anticipated in 2021-22.
- Province 2 was completed in 2020-21 and the Review Committee is consulting with the States on recommendations from the Review.
- Province 3 was completed in 2020-21 and the Review Committee determined to maintain the current prescriptions unchanged.

The Agreement provides that the Review Committee shall have the power to alter the permissible distance, Permissible Annual Volume, Allowable Annual Volume, and to declare a period of restriction. The relevant state ministers have the power to alter the permissible rate of potentiometric surface lowering and the permissible level of salinity, on the recommendation of the Review Committee[2].

The Agreement provides that the Review Committee may also:

- coordinate, or cause to be carried out, surveys, investigations and studies concerning the use, control, protection, management or administration of the groundwater in the Designated Area.
- make recommendations to the Minister of each Contracting Government or to any authority, agency or tribunal of the Contracting Governments concerning any matter which, in the opinion of the Review Committee, may in any way affect the investigation, use, control, protection, management or administration of the groundwater within the Designated Area.
- review the Agreement and, if in its opinion, make recommendations to the Contracting Governments for amendments to the Agreement that are considered necessary or desirable.

[1] The Review Committee does not manage or control any public finances or assets.
[2] A full list of Government Gazette notices relating to the current prescriptions is provided in Appendix A of this report.

The Review Committee met three times during the 2020-21 year:

22 June 2021	Meeting 143	Teleconference
28 April 2021	Meeting 142	Teleconference
1 December 2020	Meeting 141	Teleconference

During the year membership of the Review Committee comprised:

South Australia		**Victoria**	
Mr N Power	Member (new)	Ms A May	Member
Mr D Jordan	Member	Mr R Nott	Member (reappointment)
Mr T Collins	Deputy member (retired)	Mr K Wilson	Deputy member
Ms B Sorensen	Deputy member (new)		

Ms Birgitte Sorensen and Mr Neil Power were appointed as members for South Australia on 17 March 2021 replacing Mr Tim Collins and Ms Sandy Caruthers.

Mr Randal Nott was reappointed as a Victorian member on 7 June 2021.

3. General Information

Groundwater resources in the South Australian–Victorian border region

There are two main aquifer systems along the border, comprising the Tertiary Confined Sand Aquifer and the overlying Tertiary Limestone Aquifer (Figure 3 and 4). A thin Pliocene Sands Aquifer overlies the Upper Tertiary Aquitard in parts of the Designated Area.

The Tertiary Limestone Aquifer is the principal source of groundwater throughout the Designated Area, with water being used for a range of purposes – municipal supplies for the towns of Murrayville, Pinnaroo, Naracoorte, Penola, Nangwarry, Tarpeena and Mount Gambier, individual domestic and livestock water supplies, industry, and irrigation of agricultural crops and recreational grounds.

Groundwater salinity in the Tertiary Limestone Aquifer is mostly less than 3,000 EC (about 1,700 mg/L TDS) in the Designated Area, except in the north where it exceeds 30,000 EC (about 18,000 mg/L TDS, or roughly half that of seawater).

In the Designated Area, the Tertiary Limestone Aquifer has been subdivided into three hydrogeological provinces as shown in Figure 3 and described below:

> Province 1 occurs largely in the Otway Basin and is characterised by Quaternary calcareous sandstone overlying the Tertiary Limestone Aquifer forming one unconfined aquifer system.
>
> Province 2 is in the Murray Basin where the Tertiary Limestone Aquifer is unconfined and either outcrops at the surface or is overlain directly by the Pliocene Sands Aquifer.
>
> Province 3 is in an area of the Murray Basin where the Tertiary Limestone Aquifer is confined by the Upper Tertiary Aquitard. A thin Pliocene Sands Aquifer overlies the Upper Tertiary Aquitard in some parts of this province.

Management approach

When the Agreement was established in 1985, the groundwater shares (Permissible Annual Volumes) between the two adjacent state Designated Area zones were equal. As more has been learnt about the groundwater resources and the risks to the resources from use, the limits have been amended to protect existing entitlements while managing undue depletion or degradation of the resource.

In accordance with its role to advise the states, as outlined in the previous section, the Review Committee has taken the following management approach for each province (refer to Figure 3).

Tertiary Limestone Aquifer – Province 1
Province 1 is the southern portion of the South Australian-Victorian border, where the Tertiary Limestone Aquifer in the Otway Basin is unconfined the water table is shallow and recharge is high where land is cleared and soil is sandy. The Tertiary Limestone Aquifer is a high yielding renewable resource replenished by rainfall, but parts of Province 1 have experienced long-term declines in groundwater levels.

In 2008, following its Five-Year Management Review of Province 1 (Border Groundwaters Agreement Review Committee 2008), the Review Committee recommended that a new management approach was needed to achieve long term sustainability. The current mix of land use and groundwater extractions is out of balance (in that outflows and extractions exceed inflows) and is not sustainable in the longer term. Without a change in the current land use and/or water extractions, groundwater levels will continue to decline over parts of Province 1.

Plantation forest is a significant regional land use by area, with a hydrological impact in most of the zones in Province 1 due to recharge interception and direct groundwater extraction from shallow water tables.

In the 2008 Province 1 Management Review the Review Committee proposed to the States that a new management approach is needed in Province 1 to achieve long-term sustainability. This may require reductions in the area under plantation forests and the volume extracted via bores under groundwater entitlements to stabilise long term groundwater level declines (BGARC, 2008). To inform this approach, the Review Committee proposed a management strategy to address four key issues. These are:

- water accounting;
- inter-aquifer connectivity;
- sea-water intrusion; and
- aquifer depletion.

The states have progressed studies in these four key issues and which the Review Committee incorporated into its review of groundwater resources in Province 1 during 2020-2021.

The Review Committee recommended that both states develop a consistent approach to account for the water used by plantation forests and undertake studies into the risks arising from long term declines in groundwater levels. These included studies on the inter-connection between the Tertiary Confined Sand Aquifer on the Tertiary Limestone Aquifer, sea-water intrusion and aquifer depletion in the Lake Mundi area in Victoria. Lake Mundi is an area where the Tertiary Limestone Aquifer is thin giving it a limited resource capacity.

South Australia has implemented arrangements to account for commercial plantation forests impacts on water resources. After the adoption of the Water Allocation Plan for the Lower Limestone Coast Prescribed Wells Area in 2013, forest managers in South Australia are now required to offset plantation forest hydrological impacts with a licensed water allocation. At the time, forest managers were considered to be existing users and were granted forest water licences for existing (or approved proposed) forest compartments to offset their impact on the regional groundwater. In the South Australian Zones 1A to 4A, the plantation forest licensed impacts almost equal the Permissible Annual Volumes that can be extracted via bores in the Tertiary Limestone Aquifer in those zones. Areas under plantation are roughly equal in both States and have not changed significantly in the last decade (ABARES, 2021).

Forest areas in Victoria do not require a groundwater licence. Victoria completed a review of commercial forested data which indicates there has not been a significant change in area under plantation in Zones 1B to 4B, the main areas where commercial forest development have historically occurred in the Designated Area.

Data on plantation usage is provided under section 3 in Table 11 (Area of plantation commercial forest at 30 June 2021). This data has been included in the Annual report since

2019. The matter of forest water accounting is considered in the current review of the Agreement.

The Review Committee has completed its initial technical assessment as part of the current 5-year review of management prescriptions and is now reviewing the management implications and intends to finalise its recommendations in 2021-22.

The Review Committee determined to alter the Allowable Annual Volume for Sub-zone 1A South to within maximum level of historic extractions, from 12,507 ML to 15,000 ML. This was on the basis of existing licensee water requirements and a review and risk assessment that identified no adverse impacts have been detected due to the low level, over-use occurrences and low risk of continuing extraction at historical levels for the medium-term future. South Australia has committed to ongoing monitoring of potential adverse impacts including the potential for seawater intrusion. There are no significant risks in the adjacent Zone 1B in Victoria due to the very low allocation and use in in this zone (Table 4), where water levels here have been stable since 2001.

This alteration to the Allowed Annual Volume in Sub-zone 1A South does not increase the Permissible Annual Volume of Zone 1A. The alteration was gazetted and in effect from 1 July 2021.

Tertiary Limestone Aquifer – Province 2

Groundwater in the Tertiary Limestone Aquifer is not being significantly replenished by modern recharge across most of Province 2. As such, the groundwater resource is considered a non-renewable resource, in terms of managing the resource. The Review Committee formed this view during its management review of Province 2 in 2007 (Border Groundwaters Agreement Review Committee, 2007) and advised the states of the need to develop a common policy for water allocation and long-term groundwater management on the basis that this is a non-renewable resource.

This policy is considered important for the area of concentrated extractions in Zones 5A, 6A, 5B and 6B, (which includes the Frances–Neuarpur area) where groundwater levels have declined (up to ~0.2 m/y since 1996), primarily due to groundwater extraction. While the longer term declines have occurred and continue in some monitoring sites, there has been some stabilisation in groundwater levels at other monitoring sites, however this variation is not located in any particular area of a zone. This stabilisation is attributed to reduced extractions during periods of higher rainfall.

The Review Committee completed its review of the management prescriptions in the Tertiary Limestone Aquifer in November 2020 and found:

- In the northern part of Province 2 the water table is deep, recharge is low, use is moderate and groundwater levels are generally stable.
- In the central area, Zones 5A, 5B and the southern parts of Zone 6A and 6B, the water table is deep, recharge is low, and groundwater levels have declined since 1995 with some periods of stability. To date, declines are considered to be primarily in response to groundwater extraction and are considered manageable, with no recorded impacts on groundwater users such as depletion or loss of supply. While the current supplies are secure at the historic rate of extraction and current groundwater levels, further work is required to understand an acceptable rate of decline or what the resource condition limit might be if groundwater extraction rates increase within the existing prescriptions.
- In the south of Province 2, Zone 4A use is high (over 11,000 ML, see Table 4) and in Zones 4A and 4B plantation forests result in reduced recharge by about 6,700 ML (Table

11). There is concern that declining groundwater levels with other catchment changes may be having an impact on Mosquito Creek and Bool and Hacks Lagoons – which are Ramsar listed wetlands located to the west of the Designated Area.

As part of the Province 2 review, the Review Committee recommended to both states that investigations be undertaken to determine an acceptable level of groundwater decline. The Review Committee is working with the states to consult on the recommendations to better understand potential adverse impacts from declines in groundwater levels and to develop management options and a common policy to mitigate any potential adverse impacts.

Tertiary Limestone Aquifer – Province 3

The Tertiary Limestone Aquifer in Province 3 is not being replenished by modern recharge and has been managed as a non-renewable resource since 2001. The aquifer is confined by overlying formations and distant from recharge areas. Consequently, the aquifer does not respond to seasonal recharge from rainfall. Intensive groundwater development began after 2001, particularly in Zones 9A, 10A, 9B and 10B, and the observed long-term water level trends and seasonal drawdowns are consistent with the pressure response to extractions from a confined aquifer. A cone of depression in the pressure levels has formed, with its centre located at Peebinga in Zone 10A, an area of intensive groundwater extraction. The overall rate of decline has reduced as the pressure levels tend towards a steady state.

A review of the management prescriptions in Province 3 was completed in 2020-21 and the Review Committee determined to maintain the current prescriptions. Groundwater levels are generally stable with no long-term declining trends since 2007 and groundwater use is low, except for small declines near areas of intensive development around Murrayville Groundwater Management Area. There is no immediate risk of increased groundwater salinity, due to the lateral movement of saline groundwater, or the vertical leakage of saline water from the overlying Pliocene Sands Aquifer, however there is a need to continue to monitor the resource trends.

There are no known environmental assets or ecosystems associated with this confined aquifer, which are compromised by the volumes being extracted under these management arrangements.

The management regimes in place in both South Australia and Victoria aim to ensure people relying on groundwater bores for domestic and stock purposes can still access the resource. The states have implemented measures to prevent uncontrolled localised drawdowns arising from intense groundwater extraction. This means the potential for localised areas of drawdown having adverse impacts on domestic and livestock users, dewatering the aquifer, or accelerating water quality change is low but should continue to be monitored.

Tertiary Confined Sand Aquifer

Management prescriptions for the Tertiary Confined Sand Aquifer in the Designated Area remain unchanged since 2001.

Pliocene Sands Aquifer

The Pliocene Sands Aquifer overlies the Tertiary Limestone Aquifer in the Murray Basin, mainly in the northern part of the Designated Area. The groundwater in the Pliocene Sands Aquifer is generally saline. In 2007, the Review Committee determined a Permissible Annual Volume for the Pliocene Sands Aquifer in Zone 11A to provide for salinity mitigation extractions for the Murtho Salt Interception Scheme. The scheme intercepts saline groundwater that would normally enter the River Murray. The Permissible Annual Volume was increased during

2017-18 to enable expansion of the salt interception scheme. This program aligns with the Murray–Darling Basin Plan.

Permissible Annual Volumes and Allowable Annual Volumes

The Permissible Annual Volumes for each aquifer in each zone at 30 June 2021 are set out in Table 2.

Table 2: Permissible Annual Volumes at 30 June 2021

South Australia				Victoria		
Permissible Annual Volume			Zone	Zone	Permissible Annual Volume	
Pliocene Sands Aquifer (ML/y)	Tertiary Limestone Aquifer (ML/y)	Tertiary Confined Sand Aquifer (ML/y)			Tertiary Limestone Aquifer (ML/y)	Tertiary Confined Sand Aquifer (ML/y)
7763	3 700	0	11A	11B	1 823	0
	14 000	320	10A	10B	6 720	560
	11 595	570	9A	9B	5 960	630
	5 121	340	8A	8B	3 500	330
	8 259	350	7A	7B	5 782	350
	8 758	360	6A	6B	10 279	360
	18 943	540	5A	5B	12 833	570
	22 102	710	4A	4B	14 000	300
	24 054	1 900	3A	3B	16 500	1 000
	25 000	2 900	2A	2B	25 000	5 100
	31 812	9 200	1A	1B	45 720	14 500

The Allowable Annual Volumes for the sub-zones that have been determined for the Tertiary Limestone Aquifer in Zones 1A, 6A and 9A at 30 June 2021 are set out in Table 3. The locations of the sub-zones are shown in Figure 5.

Table 3: Allowable Annual Volumes for the Tertiary Limestone Aquifer for year ending 30 June 2021

South Australia Allowable Annual Volumes	
Tertiary Limestone Aquifer (ML/y)	Sub-zone
2 400	9A North
7 760	9A South
4 658	6A South
12 507*	1A South

*The Review Committee determined to change the AAV in Sub-zone 1A South from 12,507 ML to 15,000 ML. The change was gazetted and effective 1 July 2021.

Allocations and volumes extracted

The allocations and the volumes extracted[3] for the Tertiary Limestone Aquifer are listed in Tables 4 and 5. Water extractions in all the management zones in 2020-21 are within the Permissible Annual Volumes. A total of 139,442 ML was extracted from the Tertiary Limestone Aquifer in the Designated Area, approximately 10% higher than in 2019-20.

Table 4: Permissible Annual Volumes, number of licences, allocations and annual volumes extracted for the Tertiary Limestone Aquifer at 30 June 2021

South Australia					Victoria				
Tertiary Limestone Aquifer				Zone	Zone	Tertiary Limestone Aquifer			
Permissible Annual Volume (ML/y)	Licensed Allocations					Permissible Annual Volume (ML/y)	Licensed Allocations		
	Licences	Volume Allocated (ML)	Volume Extracted (ML)				No. of Licences	Volume Allocated (ML)	Volume Extracted (ML)
3700	8	3 700	2 178	11A	11B	1 823	3	1 600	1 654[1]
14 000	33	14 000	9 893	10A	10B	6 720	22	6 718	4 455
11 595	7	10 160	8 794	9A	9B	5 960	3	5 300	1 309
5121	26	6 542	1 505	8A	8B	3 500	7[2]	3 130[1]	1 613
8259	71	9 132	3 873	7A	7B	5 782	13	5 782	3 124
8758	39	10 629	5 708	6A	6B	10 279	16	10 279	5 705
18 943	122	23 704	11 852	5A	5B	12 833	39	12 833	7 527
22 102	171	30 928	11 290	4A	4B	14 000	11	2 803	286
24 054	238	32 419	10 732	3A	3B	16 500	4	515	62
25 000	81	26 899	13 096	2A	2B	25 000	43	24 979	6 521
31 812	284	46 520	25 794	1A	1B	45 720	18	4 457	2 471

Note 1 Carryover volume utilised - The Carryover Declaration for Murrayville Groundwater Management Area 2017 permits licensees to access the volume of groundwater not taken in the prior water season, up to 30% of licensed volume.
Note 2: This is a decrease of 1 licence from the previous year as a result of non-renewal of a licence.

Table 5: Allowable Annual Volumes, number of licences, allocations and annual volumes extracted for the Tertiary Limestone Aquifer at 30 June 2021

South Australia				
Tertiary Limestone Aquifer				Sub-Zone
Allowable Annual Volume (ML/y)	Licensed Allocations			
	Licences	Volume Allocated (ML)	Volume Extracted (ML)	
2 400	2	2 400	1 374	9A North
7 760	5	7 760	7 419	9A South
4 658	18	5 321	2 665	6A South
12 507[3]	50	21 228	13 665	1A South

Note 3 The Review Committee determined to change the AAV in Sub-zone 1A South from 12,507 ML to 15,000 ML. The change was gazetted and effective 1 July 2021.

[3] The 'volume extracted' is the volume of groundwater extracted under a permit/licence and does not take into account the volume extracted for domestic and stock use or the impacts of plantation forests. The Agreement does not apply to these uses.

In 2013, South Australia implemented the conversion of all area-based irrigation allocations to volumetric allocations and while not granting any new allocations it has resulted in allocations exceeding the Permissible Annual Volumes in eight zones and the Allowable Annual Volume in two sub-zones.

On five occasions over the past ten years (2011 to 2021) groundwater extractions exceeded the Allowable Annual Volume in Sub-zone 1A South. The groundwater resources in this area near the coast have the potential risk for seawater intrusion from groundwater extraction. As noted previously, the Review Committee determined to alter the Allowable Annual Volume for Sub-zone 1A South to within maximum level of historic extractions, from 12 507 ML to 15 000 ML. The alteration was gazetted and in effect from 1 July 2021.

While there is un-allocated water in the Tertiary Limestone Aquifer in Zones 1B, 3B and 4B a moratorium exists under the Victorian *Water Act 1989* on issuing new groundwater licences in the Tertiary Limestone Aquifer in Zones 1B, 2B, 3B and part of Zone 4B and for the Tertiary Confined Sand Aquifer in Zones 1B, 2B and 3B. The number of licences and the allocated volume has increased in Zone 2B due to a review of the location of a licence that was previously considered to be outside the Designated Area and subsequently found to be in Zone 2B.

The allocations and volumes extracted for the Tertiary Confined Sand Aquifer are listed in Table 6.

Table 6: Permissible Annual Volumes, allocations and annual volumes extracted for the Tertiary Confined Sand Aquifer at 30 June 2021

South Australia					**Victoria**				
Tertiary Confined Sand Aquifer				Zone	Zone	Tertiary Confined Sand Aquifer			
Permissible Annual Volume (ML/y)	Licensed Allocations					Permissible Annual Volume (ML/y)	Licensed Allocations		
	No. of Licences	Volume Allocated (ML)	Volume Extracted (ML)				No. of Licences	Volume Allocated (ML)	Volume Extracted (ML)
0	0	0	0	11A	11B	0	0	0	0
320	0	0	0	10A	10B	560	0	0	0
570	0	0	0	9A	9B	630	0	0	0
340	0	0	0	8A	8B	330	0	0	0
350	0	0	0	7A	7B	350	0	0	0
360	0	0	0	6A	6B	360	0	0	0
540	0	0	0	5A	5B	570	0	0	0
710	1	102	29	4A	4B	300	0	0	0
1 900	2	259	148	3A	3B	1 000	0	0	0
2 900	2	150	27	2A	2B	5 100	0	0	0
9 200	4	1 704	778	1A	1B	14 500	0	0	0

The Permissible Annual Volume and volume extracted for the Pliocene Sands Aquifer are listed in Table 7.

It should be noted that the groundwater from the Pliocene Sands Aquifer is saline and the extractions relate to the interception of groundwater that would normally enter the River

Murray. While there is no formal licenced water allocation, salt interception schemes operated by the Government of South Australia are consistent with the Murray–Darling Basin Plan and in accordance with the Agreement and the relevant Permissible Annual Volume. The 4146 ML of water extracted from the Pliocene Sand Aquifer in Zone 11A, via the Murtho salt interception scheme, is estimated to contain 158,142 tonnes of salts.

Table 7: Permissible Annual Volume, number of licences, volume allocated and annual volume extracted for the Pliocene Sands Aquifer at 30 June 2021

South Australia				
Pliocene Sands Aquifer				
Permissible Annual Volume (ML/y)	Licensed Allocations			Zone
	No. of Licences	Volume Allocated (ML)	Volume Extracted (ML)	
7 763	0	0	4 146	11A

While the Agreement does not apply to bores for domestic and livestock purposes, the large number of these bores in the Designated Area indicates the important role groundwater plays for these purposes. The estimated number of domestic and livestock bores for each zone are listed in Table 8.

Table 8: Number of domestic and livestock bores

South Australia		Victoria	
Number of Domestic and Stock Bores[4]	Zone	Zone	Number of Domestic and Stock Bores[5]
16	11A	11B	17
166	10A	10B	243
25	9A	9B	47
62	8A	8B	113
749	7A	7B	104
391	6A	6B	56
1370	5A	5B	162
896	4A	4B	339
1155	3A	3B	79
632	2A	2B	577
1648	1A	1B	625

Permissible distance from the border

The permissible distance is the distance from the South Australia–Victoria border within which all applications for a permit or licence must be forwarded to the Review Committee for approval. The permissible distances at 30 June 2021 are specified in Table 9.

[4] The numbers of domestic and livestock bores are derived from spatial analysis of the state SAGEODATA borehole records. It does not necessarily indicate the bores in use.
[5] The numbers of domestic and livestock bores are best estimates made in 2004, based on the State database records.

Table 9: Permissible distances at 30 June 2020

South Australia			Victoria		
Tertiary Confined Sand Aquifer Distance (km)	Tertiary Limestone Aquifer Distance (km)	Zone	Zone	Tertiary Limestone Aquifer Distance (km)	Tertiary Confined Sand Aquifer Distance (km)
3	3	11A	11B	3	3
3	3	10A	10B	3	3
3	1	9A	9B	1	3
3	1	8A	8B	1	3
3	1	7A	7B	1	3
3	1	6A	6B	1	3
3	1	5A	5B	1	3
3	1	4A	4B	1	3
3	1	3A	3B	1	3
3	1	2A	2B	1	3
3	1	1A	1B	1	3

Permissible potentiometric surface lowering

The Agreement provides for a rate of drawdown that must not be exceeded. The prescribed permissible potentiometric surface lowering rates for each zone are shown in Table 10.

Table 10: Permissible potentiometric surface lowering rates at 30 June 2021

South Australia		Victoria	
Rate (m/y)	Zone	Zone	Rate (m/y)
0.65	11A	11B	0.65
0.65	10A	10B	0.65
0.65	9A	9B	0.65
0.05	8A	8B	0.65
0.05	7A	7B	0.05
0.05	Sub-zone 6A North	6B	0.20
0.20	Sub-zone 6A South		
0.20	5A	5B	0.20
0.25	4A	4B	0.25
0.25	3A	3B	0.25
0.25	2A	2B	0.25
0.25	1A	1B	0.25

Permissible salinity

The Agreement allows for the setting of permissible salinity levels. Following the technical reviews of Province 1, Province 2 and Province 3 (Border Groundwaters Agreement Review Committee 2018, 2020 and 2021 respectively) the Review Committee determined that there is no need to recommend that permissible salinity levels should be set.

Accounting for the impacts of plantation forests on groundwater resources

While the hydrological impacts of commercial plantation forests on groundwater resources in the unconfined Tertiary Limestone Aquifer are not covered under the Agreement, the Review Committee has decided to illustrate the commercial plantation forest impacts on the groundwater resources in lower zones of the Designated Area in Table 11.

Table 11: Area of plantation commercial forest at 30 June 2020

South Australia			Victoria		
Area of commercial plantation (ha)[6]	Licensed commercial plantation volume (ML)	Zone	Zone	Area of plantation (ha)[7]	Estimated plantation volume (ML) [8]
465	122	6A	6B	-	-
57	18	5A	5B	-	-
3 808	2 697	4A	4B	5 600	3 966
11 386	26 093	3A	3B	19 000	43 542
19 428	37 675	2A	2B	9 200	17 841
19 723	34 784	1A	1B	23 500	41 445

Supplementary information

Review of South Australian water allocation plans

The Water Allocation Plan for the Tatiara Prescribed Wells Area is currently being reviewed by the Limestone Coast Landscape Board and community engagement is proposed during 2021-22 regarding the proposed policies to be incorporated into a new plan. Policies being considered include an ‘unbundling’ of the licensed entitlements.

While the mandatory review of the Water Allocation Plan for the Lower Limestone Coast Prescribed Wells Area is not due until 2023, a review program is being developed for consideration by the Limestone Coast Landscape Board.

Similarly, the Water Allocation Plan for the Mallee Prescribed Wells Area is scheduled for review in 2022 by the Murraylands and Riverland Landscape Board.

[6] Data from commercial plantation forest licensee reports
[7] Data from Victorian Spatial database as Victoria does not licence plantation forest groundwater impacts
[8] Estimated by applying the South Australian methodology. Victoria does not licence commercial forest groundwater use

Mosquito Creek

The Limestone Coast Landscape Board has commenced a program to monitor groundwater trends in the Mosquito Creek riparian zone to improve the understanding of the relationship between surface flows in the creek and the groundwater resource in the adjacent area. Five groundwater sites in the Mosquito Creek riparian zone are planned to be re-equipped with data loggers to observe water table trends with the creek levels in this risk area.

Condition of the resource

Aggregate annual groundwater extractions in the Designated Area from the Tertiary Limestone Aquifer from 2006-07 to June 2020 are shown in the Figure 6 bar chart.

Compared to the groundwater levels of the early 1990s, levels remain lower in the southern parts of Province 2, however there is a general reduction in the rate of decline and some periods of stability observed since 2010, particularly when extraction has been lower. Similarly, declines in groundwater levels are evident in parts of Province 1, primarily due to a combination of plantation forest hydrological impacts, irrigation extractions and rainfall variability.

Details of the potentiometric level trends from representative observation bores for the Tertiary Limestone Aquifer and the Tertiary Confined Sand Aquifer are shown in Figures 7 and 8.

Groundwater monitoring

Following a review of the South Australian monitoring network, the Department for Environment and Water continues to monitor a network of approximately 430 wells within the Designated Area with four observations a year.

Victoria monitored 77 State Observation bores within the Designated Area, 29 bores are telemetered to provide more frequent monitoring and the remainder are monitored quarterly.

FIGURES

Figure 1: Designated Area and zones

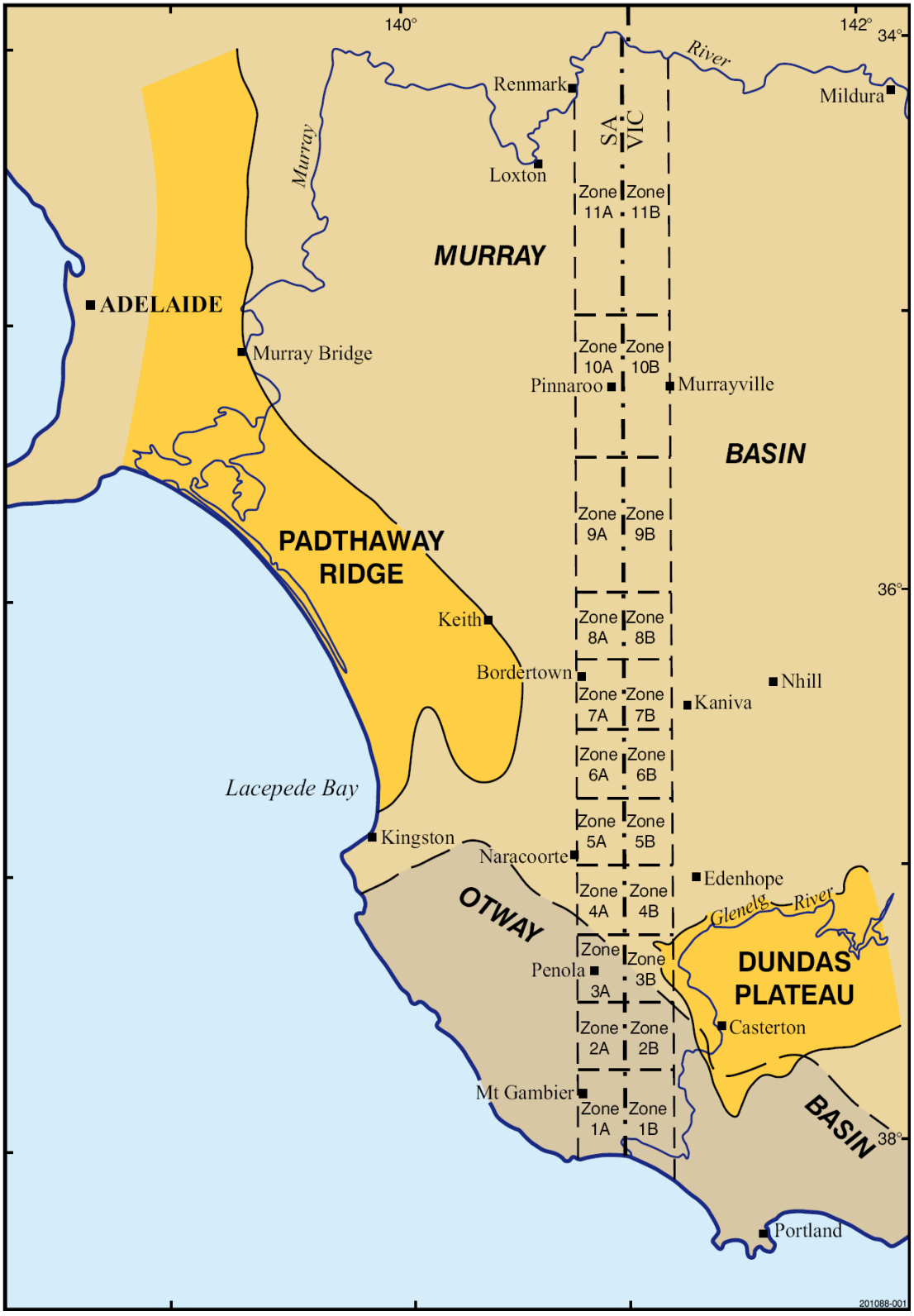


Figure 2: Relationship of management areas in South Australia and Victoria to the Designated Area

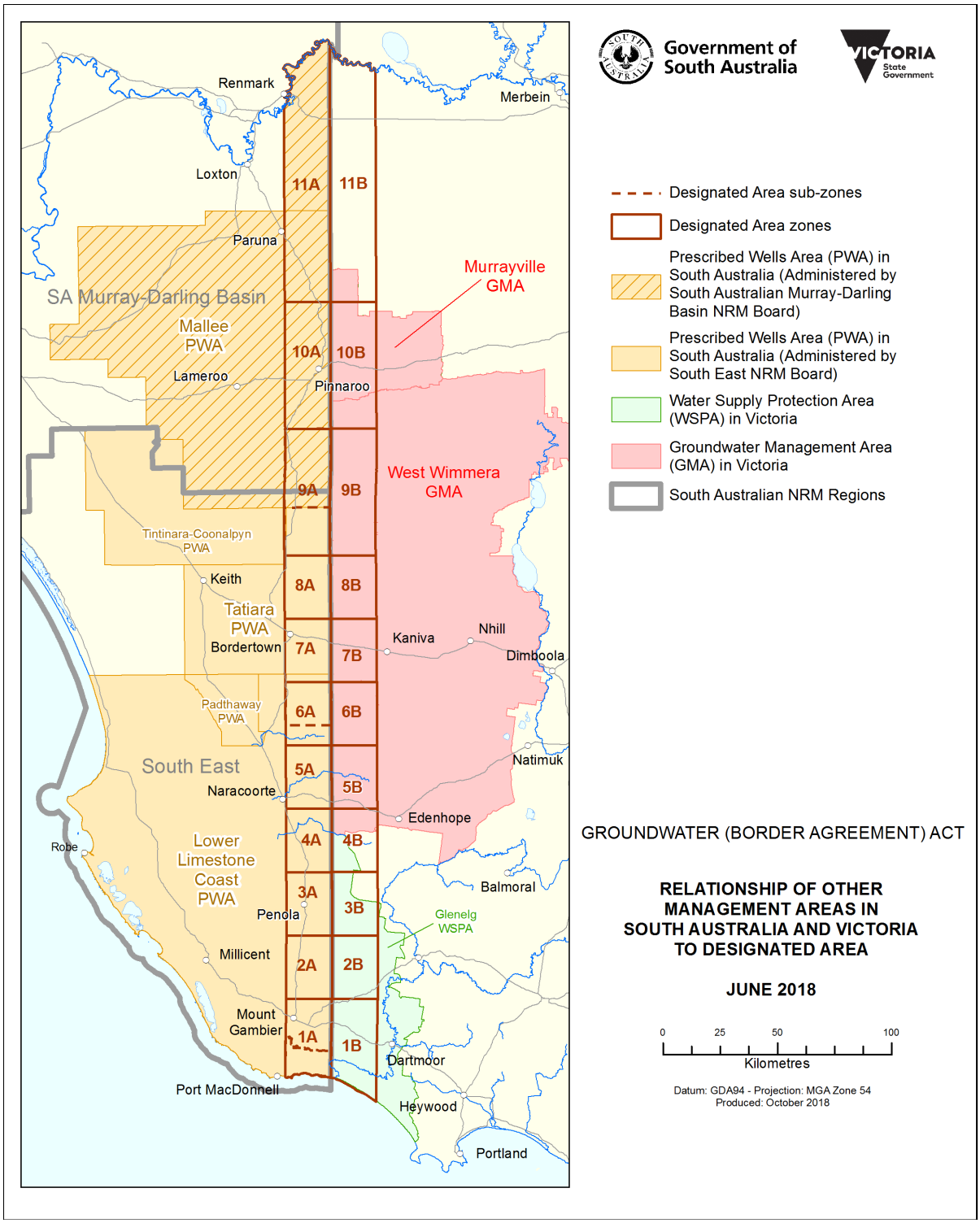


Figure 3: Hydrogeological provinces

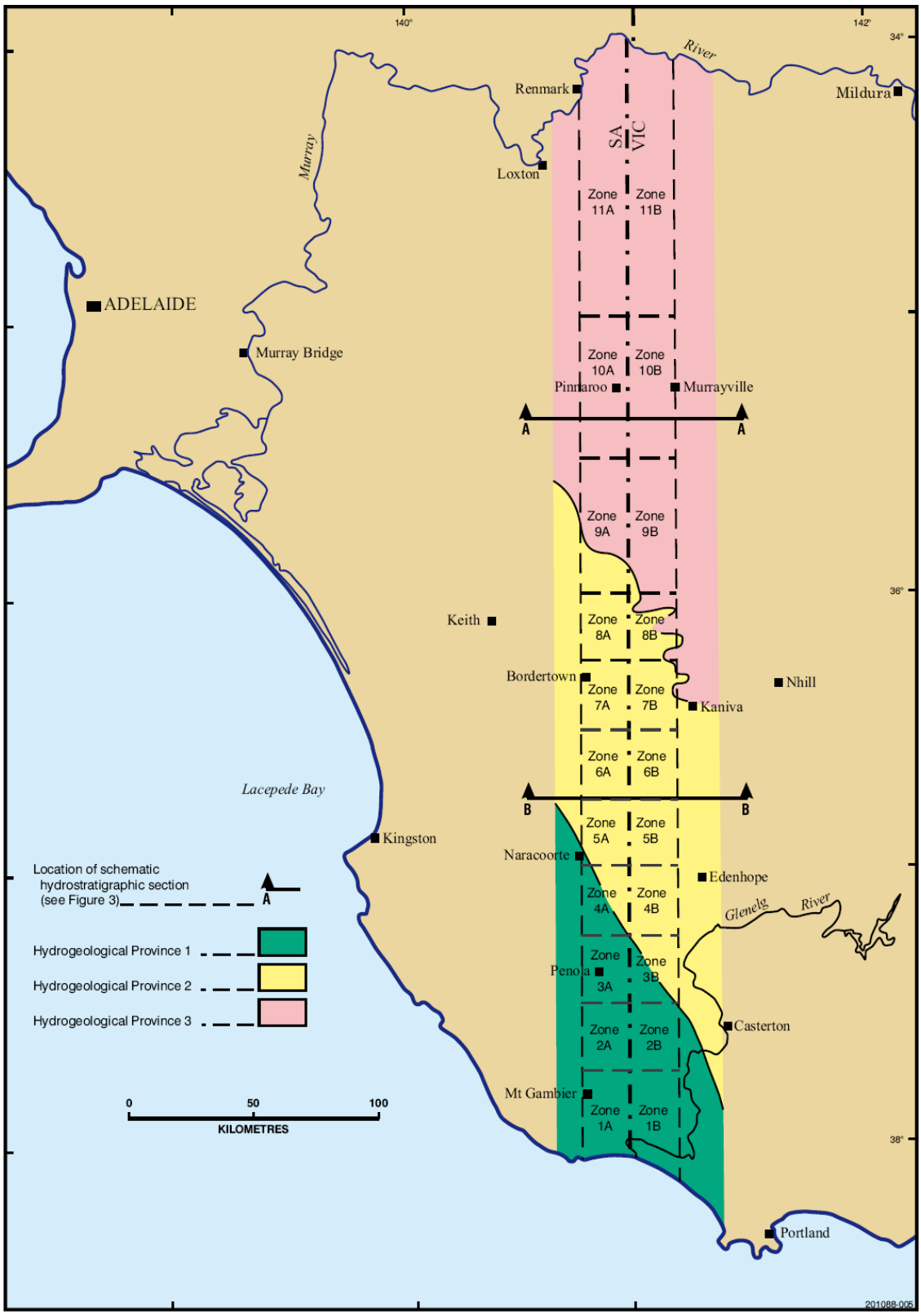


Figure 4: Schematic hydrostratigraphic cross-sections relating to Figure 3

(Locations of the cross-sections are shown in Figure 3)

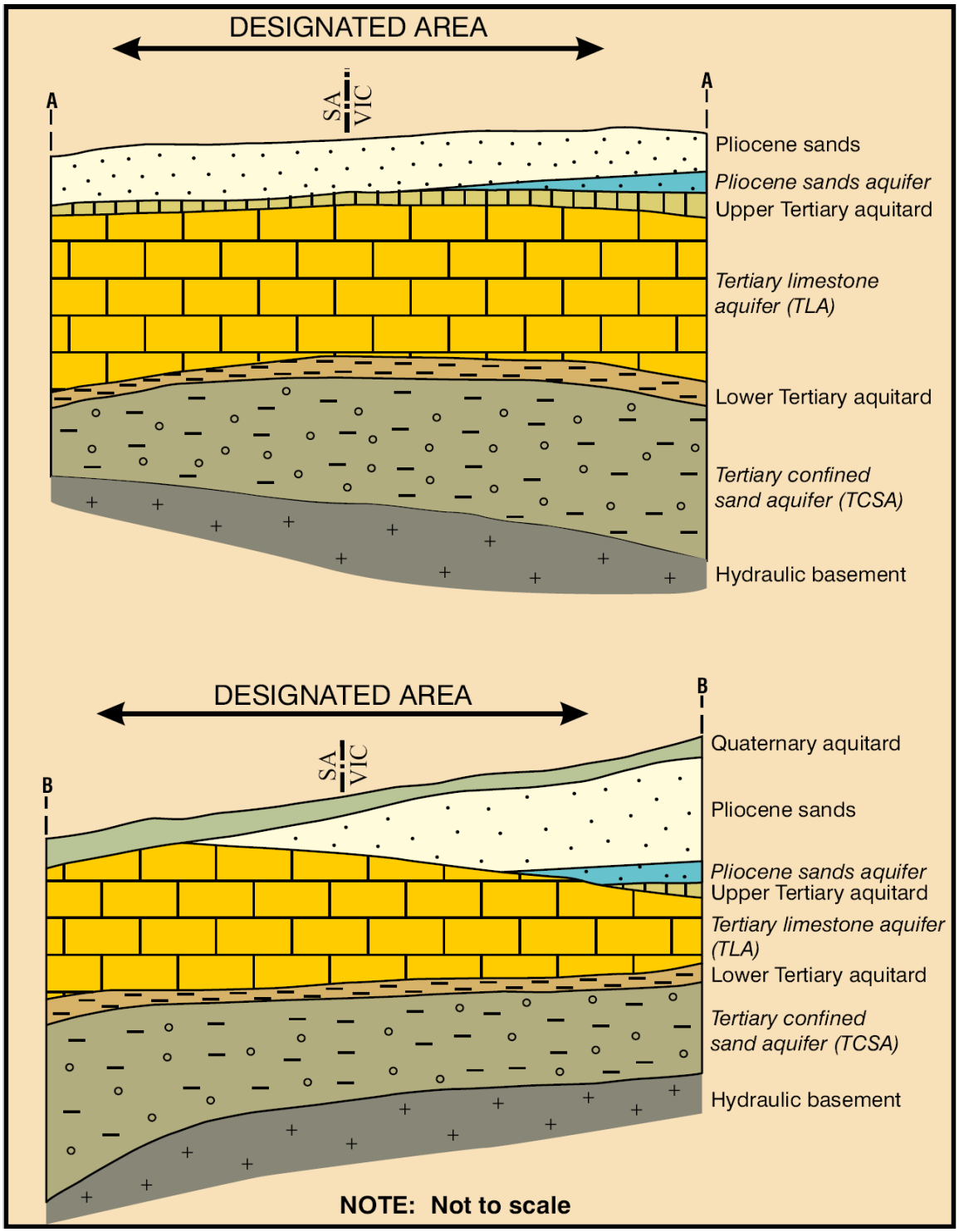
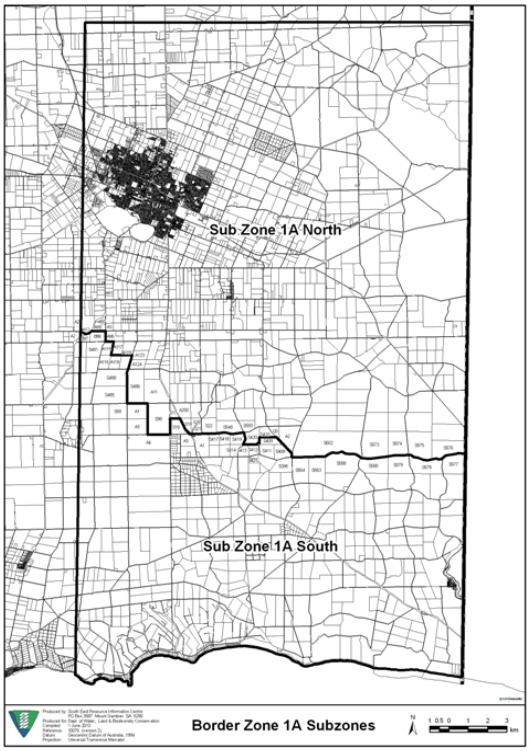
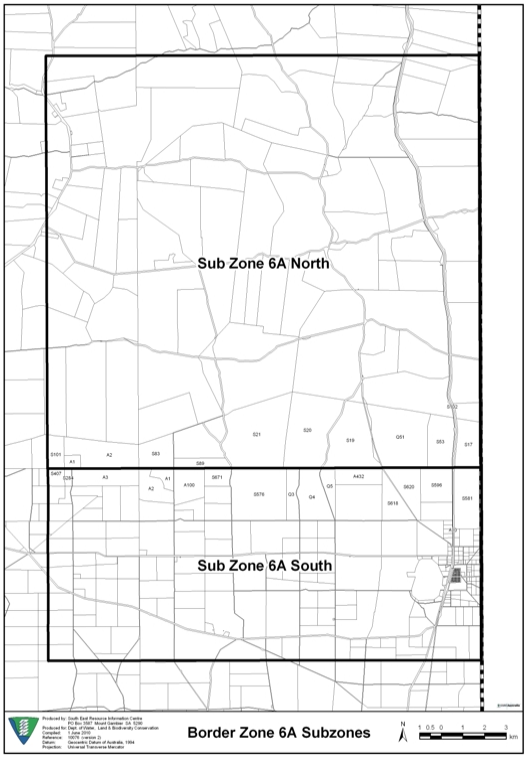
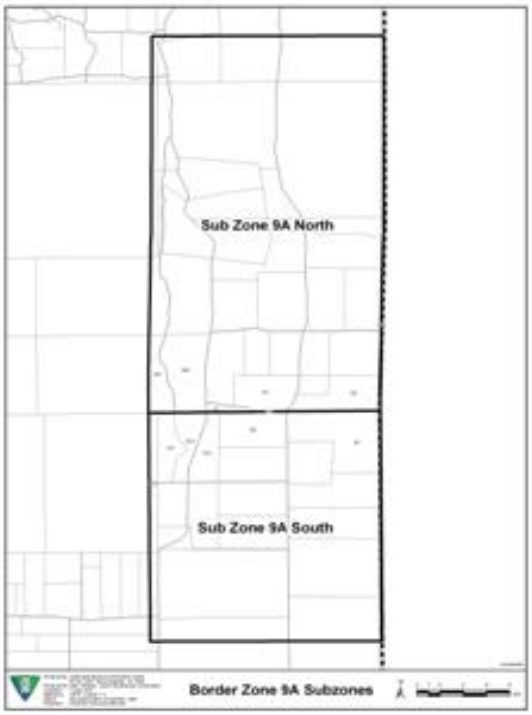


Figure 5: Sub-zone boundaries for Zones 1A, 6A and 9A





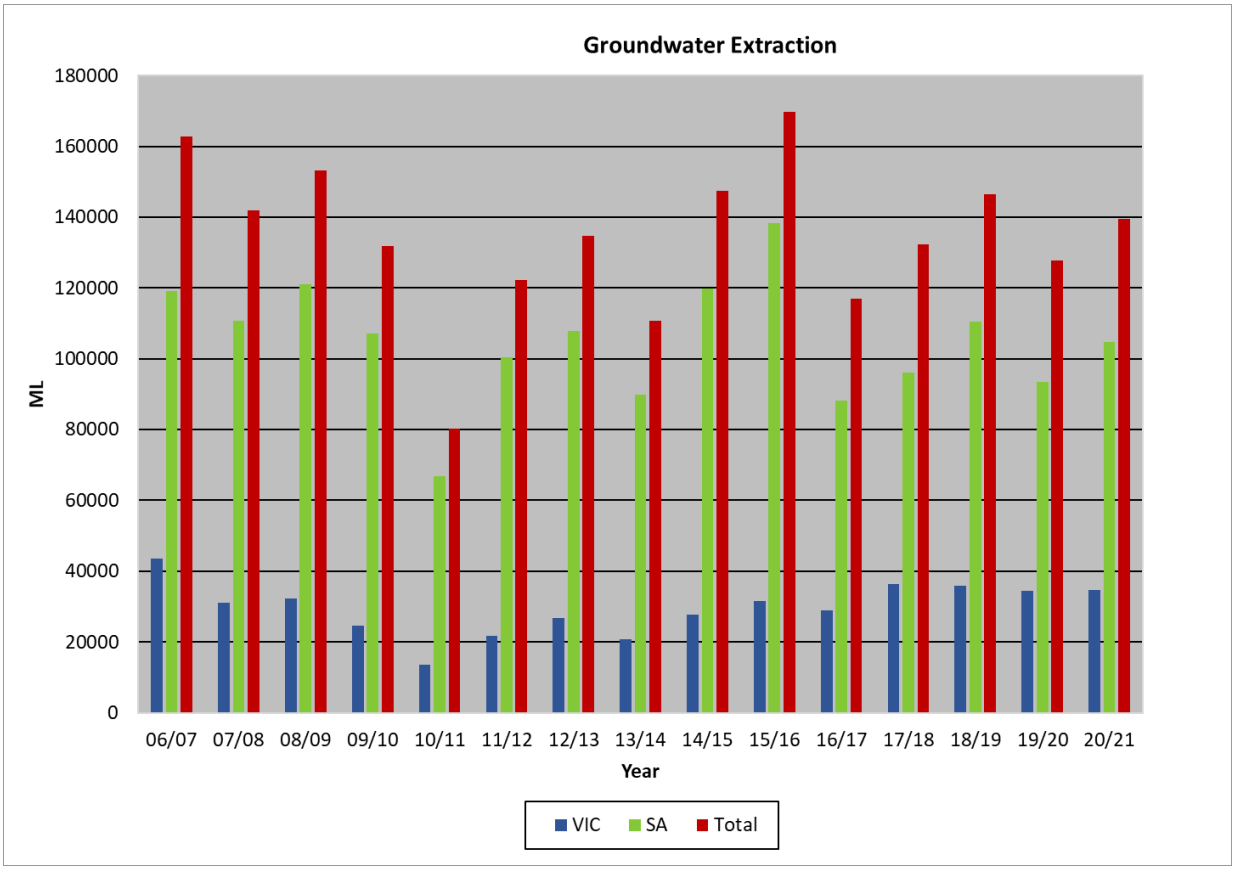


Boundaries of sub-zones are registered on:

Plan number 35/2010 (Zone 1A)
Plan number 34/2010 (Zone 6A)
Plan number 36/2010 (Zone 9A)

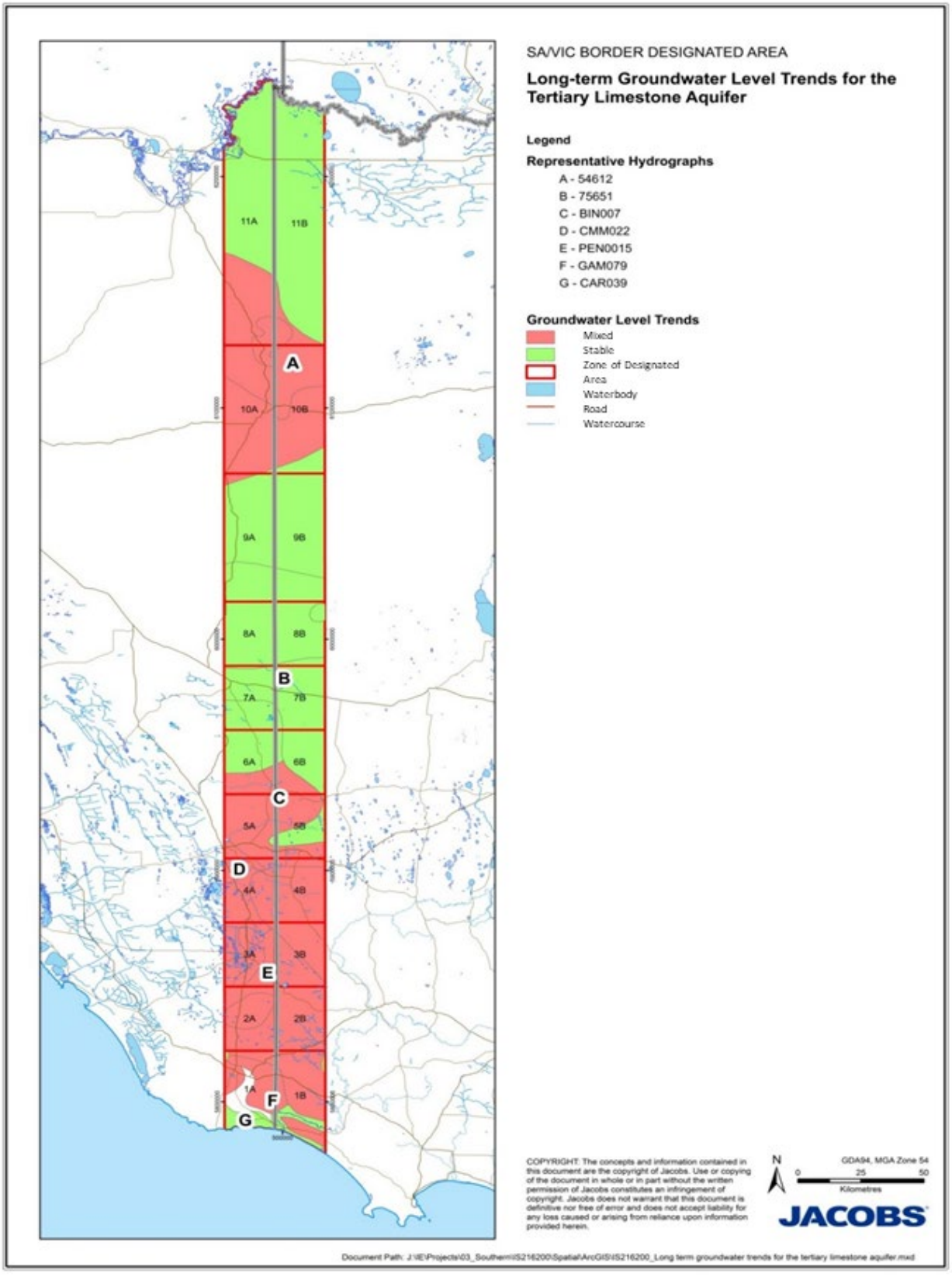
Plans can be viewed at Lands Services and Lands Titles office at
101 Grenfell Street, Adelaide

Figure 6: Annual volume extracted from the Tertiary Limestone Aquifer since 2006–07



Note: 2006–07 was the first year that comprehensive metered groundwater extraction records were obtained.

Figure 7: Groundwater-level trends for the Tertiary Limestone Aquifer with some representative hydrographs



Sample of groundwater-level hydrographs as located in opposite map (Fig. 7)

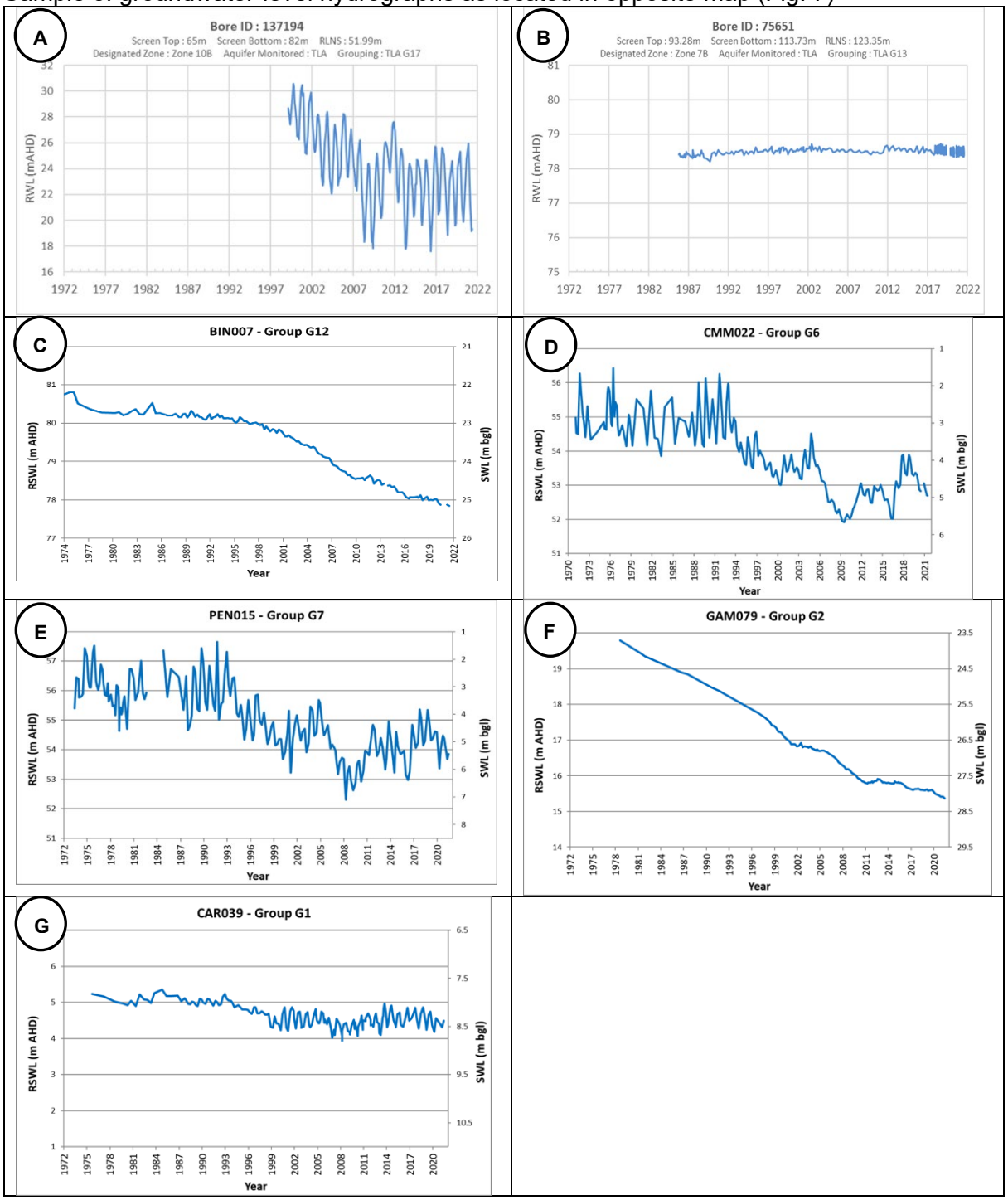
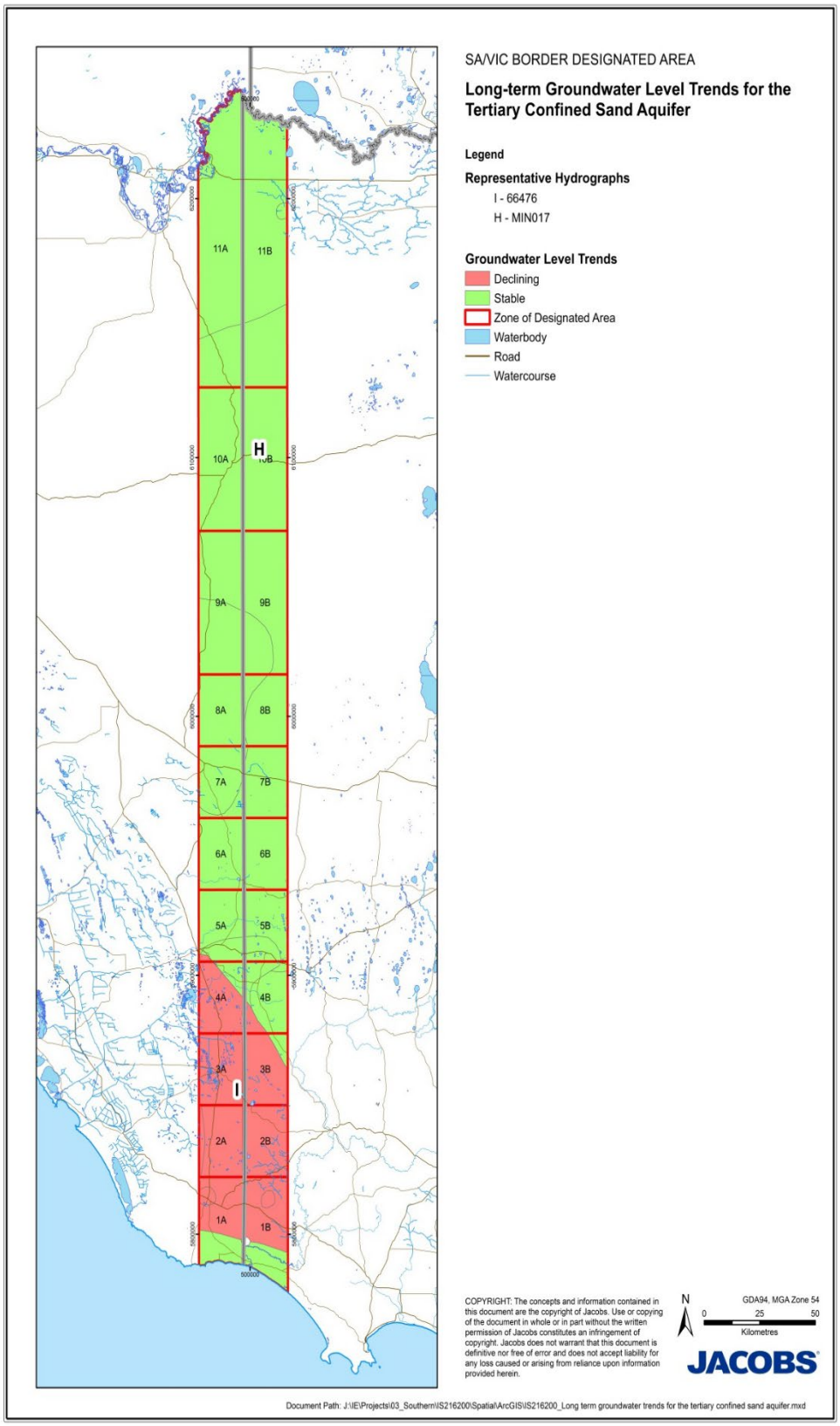
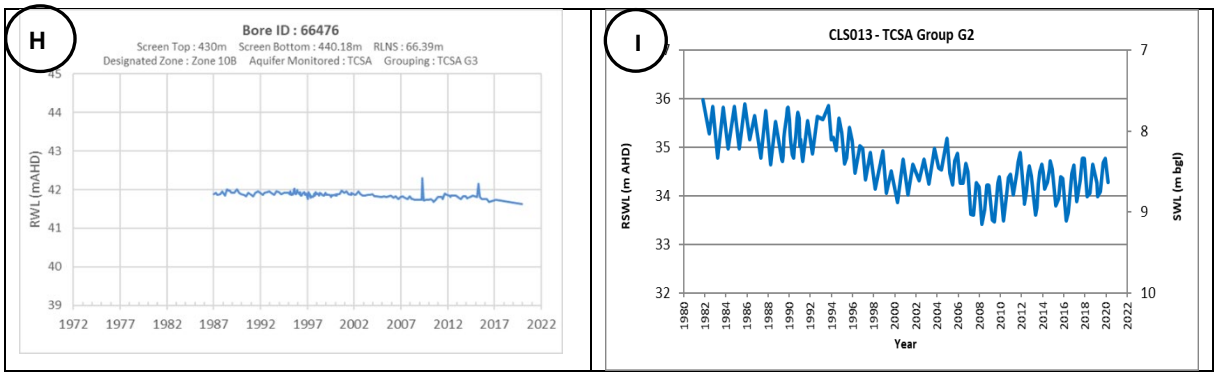


Figure 8: Groundwater-level trends for the Tertiary Confined Sand Aquifer with some representative hydrographs



Sample of groundwater-level hydrographs as located in opposite map (Fig. 8)



GLOSSARY

Aquifer – A geological structure or formation or an artificial landfill permeated or capable of being permeated permanently or intermittently with water.

Allowable Annual Volume – The allowable volume of extraction specified for a particular sub-zone or aquifer within a sub-zone as has been determined by the Review Committee under clause 28(7) of the Agreement.

Designated Area – The area comprising part of the state of South Australia and part of the state of Victoria as specified in the First Schedule of the Act. This is an area 40 km wide and centred on the South Australia–Victoria Border and is the area to which the *Groundwater (Border Agreement) Act 1985* applies.

EC (ECU) – Electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25°C; commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS.

Management Prescriptions – The prescriptions provided under the Border Groundwaters Agreement. That is; Permissible Annual Volume, Allowable Annual Volume, Permissible distance, Permissible potentiometric surface lowering, and Permissible salinity.

Permissible Annual Volume - The Permissible Annual Volume of extraction specified for a particular zone or aquifer in a particular zone in the Designated Area.

Permissible distance – The distance from the border in which all applications for licences must be referred to the Review Committee to determine whether the licence should be issued.

Permissible potentiometric surface lowering – An average annual rate of potentiometric surface lowering (drawdown) within a zone as prescribed under the Agreement or has been agreed by the minister for each Contracting Government.

Permissible salinity – A certain level of salinity within a zone as has been agreed by the minister for each Contracting Government.

Prescribed Wells Area – An area declared to be prescribed under the South Australian *Natural Resources Management Act 2004*. Prescription of a water resource requires that future management of the resource be regulated via an approved water allocation plan and extraction of water be licensed.

TDS – Total dissolved solids, measured in milligrams per litre (mg/L); a measure of water salinity.

Tertiary Limestone Aquifer – Comprises aquifers in the Murray Group, Heytesbury Group, Coomandook Formation, Bridgewater Formation and Padthaway Formation, called collectively the Tertiary Limestone Aquifer, the base of which is identified as marl or black carbonaceous silt, sand or clay.

Tertiary Confined Sand Aquifer – Comprise aquifers in the Wangerrip Group and Renmark Group, below the Tertiary Limestone Aquifer.

Water Supply Protection Area – An area declared under the Victorian *Water Act 1989* to protect the area's groundwater or surface water resources through the development of a management plan, which aims for equitable management and long-term sustainability.

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APPENDICES

APPENDIX A

Notices in Government Gazette relating to the current amendments to the prescriptions

The Agreement requires that notices of the amendments be made in papers circulating in the area and the Government Gazette. The amendments took effect from the date nominated in the notice. The list of the notices in Government Gazette since May 2008 relating to the current amendments to the prescriptions is provided below.

South Australia

Publish date of Gazette	Notice
22 May 2008	Alteration of Permissible Annual Volumes for Zone 11A (sets a Permissible Annual Volume for the Parilla Sands Aquifer, Tertiary Limestone Aquifer and Tertiary Confined Sands Aquifer) (Note the Permissible Annual Volume for Tertiary Limestone Aquifer was superseded by the notice on 1 July 2010)
15 October 2009	Alteration of Permissible Annual Volume – Zone 6A
15 October 2009	Alteration of permissible distance – Zones 1A, 2A, 3A, 4A, 5A, 6A, 7A, 8A, 9A, 10A and 11A
15 October 2009	Notice of the alteration of Permissible Annual Volume – Zones 7A, 8A and 9A. (Note the Permissible Annual Volume for Zone 7A was superseded by the 1 July 2010 notice and Permissible Annual Volume for Zone 8A was superseded by 2 December 2010 notice)
1 July 2010	Sub-zoning of the Tertiary Limestone Aquifer in Zone 1A (also sets an Allowable Annual Volume for Sub-zone 1A South)
1 July 2010	Sub-zoning of Tertiary Limestone Aquifer in Zone 6A (also sets an Allowable Annual Volume Sub-zone 6A South and sets a permissible rate of potentiometric surface lowering for Sub-zones 6A South and 6A North)
1 July 2010	Sub-zoning of the Tertiary Limestone Aquifer in Zone 9A (also sets an Allowable Annual Volume Sub-zone 9A South and Sub-zone 9A North)
1 July 2010	Alteration of permissible rate of potentiometric surface lowering -Zone 5A
1 July 2010	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zones 1A, 3A, 4A, 5A, 7A, 10A and 11A
2 December 2010	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zone 8A
30 January 2014	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zone 7A
1 August 2017	Noora Prescribed Wells Area revocation of declaration as a prescribed water resource
21 June 2018	Alteration of Permissible Annual Volume for the Pliocene Sands Aquifer in Zones 11A
1 July 2021	Notice of Alteration of Allowable Annual Volume – Sub-zone 1A South

Victoria

Publish date of Gazette	Notice
15 October 2009	Alteration of Permissible Annual Volume – Zones 7B and 8B
15 October 2009	Alteration of permissible distance – Zones 1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B, 9B, 10B and 11B
15 July 2010	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zone 8A
15 July 2010	Alteration of permissible rate of potentiometric surface lowering - Zones 5B and 6B
23 November 2015	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zones 5B and 6B
27 June 2020	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zones 5B and 6B