

South Australian–Victorian Border Groundwaters Agreement Review Committee



Thirty-Fourth Annual Report

To 30 June 2019

Adelaide and Melbourne

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PREFACE

The Border Groundwaters Agreement Review Committee's Annual Report for 2018–19 fulfils the requirement under clause 30(1) of the Border Groundwaters Agreement to report on its activities during the year to 30 June 2019. 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 1985*, 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 only reliable natural water source. It is used extensively in both states for irrigation, industry and public water supplies, as well as livestock and domestic uses. While groundwater supplies are relatively secure, the Border Groundwaters Agreement Review Committee (Review Committee) has sought to continually improve the technical understanding of the resources to inform a review of the management prescriptions defined by the Agreement to maintain the ongoing sustainable and equitable use of groundwater along the South Australian–Victorian border.

The Review Committee has completed a comprehensive review of the Agreement; its usefulness, relevancy and suitability in terms of objectives for managing the groundwater resources both equitably and sustainably along the border. The approach taken was one of collaboration between the two Contracting Governments and members of the Review Committee. The review has considered the outcomes delivered by the Agreement and how these can be improved to better protect and manage the groundwater into the future while maintaining the principle of equitable sharing of the resource. The Review Committee is now preparing its advice and recommendations to the two Contracting Governments for building on the current arrangements, to ensure the sustainability of the shared groundwater resource.

During the year the Review Committee continued its oversight of groundwater trends in the central and southern parts of the Designated Area along the border. While the longer term declines remain, rates of decline have reduced or stabilised in some of these areas. Groundwater water levels are within the permissible rates of potentiometric surface lowering and extractions remain within the Permissible Annual Volumes, but increased extractions under drying conditions are a risk for further water level declines in the longer term. It is accepted that groundwater in the Tertiary Limestone Aquifer is not being significantly replenished by modern recharge across most of the central region and the Review Committee considers this groundwater as a non-renewable resource for water allocation and management purposes. The Review Committee has kept the current management prescriptions unchanged in these parts of the Designated Area, but it considers that the relevant jurisdictions will need to consider actions to ensure that there is no significant increase in extractions above the current levels.

The volume of groundwater extraction for the year to 30 June 2019 in each management zone within the Designated Area was within the Permissible Annual Volume of extraction for each zone, however the Allowable Annual Volume of extraction for Sub-zone 1A South was exceeded due to the exercising of carry-over provisions in that sub-zone. The observed exceedance is within the scope permitted under the state carry-over provisions.

The total groundwater extractions across the Designated Area for the 2018-19 year were about 11 per cent above those of the previous year.

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.

Extraction licences or 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 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
<ul style="list-style-type: none">• Mallee Prescribed Wells Area• Tatiara Prescribed Wells Area• Lower Limestone Coast Prescribed Wells Area	<ul style="list-style-type: none">• 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 (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 was completed in 2018–19 and the Review Committee determined to maintain the current prescriptions unchanged
- Province 2 was completed in 2017–18 and the Review Committee determined to maintain the current prescriptions unchanged.
- Province 3 was completed in 2015–16 and the province is required to be reviewed by 2020–21.

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 Committee².

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 Contracting Governments 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.

The Review Committee met twice during the 2018–19 year:

21 November 2018
13 June 2019

Meeting 137
Meeting 138

Melbourne
Teleconference

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.

During the year membership of the Review Committee comprised:

South Australia		Victoria	
Ms S Carruthers	Member	Dr G Mitchell	Member (retired)
Mr N Power	Member	Ms A May	Member
Mr T Collins	Deputy member	Mr R Nott	Member
		Mr T McDevitt	Deputy member (retired)
		Mr K Wilson	Deputy member

Ms Sandy Carruthers was President during the 2018–2019 year.

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 principle source of groundwater throughout the Designated Area, with water being used for a range of purposes – municipal supplies for towns such as Murrayville, Pinnaroo, Penola 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 3000 EC (about 1700 mg/L TDS) in the Designated Area, except in the north where it exceeds 30 000 EC (about 18 000 mg/L TDS).

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 ensure the protection of the existing entitlements and the protection of resources from undue depletion or degradation.

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

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.

The Review Committee has previously advised that 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. In the meantime, the Review Committee proposed a management strategy to address four key issues. These are:

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

In respect to water accounting, the Review Committee recommended the states develop a consistent approach to account for the water used by plantation forests. 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. The matter of forest water accounting is considered in the current review of the Agreement.

South Australia has implemented arrangements to account for commercial plantation forests impacts on water resources. After the adoption of the regional water allocation plan 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.

The Review Committee recommended that both states 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. The states have finalised these initial studies and the Review Committee has sought to supplement its knowledge with additional groundwater modelling into its review of groundwater resources in Province 1 during 2020.

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. Along with other matters, this approach is provided for in the Committee's recommendations.

In the area of concentrated extractions in Zones 5A, 6A, 5B and 6B, (which includes the Frances–Neuarpuir area) groundwater levels have declined (up to ~0.2 m/y since 1996), primarily due to groundwater extraction. While the longer term declines remain, there has been some recent stabilisation at some monitoring sites and the Review Committee is investigating the trends and implications.

Tertiary Limestone Aquifer – Province 3

Groundwater 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, and the observed long-term water level trends and seasonal drawdowns are consistent with pressure response of pumping from a confined aquifer. A cone of depression in the groundwater pressure levels has formed, with its centre located at Peebinga, an area of intensive groundwater extraction. The overall rate of decline has reduced as the pressure levels tend towards a steady state.

Schemes are in place in both South Australia and Victoria to ensure people relying on groundwater bores for domestic and stock purposes can still access the resource. The impacts on domestic and livestock bores need to continue to be managed by the states.

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 Pliocene Sands Aquifer, however there is a need to continue to monitor the resource trends.

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

There is potential for localised areas of drawdown, which could increase the impact on domestic and livestock users, or increase the risks of dewatering the aquifer or accelerating water quality change. The states have implemented measures to prevent uncontrolled localised drawdowns arising from intense groundwater extraction.

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 2019 are set out in Table 2.

Table 2: Permissible Annual Volumes at 30 June 2019

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	3700	0	11A	11B	1823	0
	14 000	320	10A	10B	6720	560
	11 595	570	9A	9B	5960	630
	5121	340	8A	8B	3500	330
	8259	350	7A	7B	5782	350
	8758	360	6A	6B	10 279 ^{note}	360
	18 943	540	5A	5B	12 833 ^{note}	570
	22 102	710	4A	4B	14 000	300
	24 054	1900	3A	3B	16 500	1000
	25 000	2900	2A	2B	25 000	5100
	31 812	9200	1A	1B	45 720	14 500

Note: PAV adjustment related to revised location of existing licenses in Zones 5B and 6B.

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 2019 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 2019

South Australia	
Allowable Annual Volumes	
Tertiary Limestone Aquifer (ML/y)	Sub-zone
2400	9A North
7760	9A South
4658	6A South
12 507	1A South

Allocations and volumes extracted

The allocations and the volumes extracted³ for the Tertiary Limestone Aquifer are listed in Tables 4 and 5. Water extractions in all the management zones in 2018-19 are within the Permissible Annual Volumes, however the Allowable Annual Volume was exceeded in Sub-zone 1A South; this being due to the exercising of the carry-over provisions for unused allocations in the preceding water year.

Table 4: Permissible Annual Volumes, number of licences, allocations and volumes extracted for the Tertiary Limestone Aquifer at 30 June 2019

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	3700	2003	11A	11B	1823	3	1600	1215
14 000	34	14 000	11 433	10A	10B	6720	22	6718	4373
11 595	7	10 160	8059	9A	9B	5960	3	5300	642
5121	25	6542	1587	8A	8B	3500	8	3430	1092
8259	76	9133	4202	7A	7B	5782	13	5782	4001
8758	40	10 629	5551	6A	6B	10 279	16	10 279	6325
18 943	130	23 723	12 021	5A	5B	12 833	39	12 833	8912
22 102	177	30 883	11 884	4A	4B	14 000	12	2880	115
24 054	243	32 476	13 216	3A	3B	16 500	5	515	53
25 000	80	26 907	14 447	2A	2B	25 000	43	24 859	7338
31 812	323	46 526	26 091	1A	1B	45 720	18	4457	1846

Table 5: Allowable Annual Volumes, number of licences, allocations and volumes extracted for the Tertiary Limestone Aquifer at 30 June 2019

South Australia				
Tertiary Limestone Aquifer				Sub-Zone
Allowable Annual Volume (ML/y)	Licensed Allocations			
	Licences	Volume Allocated (ML)	Volume Extracted (ML)	
2400	2	2400	1765	9A North
7760	5	7760	6294	9A South
4658	18	5321	2280	6A South
12 507	52	21 227	14 054	1A South

³ Note that 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 bores for domestic and stock purposes, or the impacts of plantation forests.

Most of the zones are fully committed in the Tertiary Limestone Aquifer, in that the volumes licensed have reached the Permissible Annual Volumes. 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. The allocated volume has increased in Sub-zone 1A South during 2018-19 due to the correction of an earlier administrative error in interpretation of existing activities.

There is un-allocated water in the Tertiary Limestone Aquifer in Zones 1B, 3B and 4B. There is currently a moratorium on new licences and permanent transfers of groundwater entitlements in Zones 1B, 2B, 3B and part of Zone 4B under Victoria's water legislation.

The allocations and volumes extracted for the Tertiary Confined Sand Aquifer are listed in Table 6. A moratorium exists under the Victorian *Water Act 1989* on issuing groundwater licences for the Tertiary Confined Sand Aquifer in Zones 1B, 2B and 3B.

Table 6: Permissible Annual Volumes, allocations and volumes extracted for the Tertiary Confined Sand Aquifer at 30 June 2019

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	26	4A	4B	300	0	0	0
1900	1	259	139	3A	3B	1000	0	0	0
2900	2	150	23	2A	2B	5100	0	0	0
9200	4	1704	790	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. It is estimated that the extraction of 2825 ML of water from the Pliocene Sand Aquifer in Zone 11A, via the Murtho salt interception scheme, diverted a salt load of 75 436 tonne away from the River Murray.

Table 7: Permissible Annual Volume, number of licences, volume allocated and volume extracted for the Pliocene Sands Aquifer at 30 June 2019

South Australia				
Pliocene Sands Aquifer				
Permissible Annual Volume (ML/y)	Licensed Allocations			Zone
	No. of Licences	Volume Allocated (ML)	Volume Extracted (ML)	
7763	0	0	2825	11A

While the Agreement does not apply to bores for domestic and livestock purposes, the large number of 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 2019 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 2019

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 2019

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 2013, 2017 and 2015 respectively) the Review Committee determined that there is no need to recommend that permissible salinity levels should be set.

Accounting for the impacts of commercial 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 commercial plantation forest at 30 June 2019

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
575	121	6A	6B		
57	18	5A	5B		
3914	2696	4A	4B	5600	3857
12 290	26 093	3A	3B	19 000	40 339
21 019	37 675	2A	2B	9200	16 490
20 133	28 481	1A	1B	23 500	33 244

Reports from the states

The Agreement requires that the Contracting Governments provide an annual report to the Review Committee detailing the number of permits or licences issued, volumes authorised, and details of potentiometric surface levels in each zone. In addition, the states also reported on other activities that related to groundwater management in the Designated Area, as follows.

Groundwater management plans

South Australia's volumetric conversion program, through water allocation plans and involving about 4000 volumetric irrigation licenses, resulted in the aggregated allocations exceeding the Permissible Annual Volume and Allowable Annual Volume in all zones in the Lower Limestone Coast Prescribed Wells Area. Effective July 2016, a range of reductions were incorporated in the current water allocation plan. This reduction program consists of staged reductions every two years through to 2022, however this program has been placed on hold by the State

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 plantation forest groundwater use

Government following its election in March 2018. This is in line with an election commitment to enable an independent expert review of the science underpinning the reductions set out by the 2013 *Water Allocation Plan for the Lower Limestone Coast Prescribed Wells Area* and a revised risk assessment for the management zones.

The science review was carried out by an independent panel of scientists commissioned by the Goyder Institute for Water Research. The main points from the science review, relative to the Designated Area, are summarised as:

- The amount of science available for the groundwater and groundwater dependent ecosystems (GDEs) is extensive and well above average compared to other parts of Australia and the world.
- There has been some recovery of water levels since 2012 and stabilisation of water levels over the last two years in most areas.
- The panel found some anomalies in the 2012 Risk Assessment regarding data confidence categories for aquifer thickness, water level and salinity trend assignments, and cut off values between risk levels. The majority of these can be explained by the application of the precautionary principle or pertain to the risk assessment methodology used in 2012.
- The panel has made recommendations regarding the risk assessment methodology e.g. that aquifer thickness not be considered as a factor when determining risk to GDEs.
- The panel has also made various recommendations to increase scientific understanding of the resource and GDEs, including maintaining and expanding the existing monitoring network (including salinity monitoring), updating and expanding groundwater models, and expanding monitoring activities associated with GDEs.

The Minister received the results of the science review in March 2019, and agreed to await the outcomes of a new risk assessment for the groundwater and its users prior to making a decision regarding the allocation reductions currently on hold and the requirement for any further reductions. The expert's review report provides another analysis for the Review Committee to consider in its technical assessment of Province 1 and Province 2.

Victoria introduced staged reductions in licence allocations in Neuarpuur Sub-zone 1 in Zones 5B and 6B in 2011 which were fully implemented. Victoria is developing new management arrangements for the Glenelg Water Supply Protection Area.

Investigations

The Department for Environment and Water undertook a study of the risk of sea water intrusion and is sponsoring a range of activities which includes groundwater modelling, a review of water table trends, a review of the condition of groundwater dependant ecosystems and the risks to these natural assets. Advising the outcome of these investigations is to be coordinated with the outcome of the South East science review implemented by the South Australian Minister for Environment and Water. It is anticipated that the subsequent management options are to be advised in 2020.

The Department of Environment, Land, Water and Planning commissioned a groundwater modelling project to investigate the groundwater resources of Province 2 and a review of groundwater quality information in the Designated Area. These studies will inform a review of groundwater resources in Province 2 in 2019-20.

Condition of the resource

Aggregate annual groundwater extractions in the Designated Area from the Tertiary Limestone Aquifer from 2006-07 to June 2019 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. The groundwater monitoring network in both states remains under continuing review.

FIGURES

Figure 1: Designated Area and zones

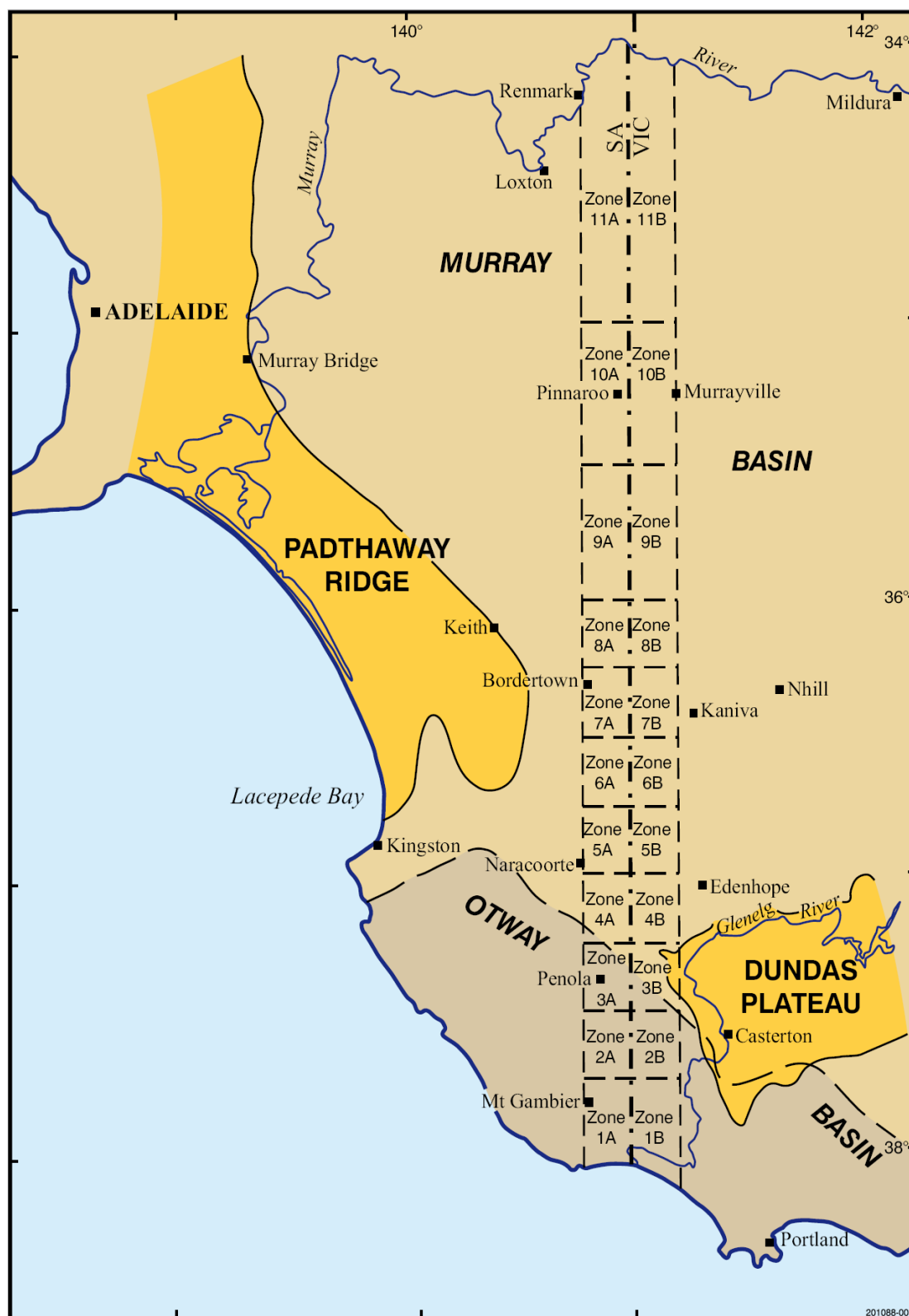


Figure 2: Relationship of management areas in South Australia and Victoria to the Designated Area

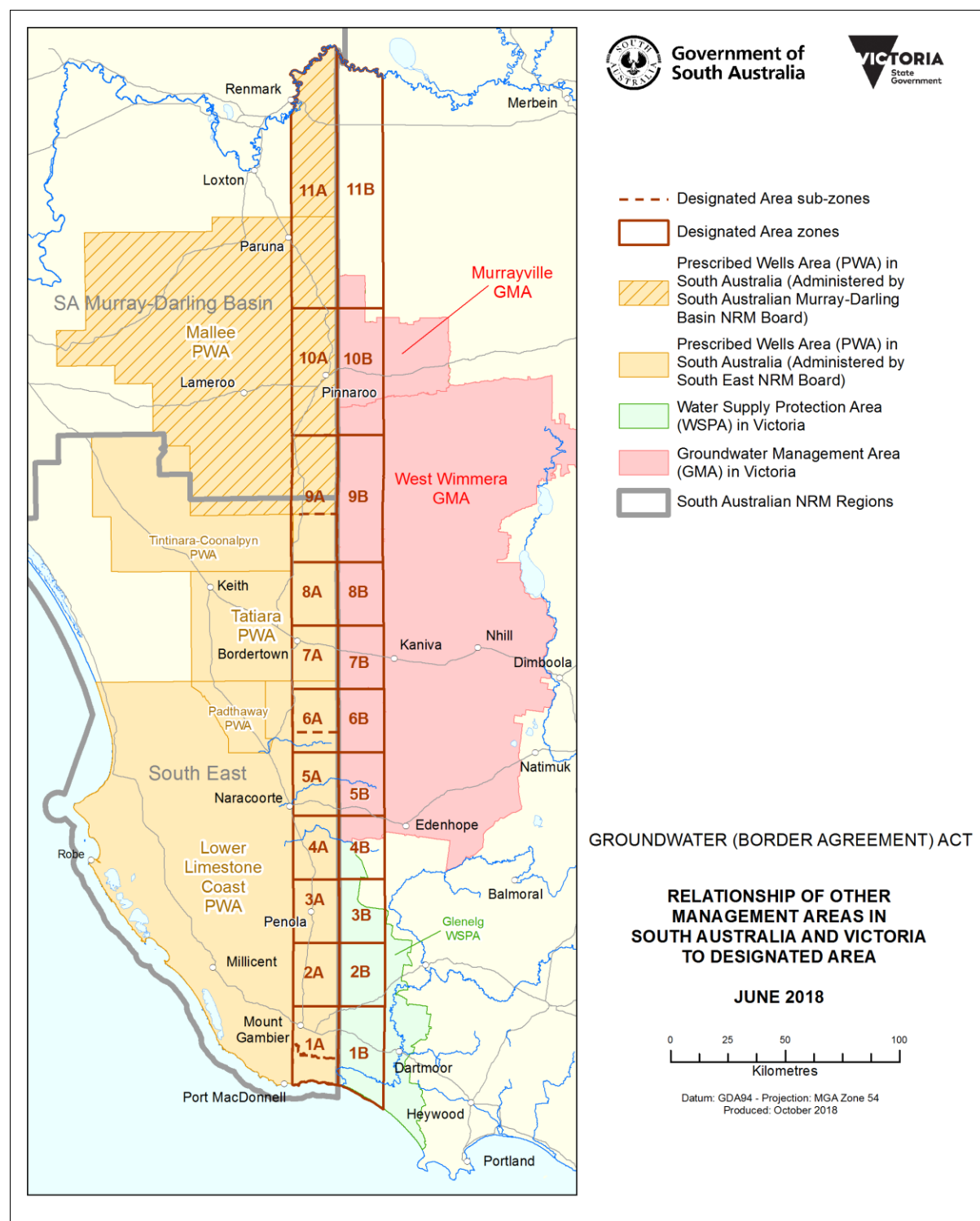


Figure 3: Hydrogeological provinces

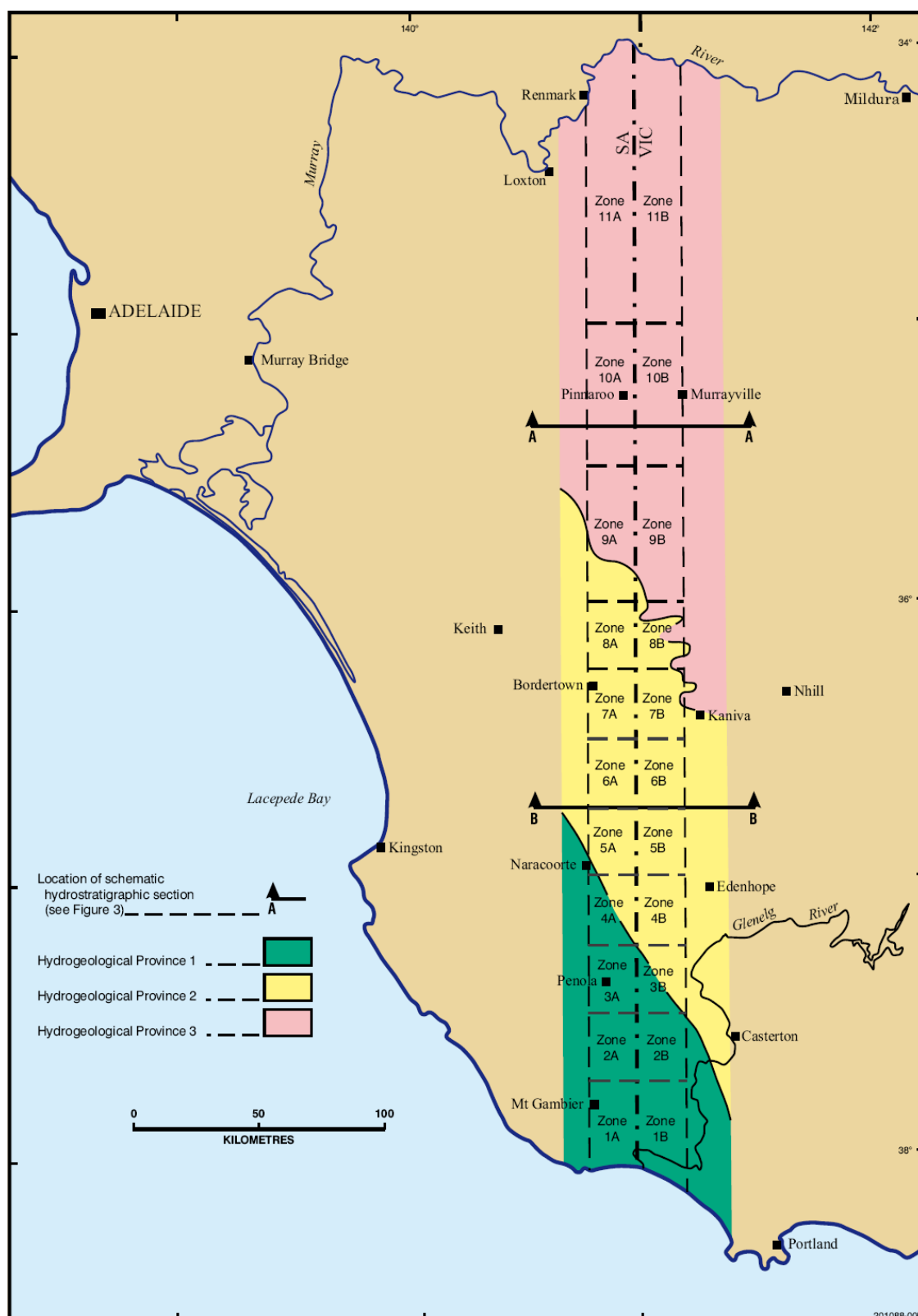


Figure 4: Schematic hydrostratigraphic cross-sections relating to Figure 3

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

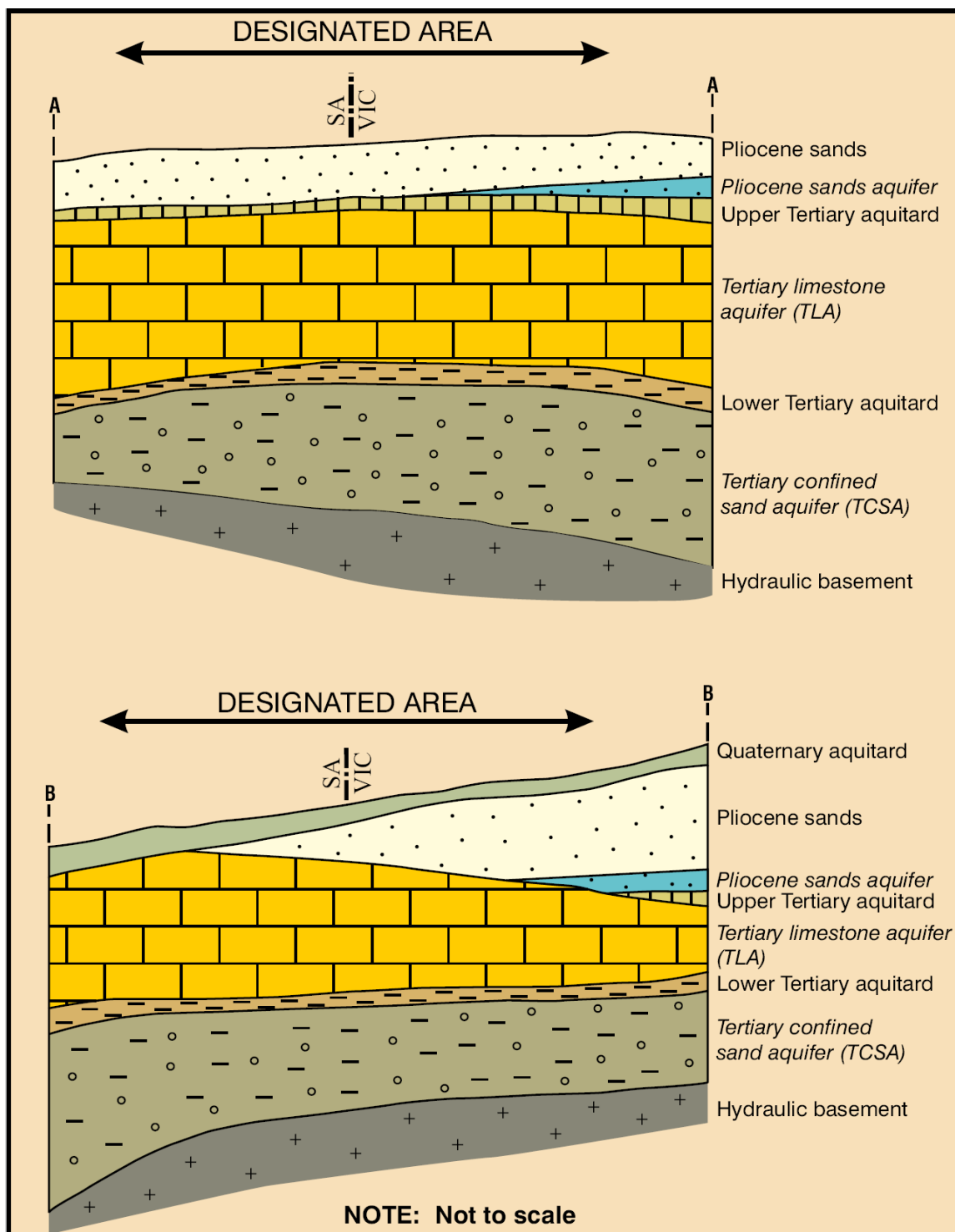
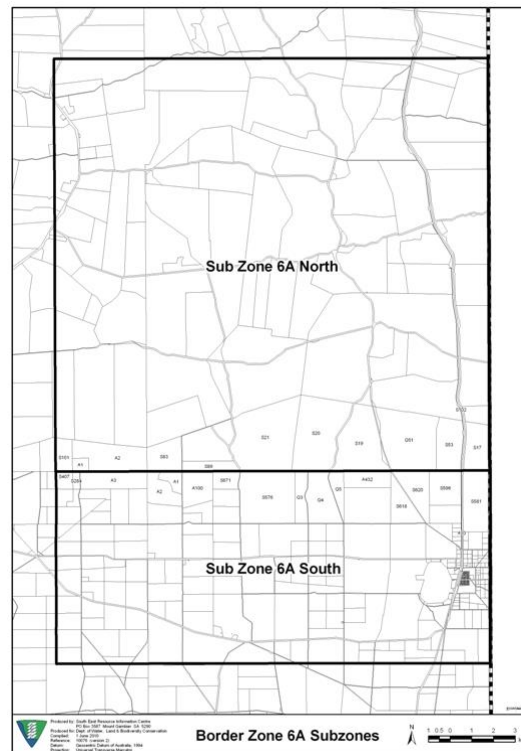
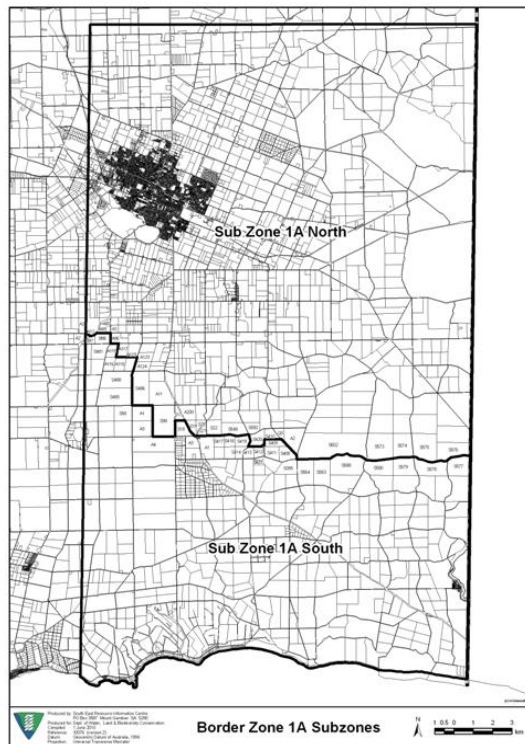


Figure 5: Sub-zone boundaries for Zones 1A, 6A and 9A

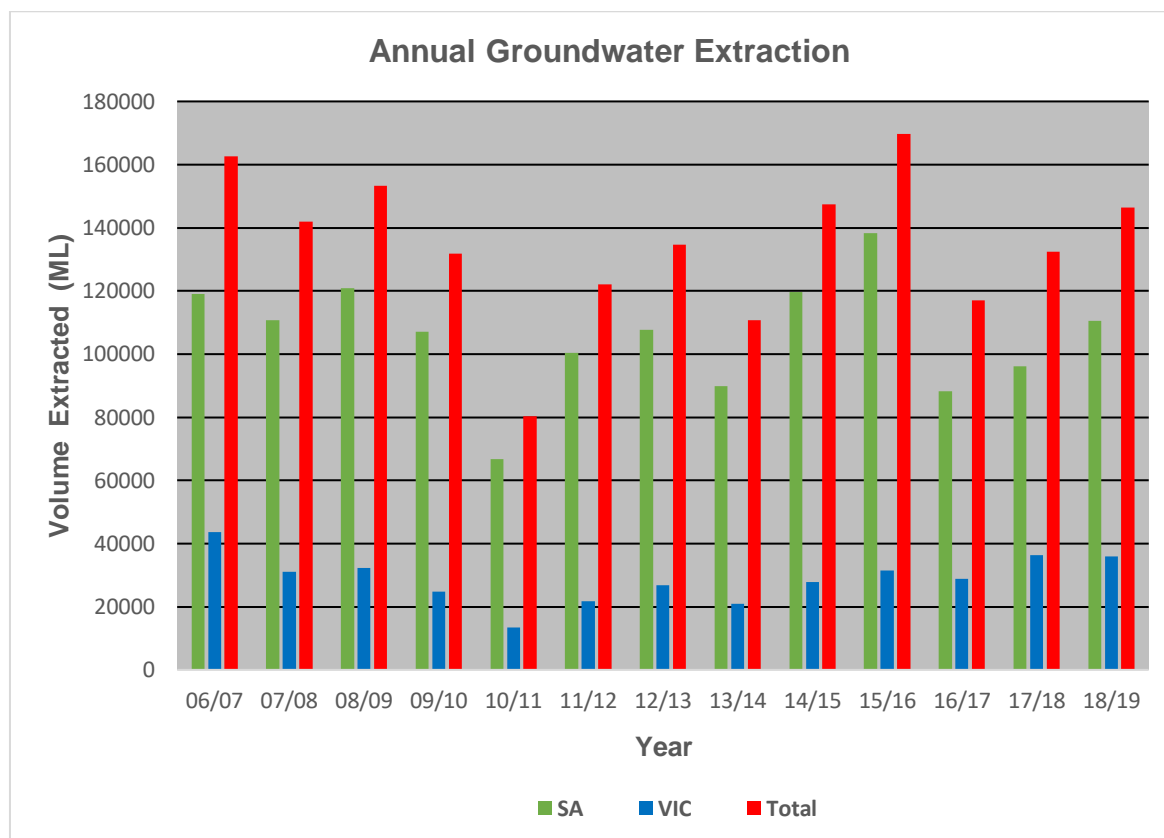


Boundaries of sub-zones are registered on:

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

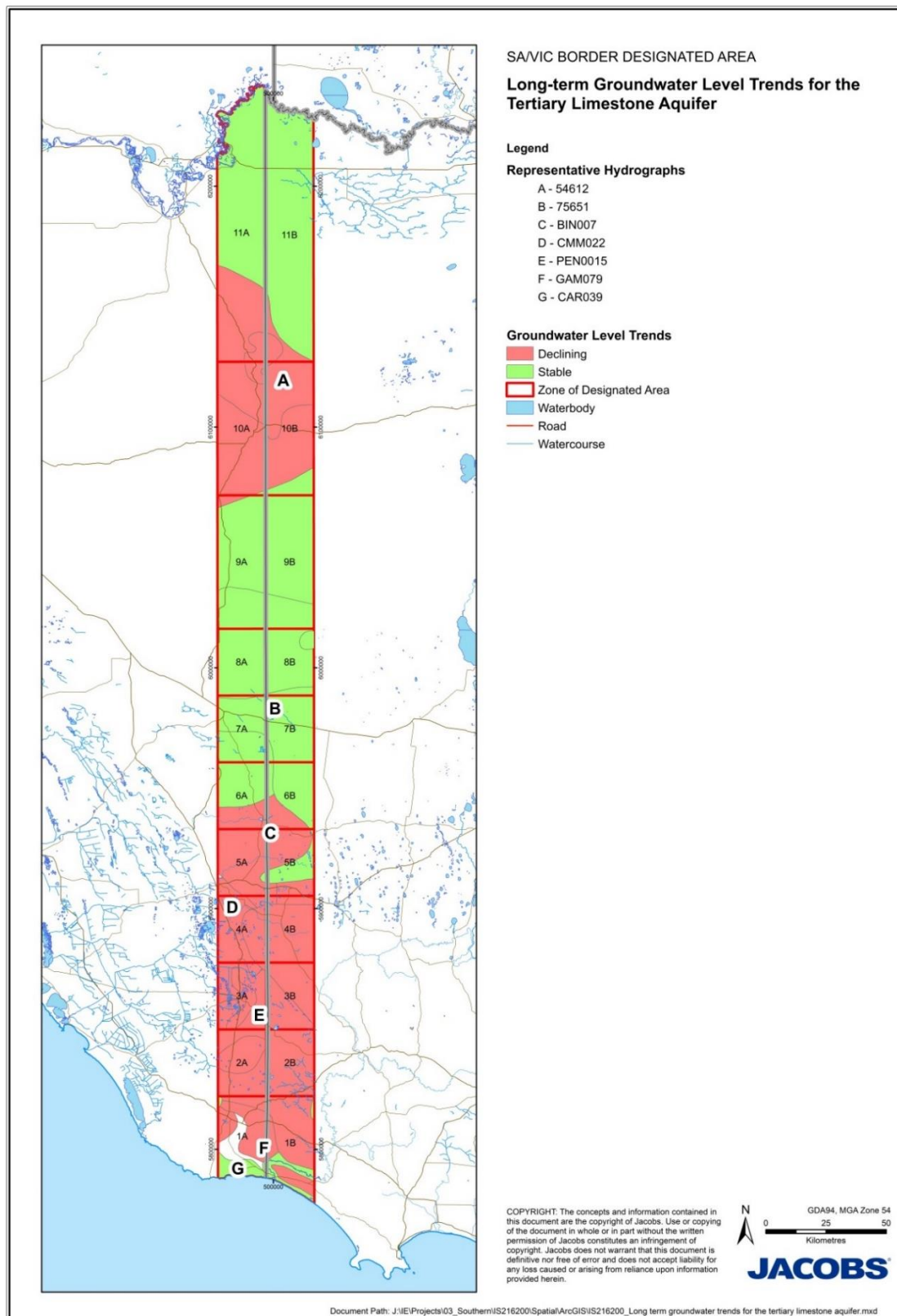
Plans can be viewed at Lands Services and
Lands Titles office at
101 Grenfell Street, Adelaide

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)

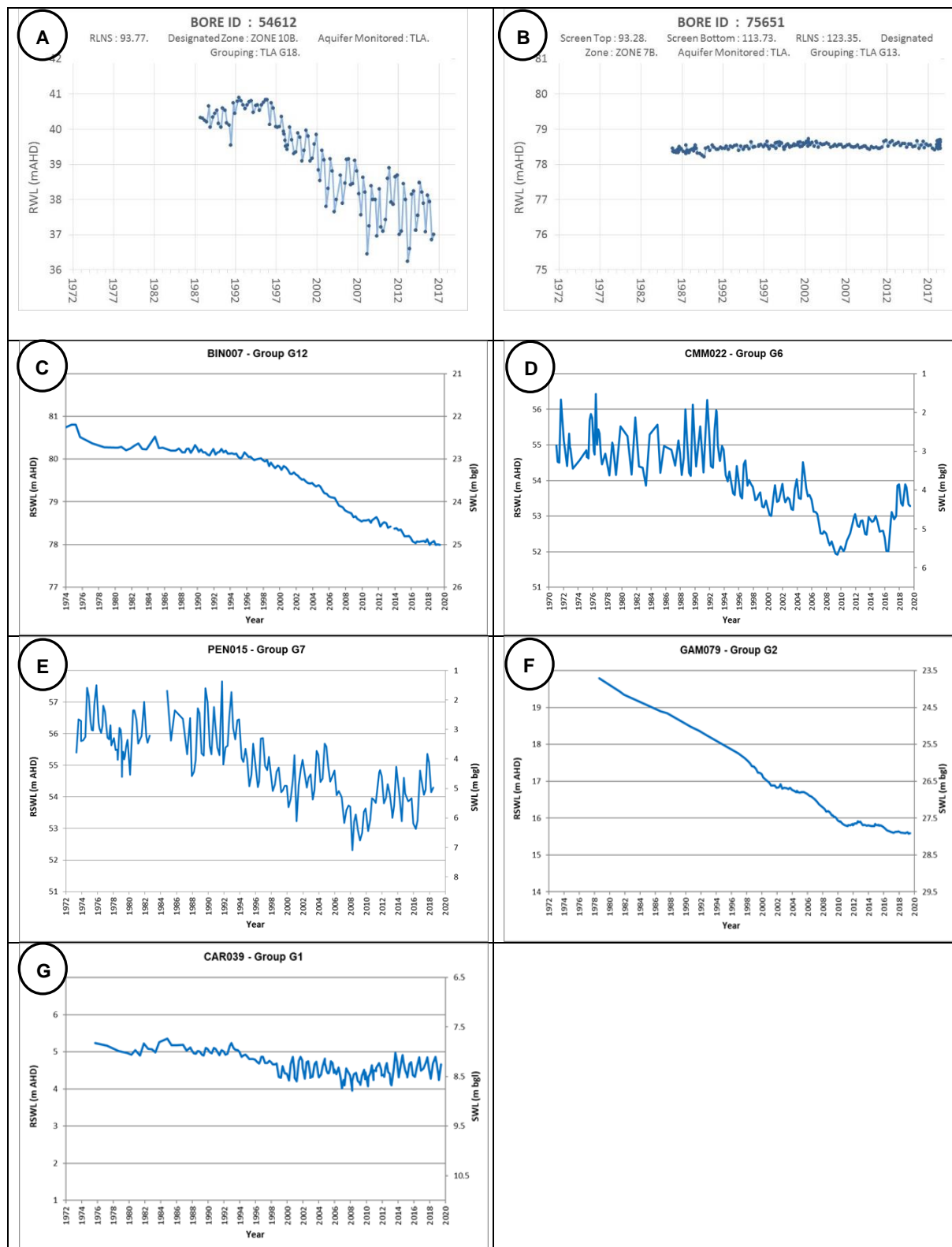
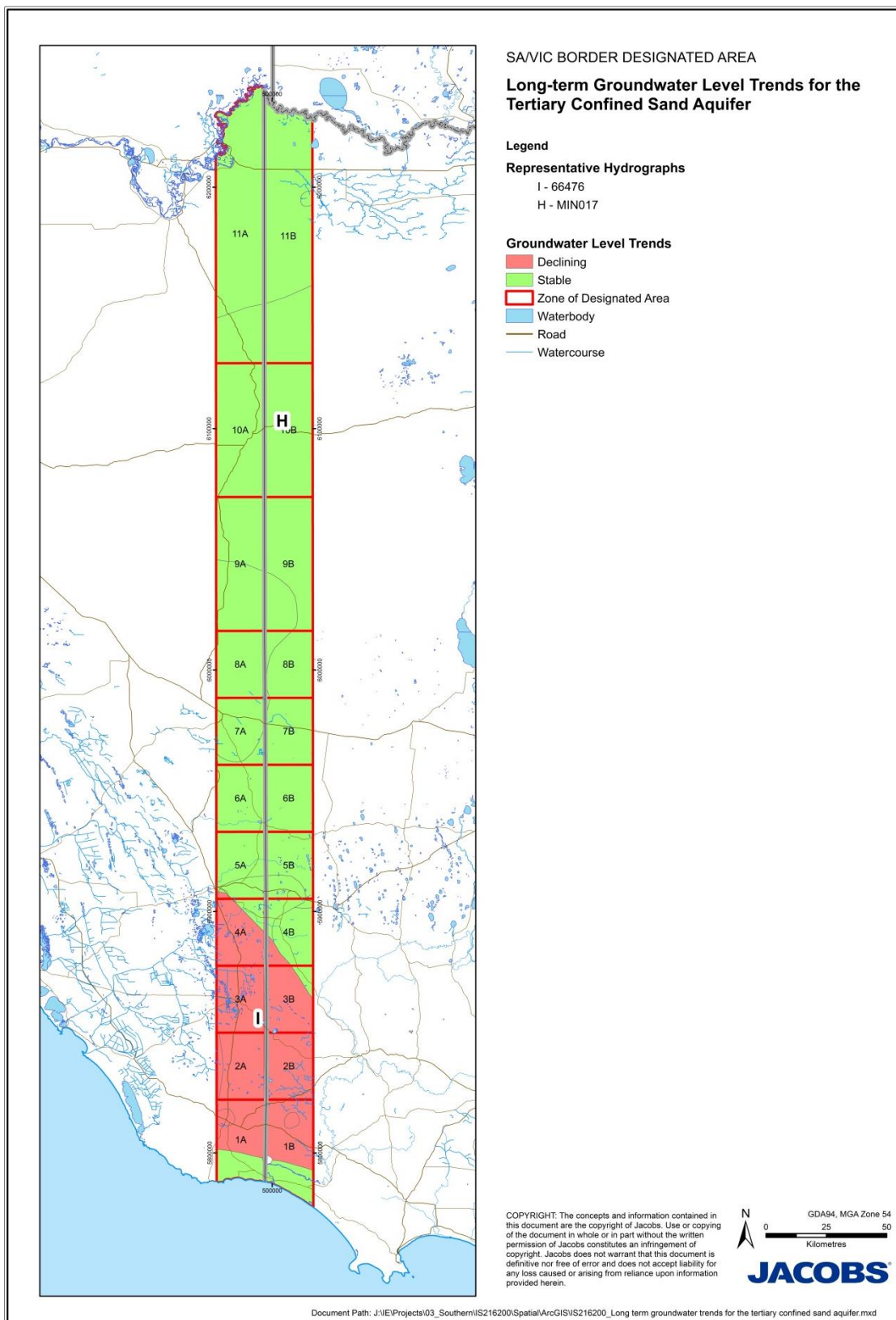
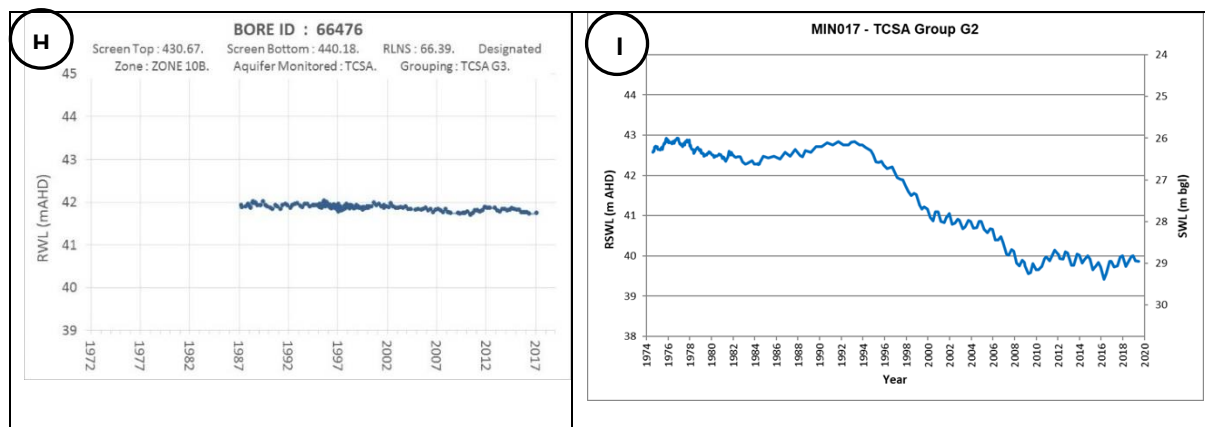


Figure 8: Groundwater-level trends for the Tertiary Confined Sand Aquifer with some representative hydrographs



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 ($\mu\text{S}/\text{cm}$) 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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SKM (2012). *Review of groundwater level trends in the SA-Vic Designated Area*.

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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

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 2019	Alteration of Permissible Annual Volume for the Tertiary Limestone Aquifer in Zones 5B and 6B