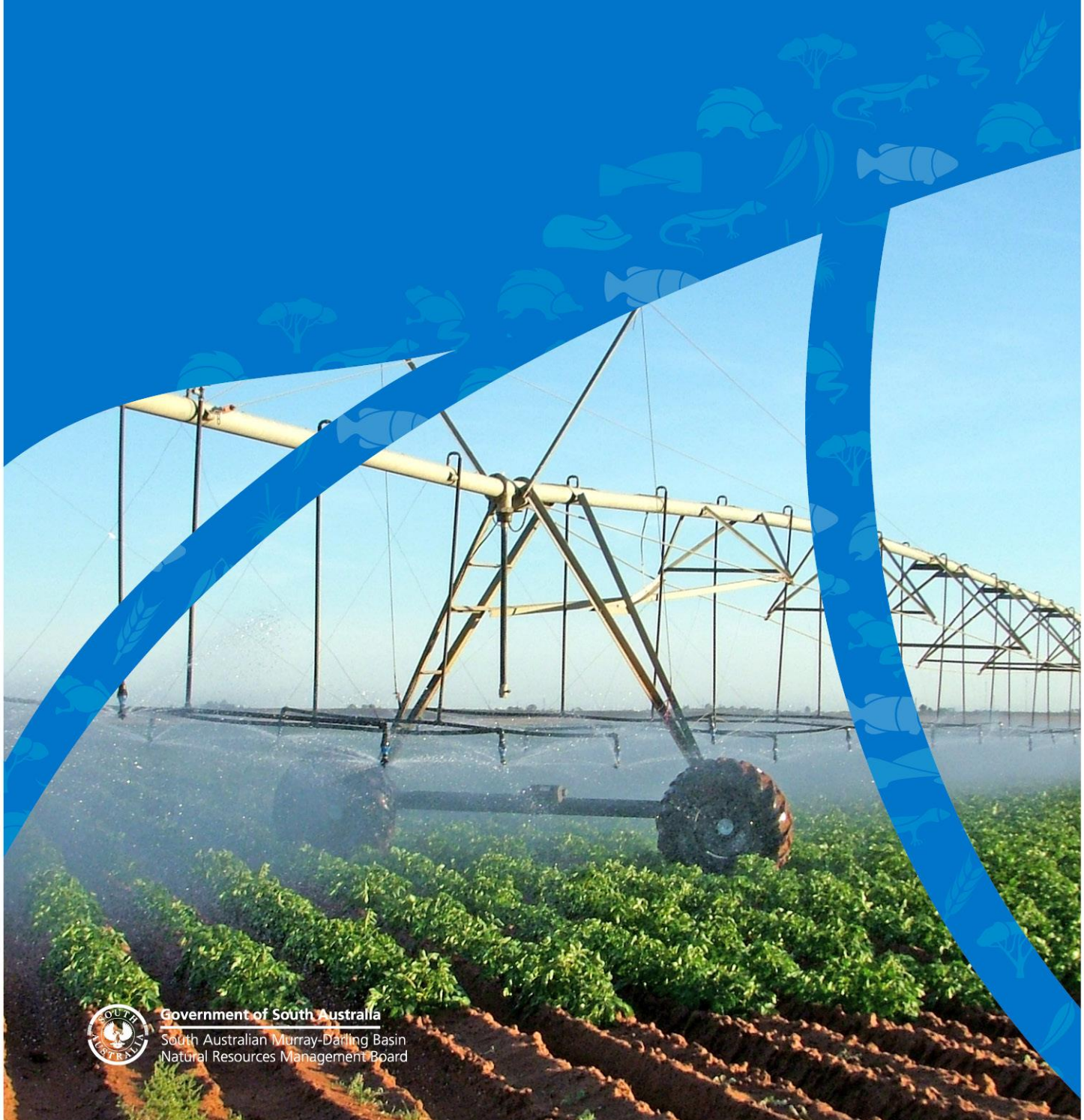


Natural Resources
SA Murray-Darling Basin



Water Allocation Plan

For the Mallee prescribed wells area



Government of South Australia
South Australian Murray-Darling Basin
Natural Resources Management Board

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I, Hon Ian Hunter MLC, Minister for Sustainability, Environment and Conservation, after taking into account and in accordance with the requirements of section 89 of the *Natural Resources Management Act 2004* hereby adopt these amendments to the Water Allocation Plan for the Mallee Prescribed Wells Area.

A handwritten signature in black ink, appearing to read 'Ian Hunter', written in a cursive style.

IAN HUNTER MLC

MINISTER FOR SUSTAINABILITY, ENVIRONMENT AND CONSERVATION

Date: 29/4 / 2017

Water Allocation Plan
For the
Mallee Prescribed Wells Area

I, Paul Caica, Minister for Sustainability, Environment and Conservation, hereby adopt this Water Allocation Plan pursuant to section 80 (3) (a) of the *Natural Resources Management Act 2004*.

A handwritten signature in black ink, appearing to read 'P. Caica', with a stylized flourish at the end.

Paul Caica MP
Minister for Sustainability, Environment and Conservation

Date: 02.05.12

Acknowledgement

We acknowledge the lands and waters of the Mallee Prescribed Wells Area as including portion of the Country of the First Peoples of the River Murray and Mallee Region (Ngaiawang, Ngawait, Nganguruku, Erawirung, Ngintait, Ngaralte, and Ngarkat peoples) (referred to hereafter as First Peoples). First Peoples have occupied, enjoyed, utilised and managed these traditional homelands since time immemorial.

The South Australian Government acknowledges that according to First Peoples traditions, customs and spiritual beliefs these lands and waters remain their traditional Country. The State also acknowledges and respects the rights, interests and obligations of First Peoples to speak and care for their traditional Country, lands and waters in accordance with their laws, customs, beliefs and traditions.

The recognition of First Peoples' interests in this Plan is a starting point for ongoing engagement regarding water planning.

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1. The Mallee Prescribed Wells Area

1.1 Location of the Mallee Prescribed Wells Area

The Mallee Prescribed Wells Area (Mallee PWA) covers the underground water resources in a large portion of the Murraylands area of South Australia, which incorporates the Hundreds of McGorrery, Kekwick, Allen, Mindarie, Chesson, McPherson, Auld, Billiatt, Kingsford, Peebinga, Pinnaroo, Parilla, Bews, Cotton, Molineux, Price, Allenby, Day, Quirke, Fisk, Bandon, Vincent, Wilson, Hooper, Marmon Jabuk and the Out of Hundreds area (refer to Figure 1). The Mallee PWA extends into the Designated Area, commonly known as the Border Zones. The Designated Area is located along a 40 kilometre strip of the South Australian/Victorian border (20 km on each side, Figure 2), and is regulated by the Groundwater (Border Agreement) Act 1985. The Designated Area is divided into a series of zones on each side of the border. In South Australia, the southern part of Border Zone 11A, all of Border Zone 10A and Border Sub-zone 9A North of the Designated Area are located within the Mallee PWA.

The Mallee PWA includes part of the traditional lands and waters of the First Peoples of the River Murray and Mallee (First Peoples). The Aboriginal nations in this area rely on the interconnectivity between land, waters, spirit and all living things. First Peoples are recognised native title holders in the Riverland region of South Australia and entered into the River Murray and Crown Lands Indigenous Land Use Agreement (RM ILUA) with the Crown of South Australia in 2012. This area is outlined in Figure 3, but is not intended to represent the boundaries of individual nation's Country.



Figure 1: The location of the Mallee Prescribed Wells Area

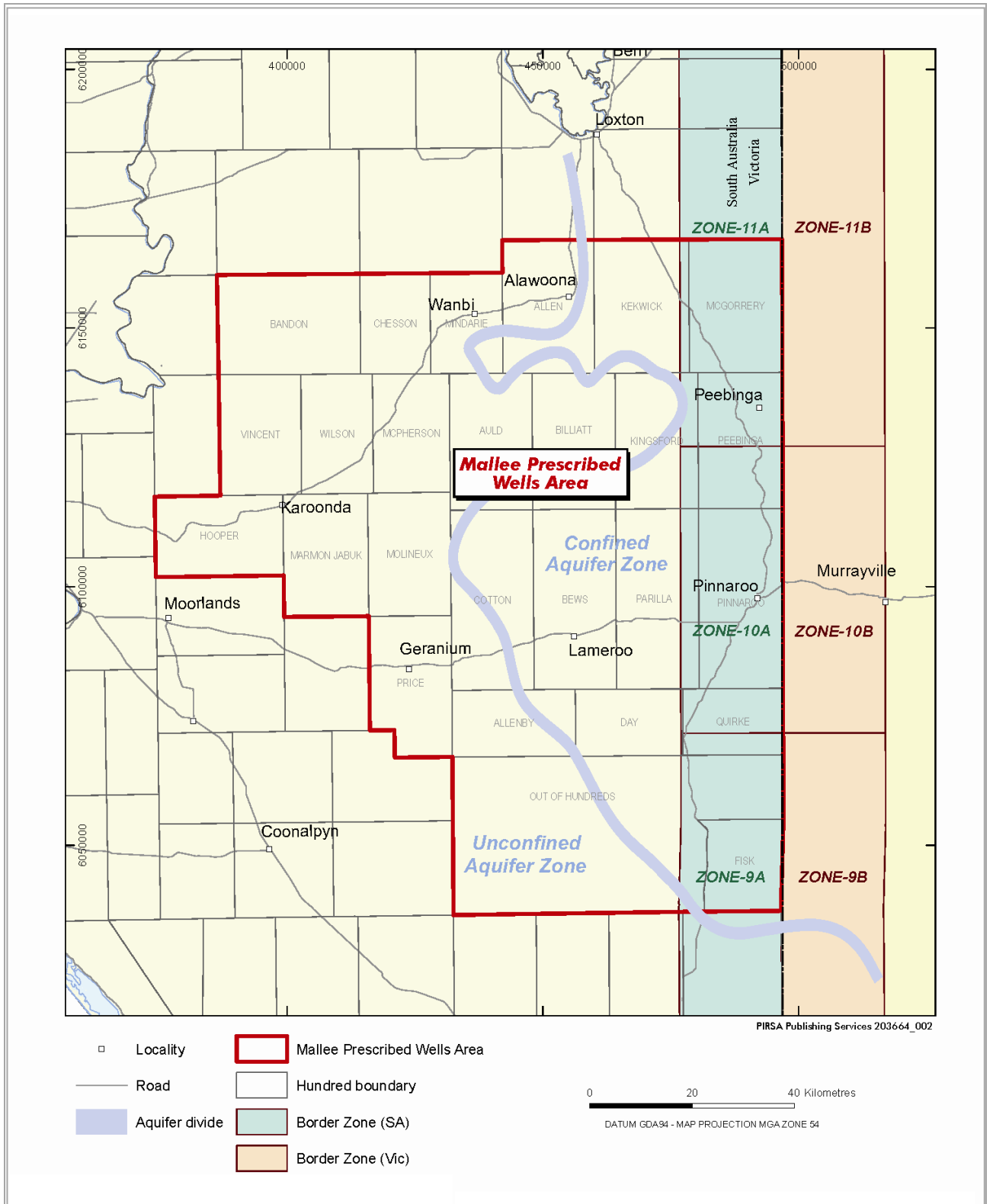


Figure 2: Map of the Mallee Prescribed Wells Area

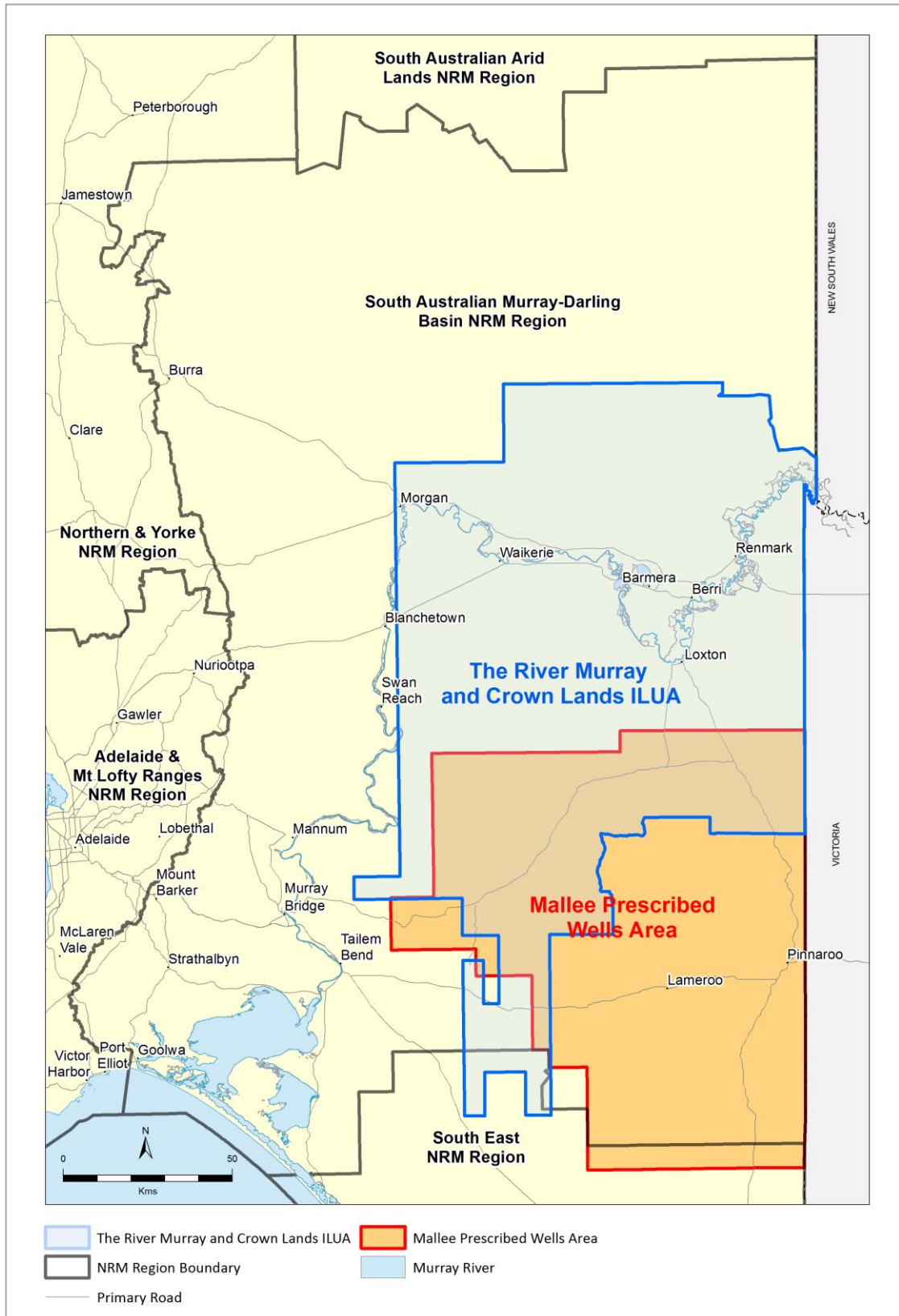


Figure 3: Location of the River Murray and Crown Lands Indigenous Land Use Agreement

1.2 Background to the Water Allocation Plan

The Water Allocation Plan for the Mallee Prescribed Wells Area (the Plan), replaces the previous Water Allocation Plan for the Mallee Prescribed Wells Area adopted by the Minister for Water Resources on 21 December 2000.

The *Natural Resources Management Act, 2004* (the Act) requires the South Australian Murray Darling Basin Natural Resources Management Board (the SAMDB NRM Board) to prepare water allocation plans for each of the prescribed water resources in its area. A water allocation plan is a statutory instrument that is used for various purposes in the administration of the Act; in particular, to guide the granting of licences to take water, permitting criteria of water affecting activities, and the transfer of licences and/or water allocations.

Water allocation plans are subject to review at least once within 10 years following the adoption of the Plan, in accordance with section 81 of the Act.

South Australia recognises the importance of, and is committed to identifying and incorporating, Aboriginal values in the development of water allocation plans where possible. In 2017, minor amendments under section 89(2) of the Act were made to improve First Peoples' interests and worldviews in the Plan as a step towards Murray-Darling Basin Plan compliance and greater recognition of Aboriginal values and perspectives.

The amendments incorporated into this Plan in consultation with First Peoples are a starting point for an ongoing conversation and involvement of Aboriginal nations in water planning.

1.2.1 Aboriginal History

For thousands of generations, First Peoples have cared for lands and waters within the Mallee PWA. For these Aboriginal nations, this Country was formed by creation ancestors and is the cultural responsibility of First Peoples. The management of water sources shaped this cultural landscape that sustained Aboriginal culture and economy.

Soaks and other surface water sources sustained the culture and economy of Aboriginal nations for thousands of generations. Like water flowing down the Murray-Darling system through and into the First Peoples lands and waters, groundwater flows are also seen as the life blood of the living body of the Country. Therefore maintaining connectivity between parts of the living body is a cultural priority.

European colonisation of South Australia significantly disrupted Aboriginal nations' care and control of their Country. Despite this, the First Peoples continue to maintain their connection to Country.

Aboriginal nations acknowledge the continued importance of the Mallee PWA for the local and regional communities and seek for the underground and surface water sources to be managed respectfully so they continue to sustain Country and future generations.

1.2.2 Aboriginal Engagement

The Inter-Governmental Agreement on a National Water Initiative demonstrates a commitment by all states and territories to include Indigenous representation and incorporate Indigenous social, spiritual and customary objectives and strategies in water planning, and take account of the possible existence of native title rights to water.

The Murray-Darling Basin Plan, which provides an overarching plan for water management in the Murray-Darling Basin, requires that accredited water resource plans (WRPs) identify the objectives and outcomes of Indigenous people related to the management of water resources, and have regard to Indigenous values and uses of water as well as cultural flows (MDBA, 2012). WRPs must also have regard to a range of other matters set out in Section 10.53 of the Murray-Darling Basin Plan.

The process of integrating Aboriginal values and interests into water management is a requirement of the Murray-Darling Basin Plan (Chapter 10, Part 14) and is a complex and ongoing matter. This is a preliminary step towards recognising Aboriginal understanding of the relationship between healthy lands and waters and all living things.

First Peoples' engagement in water planning has occurred for many years with the River Murray and Mallee Aboriginal Corporation (RMMAC) through formal agreements with the South Australian Government.

The River Murray and Mallee Aboriginal Corporation (RMMAC) and the South Australian Government entered into the River Murray and Crown Lands Indigenous Land Use Agreement (ILUA) in 2012. An ILUA Liaison Committee, with RMMAC and SA Government representatives, meet regularly to discuss matters relevant to the ILUA. In addition to this committee, engagement with First Peoples occurs primarily through the RMMAC Board.

The RMMAC Strategic Plan 2013–2016 has also been prepared to represent the First Peoples, and sets out objectives and strategies for working with government agencies and other stakeholders to achieve those objectives.

More work with Aboriginal groups will ensure future water allocation plans have regard for Aboriginal values and uses of water, and identify the nations' objectives and desired outcomes for the management of the water resources. Future consultation and engagement will provide opportunities for Aboriginal nations' interests to be integrated into future iterations of the Plan.

In developing future plans, the Board will be applying the following objectives in relation to Aboriginal engagement in water planning:

- a. Acknowledge the connection between healthy land and waters and healthy people and culture.
- b. Recognise Aboriginal cultural responsibility for Country and work with Aboriginal nations and groups to incorporate Aboriginal expertise, capacity and cultural knowledge to inform management responses that relate to water planning.
- c. Build upon existing relationships and formal agreements in relation to water resource management and support the involvement of Aboriginal nations in the development of plans and procedures that relate to water.

1.3 History of Water Allocation Planning in the Mallee

Date	Event
August 1983	The underground water in the Mallee becomes a proclaimed resource. Licences granted to existing users and people with financial commitment.
1984	The initial management policy approved and adopted by the Minister for Water Resources.
1985	The <i>Groundwater (Border Agreement) Act 1985</i> (South Australia/Victoria) comes into force.
March 1986	A review of the 1984 management policy adopted to include the permissible annual volume (PAV) for the Designated Area.
1987	B.M. Harris and S.R. Barnett (Department of Mines and Energy) undertake underground water investigation and prepare a management proposal for the Mallee.
March 1988	A second policy review adopted in response to the 1987 Harris and Barnett report.
1993	A third policy review conducted with the intention to free up unused allocations and increase flexibility in management.
1996	A fourth policy review adopted in July 1997.
1997 – 1998	Policy review conducted with extensive community consultation.
1997 – 2000	Public invited to comment and provide input into proposal statement and draft water allocation plan. Additional meetings beyond the minimum consultation requirements of the <i>Water Resources Act, 1997</i> held with local councils and other interested parties.
March 1998	Draft water allocation plan prepared and released for public consultation.
December 2000	Water Allocation Plan for the Mallee PWA adopted by the Minister for Water Resources.
11 March 2004	Notice of Intent to expand the boundary of the Mallee PWA gazetted to include the Hundreds of Bandon, Vincent, Wilson, Hooper, Marmon Jabuk. (The Notice also proposed the inclusion of Mantung, Bakara, Forster, Bowhill, Peake, Sherlock and Roby).
22 July 2004	Notice of Intent to expand the boundary of the Mallee PWA to include the Out of Hundreds area (Area A) to the south of the existing boundary.
3 March 2005	Notice of Prohibition on the Hundreds of Bandon, Vincent, Wilson, Hooper, Marmon Jabuk, and the Out of Hundreds area (Area A).
June 2005	Review of the Water Allocation Plan for the Mallee PWA completed and submitted to the Minister for Environment and Conservation and the Minister for the River Murray.
27 October 2005	Regulation to prescribe the Out of Hundreds (Area A) and the Hundreds of Bandon, Vincent, Wilson, Hooper, Marmon and Jabuk of the Mallee PWA. (<i>The Hundreds of Peake, Roby and Sherlock were prescribed separately, whilst Mantung, Bakara, Forster and Bowhill were not prescribed as they were considered a low risk of over development</i>).
February 2007	Concept Statement for the Water Allocation Plan for the Mallee PWA released by the SAMDB NRM Board.
20 October 2010 – 14 January 2011	Consultation on the draft Water Allocation Plan for the Mallee PWA undertaken by the SAMDB NRM Board
May 2012	Adoption for the Water Allocation Plan for the Mallee PWA.
January – April 2017	Consultation with First Peoples of the River Murray and Mallee about the Water Allocation Plan
29 November 2017	Adoption of amendments pursuant to section 89(2) to improve consistency with the Murray-Darling Basin Plan

1.4 Description of the Prescribed Water Resources

1.4.1 Geology

Underlying the Mallee PWA is the Murray Basin which extends from the Mount Lofty Ranges eastward to the Great Dividing Range.

The Murray Basin consists of layers of sand, clay and limestone up to 300 metres thick. These sediment layers were deposited 30 million years ago during the tertiary period when an ocean inundated the area during the separation of Australia and Antarctica by continental drift. The sediments are flat lying and relatively uniform in thickness (Figure 4).

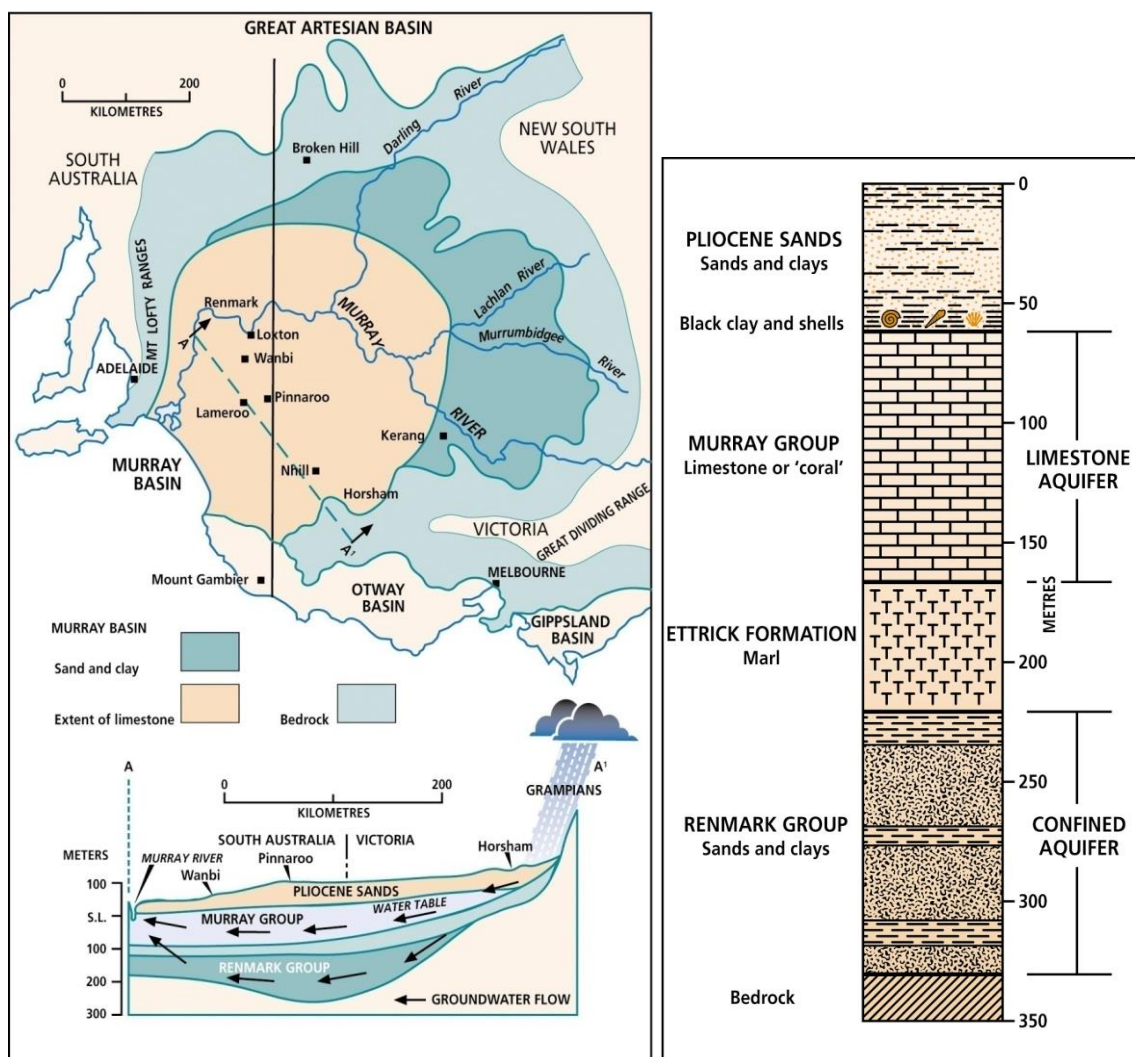


Figure 4: Geology of the Mallee Prescribed Wells Area

Note: Pliocene Sands Aquifer is more commonly known, and referred to from here on in, as the Parilla Sands Aquifer.

1.4.2 Hydrogeology

Parilla Sands aquifer

The Parilla Sands aquifer overlies a tertiary limestone aquifer (shown as the Pliocene Sands aquifer in Figure 4). The Parilla Sands aquifer contains underground water in the eastern part of the Mallee PWA. In the western part of the Mallee PWA, the Parilla Sands aquifer is higher than the water table and therefore it is unsaturated. Salinities in this aquifer increase to the north and east, from 1500 milligrams/litre (mg/L) near Pinnaroo to over 20 000 mg/L at the northern margin of the Mallee PWA and to the east of Murrayville in Victoria.

Murray Group limestone aquifer

The most extensively used water-bearing layer or aquifer in the Mallee is the tertiary limestone aquifer, locally known as the Murray Group limestone aquifer, or 'coral'. The Murray Group limestone aquifer is described in the *Groundwater (Border Agreement) Act 1985* as the tertiary limestone aquifer. It extends from the Mount Lofty Ranges in the west to Swan Hill, Victoria, in the east. Very little, if any, rainfall recharges this aquifer at the Mallee PWA. The main recharge source is rainfall in south-western Victoria. From there, it moves slowly within the Mallee PWA towards the River Murray, which acts as a drain for all the aquifers in the Murray Basin (refer Figure 5)

The rate of movement of the underground water is slow (only about half a metre per year) because the flat terrain and large distances result in low water table gradients.

The salinity contours for the Murray Group limestone aquifer have been determined by taking water samples from hundreds of wells across the Mallee PWA. Salinity increases in this aquifer in a north-westerly direction from about 1 000 mg/L at Pinnaroo and Murrayville, to up to 20 000 mg/L towards Loxton (refer Figure 6). Slow moving underground water dissolves soluble salts as it passes through the aquifer and there are gradual additions of minute amounts of salt carried downwards by infiltrating rainfall over thousands of years.

There is a large area where the salinity is below 3 000 mg/L (refer Figure 6) providing underground water supplies suitable for irrigation, depending on the salt tolerance of suitable crops. The large area of good quality underground water was recharged through the deep sandy soils of the Big and Little Deserts about 20 000 years ago when the climate was much wetter than it is today.

The increased recharge resulting from native vegetation clearance has not yet reached the water table in the Murray Group limestone aquifer. When it does, not only will the watertable rise, but salt stored in the unsaturated zone will be flushed into the aquifer at concentrations of up to 30 000 mg/L, potentially increasing the salinity of the water in the aquifer. The rate and magnitude of salinity increase in the aquifer will vary across the Mallee PWA.

Figure 2 shows the area to the west where the Murray Group limestone aquifer is unconfined (Murray Group limestone unconfined aquifer). The salinity of the top ten metres of this aquifer could increase from 2 000 mg/L to 3 000 mg/L over the next 100 years.

To the east, where most of the irrigation occurs, the Murray Group limestone aquifer is confined by a clay layer (Murray Group limestone confined aquifer), which will delay the impact from the salt being flushed down through the unsaturated zone. However, the drawdown due to irrigation extractions could possibly result in downward leakage of more saline underground water from the water table above the clay layer. Recent underground water modelling (Barnett and Osei-bonsu, 2006) suggests this is a long-term risk over the next 100-150 years.

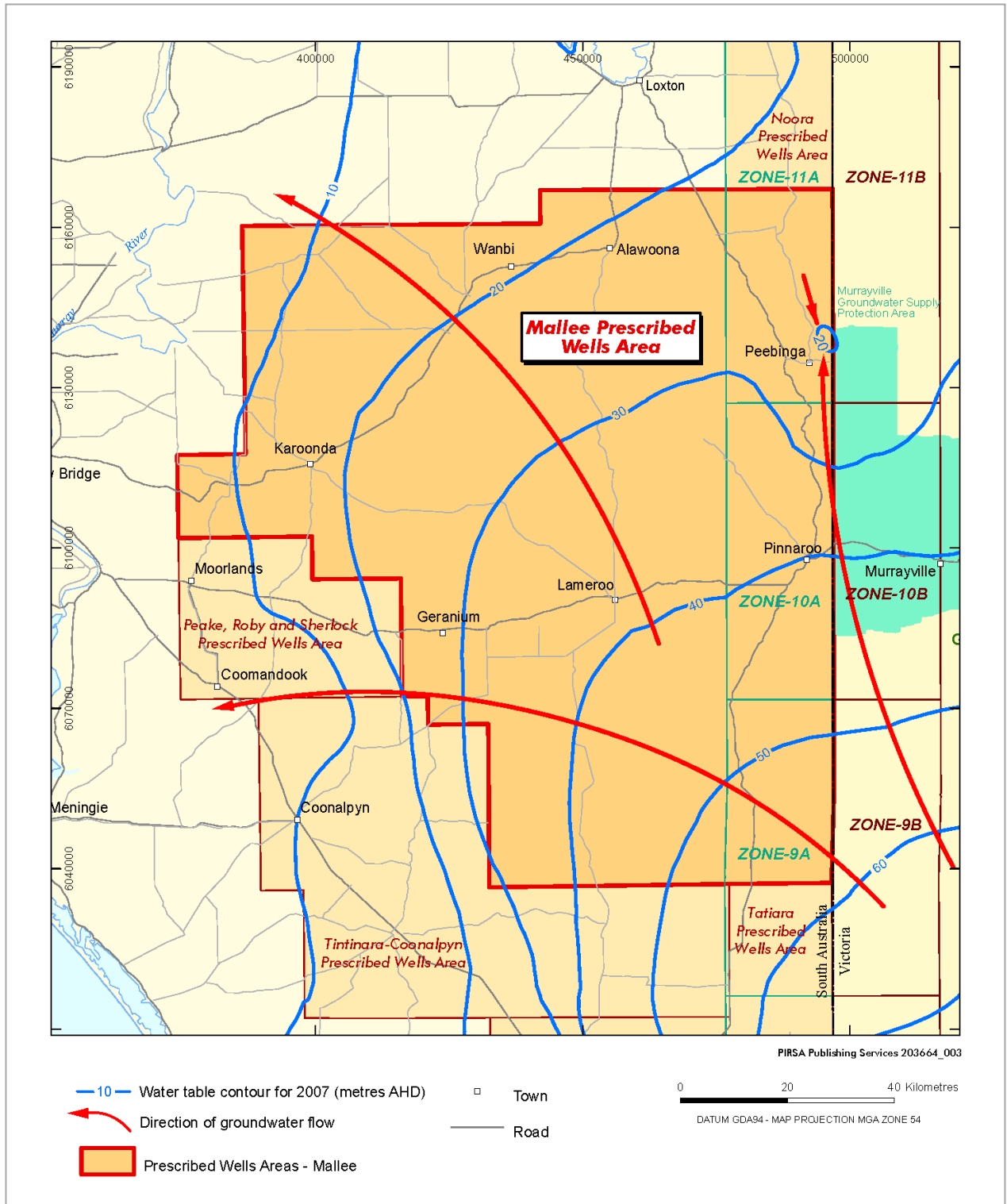


Figure 5: Movement of the underground water in the Mallee Prescribed Wells Area

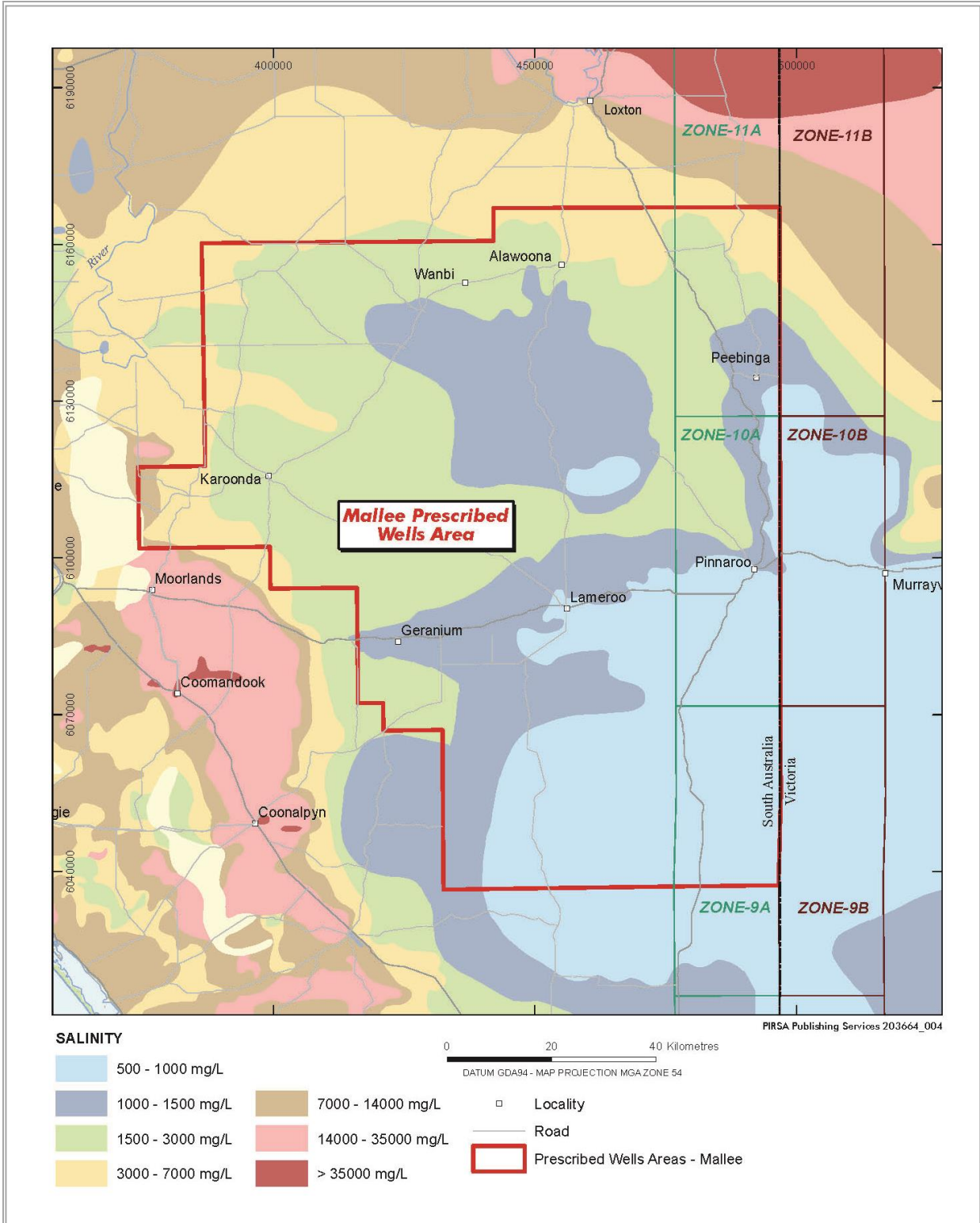


Figure 6: Salinity of the underground water in the Murray Group limestone aquifer

Yields from wells in the Murray Group limestone aquifer vary from 0.5 litres/second (L/s) from stock windmills which only penetrate a few metres into the top of the aquifer, to irrigation supplies of over 60 L/s from wells drilled to a depth of almost 200 metres.

The Murray Group limestone aquifer in the Mallee PWA averages over 100 metres in thickness, with a maximum of about 140 metres on the state's border to the north of Pinnaroo (refer Figure 7).

Renmark Group confined aquifer

Beneath the Murray Group limestone aquifer lies the tertiary confined sand aquifer (as described in the *Groundwater (Border Agreement) Act 1985*), and locally known as the Renmark Group confined aquifer. The flow directions in the Renmark Group confined aquifer are similar to the overlying Murray Group limestone aquifer. Here the underground water is stored under pressure. When intersected by several deep investigation wells drilled in both South Australia and Victoria, the water rose to a slightly higher level than the water level in the overlying Murray Group limestone aquifer. This indicates that upward leakage to the Murray Group limestone aquifer could be occurring.

Generally the salinity of the Renmark Group confined aquifer is similar to the Murray Group limestone aquifer, except in the Peebinga – Berrook area where it is higher (about 5 000 mg/L). There are no water supply wells completed in this aquifer because of the high drilling costs (sandscreens are required), and the uncertainty of obtaining large supplies from the interbedded sands and clays.

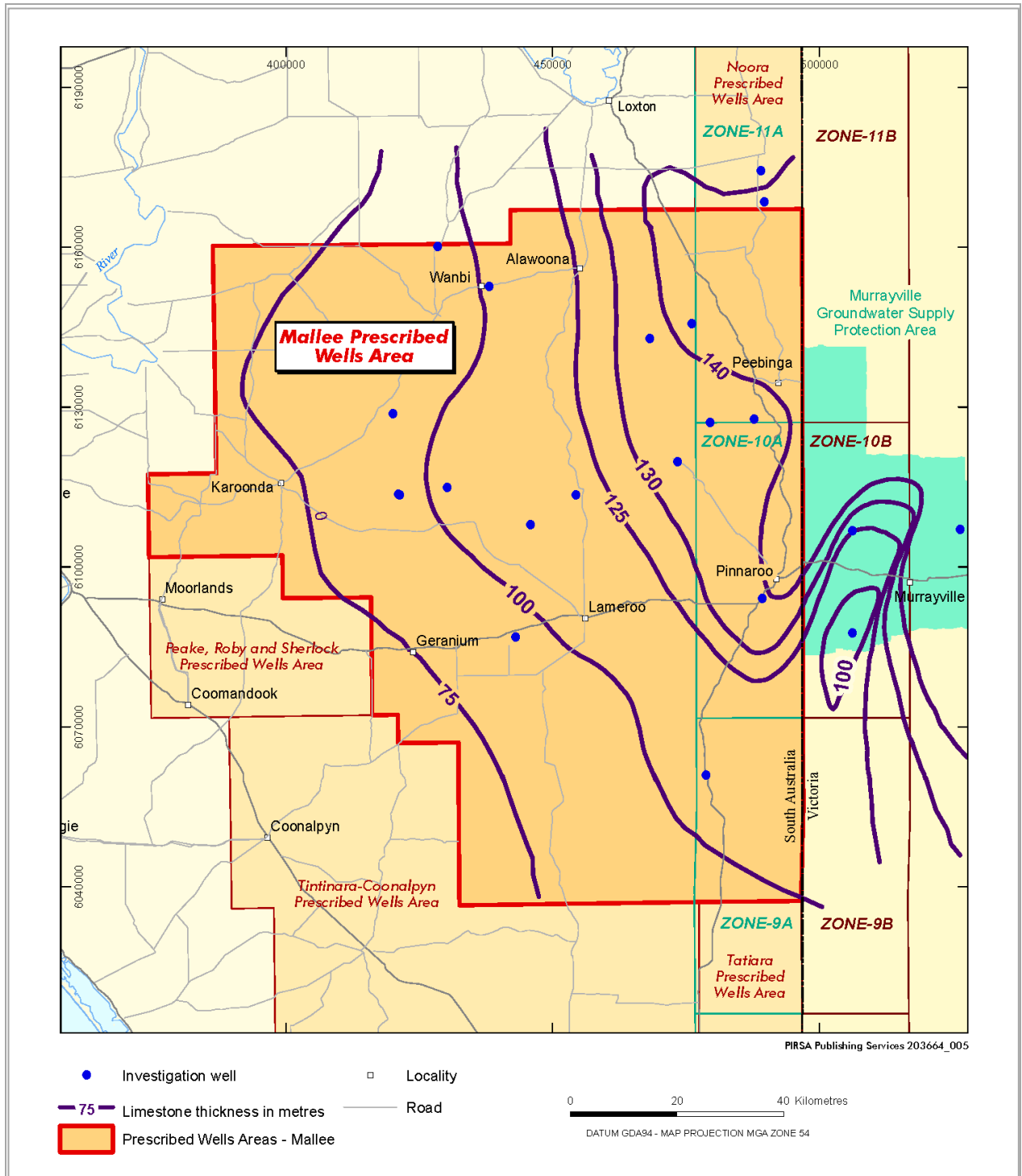


Figure 7: Thickness of the Murray Group limestone aquifer

2. Assessment of the needs of underground water dependent ecosystems

Section 76 (4)(a)(i) of the Act requires a water allocation plan to include an assessment of the quantity and quality of water needed by water dependent ecosystems, and the times or period in which those ecosystems will need the water.

The Murray Group limestone aquifer and the Renmark Group confined aquifer are too deep below the surface to support any terrestrial vegetation or wetlands. Both aquifers contribute to the baseflow of the River Murray; however this discharge is mostly saline and is intercepted by salt interception schemes in some areas.

Water quality in the Parilla Sands aquifer is poor with salinities reaching 20,000 mg/L with typical depth to water table up to 40 metres and as such does not support terrestrial vegetation.

A study was undertaken in October 2003 to determine the existence of stygofauna (underground water dependent ecosystems) within the Mallee PWA (RMCWMB, 2003). The study found no evidence of stygofauna within the Murray Group limestone aquifer. At the time of the study, sampling techniques were adapted for the Mallee conditions and it was recognised that it was difficult to comprehensively sample such an aquifer, particularly where samples can only be taken from disturbed sites.

Further investigations undertaken in January 2009 (Leijs, 2009), achieved little results with only one Oligochaete worm (segmented or earth worm) in one observation bore in the Hundred of McGorrery in the north of the Mallee PWA. As no stygofauna or aquifer dependant ecosystem have been found to date, principles to manage underground water dependent ecosystems have not been incorporated in this Plan.

Aboriginal nations have deep knowledge of the connectivity of underground and surface water sources on their lands and waters. Through respectful partnership, this knowledge could assist in addressing knowledge gaps and assessment of the needs of underground water dependent ecosystems in the region, where they exist.

A decline in the ecological condition of the underground water and surface water systems can also be understood as a threat to Aboriginal nations' health and wellbeing. In this way, Aboriginal nations support the intent of the Plan to sustainably manage this part of Country.

3. Assessment of the effects on other water resources

Pursuant to Section 76 (6) of the Act, where the taking and use of water from a water resource has, or is likely to have, a detrimental impact on the quantity or quality of water that is available from another water resource, the Plan for the first mentioned resource must take into account the needs of persons and ecosystems using water from other water resources. The Plan must also consider the needs of persons and ecosystems using water from the resource and to achieve an equitable balance between competing interests, may include provisions designed to prevent or reduce those detrimental impacts.

3.1 Renmark group confined aquifer

The potentiometric surface of the Renmark Group confined aquifer is naturally higher than the level in the overlying Murray Group limestone aquifer, which could potentially lead to minor upward leakage of water into the Murray Group limestone aquifer. Declines in underground water levels (drawdown) due to extractions from the Murray Group limestone aquifer have increased the head difference, and may lead to an increased potential for upward leakage from the Renmark Group confined aquifer to the Murray Group limestone aquifer, but not to significant levels. Observation wells completed in the Renmark Group confined aquifer show very little or no response to extractions from the overlying Murray Group limestone aquifer. There are currently no users extracting water from the Renmark Group confined aquifer.

3.2 River Murray prescribed watercourse

Although the Murray Group limestone aquifer eventually discharges into the River Murray, the slow underground water movement results in a travel time of thousands of years from the Mallee PWA to the river. Whilst extraction from the Murray Group limestone aquifer is greater than recharge, the overall capacity of the Murray Group limestone aquifer ensures that through flow connection with the River Murray is maintained.

3.3 Murrayville water supply protection area

The taking of water from the Murray Group limestone aquifer in the Mallee PWA may have contributed to drawdown of underground water levels in the Murrayville Water Supply Protection Area in addition to that caused by extractions from the same aquifer within the Murrayville Water Supply Protection Area. Modelling (Barnett and Osei-bonsu, 2006) indicates extraction from this aquifer in South Australia may cause an additional 3-5 metres drawdown in the area of maximum drawdown in Victoria, close to the Border, and an extra 1-2 metre drawdown at the eastern boundary of Border Zone 10B (refer Figure 7).

Analysis of monitoring suggests this modelled impact is over-estimated.

3.4 Peake, Roby and Sherlock Prescribed Wells Area

With regard to the Murray Group limestone unconfined aquifer, there may be small drawdown impacts on the Peake, Roby and Sherlock Prescribed Wells Area if extractions in the Mallee PWA were to concentrate close to the common boundary. Principles in Section 6.1 of this Plan intend to prevent concentrated extractions.

As there are no extractions in the Mallee PWA from the Renmark Group confined aquifer, there will be no impacts on users from this aquifer in the Peake, Roby and Sherlock Prescribed Wells Area.

3.5 Tintinara Coonalpyn Prescribed Wells Area

The Murray Group limestone aquifer extends towards the south-west in the Tintinara area, where irrigation of lucerne, olives and vegetables occurs. Underground water moves to the west on a completely different flowpath to that beneath the Mallee PWA and the vast majority of users will not be affected by the taking of underground water in the Mallee PWA. There may, however, be small drawdown impacts on the Tintinara Coonalpyn Prescribed Wells Area if extractions in the Mallee PWA are concentrated close to the common boundary.

3.6 Tatiara Prescribed Wells Area

The Murray Group limestone aquifer extends southwards into the Tatiara Prescribed Wells Area in Border Sub-zone 9A South of the Border Designated Area. All of the area within three kilometres of the common boundary is a national park (no licensed extractions occur within the national park), and therefore there will be negligible impacts on the Tatiara Prescribed Wells Area from any extractions within the Mallee PWA.

4. Assessment of the capacity of the resource to meet demands

4.1 The capacity of the resource

Parilla Sands aquifer

No permissible annual volume (PAV) has been determined for the overlying Parilla Sands aquifer due to its low yield and limited area of good quality water.

Murray Group limestone aquifer

An earlier review (Barnett, 2006) and current assessments of monitoring trends have found no major adverse impacts resulting from the current extractions of up to 50 000 megalitres/year (ML/year) from the Murray Group limestone aquifer. The PAV for the Murray Group limestone aquifer in the Mallee PWA, with the addition of the yellow management area and the Out of Hundreds area has been set at 61 300 ML/year. The PAV is based on components of recharge, lateral through-flow and taking of water beyond the ability of the aquifer to recharge up to its previous level. In the Out of Hundreds management area (refer Figure 8) in the south, only the area cleared of native vegetation was considered when calculating the resource capacity.

A management decision has been made to allow controlled depletion of the Murray Group limestone aquifer due to the slow moving, robust nature of the aquifer and large amount of storage within the Murray Group limestone aquifer. The rate of groundwater lowering that is created by the taking of water at the set PAV limits is an agreed position by the South Australia and Victorian (for the Designated areas) governments. After taking the derived inflows, outflows and inter-aquifer leakage volumes from the underground water model, the extraction of 61,300 ML each year would lead to a depletion of 15% of the total resource volume of water in storage after 300 years. Overall, the impacts of extracting 61 300 ML annually from the Murray Group limestone aquifer for licensed purposes are acceptable both in the short and long-term. The resource has the capacity to provide this volume for the life of the plan.

Given the location and aquifer characteristics in the area, it is unlikely there will be any long-term adverse effects.

Unlicensed taking of water, such as for stock and domestic purposes, dryland crop spraying and fire fighting are not accounted for in the PAV (crop spraying and fire-fighting are covered by a state-wide authorisation). The volumes required for these purposes are small compared to the PAV. The estimated volume for stock and domestic purposes is included in the figures stated in Section 4.2.1 of this Plan.

As discussed in Section 4.2.6 of this Plan, the Minister has authorised the taking of water from the Murray Group limestone unconfined aquifer for use in sand mining operations. The authorisation allows a maximum of 42,920 ML to be taken over the 10 years of the authorisation (based on an average of 4,292 ML per year). The taking of water under this authorisation has been taken into account in providing for the allocation of water in this Plan and therefore does not need to be deducted from the PAV when determining the volume of water that is available for allocation. Based on monitoring from current mining operations and groundwater modelling in the region, the impacts of mining extractions are within acceptable limits and do not pose a threat to the sustainability of the resource or other water uses.

Irrigation from the Murray Group limestone confined aquifer (eastern part of the Mallee PWA) (Figure 2) has been established for some time and extractions are relatively stable. In this area, drawdowns have approached equilibrium and the extent of the cone of drawdown remains static. The establishment of management areas with an allowable annual volume (AAV) of extraction aims to prevent further concentrations of pumping in this area, and consequently extractions and drawdowns are not expected to increase markedly in the future.

Water in the Murray Group limestone confined aquifer is pressurised. Water levels measured in wells have risen up to 30 metres above the top of the aquifer. The previously observed drawdowns of up to 15 metres represents a drop in pressure in specific locations, but does not represent a lowering of the water level. Whilst pressure levels remain above the top of the Murray Group limestone aquifer, the aquifer (which is over 100 metres thick in the Pinnaroo and Peebinga area), is not being dewatered.

Drawdowns, created by extractions in the Murray Group limestone unconfined aquifer (western part of the Mallee PWA) (refer Figure 2) are expected to be low, namely up to 2-3 metres compared to the pressure response in the Murray Group limestone confined aquifer. Drawdowns occur very slowly in the Murray Group limestone unconfined aquifer compared to the pressure response in the confined part of the Murray Group limestone aquifer.

Drawdowns resulting from irrigation extractions in areas of good quality underground water may lead to increases in salinity by two processes.

1. Downward leakage from the overlying confining layer.
2. Lateral inflows of more saline underground water from the north.

Underground water modelling (Barnett and Osei-bonsu, 2006) indicates that salinity increases due to these processes are a long-term risk occurring over decades, due to the very slow rate of underground water movement. Another potential cause of salinity increase is the downward flushing of salt, previously concentrated in the root zone of Mallee vegetation. This flushing is caused by the increased recharge following vegetation clearance. Only the Murray Group limestone unconfined aquifer in the western half of the Mallee PWA is at risk. This process of aquifer salinisation is inevitable in the long-term, but monitoring has indicated that the salt has not yet reached the watertable of this aquifer.

Because the potentiometric surface (pressure) of this aquifer slopes downwards from south to north, most of the water entering the area of maximum drawdown comes from the south where salinity is lower.

Renmark Group confined aquifer

The PAV for the underlying Renmark Group confined aquifer has been limited to the volume held on licence from the Mallee PWA by SA Water at the date of adoption of this plan, which is 402 ML for public water supply purposes. Due to its higher pressure, this aquifer contributes water to the overlying Murray Group limestone aquifer by upward leakage. The rate of leakage has increased as a result of the taking of water from the Murray Group limestone aquifer, and makes a contribution to the water balance. However, the quantum of leakage from the Renmark Group aquifer into the overlying Murray Group limestone aquifer is relatively insignificant compared to the amount extracted from the Murray Group limestone aquifer. If significant extractions were to occur from the Renmark Group confined aquifer, this leakage could be reduced, leading to increased drawdowns in the Murray Group limestone aquifer.

Border (Groundwater Agreement) Act 1985

Five management areas in the Mallee PWA are located within the Designated Area, commonly known as the Border Zones. The Border Groundwaters Agreement is an agreement between the South Australian and Victoria Governments to manage the groundwater resources along the border in a sustainable manner. Under the *Groundwater (Border Agreement) Act 1985*, the Border Groundwaters Agreement Review Committee (Review Committee) sets a limit to the volume of water permitted to be extracted from licensed wells in a zone (PAV) or sub-zone (AAV) within the Designated Area. South Australia's *Natural Resources Management Act 2004* and its equivalent legislation in Victoria, are subject to this agreement.

The Review Committee set PAV and AAV limits for the Parilla Sands aquifer, Murray Group limestone aquifer and the tertiary sands aquifer (commonly known as the Renmark Group confined aquifer). The allocation principles in this Plan are consistent with the limits set by the Review Committee for Border Zone 9A north, 10A and 11A south.

On 23 June 2010, the PAV's for the three Border Zones in the Mallee PWA (Border Sub-zone 9A North and Zones 10A and 11A) were altered by the Review Committee to continue to support irrigation investment in Border Zone 10A and to protect Border Zone 11A from the risk of flow reversal from the north of Peebinga, where groundwater salinities are higher, and subsequently draw more saline water into the pumping zone. The PAV for the Murray Group limestone aquifer, in the Border Sub-zone 9A was reduced from 3,835 ML to 2,400 ML; Zone 10A was increased from 9,400 ML to 14,000 ML; Zone 11A was reduced from 6,681 ML to 3,700 ML. The Review Committee has the power to alter PAVs in the Border Zones to ensure equitable sharing of the resources and the protection of the resource from undue depletion or degradation.

Drainage or discharge of water into a well

There is no current demand and a very low likelihood that there will be demand for drainage and discharge of water into wells during the life of this Plan. The Mallee PWA is in a low rainfall area, with no rivers, streams or excess surface water available for drainage or discharge into a well. Due to the lack of necessity, there have been no investigations to evaluate the effect of drainage or discharge on the aquifers of the Mallee PWA.

4.2 Current Demands

Unlicensed purposes

4.2.1 Stock and domestic use

It is estimated that 850-1,150 ML of water is used per year for domestic purposes and 800-1,100 ML per year for unlicensed stock water use (includes water use for all stock that are not intensively farmed) in the Mallee PWA (Weir 2005).

4.2.2 Aboriginal business and cultural needs

A notice has been published pursuant to Section 128 of the Act, authorising native title holders to take water from a prescribed water resource that is situated on the native title holders land or waters for the purpose of:

Personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests, providing that the taking does not involve stopping, impeding or diverting the flow of water for the purpose of collecting the water or diverting the flow of water from a watercourse.

Access to and use of water from the Mallee PWA is therefore exempt from licensing for these purposes. The authorisation is limited to native title holders (including native title claimants) accessing water in the exercise or enjoyment of their native title rights and interests.

It is acknowledged that Aboriginal values and uses are not limited to the water authorised to be taken under the Section 128 notice. More engagement is required to identify Aboriginal objectives and outcomes, and to have regard to values and uses.

Licensed purposes

The following information is a statement of water use for different licensed purposes to indicate current demand. The data has been sourced from the SAMDB NRM Board's annual water use summary reports, which have been collated annually since the 2001/2002 water use year. The fluctuations in water use, allocations, water use measurements, location details or changes in practices by businesses using the water in the Mallee PWA are noted in the annual water use report for the year in question. (RMCWMB, 2003 & 2004, SAMDB NRM 2006 - 2009)

4.2.3 Town water supplies

As shown in Table 1, water use in towns is generally stable with the exception of drought years. Town/public water use has not exceeded current town water allocations.

Table 1: Town (reticulated) water use in ML

Town	2001/2 002	2002/2 003	2003/2 004	2004/2 005	2005/2 006	2006/2 007	2007/2 008	2008/2 009
Pinnaroo	145.2	173.2	167.7	149.9	143.6	170.6	153.3	152.9
Lameroo	116.4	134.3	94.9	101.8	105.6	117.6	111.8	116.8
Geranium	22.4	13.3	9.9	13.6	9.4	10.3	11.3	10.3
Parilla	12.0	14.7	9.7	10.6	12.2	14.8	15.4	14.5
Paruna	N/A	N/A	5.2	5.8	4.0	5.3	4.2	6.2
Alawoona	3.1	4.2	2.6	3.7	2.5	2.9	3.4	3.4
Wanbi	N/A	N/A	N/A	N/A	1.8	3.1	3.2	2.5
Totals	299.1	339.7	290.0	285.4	279.1	324.6	308.7	306.7

4.2.4 Recreational and environmental purposes

There are no existing licences for environmental purposes in the Mallee PWA.

Allocations for recreational purposes appear to be sufficient to meet current demands. Previous use shown in Table 2 has been less than currently allocated.

Table 2: Recreational water use in ML

Purpose	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009
Local Council parks	257.5	144.4	118.2	160.1	144.4	199.3	216.3	178.1
Schools	61.6	88.8	79.8	92.7	86.1	93.9	111.6	106
Sporting clubs	72.3	74.0	48.4	68.1	83.4	82.4	106.1	82.7
Totals	391.4	307.2	246.4	320.9	313.9	375.6	434.0	366.8

4.2.5 Intensive farming

Between 2001–2009, less than half of the allocated water for intensive farming were used (refer Table 3). This indicates that allocations for intensive farming are generally under-utilised. Changes to intensive farming practices, particularly in piggeries (e.g. eco-shelters which require less water for wash down) may have seen a decline in water required for this industry.

Table 3: Intensive farming water use (ML)

Intensive Farm	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009
Pigs	192.1	119.7	176.2	166.7	150.9	145.9	164.9	144.9
Cattle	24.0	195.8	46.5	30.8	18.4	46.8	38.4	17.0
Lambs / sheep	2.5	00.3	0	4.3	3.5	0.9	8.1	10.1
Poultry	56.0	0	0	0	0	n/a	n/a	n/a
Yabbies /marron	18.6	00.2	0	0	161.0	13.6	2.3	3.2
Dogs	0	0	0	0	1.5	1.5	1.1	1.1
Rabbits	n/a	n/a	n/a	n/a	n/a	n/a	0.05	1.6
Totals	293.2	316.0	222.7	201.8	335.3	208.7	214.8	188.9

4.2.6 Industrial

The requirement for industrial water allocations has increased since 2005 due to the expansion of vegetable packing sheds in Pinnaroo and Parilla.

However, it is difficult to accurately determine industrial use as the same water flow meters are often used for multiple purposes,(e.g. irrigation and packing shed).

Since the previous Plan was adopted, the Minister has authorised the taking of water from the Murray Group limestone unconfined aquifer for use in a sand mining development under Section 128 of the Act. Whilst this is not a licence, it does give authorisation to take water under the Act. The authorisation was gazetted on 16 March, 2007 and allowed for up to 6,000 ML to be taken from the Murray Group limestone aquifer per water use year until 2017, but not more than 42,920 ML in the 10 years. The volume taken has not exceeded the authorisation. As outlined in Section 4.1 of this Plan, the impacts of mining extractions are within acceptable limits and do not pose a threat to sustainability of the resource or other water users.

4.2.7 Irrigation

Irrigation continues to be the largest user of underground water in the Mallee PWA. Since 2001/2002 there has been an obvious trend of increasing irrigation water use (Table 4). The water use across the Mallee PWA however, remained below the total volume allocated to irrigation licences. The extraction points for irrigation are clustered geographically within areas of better quality and low salinity water.

Table 4: Irrigation water use from 2001 to 2009

	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/20 08	2008/ 2009
Water use	25 029	28 761	27 321	32 824	27 591	34 504	48 096	40 118

4.3 Future demands

As water resources decline in other areas of Australia, there may be more demand in the future for water from the Mallee PWA. However, the amount of future interest for water in Mallee PWA from external or new developers is difficult to quantify. Locally, in areas with good water quality and suitable soils, the demand for water may exceed the capacity. However, improvements in efficiency of irrigation and industrial developments could accommodate greater development in those areas.

The following expected future water demands are based on trends in water use, local knowledge of demand, and limitations of water quality and infrastructure. Water allocation plans are required to be reviewed within 10 years of the Minister adopting the Plan. The reality of the expected demand will be assessed during the review.

4.3.1 Stock or domestic use

Dryland farming is expected to remain the largest land use in the Mallee PWA. Although associated water requirements for stock and domestic use are relatively small compared to irrigation, the availability of stock and domestic water is of vital importance for dryland farmers in the Mallee PWA.

Domestic use is expected to stay the same or slightly decline, in line with population trends in the Mallee PWA. It is difficult to predict numbers of stock in the future, because of changes in profitability of grazing enterprises. Future stock water demands are likely to be similar to present use, but may increase if favourable climatic conditions occur, therefore improving the availability of fodder, which may lead to increased stocking numbers. Taking water for stock or domestic purposes does not require a licence and is therefore not included within the PAV.

4.3.2 Town water supplies

Water usage for town water supplies has declined while the town populations remain static. This decline has been largely attributed to changed water user behavior in response to recent drought conditions. Current allocated volumes should be sufficient to meet demands for the duration of this Plan.

4.3.3 Recreational and environmental purposes

Future water use for recreational purposes is estimated to remain the same as current use, or slightly decline due to local government initiatives to utilize recycled wastewater or treated stormwater for recreational parks and lawns.

There are no known future water requirements for environmental purposes given the lack of water dependant ecosystems in the Mallee PWA.

4.3.4 Aboriginal business and cultural uses

Aboriginal nations want a future that maintains the continuation of their culture upon Country and that continues to give life to their people who live and work in and outside of the region. First Peoples seek to re-establish the economic benefits that flow from their Country into their communities and institutions.

RMMAC has expressed interest in pursuing economic development opportunities on behalf of the First Peoples.

The RMMAC Strategic Plan identifies a range of interests including:

- Economic business opportunities in the Mallee PWA while preserving the environment, heritage and cultural and spiritual wellbeing;
- Greater involvement in the management and access to land and water in the Mallee PWA; and
- Securing cultural flows.

The current and future Aboriginal needs for water have not been identified or quantified at this time. The SAMDB NRM Board will be working with the First Peoples and other Aboriginal groups that assert an interest in the area to identify and quantify these needs.

4.3.5 Intensive farming

Previously it was thought that diversification of income through alternative intensive animal keeping would increase the demand for water allocations for intensive farming purposes. However, many of these markets have not come to fruition.

There is general interest in increasing the number of cattle feedlots, piggeries and dairy businesses in the Mallee PWA. These business interests are currently working with Regional Development Australia -Murraylands and Riverland Incorporated to investigate the viability and availability of suitable infrastructure and labour requirements for the proposed developments. The additional water demand for the proposed developments will be able to be met from current allocations.

Opportunistic and temporary feedlotting ('drought lots') during low rainfall years and drought conditions is an increasingly common practice in the Mallee PWA. However, temporary feedlotting is not anticipated to create additional water use beyond the current unlicensed non-intensive stock water use estimates.

4.3.6 Industrial

Manufacturing

There are no known proposals or demand for the expansion of vegetable packing sheds or other manufacturing developments that require water.

Mineral resource mining

In the north-west section of the Mallee PWA, near the township of Mindarie, the Minister has authorised the taking of water from the Murray Group limestone unconfined aquifer for use in a sand mining development. The authorisation is valid until 2017, demonstrating a future demand from mining in the green management area with plans to extend into the yellow management area (refer Table 5 and Figure 5). The extent or timing of these operations is currently unknown.

4.3.7 Irrigation

Irrigation is expected to require the greatest water allocation. Based on the current types of irrigated crops, some areas in the Mallee PWA have limited horticultural crop potential due to water quality and soil type. Such areas are likely to remain dryland farming, or may develop intensive farming or industrial activities. Irrigation developments tend to concentrate in areas that combine good quality water with suitable soils. The productive capacity of the land will also depend on land management practices and avoiding land degradation issues such as erosion, water logging or perched water tables. Annual irrigated crops like potatoes require different soil characteristics and water quality compared to more permanent plantings such as olives. Depending upon crop tolerance to the land characteristics and water quality, irrigation development may expand to areas that were considered less suitable.

Since 2000, drought and historical low flows in the River Murray saw several large irrigation developments move water use from the River Murray to the Mallee PWA. When the River Murray and other water resources within the Murray Darling Basin become stressed and allocations are restricted, an increase in demand for alternative water resources, including the underground water resource in the Mallee PWA, is expected to occur.

4.3.8 Climate change

The effects of climate change in Australia, particularly in the Mallee PWA, are not yet clearly understood. Therefore it is difficult to know how the effect of climate change will impact on the demand for water in the area.

The likely increase in temperatures, together with predicted low frequency and high intensity rainfall for the Mallee PWA could lead to an increase in demand for water use, particularly for irrigated crops. There may be a change in planting seasons for annual crops to adjust to, and utilise, the change in rainfall patterns. There may also be a demand for alternative crops to suit the changing climatic conditions (including characteristics such as increased disease resistance and heat tolerance, and lower water use requirements). Intense rainfall events may assist in leaching salt loads from crop root zones which will benefit irrigated crops however increasing salt loads from irrigated soils may become an issue leading to an increase in the salinity of underground water.

There is little information at this stage on whether climate change in the Mallee PWA will lead to water resources, land and infrastructure becoming more or less suitable for current and future water use developments.

Climate change will have little effect on recharge to the Murray Group limestone aquifer as the major recharge of this aquifer occurred thousands of years ago (refer Section 1.2.2). Thus, the short-term effects of climate change on recharge and allocations in the Mallee PWA are considered minor.

First Peoples' position on climate change

First Peoples have long experience with climate change. Their creation stories tell of the flooding of lands and the changes to rivers. Their Old People have watched the impacts of the degradation of their lands and waters since European occupation. They recognise the impacts of global warming on their lands and waters and all living things. In recent years, First Peoples have observed changes to their local environment that tell them that climate change is a reality. They see that the breeding behaviour of birds is changing, as is the colour of fish and their behaviour, and the fruiting and flowering of their bush foods is changing too.

First Peoples have watched their fresh water holes, wetlands and floodplain nurseries dry up or turn salty. When they lose these places they lose part of their cultural heritage and an irreplaceable record of their adaptation to climate change in the past. They have also noticed that some animal and plant species have declined in size and abundance, and some species have disappeared altogether.

First Peoples support action to address climate change, and are willing to work with all levels of government to reverse the damage done by industrialisation and unsustainable practices.

4.4 Management arrangements

Water licence entitlements will reflect the AAV of water that can be extracted from specific management areas. The AAVs and PAVs will ensure greater security and stability of the water resource. On-going adaptive management is essential for enabling progress for sustainability, ensuring future resource security and equity for the local community, licensees, landholders and the environment is achieved.

The Plan aims to allocate water to active users who have shown development in accordance with their licence conditions. This is reflected in the allocation methodology, which provides equity for current users and their current requirements. The Plan also allows for water trading creating avenues for new users and existing users to obtain water.

The Act requires that a water allocation plan provide for the allocation and use of water so that an equitable balance is achieved between environmental, social and economic needs and at a rate of use that is acceptable. Section 76 (4)(c) of the Act requires the Plan take into account the present and future needs of the occupiers of land in relation to existing requirements and future capacity of the land, and the likely effect of those provisions on the value of the land.

While the overall capacity of water resources in the Mallee PWA is large enough to meet all existing demands for water for its long-term sustainability, the setting of AAVs is necessary to sustain future demands. The Plan also recognises there are varying effects of water extraction in localised areas. Therefore an AAV has been set for all defined management areas.

Generally, the effects on land values as a result of the policies in this Plan are thought to be minimal. Land suitable for irrigation in an area with good quality underground water will always have a higher value than land that is not suitable for irrigation or land in an area with more saline underground water. This could lead to higher prices for water allocated in the areas with good quality water and suitable soils. There is also the opportunity for water allocations to be transferred across the Mallee PWA, although this depends upon current extractions and associated AAV within management areas. The prospect of selling or trading water that results from improved irrigation practices may also be achievable where permitted under the transfer rules (refer Section 6).

4.4.1 Volumetric Conversion

Historically, irrigation licences in the Mallee PWA were issued in hectare irrigation equivalents (haIEs), which allowed irrigators to irrigate up to a maximum area of crops. The haIE was an estimate of the irrigation requirement (volume of water) of a reference crop. All crops grown in the Mallee PWA require less water per hectare than the reference crop, so a ratio was used to determine the irrigation requirements between the reference crop and other crops grown in the region. This is known as the crop area ratio (CAR). The area-based allocation method (haIEs) used area as the compliance measure rather than volume.

Since 1984, state and national water resource policy has required volumetric water allocations to improve specification of water users' entitlements and enable better water resource management capability, including for compliance with extraction limits (AAVs/PAVs). Volumetric allocations support the state and national policy requirement to measure water use.

The haIE allocation system assumed a volumetric estimate using an internationally recognised method (Food and Agriculture Organisation 1977, FAO Irrigation and Drainage Paper #24) to derive the original irrigation requirements for crops in the Mallee (Desmier, 1991). A revision of the FAO methodology (FAO Irrigation and Drainage Paper #56, Skewes M, 2004), identified an increase in the net irrigation requirements (NIR) for the reference crop (see Appendix). The NIR volumes were used to develop a volumetric conversion methodology, which included extra components (refer principle 8 in this Plan) to formulate total irrigation requirements (EconSearch Pty Ltd, 2006, MWRC minutes). The SAMDB NRM Board has determined that the revised FAO methodology is the most up-to-date science and the use of Skewes rates is the most appropriate method to determine the amount of water required for individual crops in the Mallee PWA. The resulting methodology is specific for the Mallee PWA. Volumetric conversions allows the determination of irrigation requirements, greater flexibility to meet crop water requirements and caters for a broader range of differing environmental conditions.

The irrigation and crop management practices vary greatly amongst water users in the Mallee PWA and from season to season. If all haE allocations (developed or undeveloped) were converted using NIR, then allocations would exceed the PAV for the Mallee PWA and reductions to allocations would be required. Policies prioritise assigning water to developed allocations over inactive allocations. Some allocations have been inactive for quite some time. The philosophy of this decision is to protect existing economic and social investment in the resource and to ensure minimal impact to ongoing irrigation operations in the Mallee PWA. In order to achieve this aim, the volumetric conversion methodology prioritises allocations that have been developed. In some areas of the Mallee PWA, demand is greater than the capacity of the resource. Where this occurs, reduction of existing developed allocations may have a social and economic impact.

It is acknowledged that licensees who have inactive allocations may be adversely affected. However the consequences of reducing an allocation that has never been developed is anticipated to be less than the impact of reducing an allocation that has been used to irrigate crops. To protect and maintain the economic investment in the resource and maintain the social aspects of commercial activity in the Mallee PWA, a priority order of allocation was required for volumetric conversion. This allocation methodology focuses on developed allocation taking priority over undeveloped allocations, and is considered to be the most equitable methodology for volumetric conversion.

The priority order of allocation is as follows:

Priority 1 – Development of haEs during the assessment period (1st July 2004 to 30 June 2009, refer Principle 11)

Priority 2 – Development of haE after the assessment period (1st July 2009 to date of adoption of this Plan)

Priority 3 – Undeveloped haEs (no development between the assessment period and the date of adoption of this Plan)

The beginning of the assessment period (1 July 2004) aligns with the commencement of the current licence condition for active and expeditions use. The SAMDB NRM Board has determined the assessment period until July 2009 to allow greater flexibility for growers. The second priority for volumetric conversion was introduced to allow growers further opportunity to develop and to accommodate development that occurred through transfer after 1 July 2009 and up to adoption of the Plan.

Using revised NIR and levels of allocation development, the SAMDB NRM Board formulated an equation to convert developed haE from area to volume. Using this formula (refer principle 8 in this plan), the developed haE is converted into what is known as the conversion volume. The process for converting all haEs (developed and undeveloped) from area to volume is known as volumetric conversion. For the purpose of volumetric conversion, a developed haE is a haE allocation that has been utilised by applying water through an irrigation system to grow horticultural or agricultural crops in the Mallee PWA.

The volumetric conversion policies within this Plan are based on a level of licence development within a given period. This period is known as the assessment period. All development after this period will be converted at a lesser priority. The licensed volume for development after the assessment period will then be issued depending on the management area's existing allocation principles and available AAV.

4.5 Risk assessment

During the development of this Plan, the SAMDB NRM Board has considered the likely risks to the resource and the consequences of managing these risks through the policies in the Plan. Any existing threatening processes have been dealt with through the allocations, transfer, permits and monitoring sections of this Plan, while future risks and consequences will be managed through regular monitoring of the resource, which will assist in the review of this Plan within 10 years of adoption.

The PAV for the Mallee PWA does meet current demand, although the AAVs in some management areas, particularly the red management areas, is likely to be less than current and future demand. Red management areas generally align with areas of low salinity underground water and where developed businesses with the ability to expand are located.

The transfer arrangements in this Plan have been amended from the previous plan (MWRPC, 2000), by widening the trading area, reducing the number of management zones, and removing the minimum allocation limit allowed to remain in a management area. Although the transfer arrangements in this Plan intend to “free up trade”, there is a risk that trading will be limited in some management areas that are expected to be fully allocated following the volumetric conversion of irrigation licences. This may mean that no further allocations can be traded in.

There is a risk that the pressure of drought conditions, water restrictions and water quality deterioration in neighbouring prescribed areas will place an increased demand on water and land resources in the Mallee PWA, hence the use of AAVs in management area to limit extractions to acceptable drawdown levels and salinity impacts.

4.6 Management areas

For the purposes of allocations and transfer criteria (refer Sections 5 and 6) in this Plan, the Mallee PWA has been divided into management areas.

It was determined that the most equitable approach to managing the resource was to consider the resource at management area level rather than at an individual licence level. If individual circumstances were considered in all management zones, there is a risk of determining policy that would reduce the impact on one individual to the possible detriment of other licencees. The Plan considers the management of the resource and the ability for the resource to sustainably provide for water users. The Plan ensures that an allocation limit has been established for each management area based on the capacity of the resource.

For the purposes of transfer, criteria is set to ensure that water is only transferred within areas of equal stress, or alternatively from areas of high stress to low stress without impacting the AAV for the management areas.

There are additional transfer rules for the Designated Area, to ensure all transfers occur in accordance with the *Groundwater (Border Agreement) Act 1985*. The yellow and Out of Hundreds management areas also have strict transfer rules that ensure no water is traded in or out of these management areas.

The management areas are described as follows:

- Red management areas consist of properties within the Hundreds of McGorriery, Peebinga, Pinnaroo and Parilla. Red management areas encompass wells that extract water from the Murray Group limestone confined aquifer and are considered to have access to the best quality water within the Mallee PWA. These management areas also contain the highest density of active licensed wells that create the maximum drawdowns within the Mallee PWA. Red management areas are defined by GR¹ Map No 49/2010.
- Green management areas consist of the whole of Hundreds of Kekwick, Allen, Mindarie, Chesson, McPherson, Auld, Billiatt, Kingsford, Bews, Cotton, Molineux, Price, Allenby, Day, Quirke & Fisk, and properties within the Hundreds of McGorriery, Peebinga, Pinnaroo and Parilla. Green management areas access water from the Murray Group limestone unconfined aquifer or Murray Group limestone confined aquifer and contain areas of smaller drawdown and demand. Green management areas are defined by GR Map No 49/2010.
- Yellow and Out of Hundreds management areas consist of the whole of Hundreds of Bandon, Vincent, Wilson, Hooper, Marmon Jabuk as well as the Out of Hundreds area (the area immediately west of Border Zone 9A North and within the prescribed boundary). The yellow and Out of Hundreds management areas are the newest areas to be prescribed as part of the Mallee PWA. Yellow and Out of Hundreds management areas are defined by GR Map No 49/2010.

¹ General Registry

5. Water allocation

Objectives

- a) Maintain an acceptable water level throughout the Mallee PWA that enables reasonable access by all water users.
- b) Prevent unacceptable impacts on the underground water resource or the productive capacity of the land from the taking and use of water.
- c) Provide for the efficient use of water.
- d) Maintain acceptable water quality so that the resource can continue to be used for licensed and unlicensed purposes including stock and domestic use.
- e) Minimise adverse impacts of groundwater extraction on Aboriginal cultural values, and in particular on the natural flow of groundwater in the area and other parts of connected First Peoples' Country
- f) Promote awareness of Aboriginal values associated with the lands and water.

5.1 Allocation principles

- 1. Water shall be allocated by volume.
- 2. Water shall be allocated from the Murray Group limestone aquifer pursuant to Table 5.
- 3. Water shall only be allocated from the Renmark Group confined aquifer to SA Water for public water supply.
- 4. The allowable annual volume from the Renmark Group aquifer is limited to the volume held on licence in the Mallee PWA by SA Water at the time of adoption of this Plan of 402 ML. Additional limits apply to the Border Zones as legislated by the *Border (Groundwater Agreement) Act 1985*, which may be amended from time to time.
- 5. No water shall be allocated from the Parilla Sands aquifer.
- 6. Where there is unallocated water in a management area of the Mallee PWA, the Minister may make water available for allocation consistent with the South Australian Unallocated Water Policy Statement (2010).
- 7. Allocations are for use within the water use year for which they are granted.

Table 5: Management Areas and related allowable annual volume (AAV) for the Murray Group limestone aquifer

Management areas	AAV (ML)
Green management area (outside of Designated Area)	25 700
Parilla red management area	7 000
Yellow management area	7 000
Out of Hundreds management area	1 500
Border Zone 11A* (PAV = 3 700 ML)	
(11A Red Management Area)	3 500
(11A Green Management Area)	200
Border Zone 10A* (PAV = 14 000 ML)	
(10A Red Management Area)	6 000
(10A Parilla Red Management Area)	3 000
(10A Green Management Area)	5 000
Border Zone 9A Sub-zone North* (AAV = 2 400 ML)	
(9A North Green Management Area)	2 400
Total permissible annual volume (PAV)	61 300

**The PAV and AAV for each Border Zone are set in accordance with the Border Groundwaters Agreement.*

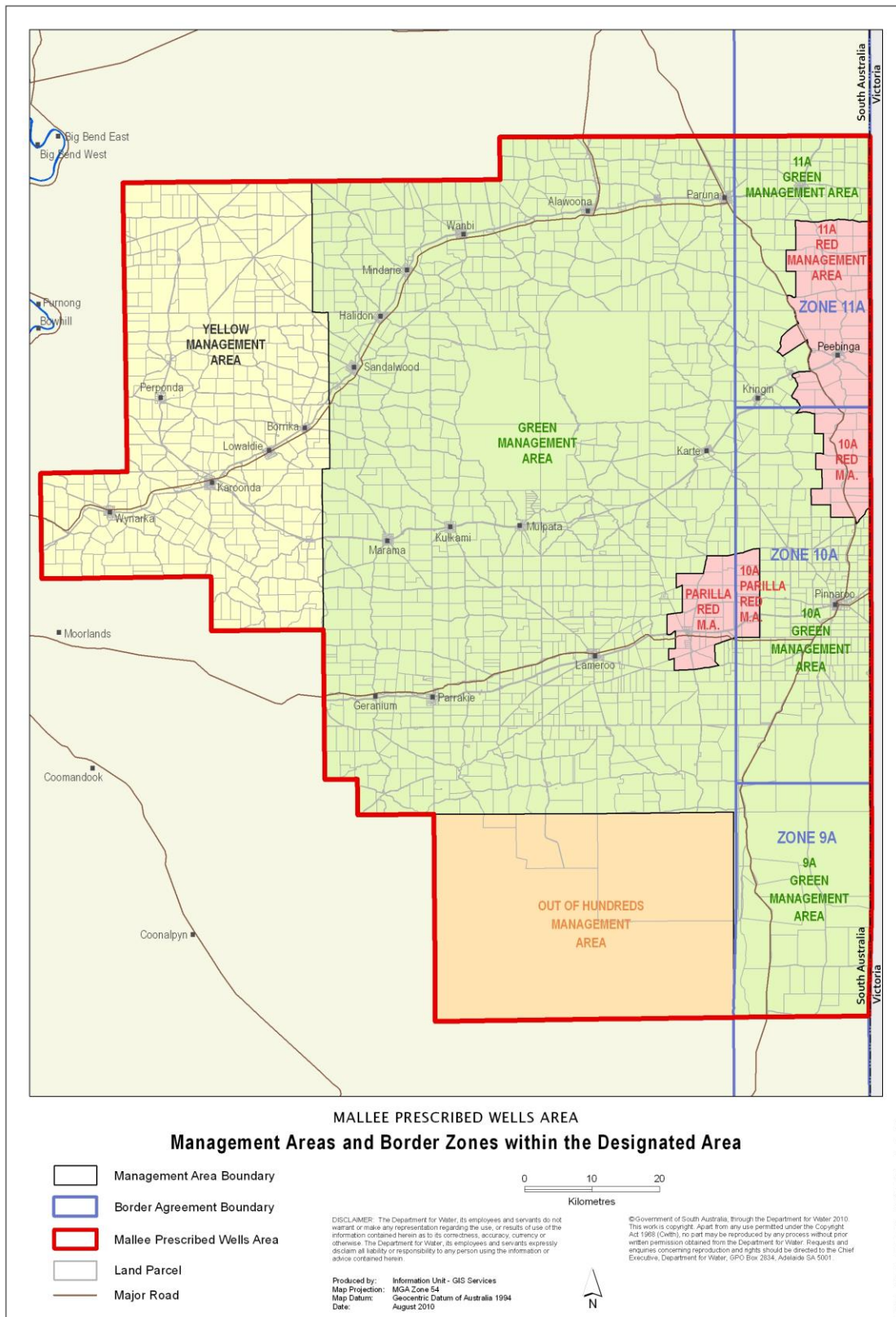


Figure 8: Management areas and Border Zones within the Designated Area for the Murray Group Limestone confined aquifer

5.2 Volumetric conversion for irrigation allocations

The following principles will be applied to area-based allocations (allocations in the form of haEs) in existence at the date of adoption of this Plan.

5.2.1 Conversion volume for developed allocations

8. All developed area-based irrigation allocations (haE) will be converted to a volume known as the **Conversion Volume**.

Conversion Volume = Base Allocation + Crop Area Ratio (CAR) component + Delivery component.

Where by:

Base Allocation is the developed haE x **NIR** of the reference crop (see Appendix A).

Crop Area Ratio (CAR) component (where applicable) = CAR is a ratio between the volume of water required for the reference crop compared to the volume required for a particular crop type grown. The CAR component will only be applied where the revised CAR decreased by more than 5% to the previous CAR, during the review from Desmier rates (FAO #24) to Skewes rates (FAO #56) (refer to Appendix).

Delivery component = a volume is provided to ensure the crop receives its **NIR** whilst some of the unavoidable water losses are provided for, such as losses through irrigation systems due to site characteristics and variable climatic conditions. For the purpose of volumetric conversion, 85% irrigation efficiency target was considered appropriate.

9. For the purposes of principle 8 and notwithstanding principle 17 and 25, the **Conversion Volume** for individual irrigation allocations is calculated on the maximum area (in hectares) under irrigation (i.e. developed) during a single water use year within the **Assessment Period**.
10. The **Assessment Period** is from 1 July 2004 to 30 June 2009.
11. If an area is cropped more than once in a water use year then the total area for the purpose of principle 9 is the sum of each irrigated cropped area.
12. For the purpose of principles 8 and 9, the maximum area irrigated during a single water use year during the **Assessment Period** will be based on the licensee's annual water use reports, unless the Minister, having regard to relevant and verifiable information provided by the licensee, considers that the annual water use reports materially incorrectly estimates the area under irrigation in these years, in which case the Minister may determine that area according to that relevant and verifiable information. For the avoidance of doubt, a statutory declaration or sworn statement shall not amount to "relevant and verifiable" information for these purposes.
13. Notwithstanding principle 12, where a licensee has failed to submit an annual water use report for one or more water use year(s), the licensee will be assumed to have carried out no irrigation for the year(s) where the annual water use report was not provided.
14. Where a licensee objects to the assumption in principle 13, the Minister, having regard to relevant and verifiable information provided by the licensee, may determine that area according to that relevant and verifiable information. For the avoidance of doubt, a statutory declaration or sworn statement shall not amount to "relevant and verifiable" information for these purposes.
15. Principle 13 and 14 apply to water use year(s) within the **Assessment Period** and post the Assessment Period, up to the date of adoption of this Plan.
16. If the Minister considers it appropriate to gather water use information for any part of a water use year not yet reported on, a water use report is to be completed by the licence holder and returned to the Minister's Department within 28 days of issue.
17. If the licensee has developed haE that exceed the allocated haE in any given water use year, only the allocated haE will be considered for the **Conversion Volume**.

18. Where the holder of a water licence has developed more than one crop type which has resulted in the licence holder's allocated haEs being exceeded, the **Conversion Volume** will be determined by proportionally reducing each crop type, until the developed haE's are within allocation at the date of adoption.
19. Principles 20 through 22 are to be applied in order as listed.
20. Where the sum of **Conversion Volume** allocations calculated for the **Assessment Period** pursuant to principle 8 and according to principles 8 – 18, plus existing volumetric allocations exceeds the management area's AAV, then proportional variations to Conversion Volumes will occur until the management area's AAV is reached.
21. Where the sum of **Conversion Volume** allocations and existing volumetric allocations is less than the management area's AAV:
 - 21.1 Additional haEs developed after 1 July 2009 (post the Assessment Period) and prior to the adoption of this Plan, will be considered for volumetric conversion; and
 - 21.2 haE's developed post the Assessment Period and prior to the adoption of this Plan will be converted as per principle 8.
22. Where principle 21 is applied and the sum of the Conversion Volume allocations, calculated under principle 8 and the Conversion Volume allocations calculated under principle 21 exceed the AAV, then the Conversion Volume allocations calculated under principle 21 will be reduced proportionately until the management area's AAV is reached.

5.2.2 Undeveloped allocations

23. If resulting allocations from principles 20 and 22 are less than the management area's AAV, then undeveloped haEs will be converted proportionally, up to 100% of the **Net Irrigation Requirements** of the reference crop volume per undeveloped haE, until the management area's AAV is reached.
24. If resulting allocations from principle 23 remain under the management area's AAV, then the balance of the AAV is considered available for temporary auxiliary allocations according to principles 29.

5.2.3 Transfers prior to date of adoption of the Plan

25. In determining the conversion volume any developed haEs that have been transferred permanently from a licence prior to the date of adoption will not be considered in calculating the conversion volume for the transferors licence.
26. The act of transferring an undeveloped haE allocation(s) is not considered development.
27. When determining Conversion Volumes where transfers of allocations have occurred, undeveloped haE's are assumed to be transferred in the first instance.
28. With respect to the transfer of an allocation up to the date of adoption of this Plan, the development history as per principles 12, 13 and 16 will be considered in determining the level of development.

5.2.4 Temporary auxiliary allocation (TAA)

29. Where the sum on Conversion Volume allocations calculated pursuant to principle 8 – 28, plus existing volumetric allocations is less than the respective management areas AAV, then temporary auxiliary allocations (TAA's) may be available subject to the following;

$$\text{TAA (ML)} = \left(\frac{\text{Individual Conversion Volume}}{\text{The sum of all conversion volumes and existing volumetric licences within the management area}} \right) \times \text{Volume of TAA available}$$

- 29.1 Successful applicants will for a TAA will obtain a proportion of the water available for TAA. calculated in accordance with the following;
- 29.2 A TAA shall only be granted to the holder of a irrigation licence where the Minister is satisfied that the licensee's historic water use is greater than the licensee's volumetrically converted water allocation.
- 29.3 A TAA may not be transferred.
- 29.4 A TAA will be composed of three components as follows:
 - 29.4.1 The first component will be 20% of the total TAA and will expire at the end of the first water use year after the date of adoption of this Plan.
 - 29.4.2 The second component will be 40% of the total TAA and will expire at the end of the second water use year after the date of adoption of this Plan.
 - 29.4.3 The third component will be 40% of the total TAA and will expire at the end of the third water use year after the date of adoption of the Plan.
- 29.5 As TAA expires the allocations becomes unallocated water subject to principle 6.

5.3 Allocations for other licensed purposes

- 30. A water licence is required for intensive farming as defined by Chapter 1, 3 (1) of the Act, including but not limited to intensive stocking of pigs, cattle, sheep, poultry, goats, and aquaculture.
- 31. A water licence is required for a feedlot (Refer to section 10 of this Plan for the definition of a feedlot).
- 32. A water licence is required for reticulated public water supply, industrial purposes, (including but not limited to, vegetable packing sheds, processing plants and mining), recreational purposes (including but not limited to, public or school lawns, amenities and sporting facilities).
- 33. A drought alleviation water allocation granted prior to the adoption of this Plan will be converted to an irrigation licence at the date of adoption of this Plan.
- 34. For the purpose of principle 33, drought alleviation allocations which are in haE will be converted to volume, whereby each haE equals the net irrigation requirement of the reference crop (refer to NIR Skewes figures in Appendix A) for the management area where the licence is held.

5.4 Effects of water use on the productive capacity of the land

- 35. The taking and use of the allocation shall not cause degradation of the land on which the allocation is used, by way of increased soil salinity, soil erosion, perched water tables, or any other means.

5.5 Use of water

- 36. Water shall be used or applied using water efficient technologies and techniques appropriate for the particular circumstances and in accordance with industry best practice standards.
- 37. If, in the opinion of the Minister, a licensee is not meeting principle 36 then the Minister may require the licensee to:
 - 37.1 develop, to the satisfaction of the Minister, a program for the efficient use of water containing requirements specified by the Minister's Department from time to time in relation to principle 36; and
 - 37.2 comply with the requirements of that program to the satisfaction of the Minister.

5.6 Effects of water use on the underground water resource

This Plan includes principles designed to minimise detrimental effects of use of water on the underground water resource. The likelihood of any such water impacts being conveyed to other water resources will be minimised by these principles and will also protect the resource and water users within the Mallee PWA.

6. Transfer

Objectives

- a) Maintain an acceptable water level within the Murray Group limestone aquifer that enables reasonable access to water by all water users.
- b) Maintain and enhance development in the Mallee PWA by ensuring that transfers are sustainable and do not interfere with existing developments.
- c) Prevent unacceptable impacts on the underground water resource or the productive capacity of land from the taking and use of water.
- d) Maintain an acceptable water quality that enables the continued use of the resource for licensed and stock and domestic purposes.
- e) Allow for the continuation of extraction in the intensively irrigated and drawdown impacted areas.
- f) Allow for the transfer of allocations from areas determined to be hydrogeologically under stress, to areas which are not determined to be hydrogeologically under stress (refer Section 6.1.2 and Table 6).
- g) Minimise adverse impacts of groundwater extraction on Aboriginal cultural values, and in particular on the natural flow of groundwater in the area and other parts of connected First Peoples' Country
- h) Promote awareness of Aboriginal values associated with the lands and water.

6.1 Transfer principles

38. The transfers of allocations in the Mallee PWA are subject to principles 8 – 37 relating to allocations and the effects of water use.
39. Permanent and/or temporary transfers of allocations shall only be permitted within, and between, management areas as specified in Table 6 and subject to principles 40 to 45.
40. The transfer of allocations must not result in the AAV of any management area being exceeded (refer Table 5).
41. A transfer within the Designated Area is not permitted if the transfer of an allocation is to a well endorsed as a source on a licence located less than three kilometres from a well endorsed as a source on a licence, and/or less than two kilometres from a well endorsed as a source on a licence outside the Designated Area (refer Section 6.1.2 of this Plan for exceptions).
42. A transfer outside the Designated Area is not permitted if the transfer of an allocation is to a well endorsed as a source on a licence located less than two kilometres from a well endorsed as a source on a licence, located in the same aquifer, or and/or less than three kilometres from a well endorsed as a source on a licence, located within the same aquifer, within the Designated Area (refer Section 6.1.2 of this Plan for exceptions).
43. In the case of a temporary transfer, the allocation is to be accounted for in both the originating and receiving management areas for the duration of the temporary transfer.

Table 6: Matrix for transfers between and within management areas

FROM \ TO	Green	Parilla Red	Yellow	Out of Hundreds	11A Red	11A Green	10A Red	10A Parilla Red	10A Green	9A North Green
Green	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓
Parilla Red	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗
Yellow	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗
Out of Hundreds	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗
11A Red	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗
11A Green	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓
10A Red	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗
10A Parilla Red	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
10A Green	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓
9A North Green	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓

✓ Transfer permitted subject to relevant transfer and allocation principals

✗ Transfer not permitted

6.1.1 Exception clauses

44. Upon receipt of information provided by the licensee, the Minister will consider permanent and temporary transfers where the proposed extraction point is less than three kilometres from a well endorsed as a source on a licence within the Designated Area, or less than two kilometres from a well endorsed as a source on a licence within the yellow, green, Out of Hundreds or red management areas outside of the Designated Area, if the proposed location of the extraction point and proposed manner of taking water is such that the transfer of water will not have any potential to interfere with the quality and quantity of water supply from wells endorsed as a source on a licence.
45. Principles 41 and 42 do not apply to the transfer of water allocations where there is no change to the location of the point of taking, the volume of water allocated and the conditions on the licence.

7. Permits

The following objectives and principles apply to permits for activities relating to wells under section 127(3)(a) and (b) of the Act comprising the drilling, plugging, backfilling or sealing of a well, and the repairing, replacing or altering the casing, lining or screen of a well.

In accordance with the *Native Title Act, 1993*, applications for well construction permits on land where native title has not been extinguished will need to comply with any procedural requirements of the *Native Title Act, 1993* (Cth), including any obligations under any relevant Indigenous Land Use Agreements. Advice on these requirements can be sought from the Crown Solicitor's Office.

Landholders and/or well drillers should be made aware of their obligations under the *Aboriginal Heritage Act, 1988*, which provides for the protection and preservation of Aboriginal sites of significance within South Australia.

Objectives

- a) Minimise the effect of well location on water levels.
- b) Minimise the impact of drilling, sealing, backfilling or plugging of wells on the underground water resource.
- c) Minimise the impact of repair, replacement or alteration of the casing, lining or screen of wells on the water resource.
- d) Maintain the quality of water drawn from wells and protect the water supplies from future salinisation due to native vegetation clearance.
- e) Avoid the leakage of saline water between aquifers.
- f) Raise awareness of landholder obligations and promote the Aboriginal Heritage Act, 1988
- g) Support compliance with the Native Title Act, 1993 (Cth) and any Indigenous Land Use Agreements in place.

7.1 Well permit principles

7.1.1 Minimum distance between licensed wells

46. A well constructed for a licensed purpose of taking allocated underground water must be located a minimum of:
 - 46.1 two kilometres from any well endorsed as a source on a licence located in the same aquifer outside of the Designated Area; and
 - 46.2 three kilometres from any well endorsed as a source on a licence within the Designated Area, except where:
 - 46.2.1 the taking of water will not have any potential to significantly interfere with the quality and quantity of water from existing wells endorsed as a source on a licence operated by other licensees; and
 - 46.2.2 the taking of water will not have any potential to significantly increase the local drawdown.
47. All wells are to be drilled in accordance with the general specifications for water drilling as defined in Minimum Construction Requirements for Water Bores in Australia (2003) or its replacement.

7.1.2 Minimum depth of wells and casing

Murray Group limestone confined aquifer

48. All new wells (including for stock and domestic purposes) completed within the Murray Group limestone confined aquifer shall be drilled to a minimum depth of 40 metres below the top of the aquifer. The minimum depth of casing shall be five metres below the top of the Murray Group limestone confined aquifer.

Murray Group limestone unconfined aquifer

49. All new wells (including for stock and domestic purposes) completed within the Murray Group limestone unconfined aquifer shall be drilled to at least 25 metres below standing water level. The minimum depth of casing shall be 10 metres below the standing water level.
50. Exceptions will be given to the minimum well depth, or minimum depth of casing, only where the minimum casing or well depth has the potential to adversely affect yield. This explanation must be noted on the well construction report.

7.1.3 Impact of well works on water quality

Replacement wells

51. If a well for a licensed or un-licensed purpose requires replacement, then a replacement well may be drilled provided that:
- 51.1 the original well is backfilled in accordance with a permit issued pursuant to section 127(3)(a) of the Act
 - 51.2 the replacement well is subject to principles 48 to 50 and not subject to principle 46
 - 51.3 the replacement well only takes water from the same aquifer as the original well; and
 - 51.4 the replacement well is not drilled more than 100 metres from the original well.

7.1.4 Wells in the Renmark Group Confined aquifer

52. A well from which an allocation may be taken shall not be permitted to be drilled into the Renmark Group Confined aquifer, except where principle 3 applies.

8. Monitoring

Section 76(4)(d) of the Act requires that water allocation plans must assess the capacity of the resource to meet the demands for water on a continuing basis and provide for regular monitoring of the capacity of the resource to meet those demands.

First Peoples have expressed interest in being involved with the management and monitoring of underground water resources within the Mallee PWA. As part of any future review, the SAMDB NRM Board will directly consult with RMMAC in relation to Aboriginal objectives and desired outcomes for underground monitoring and management. It will also consider opportunities for the capacity and experience building of Aboriginal nations in water resource management.

8.1 Drawdown

53. The SAMDB NRM Board and the Minister's Department will use best endeavours to monitor the standing water level of observation wells that form part of the observation well network (as amended from time to time) least once:
 - 53.1 prior to the irrigation season
 - 53.2 at the conclusion of the irrigation season; and
 - 53.3 during the irrigation season.
54. An amended monitoring frequency may be required for resource condition indicator investigations in accordance with principles in Section 5.6 and Section 8.6 of this Plan.
55. The Minister's Department will use best endeavours to record data obtained from the monitoring network onto the South Australian SAGEodata Database.

8.2 Monitoring and reporting of water use

56. The volume of water extracted from the Mallee PWA for licensed purposes will be monitored and measured in accordance with the state metering policy (as amended from time to time).
57. The following information will be provided to the SAMDB NRM Board by licensees on or before 31 July each year as part of annual water use reporting:
 - 57.1 meter reading(s) at the beginning and end of each crop or stock keeping season
 - 57.2 the volume of water use as indicated by the water flow meter for the water use year
 - 57.3 water use efficiency and irrigation scheduling
 - 57.4 the area and type of each crop irrigated or number and type of stock watered
 - 57.5 total volume of water used (with or without an operational meter) by the licensee for each stock type for intensive farming
 - 57.6 irrigation rate for each crop type
 - 57.7 problems with water quality, water logging, perched water tables or dryland salinity
 - 57.8 the nature of any soil moisture monitoring devices used on the relevant land
 - 57.9 future plans for water use developments
 - 57.10 land and/or water leasing information; and
 - 57.11 other information as requested by the SAMDB NRM Board.

58. The SAMDB NRM Board will distribute annual water use reporting forms and completed forms are to be returned to the SAMDB NRM Board by 31 July of each water use year. The SAMDB NRM Board will use best endeavours to collate the information into a Mallee PWA annual report and will make the report available to the public.

8.3 Salinity

59. All licensees will be required to submit an annual water sample collected at the end of the water use year from each active licensed source and prior to the removal of pumping infrastructure for salinity testing to the SAMDB NRM Board on or before 31 July.
60. Prior to the collection of water samples pursuant to principle 59, the Minister's Department will provide licensees information on the timing and method of sample collection.
61. The Minister's Department, in consultation with the SAMDB NRM Board will use best endeavours to take additional water samples from wells in critical areas of the Mallee PWA where underground water salinities are higher and at risk from increasing salinity due to underground water reversal of flow caused by over extraction.
62. The Minister's Department and the SAMDB NRM Board will use best endeavours to ensure that the salinity of the underground water being used for licensed purposes is monitored.
63. The Minister's Department will use best endeavours to annually upload the results onto the South Australian SAGEodata Database, and provide the data to the SAMDB NRM Board. The SAMDB NRM Board will make this data available to licensee(s).

8.4 Increased salinity due to clearance

64. At least once every two years, the SAMDB NRM Board and the Minister's Department will use best endeavours to monitor selected observation wells in the Murray Group limestone unconfined aquifer for salinity to detect any increases in salinity levels caused by the downward movement of unsaturated zone salt that is mobilised by vegetation clearance.
65. The Minister's Department, in consultation with the SAMDB NRM Board, will use best endeavours to select and monitor the appropriate wells.
66. The Minister's Department will use best endeavours to record the monitoring results on the South Australian SAGEodata Database.

8.5 Resource condition indicators

Monitoring of underground water levels and salinities has been carried out across the Mallee PWA over the last 30 years to determine if the taking of water has a detrimental effect on the quantity and quality of the underground water resource. As an early warning of potential adverse trends in resource condition, resource condition indicator limits have been established, which trigger investigative actions as described in section 8.6 of this Plan.

8.5.1 Permanent drawdown – Designated Area

67. The resource condition indicators in the Designated Area are that the taking of underground water must ensure or have the potential to ensure that:
 - 67.1 in more than 50% of all monitoring bores, for at least two consecutive years, water levels recover to within 65 centimetres (cm) of the previous year in Border Sub-zone **9A North**
 - 67.2 in more than 50% of all monitoring bores, for at least two consecutive years, water levels recover to within 50 cm of the previous year in Border Zone **10A**

- 67.3 in more than 50% of all monitoring bores, for at least two consecutive years, water levels recover to within 65 cm of the previous year in **Border Zone 11A (Hundred McGorriery)**
- 67.4 in more than 50% of all monitoring bores, for at least two consecutive years, water levels recover to within 65 cm of the previous year in **Border Zone 11A (Hundred of Peebinga)**

8.5.2 Permanent drawdown – Outside the Designated Area

- 68. In the **red management area** outside the Designated Area, in more than 50% of all monitoring bores in this management area, for at least two consecutive years, the resource condition indicators must ensure or have the potential to ensure that water levels recover to within 25 cm of the previous year.
- 69. In all other management areas outside the Designated Area and in areas not impacted by water extractions for mining (as determined by monitoring of mine activity) as described in principle 70 of this Plan, the resource condition indicators must ensure or have the potential to ensure that in more than 50% of all monitoring bores (excluding monitoring bores used for the purpose of principles 67 and 70 of this Plan), for more than five consecutive years, water levels recover to within 15cm of the previous year.
- 70. Where mining occurs:
 - 70.1 monitoring shall be conducted as part of the requirements of the Mining Act 1971 or other subsequent legislation.
 - 70.2 the underground water level monitoring data shall be forwarded to Minister's Department to verify the results and evaluate the response of the underground water resource.
 - 70.3 pursuant to principle 70.2, if the response is significantly different to that expected, an investigation will be instigated into any adverse impacts and strategies developed to minimise these impacts.

8.5.3 Salinity – all areas

- 71. In the Murray Group limestone confined aquifer, an increase in salinity of 2% or more per year for five consecutive years above the baseline for more than 50% of the monitoring bores in the management area will trigger investigative action as described in Section 8.6 of this Plan.

8.6 Action on resource condition indicators

Exceeding resource condition indicator limits may not directly mean the sustainability of the resource is under immediate threat or that the resource condition indicator has been reached due to licensed water extraction. Resource conditions indicators may be exceeded as a result of localised, seasonal or other factors.

- 72. If a resource condition indicator is exceeded then the Minister's Department will use best endeavours to:
 - 72.1 Determine the cause of the resource condition indicator breach.
 - 72.2 Determine the impacts on the underground water resources and other underground water users in the community.
 - 72.2 Identify options to mitigate the breach of the resource condition indicator.
 - 72.4 Implement the appropriate cause of action to reduce further impact on the underground water resource.

9. Consistency with other plans or legislation

This Plan was developed having regard to:

- the *Natural Resources Management Act 2004*;
- the *River Murray Act 2003*;
- the Water Allocation Plan for the Mallee Prescribed Wells Area, December 2000;
- the Water Allocation Plan for the Tintinara Coonalpyn Prescribed Wells Area, December 2003;
- the *Groundwater (Border Agreement) Act 1985*;
- an Intergovernmental Agreement on a National Water Initiative;
- Water Act 2007 (Cwth)
- Murray Darling Basin Plan 2012
- the *Environment Protection Act 1993* and related policies;
- Relevant development plans under the *Development Act 1993*, including the;
- Southern Mallee District Council Development Plan;
- District Council of Karoonda East Murray Development Plan;
- District Council of Loxton Waikerie Development Plan;
- River Murray and Crown Lands Indigenous Land Use Agreement 2012
- Murray Mallee Local Action Plan;
- Management plans for the conservation parks in or bordering on the Mallee Prescribed Wells Area;
- River Murray and Mallee Aboriginal Corporation Strategic Plan, 2013
- the State NRM Plan 2006;
- the *Aboriginal Heritage Act, 1988*;
- the *Development Act 1993*;
- the *Native Vegetation Act 1991*;
- South Australian Murray-Darling Basin Natural Resources Management Board, Strategic Framework, 2007;
- South Australian Murray-Darling Basin Natural Resources Management Board, Regional NRM Plan, 2009
- South Australia's Strategic Plan 2007
- the *Mining Act 1971*; and
- the *Petroleum and Geothermal Energy Act 2000*.

10. Definitions and abbreviations

Definitions:

Any terms used in this Plan that are defined in the *Natural Resources Management Act 2004* have the definitions set out in that Act. In addition for the purposes of this Plan the following terms have the definitions set out below:

Aboriginal Cultural Heritage: means definitions provided in the *Aboriginal Heritage Act, 1988* relating to Aboriginal objects, Aboriginal remains and Aboriginal sites.

Aboriginal object: means an object—

(a) of significance according to Aboriginal tradition; or

(b) of significance to Aboriginal archaeology, anthropology or history,

and includes an object or an object of a class declared by regulation to be an Aboriginal object but does not include an object or an object of a class excluded by regulation from the ambit of this definition

Aboriginal remains: means the whole or part of the skeletal remains of an Aboriginal person but does not include remains that have been buried in accordance with the law of the state.

Aboriginal site: means an area of land—

(a) that is of significance according to Aboriginal tradition; or

(b) that is of significance to Aboriginal archaeology, anthropology or history,

and includes an area or an area of a class declared by regulation to be an Aboriginal site but does not include an area or an area of a class excluded by regulation from the ambit of this definition.

Adoption date or date of adoption: Means the date that the Minister adopts this Plan.

Allocation: Means the annual volume or associated volume (if area-based irrigation licence) able to be taken and used within a particular management area for a particular licensed purpose.

Annual allowable volume (AAV): means the annual volume allowed to be extracted for all licensed purposes, for a specified management area.

Annual water use report: A report produced by a licensee and submitted to the SAMDB NRM Board, by 31 July each year, in accordance with Section 8 (*Monitoring*) of this Plan.

Aquaculture means farming of aquatic organisms for the purposes of trade or business or research, but excluding aquaculture activities that are a hobby or educational aquaculture farms and aquaculture activities consuming less than 1000 KL per year.

Aquifer: Means a geological structure or formation or an artificial land fill permeated or capable of being permeated permanently or intermittently with water.

Area-based licence: For the purposes of this Plan, a water licence assigned to an individual or company to extract water from the Mallee PWA up to a specified maximum amount of water, determined by the irrigation equivalent required to irrigate an area of a reference crop (measured from evapotranspiration over a standard grass surface). Sometimes referred to as 'hectare irrigation equivalent' or 'haE'.

Assessment Period: The period between 1 July 2004 and 30 June 2009, for which the period development of an area-based irrigation allocation will be identified. This is used for the basis of conversion area-based allocations to volumetric allocations.

Base Allocation component: Is one component that is used to calculate the volumetric conversion of a developed area-based irrigation allocation. The base allocation is the number of development haEs (hectare irrigation equivalents) multiplied by the net irrigation requirements, relevant to the maximum area and crop types grown, relative to the assessment period.

Border Groundwaters Agreement: The agreement entered into by the Governments of South Australia and Victoria in 1985 (and updated in 2005) to cooperatively manage water resources in the Designated Area (see 'Designated Area'). The Border Groundwaters Agreement was established under the *Groundwater (Border Agreement) Act 1985*. Water allocation plans prepared under the Act must be consistent with the terms of the *Groundwater (Border Agreement) Act 1985*.

Bore: See "well"

Cone of drawdown: An inverted cone-shaped space within an aquifer caused by a rate of underground water extraction that exceeds the rate of recharge.

Confined aquifer: Aquifer in which the upper surface is impervious (see 'confining layer') and the water is held at greater than atmospheric pressure so that water in a penetrating well will rise above the surface of the aquifer.

Confining layer: A rock unit impervious to water, which forms the upper bound of a confined aquifer; a body of impermeable material adjacent to an aquifer; see also 'Confined aquifer'.

Conversion Volume: Is a resulting volume after applying a conversion method to a *developed* area-based irrigation allocation in order to convert the area to a volume. Information required to determine the Conversion Volume includes the number of developed haEs, crop type grown, and an allowance for a volume for a delivery component.

Crop Area Ratio or CAR component: CAR is a ratio between the volume of water required for the reference crop compared to the volume required for a particular crop type grown.

Cultural Flows: Described in paragraphs 30-31 of schedule 1 of the Murray-Darling Basin Plan. Indigenous uses includes use for cultural, social, environmental, spiritual and economic purposes. Many indigenous people view water spiritually – people, land and rivers are inextricably connected. Indigenous economic interests include trading, hunting, gathering food and other items for use that alleviate the need to purchase similar items and the use of water to support businesses in industries such as pastoralism and horticulture. The environmental and cultural health of the Murray-Darling Basin is of paramount importance in serving these interests.

The concept of cultural flows helps translate the complex relationship described above into the language of water planning and management. The following definition of cultural flows is currently used by the Northern Murray-Darling Basin Aboriginal nations and the Murray Lower Darling Rivers Indigenous nations: — Water entitlements that are legally and beneficially owned by the Indigenous nations and are of sufficient and adequate quantity to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous nations. This is our inherent right. — The provision of cultural flows will benefit Indigenous people in improving health, wellbeing and provides empowerment to be able to care for their country and undertake cultural activities.

Delivery component: Is a volume component that is used to calculate the Conversion Volume of a developed area-based irrigation allocation. It provides a volume for some of the unavoidable water volume losses that occur when applying water to a crop, such as losses through irrigation systems, differential site characteristics and variable climatic conditions.

Designated Area: As defined by the *Groundwater (Border Agreement) Act 1985*, means 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 Agreement).

Development or developed haE(s): Development refers to an area-based irrigation (haE) allocation that has been activated during the Assessment Period or after the Assessment Period but prior to the adoption of the Plan (2 May 2012) by applying water through an irrigation system to grow a horticultural or agricultural crop in the Mallee PWA.

Domestic purpose: The taking of water for ordinary household purposes; includes the watering of land in conjunction with a dwelling not exceeding 0.4 hectares.

Drawdown: The occasional, seasonal or permanent lowering of the water table or reduction in pressure (head) of an aquifer resulting from the extraction of underground water.

Drought alleviation water allocation: A historical allocation that was issued when a temporary feed shortage occurred in the prescribed area, which authorised the taking of water for the purpose of growing fodder to feed stock during a drought period.

DSE: Dry Sheep Equivalent (DSE) is a unit to compare the feed requirements of different classes of stock or to assess the carrying capacity and potential productivity of a given farm or area of grazing land, taking into account district practices and climatic conditions.

Efficient use: Refers to the use of water in accordance with best practice for the particular industry that the water is being used for.

Environmental provision: Underground water in excess of the PAV that remains in the aquifer to preserve and support the environmental values and health of underground water dependent ecosystems.

Feedlot: A feedlot is specifically defined for the Mallee PWA in this Plan as;

A confined yard or area where animals are kept and either hand and/or mechanically fed for greater than eight months of the year and when stock numbers exceed the DSE (dry sheep equivalent or carrying capacity) of the property

Whereby:

"Eight months" of the year is defined as either continuous eight months, or collective parts over the water use year totalling eight months.

The *'property'* is land/area owned/leased by the same person within the Mallee PWA and is greater than 40 hectares.

The *'DSE'* will be assessed by industry standards and district average records from the relevant government agency.

First Peoples of the Murray and Mallee: Descendants of the Ngaiawang, Ngawait, Nganguruku, Erawirung, Ngintait, Ngaralte, and Ngarkat peoples, and determined native title holders pursuant to the determination made by the Federal Court of Australia (Turner v State of South Australia [2011] FCA 1312 (18 November 2011)) – referred to fully as the First Peoples of the Murray and Mallee.

Green management area: An area in the Mallee PWA consisting of the whole of Hundreds of Kekwick, Allen, Mindarie, Chesson, McPherson, Auld, Billiatt, Kingsford, Bews, Cotton, Molineux, Price, Allenby, Day, Quirke & Fisk and parts of the Hundreds of McGorrery, Peebinga, Pinnaroo, & Parilla (refer Section 4).

Hectare irrigation equivalent (hale): The quantity of irrigation water (in addition to rainfall) required to equal the water use from one hectare of a reference crop (measured from evapotranspiration over a standard grass surface) grown in the region.

Industry: The carrying on, in the course of a trade or business, of any purposes for, or incidental to:

the making of any article (or part thereof); or

the altering, repairing, ornamenting, finishing, assembling, cleaning, washing, packing, bottling, canning or adapting for sale, or the breaking up or demolition of any article; or

the obtaining, dressing or treatment of materials.

Intensive farming: As defined by the *Natural Resources Management Act 2004*, means a method of keeping animals in the course of carrying on the business of primary production in which the animals are usually confined to a small space or area and usually fed by hand or by a mechanical means.

Irrigation: Watering land by any means for the purpose of growing plants.

Irrigation season: The period in which major irrigation diversions occur, usually starting in August–September and ending in April–May.

Irrigation system: Means the specific type of irrigation equipment used to irrigate crops, which may include irrigation (above-ground or sub-surface) or spray irrigation (centre pivots, mobile, lateral move, overhead, under tree, fixed, portable travellers, wheel line, mobile gun/spray).

Licence: see also 'water licence'.

Licensed well(s): **Well(s) endorsed as a source on a licence**

Licensee: A person or company who holds a water licence.

Management area: Is an area that encompasses areas of like drawdown levels and/or intensity of use. These areas are defined by colour-codes of red (areas of high drawdown), green (areas of low drawdown) yellow & the Out of Hundreds areas (newly prescribed areas). Refer to GR map 49/2010 of Figure 8 in this plan.

Metered water use: Is water volume measured through a water flow meter.

Murray-Darling Basin Plan: the Basin Plan adopted under subparagraph 44(3)(b)(i) of the Commonwealth *Water Act 2007*.

Out of Hundreds management area: An area in the Mallee PWA consisting of a group of Hundreds termed the 'Out of Hundreds management area' where specific transfer rules apply (refer section 6).

Permissible annual volume: As defined by the *Groundwater (Border Agreement) Act 1985* means the permissible annual of extraction specified for each zone in the Second Schedule, or in relation to a particular zone, such other volume as has been determined by the committee under clause 28(2).

Potentiometric surface: The level to which water rises in a well due to water pressure in the aquifer, measured in metres may also be referred to as the "potentiometric level" or the "potentiometric head".

Recharge: The infiltration of water into an aquifer from the surface (rainfall, streamflow, irrigation etc).

Recreational use: The use of water for the irrigation of parks, gardens and sports grounds of greater than 0.4 hectares in area, whether publicly or privately owned.

Red management area: An area of high drawdown in the Mallee PWA consisting of parts of the Hundreds of McGorrrery, Peebinga, Pinnaroo & Parilla where specific transfer rules apply (refer section 6).

Standing water level (SWL): The depth to the level of underground water, usually measured from the top of the casing of a well or from the natural surface.

Stock water use: The taking of water to provide drinking water for stock other than stock subject to intensive farming (as defined by the Act) or the feedlot definition of this Plan.

Stygofauna: Aquifer fauna or the term encompassing all organisms inhabiting underground water.

Temporary auxiliary allocations: means water that the Minister may provide for a short period of time to licensees who require additional water during the production of the crop for purposes other than meeting evapotranspiration demand. These "auxiliary requirements" may include irrigation for frost control; irrigation to control sand drift in the early growth stages (Skewes 2004).

Transfer: A transfer of a licence (including its water allocation) to another person, or the whole or part of the water allocation of a licence to another licensee or the Minister under Part 3, Division 2, s. 157 of the Act. The transfer may be absolute or for a limited period.

Unconfined aquifer: Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure.

Underground water dependent ecosystem: An ecosystem that relies either wholly or partially on underground water to sustain it continuously, seasonally or episodically.

Underground water: As defined by the *Natural Resources Management Act 2004*, water occurring naturally below ground level, water pumped, diverted or released into a well for storage underground.

Undeveloped halE(s): An area-based allocation that has not been activated to irrigate a crop through an irrigation system since the granting of the licence and allocation by the Minister.

Volumetric conversion: Is the process of converting an existing area-based irrigation licence to a volumetric allocation on an irrigation licence, and any subsequent reductions that may need to occur to ensure the sum of all allocations are within the PAV of the management area in question. irrigation Refer also to 'Conversion Volume'.

Water affecting activities: Activities referred to in Section 127 (3) and 127 (5) of the Act.

Water allocation: (1) In respect of a water licence, means the water taking allocation endorsed on the licence. (2) In respect of water taken pursuant to an authorisation under section 128 of the Act, means the maximum quantity of water that can be taken and used pursuant to the authorisation.

Water allocation plan: A plan prepared by a NRM board and adopted by the Minister in accordance with the Act.

Water licence: As defined by the *Natural Resources Management Act 2004*, means a licence granted by the Minister under section 146 (of the NRM).

Water table: The upper surface of saturation in the unconfined aquifer.

Water use year: means a period of 12 months commencing on the 1 July in any year and ending 30 June of the following year.

Well: As defined by the *Natural Resources Management Act 2004* means (1) An opening in the ground excavated for the purpose of obtaining access to underground water. (2) An opening in the ground excavated for some other purpose but gives access to underground water. (3) A natural opening in the ground that gives access to underground water. May also be described as a 'bore'

Yellow management area: An area in the Mallee PWA consisting of the whole of Hundreds of Bandon, Vincent, Wilson, Hooper, Marmon Jabuk where specific transfer rules apply (refer section 6).

Abbreviations:

For the purposes of the Water Allocation Plan for the Mallee Prescribed Wells Area, the following abbreviations shall have the meanings set out below:

“**AAV**” allowable annual volume

“**AHD**” Australian Height Datum, or approximate mean sea level, measured in metres (m).

“**CAR**” Crop Area Ratio.

“**GR Plan**” General Registry Plan, being a plan or map registered and held at the Lands Title Office.

“**IR**” irrigation requirement (as determined by Desmier, 1991)

“**Mallee PWA**” the Mallee Prescribed Wells Area.

“**NIR**” net irrigation requirements (as determined by Skewes, 2004).

“**PAV**” permissible annual volume.

“**PWA**” prescribed wells area.

“**RM CWMB**” River Murray Catchment Water Management Board

“**RMMAC**” River Murray and Mallee Aboriginal Corporation ICN 7494

“**TDS**” total dissolved solids, a measure of water salinity, measured in milligrams per litre (mg/L).

“**the Act**”: the Natural Resources Management Act 2004.

“**the Minister**” the Minister responsible for the administration of the Act.

“**the/this Plan**” the Water Allocation Plan for the Mallee Prescribed Wells Area.

“**the SAMDB NRM Board**” The South Australian Murray-Darling Basin Natural Resources Management Board.

Measurements:

Ha	hectare(s)
haE	hectare irrigation equivalents
km	kilometre(s)
km ²	square kilometre(s)
m	metre(s)
m ²	square metre(s)
mg/L	milligram(s) per litre
kL	kilolitre(s)
ML	megalitre(s)
ML/year	megalitres per year
L/s	litres per second

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APPENDIX A

Irrigation Requirements for crops grown in the Mallee Prescribed Wells Area

Crop Type	^Northern Area (Average)					^^Southern Area (Average)				
	*IR Desmier	+CAR Desmier	**NIR Skewes	+CAR Skewes	% change in +CAR	*IR Desmier	+CAR Desmier	**NIR Skewes	+CAR Skewes	% change in +CAR
Reference crop	1052	1	1180	1	n/a	868	1	1020	1	0%
Broombush	300	3.51	619	1.91	-84%	150	5.79	495	2.06	-181%
Carrots (Autumn sown)	138	7.62	371	3.18	-140%	76	11.42	312	3.27	-249%
Carrots (Spring sown)			636	1.86	n/a			557	1.83	n/a
Cereal hay	161	6.53	183	6.45	-1%	103	8.43	125	8.16	-3%
Garlic (early)	409	2.57	476	2.48	-4%	286	3.03	442	2.31	-32%
Garlic (late)	377	2.79	359	3.29	15%	283	3.07	228	4.47	31%
Geralton wax	300	3.51	989	1.19	-194%	150	5.79	843	1.21	-378%
Lucerne hay pasture	916	1.15	1111	1.06	-8%	742	1.17	943	1.08	-8%
Lucerne start & finish	297	3.54	347	3.4	-4%	195	4.45	232	4.4	-1%
Medic, vetch seed	433	2.43	519	2.27	-7%	307	2.83	392	2.6	-9%
Olive fresh	916	1.15	743	1.59	28%	742	1.17	604	1.69	31%
Olive – oil	916	1.15	661	1.79	36%	742	1.17	536	1.9	39%
Onions	644	1.63	763	1.55	-6%	526	1.65	642	1.59	-4%
Pistachios	662	1.59	786	1.5	-6%	536	1.62	713	1.43	-13%
Potatoes (Summer harvest)	561	1.88	704	1.68	-12%	472	1.84	611	1.67	-10%
Potatoes (Winter harvest)	331	3.18	507	2.33	-37%	281	3.09	445	2.29	-35%
Recreation areas	1052	1	1111	1.06	6%	868	1	954	1.07	6%
Safflower	337	3.12	379	3.11	0%	272	3.19	293	3.48	8%
Summer fodder	573	1.84	725	1.63	-13%	488	1.78	641	1.59	-12%
Sunflower	337	3.12	388	3.04	-3%	272	3.19	302	3.38	6%
Vines	380	2.77	422	2.8	1%	299	2.9	347	2.94	1%
Pomegranates			842	1.40	n/a			703	1.45	n/a

Note: These figures are required for input into the excel calculator when determining water requirements per haE for crops. *IR is irrigation requirement calculated by Desmier 1991, +CAR is Crop Area Ratio **NIR is net irrigation requirement calculated by Skewes 2004. IR and NIR are in measurements of millimeters per hectare per crop. % change in CAR is the percentage change between CAR Desmier and CAR Skewes. ^Northern Areas include the Hundreds of Chesson, Mindarie, Allen, Kekwick, McGorrey, McPherson, Auld, Billiatt, Kingsford, Peebinga. ^^Southern Areas include the Hundreds of Molineux, Cotton, Bews, Parilla, Pinnaroo, Quirke, Fisk, Day Allenby, Price For crops that have been established in the Mallee PWA, after the development of this table, the NIR figures will be calculated using the best available crop water use data, crop calendars for the Mallee PWA and extrapolated climatic data from within the Mallee PWA.



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