



**West Wimmera  
Groundwater Management Area  
Local Management Plan**

**2019**



## ENDORSEMENT

This groundwater Local Management Plan (LMP) explains how GWMWater manages groundwater in the West Wimmera Groundwater Management Area (GMA). It draws together the local management rules from the West Wimmera Groundwater Management Strategy 2011 with adaptations and amendments based on recommendations from a technical review of the groundwater resource in 2018.

The 2011 West Wimmera Groundwater Management Strategy was the culmination of work by an advisory committee of regional stakeholders in consultation with the community. The Strategy emphasised the desire of the community that groundwater in the West Wimmera GMA be managed through an evidence based adaptive approach. It was intended that management regimes be implemented and subsequently refined by monitoring the effects on the resource, and in doing so addressing social, economic and environmental considerations. This LMP is the means for this adaptive management to be documented.

GWMWater will continue to work with our customers, local communities and other stakeholders to ensure that the LMP is reviewed and updated when necessary to ensure it remains consistent with the groundwater management policy framework, and as our understanding of the groundwater resources of the West Wimmera GMA continues to improve.

Signed

A handwritten signature in black ink, appearing to read "P. Vogel".

**Peter Vogel**  
Chairman

A handwritten signature in black ink, appearing to read "M. Williams".

**Mark Williams**  
Managing Director



## West Wimmera Groundwater Management Area Local Management Plan

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## Acknowledgement

GWMWater would like to recognise the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia, and Jupagulk people (past and present) as the Traditional Owners of the lands within the West Wimmera Groundwater Management Area, and acknowledge their deep connection to the land and water.

GWMWater would also like to acknowledge the valuable input and advice from the West Wimmera Groundwater Management Area Implementation Committee since its inception.

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### 1. Glossary

<b>Term/Acronym</b>	<b>Description</b>
Act	Victorian <i>Water Act 1989</i>
Aquifer	A saturated geological material that when drilled into can yield useable quantity of water (groundwater).
Available drawdown	The difference between the standing water level and the pump intake (ie. The amount of water above a pump prior to pumping).
Border Groundwaters Agreement	An agreement entered into by the Governments of South Australia and Victoria to manage the shared groundwater resource within the Border Designated Area, a 40 kilometre wide strip centred on the border, extending its full length and divided into 22 zones (11 in each state).
DELWP	Department of Environment, Land, Water and Planning
Entitlement	A right to take/use/extract water that may be limited by conditions (A take and use licence is an entitlement). Entitlement volume is the licence volume.
GMA	Groundwater Management Area
GWMWater	Grampians Wimmera Mallee Water Corporation (trading as GWMWater)
Licence volume	The volume in megalitres that may be taken under a take and use licence issued under section 51 of the <i>Water Act 1989</i> .
Observation bore	A bore drilled in a selected location for the purpose of observing parameters such as water levels, pressure changes and water quality.
PCV	Permissible Consumptive Volume. The volume of groundwater that the Minister for Water has declared may be extracted from a defined area in a season
Permanent Trade	The permanent trade of a Take and Use licence.
Potentiometric surface	A surface that represents the standing head. In an aquifer system, it represents the levels to which water will rise in cased bores. The water table is the potentiometric surface of an unconfined aquifer.
Recharge	The process of replenishment of an aquifer due to infiltration from rainfall for from surface water. Recharge may also occur by leakage from overlying or underlying aquifer systems.
Season	Period of 12 calendar months beginning on 1 July in any year and ending on 30 June in the following year.
Seasonal drawdown	The difference in groundwater level between pumping and non-pumping conditions during an irrigation season.
Standing water level	The level of water in a bore that is not being affected by withdrawal of groundwater.
Take and Use Licence	Licence issued to take and use groundwater under section 51 of the <i>Water Act 1989</i> .
Trade	The transfer of a groundwater licence. Trade may be permanent or temporary.
Zone	A defined part of the groundwater management area

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### 2. Introduction

The groundwater resource in the West Wimmera area of Victoria is the lifeblood of many communities, individuals, businesses and agricultural enterprises. Grampians Wimmera Mallee Water Corporation (GWMWater) is responsible for administering and enforcing the groundwater management arrangements for the area.

GWMWater has established a set of local management rules for managing groundwater in the West Wimmera Groundwater Management Area (GMA). The rules are documented in full within the West Wimmera Groundwater Management Strategy (the Strategy) which was developed by a GWMWater Board appointed Advisory Committee of landholders, technical experts and government representatives. Following an extensive public consultation process the Strategy was finalised and approved by the GWMWater Board in June 2011.

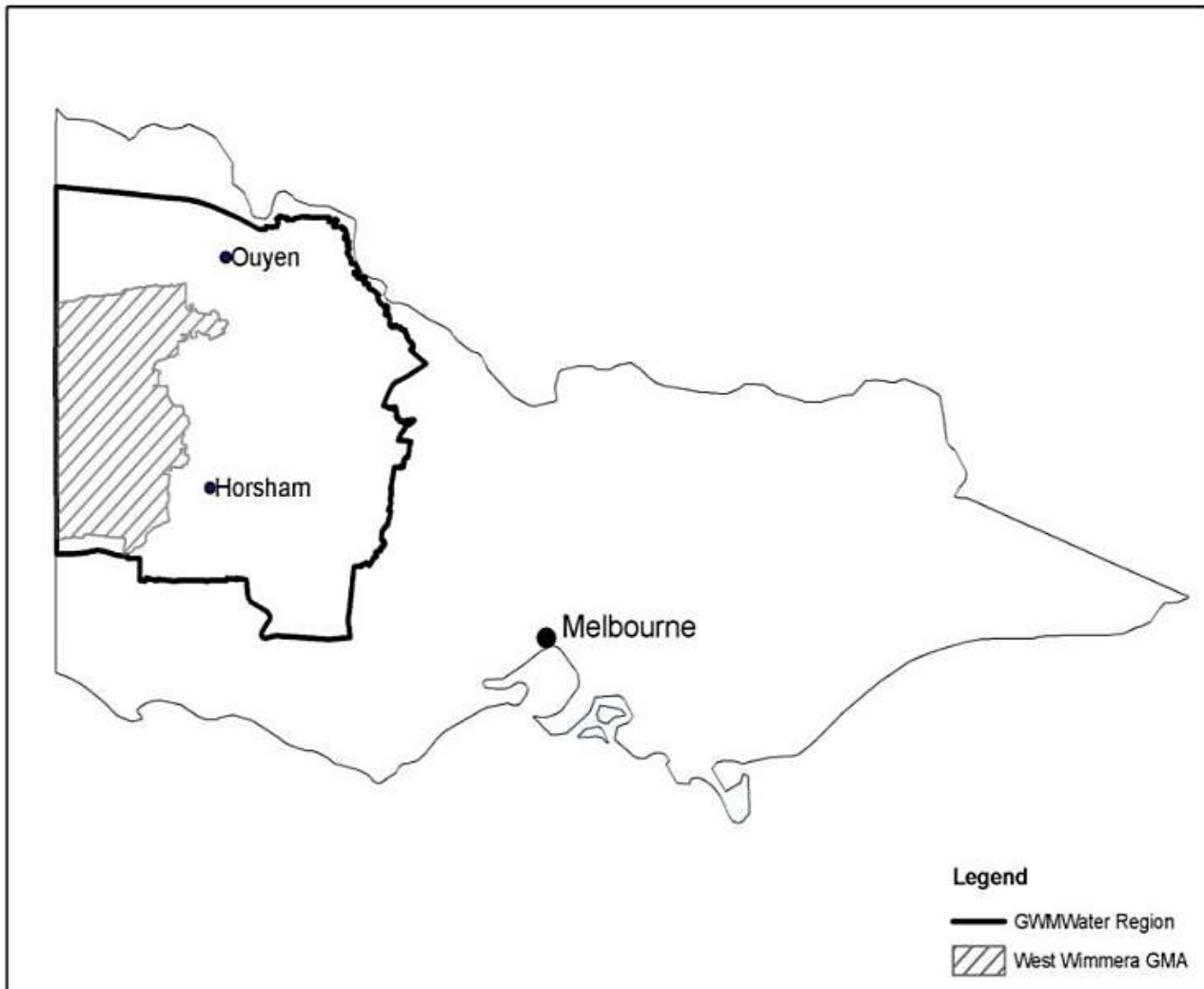
In 2018, a technical review of the West Wimmera groundwater resource was commissioned by GWMWater, and undertaken by consultant GHD. This review was a requirement of the West Wimmera Groundwater Management Strategy and assessed both resource condition and the effectiveness of the local management rules in delivering on the objectives of the Strategy. A summary of the outcomes of this technical review are included in Appendix 1.

This West Wimmera GMA Local Management Plan (LMP) draws together the local management rules from the West Wimmera Groundwater Management Strategy 2011 with adaptations and amendments based on recommendations of the technical review. The LMP describes how GWMWater manages the taking of groundwater using its powers delegated under the *Water Act 1989* and in accordance with the Policies for Take and Use Licences.

The groundwater described in the West Wimmera GMA Local Management Plan encompasses all aquifers; the primary aquifer for use is the Tertiary Limestone Aquifer. Groundwater is used for irrigation, commercial, domestic and stock, and urban purposes.

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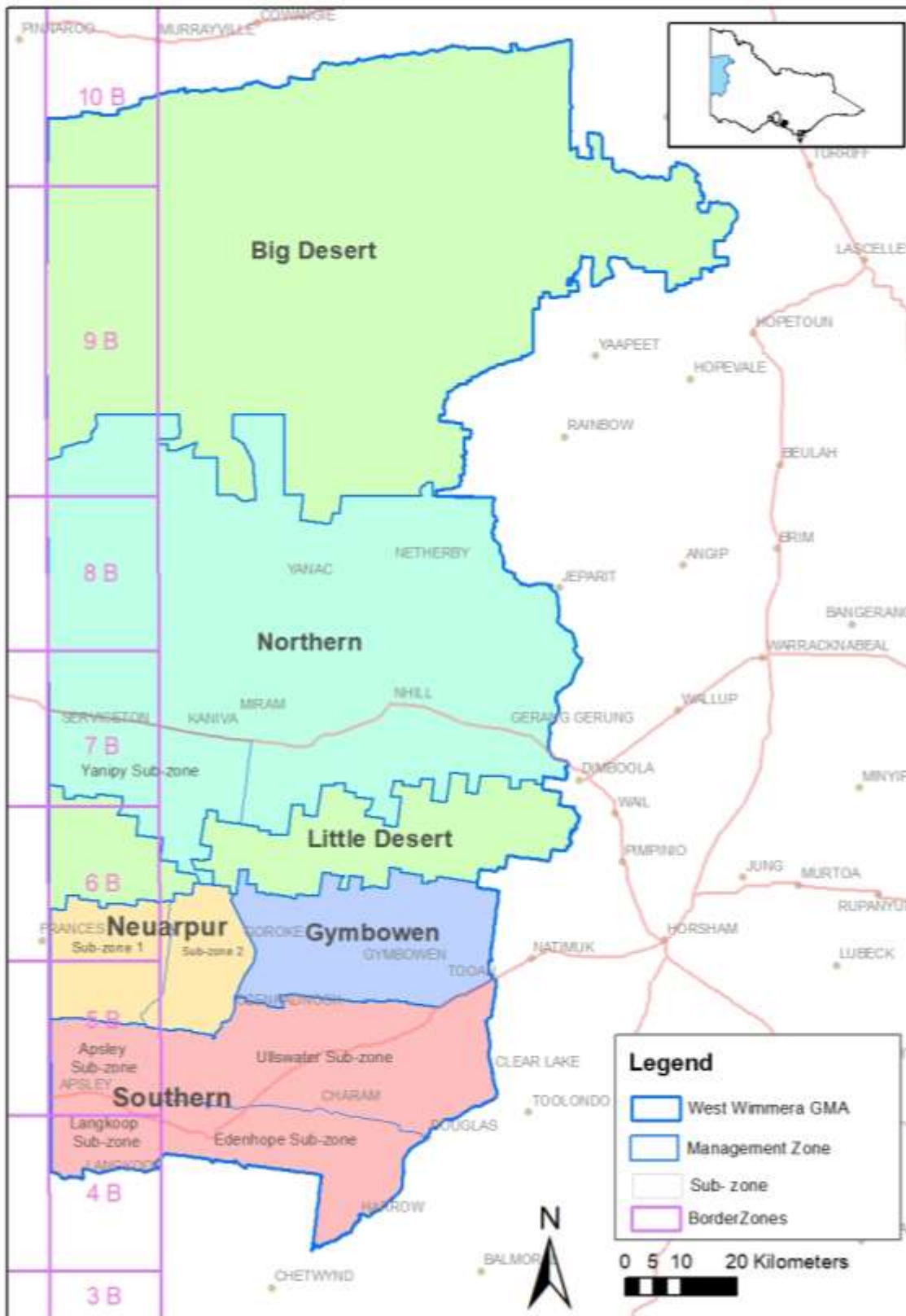
Figure 1: West Wimmera GMA location within GWMWater's area of operation.



## West Wimmera Groundwater Management Area Local Management Plan

Figure 2: Management zones of the West Wimmera GMA

### West Wimmera Groundwater Management Area (GMA)



### **3. Management objectives**

The objective of groundwater management in the West Wimmera GMA is to ensure the groundwater resource of the area is managed in an equitable manner to achieve the long-term sustainability of the resource and maintain the social, environmental and economic benefits that groundwater provides to the region.

The Strategy defines long-term sustainability of groundwater as the achievement of a stable trend in groundwater level that does not degrade consumptive or ecological uses of the resource, or the resource itself.

To achieve this objective, the Strategy incorporates a number of aims which strive to:

- Improve the understanding of the resource through monitoring, investigations, reporting and review.
- Manage the use of the resource. This includes:
  - Managing potential threats to the health and condition of the groundwater resource and preserve the environmental values of associated water resources and groundwater dependent ecosystems;
  - Ensure the resource is maintained for domestic, stock and urban water supply purposes;
  - Encourage development of best-practice irrigation and water use, provided it is within the bounds of sustainable extractions;
  - Develop arrangements to help licensees adjust to reduced groundwater availability; and
  - To address declining groundwater levels where these are evident.

There are six management zones within the West Wimmera GMA, each being of common hydrogeology, with specific management objectives to either maintain stable or to stabilise groundwater level trends. These objectives are tabulated in Table 1, and have been revised to incorporate the recommendations from the 2018 technical review.

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Table 1: West Wimmera GMA Management Zones – Summary of Management Zones and Objectives

Zone/Sub-zone	Historical Groundwater Level Trend	Establishment Basis	Current Resource Threat Notes (GHD, 2018)	Management Objective and Related Actions
<b>Big Desert</b>	Stable	Area covers the Big Desert National Park (land not available for commercial or agricultural development)	Sandy soil region; relatively high risk of groundwater salinisation with land clearing.	Maintain current stable groundwater levels <ul style="list-style-type: none"> <li>• Small volume available: limited groundwater diversions for National Park amenities /use.</li> </ul>
<b>Northern</b>	Generally Stable	Consistent hydrogeology and stable groundwater levels		Maintain stable trends across the zone, allowing: <ul style="list-style-type: none"> <li>• New entitlements within the area subject to an acceptable level of intensity of entitlements.</li> </ul>
<b>Northern (Yanipy)</b>	Generally Stable	Sub-zone where the increased use of entitlements may lead to declining groundwater levels	Higher use intensity than remainder of Northern zone	Maintain stable trends <ul style="list-style-type: none"> <li>• Allow trade out of, but not into the Yanipy sub-zone, where there is existing high intensity of use.</li> </ul>
<b>Little Desert</b>	Stable	Area covers the Little Desert National Park (land is not available for commercial or agricultural development)		Maintain current stable groundwater levels <ul style="list-style-type: none"> <li>• Small volume available: limited groundwater diversions for National Park amenities /use.</li> </ul>
<b>Neuarpur Sub-zone 1</b>	Declining	Area of intense groundwater use and historically declining groundwater levels in sub-zone 1	Intensive extraction. Reduced rainfall recharge Impact from cross border groundwater extraction	Achieve stabilised groundwater levels over a period of about 20 years with signs of stabilisation within 10 years (from 2011). <ul style="list-style-type: none"> <li>• No additional entitlements</li> <li>• Temporary trade permitted into sub-zone 2</li> <li>• No trade permitted into sub-zone 1</li> <li>• Annual restriction of 80% applied to all licences</li> </ul>

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Zone/Sub-zone	Historical Groundwater Level Trend	Establishment Basis	Current Resource Threat Notes (GHD, 2018)	Management Objective and Related Actions
<b>Neuarpur Sub-zone 2</b>	Stable	Delineated in the original Neuarpur Water Supply Protection Area. Aquifer yield is greater than adjacent zones (Gymbowen, Apsley and Ullswater)	Impact from sub-zone 1 groundwater extraction on western boundary	Maintain stable levels No additional entitlement available Temporary trade from Neuarpur sub-zone 1 to Neuarpur Sub-zone 2 permitted.
<b>Gymbowen</b>	Stable	Relative low use and aquifer yield is lower than adjacent Neuarpur Zone		Maintain stable levels. Unallocated water available for purchase, new developments subject to maximum allowable intensity of use
<b>Southern (Apsley)</b>	Declining	Declining to slightly declining trends and aquifer yield is lower than adjacent Neuarpur Zone	Intensive extraction Reduced rainfall recharge Impact from cross border groundwater extraction and adjacent Neuarpur zones	Stabilise trends where decline is present. <ul style="list-style-type: none"> <li>• Monitor the resource to improve understanding of climate related links to groundwater levels in this area.</li> <li>• Establish a restriction trigger with the objective of stabilising water level; Zone fully allocated</li> </ul>
<b>Southern (Langkoop)</b>		As above	As above and forestry	As above; stabilise or maintain groundwater level; Zone fully allocated
<b>Southern (Ullswater)</b>	Near stable trends	As above	As above	As above, stabilise or maintain groundwater level, limited development permitted. Unallocated water available to purchase in parcels up to 50 ML
<b>Southern (Edenhope)</b>	Declining levels in southern fringe	As above	As above	As above, stabilise or maintain groundwater level, limited development permitted. Unallocated water available to purchase in parcels up to 20 ML

## 4. Groundwater system

The West Wimmera GMA is underlain by a thick sequence (around 150-200m) of Cainozoic marine and non-marine sediments deposited during a series of sea level events.

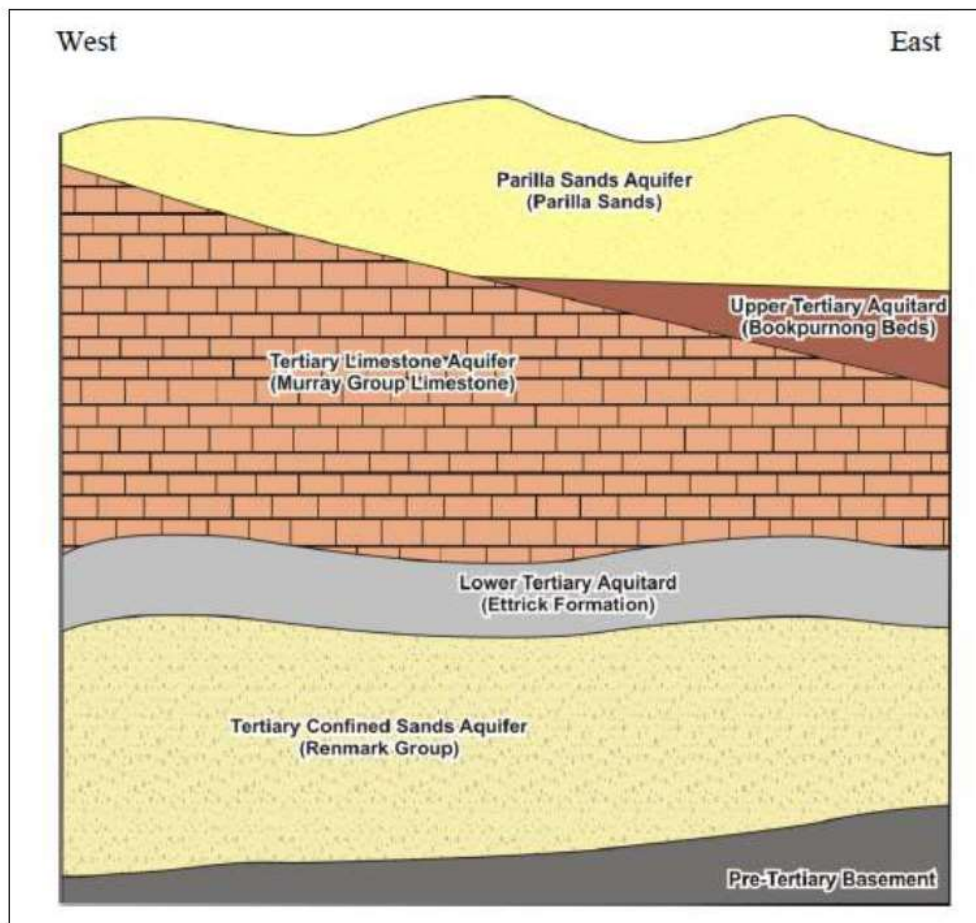
There are three main aquifer systems (from shallowest to deepest):

- Pliocene (Parilla) Sands Aquifer (PSA)
- Tertiary Limestone Aquifer (TLA)
- Tertiary Confined Sands Aquifer (TSCA)

The Tertiary Limestone Aquifer is the primary source for groundwater extraction due to the relatively high bore yields and the low salinity groundwater located at shallow depths. These main aquifer systems are generally separated by regionally extensive clay aquitards, which limit the degree of groundwater connectivity between the main aquifer systems.

The main hydrogeological units are shown in Figure 3 and are summarised in Table 2. The aquifer characteristics are further summarised in Section 4.1. The spatial extent of the major geological controls on aquifer hydrogeology are illustrated in Figure 4.

*Figure 3: Conceptualisation of West Wimmera hydrogeological units*



— Note: Source SKM (2009)

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Table 2: Generalised Regional Hydrostratigraphy (Source: GHD, 2018)

Hydrostratigraphic Unit	Geological Formation	Unit No*	Lithology	General Aquifer type/condition	Approximate Aquifer Transmissivity (m <sup>2</sup> /day)	Aquifer Salinity Range TDS (mg/L)	Notes
<b>Parilla Sands Aquifer (PSA)</b>	Parilla Sands	104	Quartz sands and sandstones, minor clay, silts	Sedimentary / unconfined	Highly variable: Limited data	Generally 1,000 to 3,000	Unsaturated in the western margin. Generally <20m saturated thickness
<b>Upper Tertiary Aquitard (UTD)</b>	Bookpurnong Beds	106	Calcareous clay, occasional silt and minor sand	Aquitard	N/A	N/A	Generally absent in the western margin
<b>Tertiary Limestone Aquifer (TLA)</b>	Murray Group Limestone (including Duddo Limestone)	107	Limestone and marly limestone	Fractured rock/ sedimentary, unconfined to confined	High variable but generally between 200-1,000	Generally <1,500	Unconfined in western portion where Bookpurnong Beds are not present and PSA is unsaturated
<b>Lower Mid-Tertiary Aquitard (LMTD)</b>	Ettrick Formation	110	Calcareous clays with thin limestone and sandstone interbedded	Aquitard	N/A	N/A	Present across the majority of the GMA separating TLA and TCSA
<b>Tertiary Confined Sand Aquifer (TCSA)</b>	Renmark Group	111	Sands, clays, silts and minor coal	Sedimentary / confined	100-500	Generally <1,500	Limited development due to depth and cost for bore construction
<b>Basement Rock (BSE)</b>	Various	114	Sandstones/siltstones/ minor mudstones and granite	Generally Aquitard	N/A	N/A	Basement of basin structure

\*As described in the Victorian Aquifer Framework at <https://www.water.vic.gov.au/groundwater/victorias-groundwater-resources/victorian-aquifer-framework> (last accessed November 2018)

#### 4.1. Aquifer Characteristics

##### **Pliocene (Parilla) Sand Aquifer (PSA)**

The Pliocene (Parilla) Sands Aquifer is present across much of the GMA and generally forms the water table aquifer system. It is directly recharged by rainfall. The Pliocene (Parilla) Sands Aquifer becomes thinner, and is unsaturated, along the western third of the GMA where the Tertiary Limestone Aquifer forms the water table aquifer. Figure 4 illustrates the western extent of saturated Pliocene (Parilla) Sands Aquifer. The groundwater flow is generally towards the north. This is a low yielding aquifer and use is limited to domestic and stock purposes.

##### **Tertiary Limestone Aquifer (TLA)**

The Tertiary Limestone Aquifer is present across much of the GMA. It varies in thickness from 20-30m along the south and south eastern margin of the GMA to over 100m in the north. It is the main aquifer used in the GMA due to its relatively shallow depth, reasonable quality and moderate to high yields. It is generally used for domestic and stock, irrigation and urban supply. All licences in the GMA are issued from the Tertiary Limestone Aquifer.

The transmissivity varies across the GMA, with lower transmissivities to the east (<300m<sup>2</sup>/day) and higher transmissivities to the west (up to 2,000m<sup>2</sup>/day) where the aquifer system is karstic and unconfined (i.e. Neuarpur Zone).

The aquifer unit is unconfined in the western portion of the GMA but becomes partially confined by the overlying Bookpurnong Beds to the east.

The Tertiary Limestone Aquifer is not present beyond the eastern extent of the GMA due to the change from shallow-marine (in the west) to marginal marine-lagoonal (in the east). Groundwater quality is generally good with Total Dissolved Solids (TDS) less than 1,500 mg/L, except for localised areas where groundwater quality is observed between 1,500 and 3,000 mg/L. Good water quality (< 1000 mg/L TDS) is found in several areas within the GMA, while areas of poorer quality (>3,500mg/L TDS) are located north of Kaniva, near Lake Hindmarsh and in isolated pockets in the south west part of the GMA. In the north-east, the groundwater quality deteriorates significantly (greater than 3,500 mg/L TDS).

Diffuse rainfall recharge to the Tertiary Limestone Aquifer is considered to be low (in the order of a few millimetres per year) across most of the GMA, varying recently (i.e. the last 200 years) due to changes in land use and climate influences. The groundwater resource is considered predominately an ancient water resource, with the majority of recharge occurring at least 20,000 years ago.

Groundwater flow in the Tertiary Limestone Aquifer is generally in a north-west direction. The vertical gradient throughout most of the GMA is downwards from the

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Pliocene (Parilla) Sands Aquifer to the Tertiary Limestone Aquifer and into the Tertiary Confined Sands Aquifer. The exception is in the north-west corner of the GMA where there is an upward gradient. Where the Bookpurnong Beds are not present, and the Pliocene (Parilla) Sands Aquifer is present, there is more potential for connection between the Pliocene (Parilla) Sands Aquifer and Tertiary Limestone Aquifer.

In the western portion of the GMA, diffuse and point source recharge occurs directly to the Tertiary Limestone Aquifer via sinkhole and karst features. Across the remainder of the GMA, recharge occurs via leakage from the overlying PSA and underlying Bookpurnong bed aquitard.

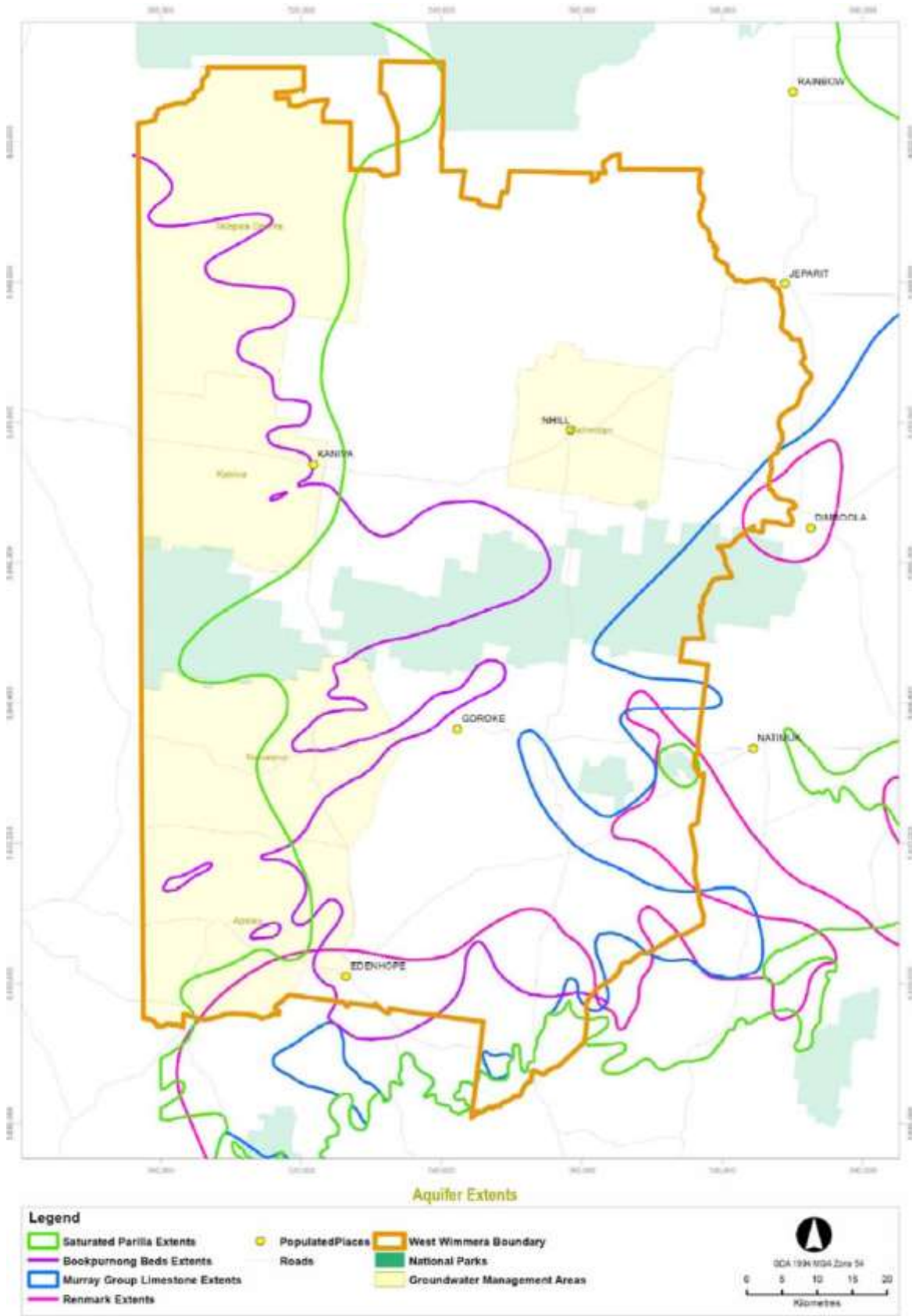
### **Tertiary Confined Sand Aquifer (TCSA)**

The Tertiary Confined Sand Aquifer (Renmark Group) is a confined aquifer underlying the Lower Tertiary Aquitard. The unit comprises unconsolidated sands, silts and clay of varying thickness. These sediments occur at depths ranging 70 to 220 metres below ground. The quality in this aquifer is reasonable with salinity values of generally less than 1,500 mg/L TDS.

Figure 5 provides a diagrammatic representation of the aquifer systems and their interaction with the landscape.

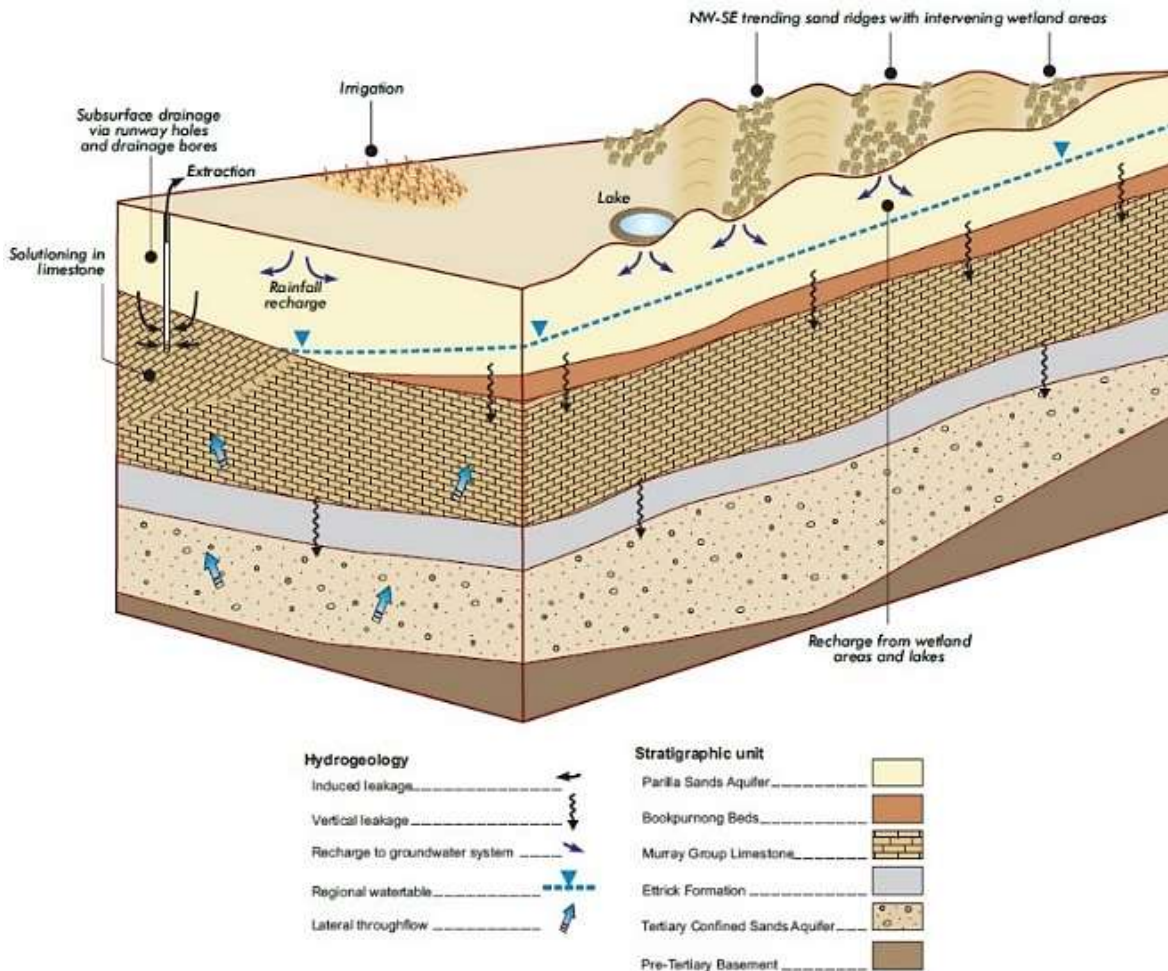
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Figure 4: Extent of major geological controls on aquifer hydrogeology (SKM,2009).



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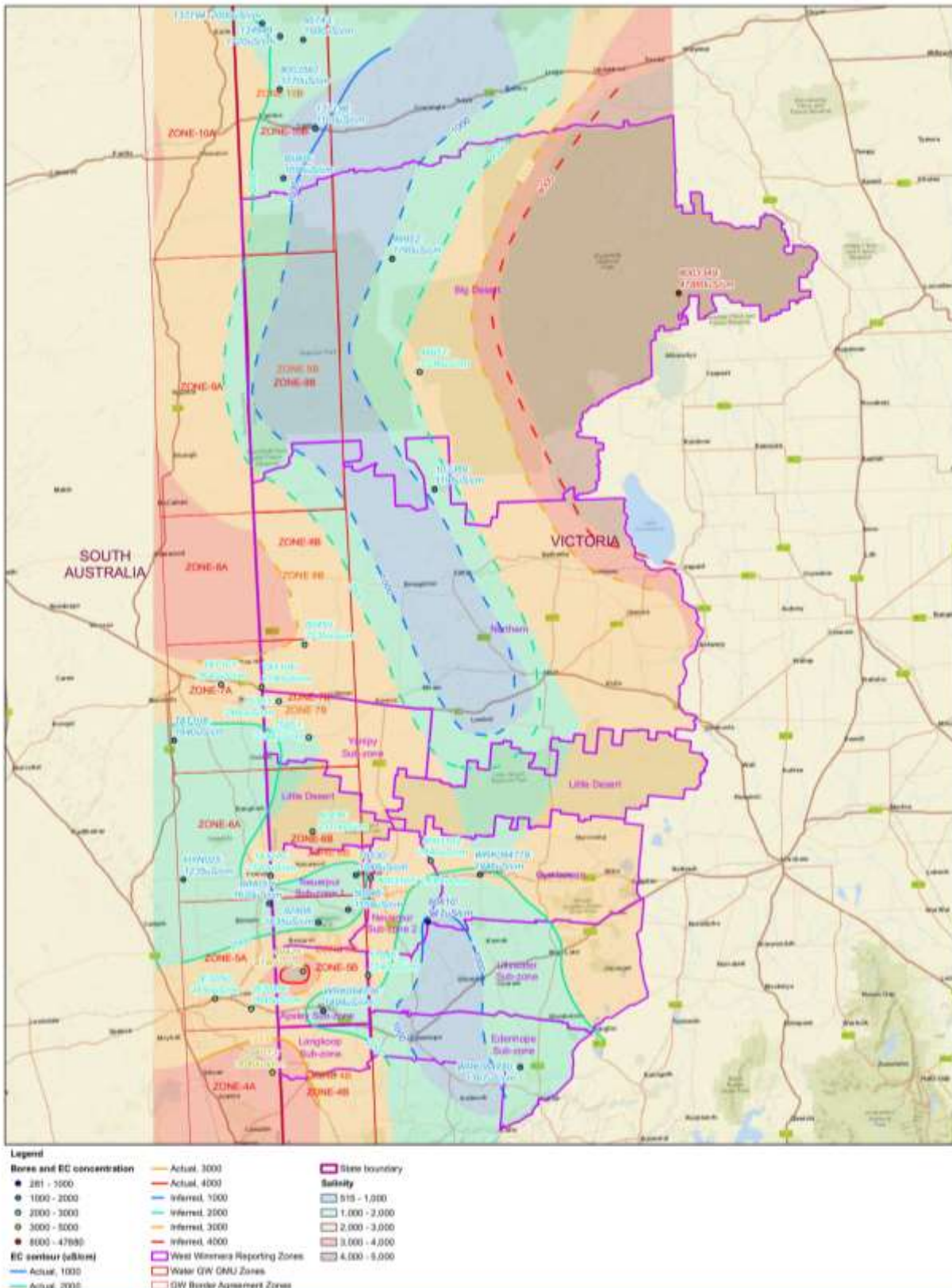
Figure 5: West Wimmera groundwater conceptual model (SKM,2009).



The conceptual model shows the relationship and flow system of the Pliocene (Parilla) Sand Aquifer, Tertiary Limestone Aquifer and Tertiary Confined Sand Aquifer systems. Diagrammatic view is looking from the South East corner of the GMA towards the North-West

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Figure 6: Groundwater salinity of the TLA- Groundwater EC contours 2016/17 (GHD, 2018)



**Legend**

<b>Bore and EC concentration</b>	● 281 - 3000	● 1000 - 2000	● 2000 - 3000	● 3000 - 5000	● 5000 - 47995
<b>EC contour (µS/cm)</b>	— Actual, 1000	— Actual, 2000	— Inferred, 1000	— Inferred, 2000	— Inferred, 3000
	— Inferred, 4000	— Inferred, 5000			
	— State boundary	— West Wimmera Reporting Zones	— Water GW GMU Zones	— GW Border Agreement Zones	
		— Salinity 0.15 - 1,000	— Salinity 1,000 - 2,000	— Salinity 2,000 - 3,000	— Salinity 3,000 - 4,000
			— Salinity 4,000 - 5,000		

<p>Paper Size A3</p> <p>0 8 16 24 32</p> <p>Kilometers</p> <p>Map Projection: Lambert Conformal Conic Horizontal Datum: GDA 1984 Grid SGA 1984 VECTOR94</p>				<p>GWM Water West Wimmera Groundwater Review</p> <p>EC Concentrations 2016/2017 Tertiary Limestone Aquifer</p>	<p>Job Number   31-35662 Revision   8 Date   21 Mar 2018</p> <p style="text-align: right;"><b>Figure 44</b></p>
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## 4.2. Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are those ecological systems that utilise groundwater to meet some or all of their water requirements. Within the West Wimmera GMA, particularly the southern third, there are numerous wetlands and waterways commonly associated with north-south terminal catchments, aligned between the sand dune ridges. Some of these features particularly in the south-west of the GMA, are likely supported by local groundwater discharge from the Pliocene (Parilla) Sand Aquifer (PSA) (or perched water table in the PSA).

The main streams receiving or with a high potential to receive groundwater discharge in the area are Mosquito Creek, Glenelg River and Wimmera River.

While further studies are required, in general these GDEs are not in direct connection with the Tertiary Limestone Aquifer (TLA), therefore the potential to impact on the GDEs through extraction from this aquifer is thought to be limited.

General information on GDEs is available through the National Atlas of Groundwater Dependent Ecosystems <http://www.bom.gov.au/water/groundwater/gde/index.shtml> (last accessed November 2018)

## 4.3. Climate influence

As discussed in Section 4.1, rainfall recharge to the aquifer is thought to be low in most of the GMA, with the exceptions being:

- In the south and south-west where groundwater is relatively shallow, and
- On the western portion of the GMA where the Tertiary Limestone Aquifer forms the water table aquifer (where the Bookpurnong beds are absent (see Figure 4)) and recharge can be both diffuse and via point sources.

The influence of rainfall itself on groundwater levels is not expected to be as dominant as the influence of groundwater extraction across much of the GMA in the future. Assuming in the future that climate becomes drier than the last 10 years (which is a real possibility under climate change scenarios), there is likely to be higher reliance on the groundwater resource (usage) and decrease in recharge in those areas outlined above which do experience direct recharge from rainfall.

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### 4.4. Recent Groundwater Resource Conceptualisation

In 2018, the Border Groundwaters Agreement Review Committee (refer to section 5.1) commissioned a technical review of Province 2 of the South Australia - Victoria Designated Area. In Victoria, the Province 2 area includes (all or in part) Border Zones 3B, 4B, 5B, 6B, 7B and 8B (refer Figure 2), and extends to the east of zones 3B to 7B.

The Province 2 technical review, conducted by consultant Jacobs (Jacobs, 2018) concluded that there is a clear response to surface events in Zone 4B (Langkoop Sub-zone), and there is likely to be some degree of episodic vertical recharge in this area.

Jacobs observed that response to surface events was less clear in the south of Zone 5B (i.e. Apsley sub-zone) and response to surface events was not apparent in the north of Zone 5B and beyond (i.e. Neuarpur sub-zone 1). Jacobs concluded that the groundwater resource in these areas (Neuarpur zone and northwards) is likely to be 'non-renewable' (extraction far exceeds natural recharge), and ongoing extraction across the Tertiary Limestone Aquifer can be expected to lead to groundwater level decline. Jacobs estimated that the time for stabilisation of groundwater levels across the broader Tertiary Limestone Aquifer (at current levels of extraction in both Victoria and South Australia) could be between 40 and 150 years.

Jacobs also estimated that under full utilisation of permissible licence volume across the broader Tertiary Limestone Aquifer, the maximum drawdown in groundwater levels may be in the order of 10m. However, it is estimated that groundwater level stabilisation would take well in excess of 70 years at this level of extraction.

In the technical review of the West Wimmera Groundwater Management Strategy, commissioned by GWMWater, consultant GHD (GHD, 2018) noted declining groundwater levels in the Tertiary Limestone Aquifer in Neuarpur sub-zone 1 is driven by extraction within the Neuarpur Zone. Declining levels were also identified as being influenced to some degree by groundwater use in the adjacent South Australian zones of the Border Designated Area, and the Apsley Sub-zone. The groundwater decline in the western side of the Apsley and Langkoop Sub-zones is also understood to be influenced by groundwater use in the adjacent South Australian zone 5A of the Border Designated Area. The conclusions reached by consultant GHD in the West Wimmera Strategy technical review appear generally consistent with those of consultant Jacobs in the Province 2 technical review.

## **5. Limits and Caps**

### **5.1. Border Groundwaters Agreement**

The *Groundwater (Border Agreement) Act 1985* (the Agreement) and subsequent amendments provide the mechanism for managing, sharing and protecting the groundwater resources in the Designated Area established by the Agreement. A Review Committee, with membership from both states, exists under the Agreement as the operating body for the effective implementation and administration of the Agreement.

The Designated Area is a 40-kilometre wide strip centred on the border of South Australia and Victoria and divided into eleven management zones on either side of the border.

The Agreement includes management prescriptions which define the permissible annual volumes (PAV), permissible rate of groundwater level lowering and permissible level of salinity for each zone. Extraction licences may not be granted or renewed within the Designated Area, other than in accordance with the management prescriptions set out in the Agreement.

Zones 4B-9B of the Designated Area are located within the West Wimmera GMA. The PAVs for each aquifer in each zone are tabulated in the most recent annual report <https://www.environment.sa.gov.au/managing-natural-resources/water/types/border-groundwaters-agreement/annual-reports> (last accessed November 2018).

Management actions as part of this Local Management Plan will be consistent with prescriptions set through the Agreement for the Designated Area.

### **5.2. West Wimmera GMA Permissible Consumptive Volume**

The permissible consumptive volume (PCV) is set by the Minister for Water and is the maximum volume of water that can be licenced in an area or water system, for a defined period. Domestic and stock use is not included in this volume.

Table 3 outlines the total volume that may be taken in a zone or sub-zone as declared in the *Permissible Consumptive Volume (West Wimmera Groundwater Management Area) Order 2013* for each of the aquifers within the West Wimmera GMA.

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Table 3: Permissible Consumptive Volume (PCV) for all aquifers

West Wimmera GMA Zone or Sub-zone	Pliocene Sands Aquifer PCV in ML	Tertiary Limestone Aquifer PCV in ML	Tertiary Confined Sand Aquifer PCV in ML	All other formations PCV in ML
Big Desert Zone	0	25	0	0
Gymbowen Zone	50	2,000	200	0
Little Desert Zone	0	25	0	0
Neuarpur Zone				
• Neuarpur Sub-zone 1	0	20,700	200	0
• Neuarpur Sub-zone 2	0	4,050	200	0
Northern Zone	50	22,390	500	0
• Yanipy Sub-zone		(6,103*)		
Southern Zone				
• Apsley Sub-zone	0	2,901	200	0
• Edenhope Sub-zone	50	680	50	0
• Langkoop Sub-zone	0	2,000	100	0
• Ullswater Sub-zone	50	888	100	0

\*the PCV for Yanipy Sub-zone is included in the overall Northern Zone PCV

## 6. Licensed volume and use

The following information provides a summary of licensed volume in the West Wimmera GMA. Further detailed information may be obtained from the Victorian Water Register <http://waterregister.vic.gov.au/>. Aggregate licensed volume and usage information is also documented in the annual report for the West Wimmera GMA, available via the GWMWater website.

*Table 4: Summary of Licences as at 30 June 2018*

<b>Management Zone</b>	<b>Number of Licences</b>	<b>Licensed volume (ML)</b>
<i>Neuarpur</i>	48	24,691
<i>Northern</i>	78	22,345
<i>Southern</i>	35	5,615
<i>Gymbowen</i>	10	952
<b>Total</b>	<b>171</b>	<b>53,603</b>

Historical usage, reported as a percent of total licensed entitlement volume, is indicative of the entitlements that have been activated in the area, and also water market potential. Entitlement volume and use since 2011/12 is tabulated below.

*Table 5: Historical water use and groundwater entitlement volume for the West Wimmera GMA.*

<b>Year</b>	<b>Number of licences</b>	<b>Licensed Volume (ML)</b>	<b>Total use (ML)</b>	<b>Use as % of licensed volume</b>
2011/12	178	53,307	14,803	28
2012/13	171	53,307	17,884	33
2013/14	172	53,307	16,964	32
2014/15	171	53,307	20,420	38
2015/16	171	53,307	25,658	48
2016/17	171	53,322	22,998	43
2017/18	171	53,603	27,310	51

## **7. Management Rules**

Management rules for the West Wimmera GMA were initially developed and documented in the West Wimmera Groundwater Management Strategy (2011), within the section titled Management Arrangements. To accommodate the level of scientific uncertainty in the groundwater system, the Strategy was based upon an adaptive management approach, whereby monitoring the effect of management on the groundwater level trends (i.e. rising, stable or declining) indicates the resource condition (i.e. whether the resource is under stress or being sustainably utilised). The main objective of the Strategy is to achieve stable groundwater trends at a level that does not degrade consumptive or ecological uses of the resource, or the resource itself, thereby indicating sustainable use of the resource.

The assessment method for classifying the groundwater status in each zone was outlined in the 2018 technical review (GHD, 2018 (Section 5)), and is discussed further in Appendix 3 - Groundwater Level Trend Assessment.

The adaptive management approach adopted in the Strategy can include response actions such as limiting extraction by enforcing restrictions, if groundwater level trends are not stable due to intensive groundwater extraction or changes in the climate. Similarly, if groundwater levels are stable or rising then there may be the opportunity to seek changes to the PCV to release further entitlements or relax trading restrictions.

The management rules contained in the Strategy have been consolidated and adapted in response to recommendations from the technical review of the Groundwater Management Strategy (March 2018), in consultation with the West Wimmera GMA Implementation Committee.

### **7.1. Annual allocations and restrictions**

The *Permissible Consumptive Volume (West Wimmera Groundwater Management Area) Order 2013* describes the maximum volume of water that can be extracted under licence in the West Wimmera GMA, the detail of which is summarised in Table 3.

The conditions of a Take and Use Licence enable GWMWater to restrict the permitted extraction volume or extraction rate, if required, to manage situations such as unacceptable decline in groundwater level or localised bore interference.

Restrictions have been in place in Neuarpur Sub-zone 1 since 2011. The initial restriction to 96% of licence volume was declared for season 2011/12 and increased by 4% each year until 2015/16 when restrictions reached their planned maximum of 80% of licence volume. Licences have remained restricted to 80% since that time and are anticipated to remain at this level until groundwater level trends stabilise.

The means of identifying changes in groundwater trends and triggers for restrictions to protect the resource are described in the following sections. Any action taken to restrict licensed

## West Wimmera Groundwater Management Area Local Management Plan

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extraction must be evidence based and adaptive. A similar technique can be adopted for the remaining management zones.

### 7.2. Method for assessing and implementing any new restrictions

#### 7.2.1. Assessment Considerations

The nature of groundwater systems is that they respond gradually over time. Even though short-term responses may be observed as a result of episodic recharge or reduced extraction in a single year, the groundwater system may also express changing water level trends which are only apparent after a number of years of observation.

When assessing the need for restrictions, groundwater level data alone is not sufficient to make an informed decision. The drivers of observed changes in groundwater levels and resource condition must be considered, as well as other factors relevant to restriction decisions, such as:

- Climatic conditions – is the observed decline in groundwater level primarily a result of recent climatic conditions rather than reflective of a sustained long-term declining trend driven by extraction.
- Groundwater extraction – is extraction a dominant factor driving the observed decline, and would restrictions act to alleviate the decline.
- Extraction in adjacent zones – is extraction in one zone of the West Wimmera GMA influencing groundwater levels in another zone.
- Cross border activities – is extraction in the adjacent South Australian zones influencing groundwater levels in West Wimmera GMA zones.
- Border Groundwater management approach – whether intervention is required to comply with agreed management of border groundwater resources.
- Social and Economic factors – the extent to which restrictions could result in, or mitigate, adverse social or economic outcomes.
- New information – information that becomes available over time from further hydrogeological investigations and studies which builds on our understanding of the resource.

‘Stable’ groundwater trends were defined by consultant GHD in the 2018 technical review as a groundwater level trend which changes (increase or decrease) by up to 0.2m over 5 years (equivalent to 0.04m/year). This 5-year time frame has been used as the basis for GWMWater’s assessment of groundwater level trends to inform the need for intervention.

#### 7.2.2. Assessment Method

Groundwater level trends will be assessed annually against a 3-year rolling average change in groundwater level and 3 year cumulative change in groundwater level.

Where a declining groundwater trend is observed in a grouped hydrograph for a particular area:

- a) equal to or greater than -0.1m on average over the prior 3 years, or
- b) equal or greater than a cumulative decline of -0.3 m over the prior 3 years,

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GWMWater will engage with local groundwater licence holders to advise of the observed trends and commence a preliminary assessment of the need for restrictions, should the rate of decline persist. Where this assessment favours the implementation of restrictions for an area, GWMWater will commence its engagement with licensees and stakeholders.

In the event a groundwater level decline of -0.1m or greater being observed for a fourth year (i.e. a 0.4m or greater cumulative change has occurred) GWMWater will update its assessment of the resource condition and need for restrictions. GWMWater will continue to engage with licensees with regards to the outcomes of its assessment, and give advice of any intention to introduce restrictions should the decline persist for a further year. Part of this engagement will include the restriction process, defining the restriction level(s), defining how restrictions would be implemented, and at what point restrictions would be relaxed or lifted.

In the event a groundwater level decline of -0.1m or greater is observed for a fifth year (i.e. a 0.5m or greater cumulative change has occurred) GWMWater will update its assessment of the resource condition and confirm the need for restrictions, prior to implementation for the following season. Licensees will be advised of the outcome of the assessment and confirmation given if restrictions are to be implemented.

Where a preliminary assessment suggests that restrictions may be required for an area, based on the considerations in section 7.2.1, GWMWater will engage with licensees throughout years 3, 4 and 5, in developing a restriction regime for the area, which enables them to adapt their water usage requirements to accommodate restricted licence volumes. Should restrictions be implemented, these will be subject to an annual review process, informed by observed groundwater level, extraction and meteorological data. Restrictions would be relaxed or lifted based on the criteria set during the consultative process of developing the restriction regime.

Where there is an observed groundwater level decline over 5 years which averages more than 0.04m/year but less than 0.1m (i.e. between 0.2m and 0.5m cumulative decline over 5 years), GWMWater will undertake a resource condition assessment to determine whether intervention is required for that particular area. The implementation of any restrictions for such areas will also follow a consultative approach with licensees and stakeholders.

In the event of a zone being within 20km of the border with South Australia, any decision to introduce restrictions will be considered in conjunction with cross-border management arrangements.

Restrictions may be considered for zones or sub-zones adjacent to the target zone for intervention, where similar declining trends have developed in the-adjacent zone or sub-zone. This action would be considered where there was reasonable evidence suggesting it would improve the effectiveness of restrictions in stabilising groundwater levels in both the target zone and adjacent zone(s).

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### 7.2.3. *Ongoing Notification of Restrictions*

Where restrictions are ultimately implemented following the assessment and consultative process described above, GWMWater will notify licensees annually of the restriction applicable in particular season, prior to the commencement of that season. GWMWater will also post current restrictions on its website, and may provide additional coverage via public notices in local media.

## 7.3. Issue, renewal or transfer (trade) of licences

### 7.3.1. *Tertiary Limestone Aquifer (TLA)*

GWMWater may approve a new or amended licence application, or an application to transfer groundwater entitlement providing matters under the *Water Act 1989*, policies for managing take and use licences, the Border Groundwaters Agreement, and the Wimmera Irrigation Development Guidelines have been considered.

Consideration of the above require that:

- i. The PCV for the zones (or sub-zones) (Table 3) of the West Wimmera GMA must not be exceeded as a result of any new application.
- ii. The total licenced entitlement must not exceed the Permissible Annual Volume set in each zone of the Designated area (Border Zone).
- iii. The zone limits in Table 3 must not be exceeded as a result of any new application, including temporary and permanent transfers.
- iv. No trading is permitted between zones (excludes sub-zones).
- v. Entitlement may be transferred permanently or temporarily within zones provided the PCVs are not exceeded and with the following limitations (see also Table 6):
  - Trading into Neuarpur sub-zone 1 is not permitted
  - Trading into Neuarpur sub-zone 2, from Neuarpur sub – zone 1 is permitted on a temporary basis only
  - Trade is not permitted into Yanipy sub-zone
  - With the exception of trade into Apsley and Langkoop sub-zones, trade across sub-zones within the Southern Zone is permitted
- vi. An application relating to the transfer or conveyance of land on which the water is taken under a licence can be transferred to the successor in the Title of that land and is exempt from the rules above.
- vii. The land to which the water is traded has an irrigation and drainage management plan approved through the process outlined in the Wimmera Catchment Management Authority's Wimmera Irrigation Development Guidelines.

Trading rules for the Tertiary Limestone Aquifer within the West Wimmera GMA are summarised in Table 6.

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Table 6: Table of Trading Rules for the Tertiary Limestone Aquifer

West Wimmera GMA Zone or Sub-zone		Trade From											
		Big Desert Zone	Gymbowen Zone	Little Desert Zone	Neuarpur Zone		Northern Zone		Southern Zone				
					Neuarpur Sub-zone 1	Neuarpur Sub-zone 2	Northern Zone	Yanipy Sub-zone	Apsley Sub-zone	Edenhope Sub-zone	Langkoop Sub-zone	Ullswater Sub-zone	
Trade To	Big Desert Zone	y	n	n	n	n	n	n	n	n	n	n	
	Gymbowen Zone	n	y	n	n	n	n	n	n	n	n	n	
	Little Desert Zone	n	n	y	n	n	n	n	n	n	n	n	
	Neuarpur Zone	Neuarpur Sub-zone 1	n	n	n	y	n	n	n	n	n	n	n
		Neuarpur Sub-zone 2	n	n	n	y#	y	n	n	n	n	n	n
	Northern Zone	Northern Zone	n	n	n	n	n	y	y	n	n	n	n
		Yanipy Sub-zone	n	n	n	n	n	n	y	n	n	n	n
	Southern Zone	Apsley Sub-zone	n	n	n	n	n	n	n	y	n	n	n
		Edenhope Sub-zone	n	n	n	n	n	n	n	y	y	y	Y
		Langkoop Sub-zone	n	n	n	n	n	n	n	n	n	y	n
		Ullswater Sub-zone	n	n	n	n	n	n	n	y	y	y	y

'y' denotes trade is permitted

'n' denotes trade is not permitted

# denotes temporary trade only is permitted

### 7.3.2. Tertiary Confined Sands Aquifer (TCSA)

There are no licences for the take and use groundwater from the Tertiary Confined Sands Aquifer in the West Wimmera GMA. Investigations suggest the capacity of this aquifer may be much less than previously understood and will be managed with a precautionary approach.

Local management rule 5.3 of the West Wimmera Groundwater Management Strategy states that 'no bore construction licences will be issued to access the Tertiary Confined Sands Aquifer, except for investigation or monitoring purposes, pending further investigation and monitoring which demonstrates through a public engagement process adequate groundwater resources are available to sustain future development'.

### 7.3.3. *Pliocene Sands Aquifer (PSA)*

There are no groundwater licences in the Pliocene Sands Aquifer of the West Wimmera GMA. The aquifer is low yielding and saline in places and is therefore unlikely to be extensively developed as a resource. In some parts of the GMA, the quality of the Pliocene Sands Aquifer is suitable for domestic and stock use.

Small permissible consumptive volumes (PCVs) have been assigned for the Pliocene Sands Aquifer to allow modest incidental use in pockets where the resource is suitable.

## 7.4. Entitlement intensity limits

A study commissioned by the Border Groundwater Agreement Review Committee established the concept of a threshold level of irrigation intensity at which groundwater levels change from being stable to declining (GWMWater, 2011). The cap on licence volume in most zones of the West Wimmera GMA was based on a maximum intensity of groundwater entitlement use beyond which could result in unacceptable decline in groundwater levels.

The Strategy proposed that these limits would also be used to assess the risk to groundwater levels of new licences or trades greater than 20ML.

GWMWater may approve an application for a new licence or trade provided that the intensity limits have been considered during the assessment process. The intensity limits are tabulated in Table 7. GWMWater will ensure that the level of assessed risk relating to the application is commensurate to the level of information and investigations required to support the application and any conditions imposed on the licence.

*Table 7: Intensity limits*

<b>Zone</b>	<b>Intensity (ML/km<sup>2</sup>)</b>
Northern	4
Neuarpur sub-zone 1	n/a #
Neuarpur sub-zone 2	15.8
Gymbowen	5
Southern	2

#due to existing intensity of use being too high to apply limits

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### 7.5. Localised bore interference

Localised bore interference occurs when the drawdown 'cone' of a bore interacts with a neighbouring bore. The impacts from groundwater pumping are site-specific because the aquifer characteristics and extraction patterns can vary.

There are policies and procedures to assess the potential risk for groundwater level interference from new groundwater licence applications. These procedures address matters in Section 40 of the *Water Act 1989*, which includes impacts on surrounding groundwater users and the environment. For new large applications or trades requiring a new bore, the following rules apply to ensure there is sufficient local monitoring to properly assess any potential impacts over time:

- a. New use of a volume greater than 399 ML per year and located more than five kilometres from an existing monitoring bore screened at a depth to monitor the Tertiary Limestone Aquifer will require the construction of a monitoring bore (to be included in the bore monitoring network) at the user's expense.
- b. GWMWater may restrict the volume that can be used in relation to an individual groundwater licence if the observed drawdown for observation bores in the area is determined by GWMWater to be adversely impacting on other authorised users, or the environment.
- c. Clause (b) above, will not apply to address impacts on another authorised user where it is determined that the impact is primarily due to the user's bore not being constructed or operated to an appropriate standard or level of efficiency.

### 7.6. Carryover

The provision for carryover is subject to declaration by the Minister for Water. The *Carryover Declaration for the West Wimmera GMA 2013* was made under section 62A of the *Water Act 1989*.

Carryover is authorised in the West Wimmera GMA with the following conditions:

- Unused groundwater which has not been traded may be carried over from one year to the next, and not subsequent years, up to a maximum of 30% of licence volume;
- The trade or transfer of carryover water is not permitted.

## **7.7. Metering and Compliance**

GWMWater meters all extraction bores associated with groundwater take and use licences. Meters are read by a GWMWater Officer or Contractor at least once annually, or where telemetry is fitted, meter readings and usage data may be obtained remotely. Annual usage volumes are recorded in the Victorian Water Register by 30 June of each year. GWMWater also conducts both periodic and random inspections of licenced extraction works and meter assets.

It is the responsibility of the licence holder to monitor their groundwater usage throughout the year to ensure their usage remains within the volume permitted to be taken annually under their licence. If a licence holder determines that they require more water than they are permitted to take, it is their responsibility to secure a licence transfer and obtain confirmation from GWMWater before taking more water.

## 8. Domestic and Stock supply

Under Section 8 of the *Water Act 1989*, landholders have the right to take groundwater from a bore for their own domestic and stock (D&S) use without a take and use licence. Landholders must apply to GWMWater or through the MyWater online process at <https://mywater.waterregister.vic.gov.au/> for a works licence to construct and install a bore for D&S use.

Domestic and stock bores are registered in the state groundwater database when a bore construction licence is issued, and updated with construction information when a bore completion report is returned. GWMWater is able to consider impacts on known D&S bores when making licensing decisions. For this reason D&S users, with older bores are encouraged to ensure that their bore(s) are registered.

Domestic and stock bores should be constructed to allow for any seasonal change in groundwater level in the local area to ensure continuity of supply.

### 8.1. Reimbursement for Lowering/Deepening of Domestic and Stock Pumps and Bores

The development of irrigation and the nature of the aquifer can lead to seasonal water fluctuations in some parts of the GMA. Declines in groundwater level can result in problems with supply to groundwater bores used for domestic and stock purposes, given they are usually drilled to a shallower depth. A program has been established to reimburse landholders for some of the costs incurred in the lowering of pumps and bores if it is demonstrated that the decline in water level is a result of impacts from licensed groundwater extraction. Guidelines for the Reimbursement in relation to Lowering/Deepening of D&S Pumps and Bores have been developed for use in the broader GWMWater region and are available from GWMWater.

### 8.2. Decommissioning redundant and failed bores

The groundwater resource may be threatened by the presence of failed or failing groundwater bores, particularly where the Tertiary Limestone Aquifer is overlain by the saline Pilocene (Parilla) Sands Aquifer. Older bores drilled into the Tertiary Limestone Aquifer are likely to deteriorate as the steel casing corrodes, allowing water from the saline Parilla Sands Aquifer to enter the fresher limestone aquifer and cause contamination.

Proper capping and decommissioning of old bores is important to protect the water quality of the groundwater resource. Decommissioning of failed and redundant bores is the responsibility of landholders, in order to preserve the integrity of the aquifer.

## 9. Water Quality

In general, the salinity of the Tertiary Limestone Aquifer (TLA) is less than 1,500 EC units (uS/cm) or 1,000 mg/L of Total Dissolved Solids (TDS) through the middle section of the GMA, and less than 2,500 EC (1,500 mg/L TDS) across most of the remaining area. Towards the southern and northern boundaries, salinity typically ranges from 2,500 to 5,400 EC (1,500 to 3,500 mg/L TDS). There are small, isolated areas of higher salinity groundwater toward the south-west corner of the GMA and north of Kaniva.

Water quality has not been identified as a resource management issue for the West Wimmera GMA at this time.

The salinity of groundwater appears to be relatively stable in most of the bores with the exception of the Big Desert where a rising trend was noted in the Pliocene (Parilla) Sands Aquifer (PSA) and the Tertiary Limestone Aquifer (TLA). Being a National Park where there is limited extraction, and vegetation clearance would not be expected, the reason for the rising trend is not apparent and is likely to be beyond the influence of this Local Management Plan.

Additional salinity monitoring of observation bores has been instigated in the Edenhope Sub-zone to fill data gaps identified in the 2018 technical review.

Downward leakage from the saline Parilla Sands aquifer via rusted or collapsed bore casing to the relatively fresh limestone aquifer remains a potential threat (as discussed in section 8.2 Decommissioning of redundant and unused bores).

## **10. Monitoring**

The condition of the groundwater resource is monitored by GWMWater and the Victorian Department of Environment, Land, Water and Planning (DELWP) through the State Observation Bore Network (SOBN). This monitoring includes quarterly groundwater level observations across the management area, as well as annual salinity monitoring at selected SOBN bores. All monitoring data will be regularly reviewed by GWMWater to ensure the groundwater management approach in place is consistent with the objectives of this LMP and the West Wimmera Groundwater Management Strategy.

Groundwater monitoring information is publicly available via DELWP Water Measurement Information System at <http://data.water.vic.gov.au/monitoring.htm>.

Groundwater monitoring locations (water level and quality) are tabulated in Appendix 2 – Groundwater Monitoring.

There may be instances where bore condition is deemed to not provide suitable data or information for monitoring purposes. In this circumstance, an individual bore may be substituted by another suitably located bore, or subsequently removed from the tables in Appendix 2 – Groundwater Monitoring.

## **11. Annual reporting**

By 1 October each year, an annual report will be prepared and made publicly available. This report will summarise and provide updates on the groundwater resource status, licensed groundwater use and trade activity for the previous season and summarise any other implementation or review activities in relation to this Local Management Plan. The annual report may also flag any need to amend or update this Local Management Plan. Current and past annual reports can be accessed from GWMWater's website [www.gwmwater.org.au](http://www.gwmwater.org.au).

## **12. Review of this Plan**

This Local Management Plan may need to be adapted in response to policy changes in groundwater resource management and as our understanding of the aquifer system continues to improve over time, to ensure appropriate management arrangements are in place. GWMWater will undertake a review of the Local Management Plan after five years from its approval, or sooner if warranted. Any significant changes to the groundwater management approach documented in this Local Management Plan must be based on sound technical understanding of the issues, and will be subject to consultation.

### 13. References

Department of Environment and Primary Industries (2014). Local Management Plan Guidelines

GHD (2018) *West Wimmera Groundwater Review: Technical Review of the West Wimmera Groundwater Management Strategy*.

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Leaney FWJ and Herczeg AL (1999). *The Origins of Fresh Groundwater in the SW Murray Basin and its Potential for Salinisation, CSIRO Tech Report 7/99*

South Australian-Victorian Border Groundwaters Agreement Review Committee, November 2017; *Thirty Second Annual Report to 30 June 2017*.

## 14. Contact details

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## **Appendix 1 – Outcomes of West Wimmera Groundwater Management Strategy technical review (2018)**

### **Background**

GHD Pty Ltd was engaged by GWMWater to undertake a 5 year Technical Review of the West Wimmera Groundwater Management Strategy to assess whether the management objectives for each of the management zones are being met, and provide recommendations for the ongoing management of groundwater in the West Wimmera Groundwater Management Area (GMA).

The West Wimmera Groundwater Management Strategy aims to “ensure the groundwater resource of the area is managed in an equitable manner to achieve the long term sustainability of the resource and maintain the social, environmental and economic benefits that groundwater provides to the region”.

The West Wimmera GMA consists of a number of zones and sub-zones each with a management objective to either maintain stable or stabilise trends in groundwater level. In the case of the intensively irrigated Neuarpur Sub-zone 1 area, the management objective is to see signs of groundwater level stabilisation in 10 years from the commencement of the Management Strategy, and stabilisation of groundwater levels in 20 years.

### **Discussion**

GHD conducted a monitoring review of groundwater level, quality and extraction data, as well as climate data, using this information to critically appraise the observed trends against the Management Strategy objectives.

GHD reported that although the management objectives have been generally satisfied over the last 5-year period, the review has only been able to assess the effectiveness of the West Wimmera Groundwater Management Strategy for the 5-6 year period it has been in place. It is recognised that stable groundwater levels identified in this review could quickly be impacted by factors such as prolonged low rainfall conditions (drought) and increased extraction in some zones or sub-zones in the future. Zones and sub-zones most at risk included Northern, Yanipy, Neuarpur Sub-zones 1 and 2, Southern Apsley and Southern Langkoop.

GHD concluded that the current suite of management tools (i.e. the management rules) have been effective in managing the groundwater resources of the West Wimmera GMA. However, as noted, there is a risks of these objectives not being met in the future if a significant increase in extraction volumes was to occur in some zones (i.e. where entitlement use is currently low) or prolonged dry climate conditions were experienced.

The declining groundwater trend in the Tertiary Limestone Aquifer in Neuarpur Sub-zone 1 was examined in detail. GHD recognised that the declining levels are driven by use within the Neuarpur Zone but are also likely to be influenced to some degree by groundwater use in the

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adjacent South Australian zones, 5A and 6A of the Border Groundwater Agreement Designated Area, and the Apsley sub-zone.

The groundwater decline in the western side of the Apsley and Langkoop Sub-zones is also influenced by groundwater use in the adjacent South Australian zone 5A of the Border Designated Area.

GHD made a number of recommendations following their review, which can be summarised into:

### *a) Restriction triggers*

Based on the technical review, the current restriction of licences to 80% of licenced volume in Neuarpur sub-zone 1 should remain in place. New restrictions are not recommended for any other zones/sub-zone.

For the moderate risk zones and sub-zones (Northern, Yanipy, Neuarpur Sub-zones 1 and 2, Southern Apsley and Southern Langkoop) it is recommended that a plan is implemented which can definitively identify a significant change in groundwater level trend, including the setting a trigger level for when restrictions may be required to protect the sustainability of the resource.

### *b) Monitoring*

In general, the current groundwater monitoring program in place was assessed to be adequate. However, some minor recommendations were made for GWMWater's consideration:

- For **groundwater level monitoring** it was recommended a selection of existing observation bores be added to the monitoring network to improve spatial and aquifer system coverage. GHD also recommended the construction of two new strategically located observation bores.
- For **water quality monitoring**, some additional quality monitoring was recommended for the Edenhope sub-zone where a slight rising salinity trend has been identified, however this is based on the results from one monitoring bore only.

### *c) Management Rules*

In assessing the effectiveness of the existing management tools, GHD recognised the current Management Zones, Permissible Consumptive Volumes (limit on extraction in a zone), carryover provisions, and localised bore interference management (by installation of monitoring bore(s)), are sound and do not require alteration.

Modifications to the some of the existing management rules were recommended to improve their effectiveness in either protecting the resource, or removing unnecessary trading restrictions.

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The proposed modifications included:

- Entitlement Intensity Rule – simplify the assessment method.
- Trading Rules – allow trade between sub-zones of the Southern Zone with the exception of into Langkoop and Apsley sub-zones (ie. Trade out of Langkoop and Apsley sub-zones only).
- Annual Reporting – include more detailed analysis to identify any ongoing decline on a yearly basis for each zone.

### **Conclusion**

GHD prepared a comprehensive technical review of the West Wimmera Groundwater Management Strategy using the available groundwater level, quality and extraction data.

A number of recommendations were made which have been incorporated into this Local Management Plan, which forms a supplementary document to the 2011 West Wimmera Groundwater Management Strategy.

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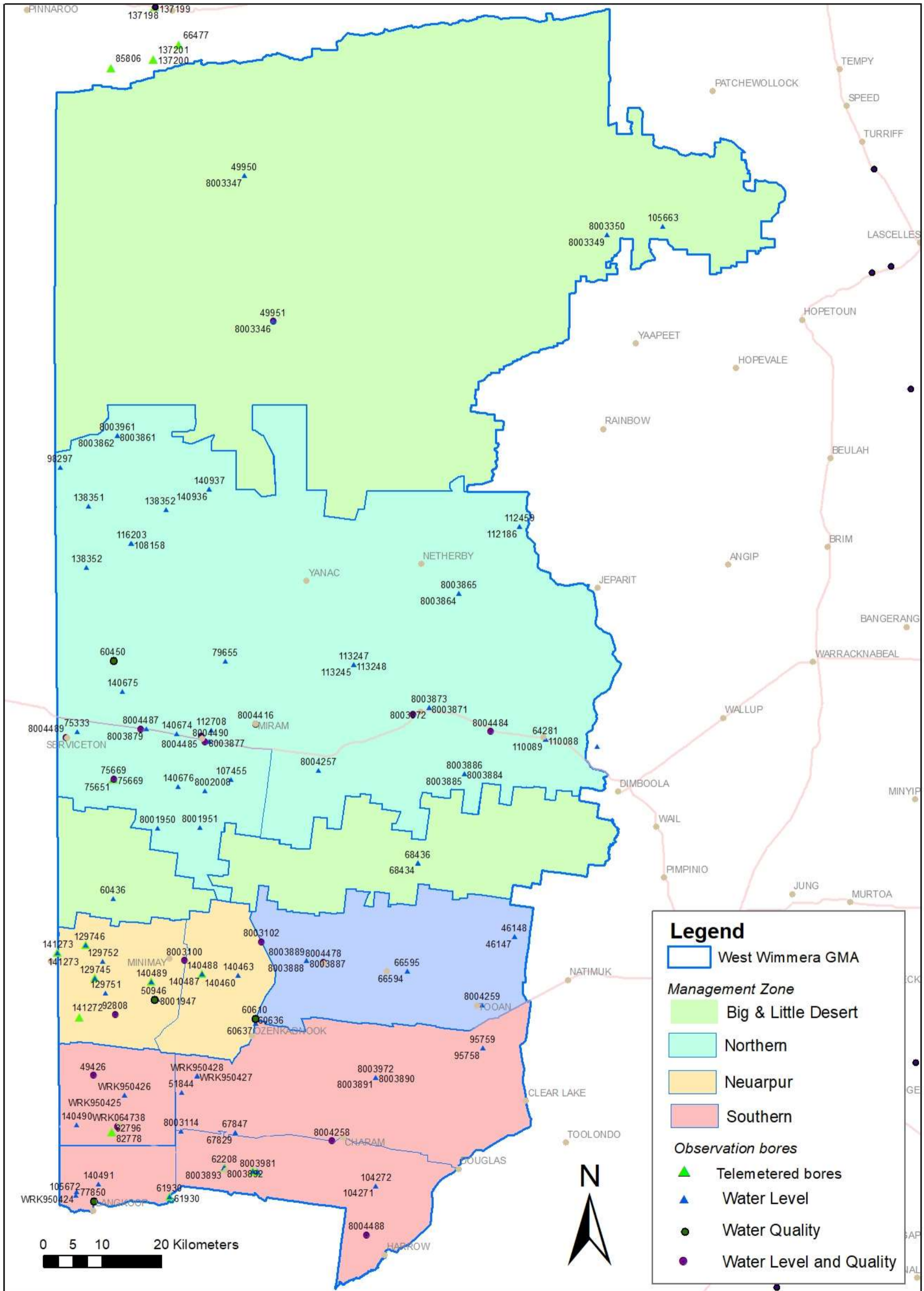
### Appendix 2 – Groundwater Monitoring Locations *Water Level – Quarterly minimum monitoring*

Bore ID	Depth (m)	Zone	Bore ID	Depth (m)	Zone	Bore ID	Depth (m)	Zone
49950	220	Big Desert	112459	35	Northern	8004487	87	Northern
49951	218	Big Desert	107455	206	Northern	8004489	87	Northern
105663	15.24	Big Desert	108158	182	Northern	8004490	112	Northern
8003346	65	Big Desert	110088	95.5	Northern	WRK064715	146.3	Northern
8003347	48	Big Desert	110089	41.35	Northern	8004416	105	Northern
8003349	60	Big Desert	112185	257.5	Northern	49426	35.96	Southern
8003350	39	Big Desert	112186	100	Northern	51844	51.81	Southern
46147	99.6	Gymbowen	112708	214	Northern	60636	58	Southern
46148	47	Gymbowen	113245	303.4	Northern	60637	12	Southern
60623	184	Gymbowen	113247	131.8	Northern	61930	90	Southern
66594	241	Gymbowen	113248	47	Northern	62208	9.44	Southern
66595	123	Gymbowen	116203	74	Northern	67829	150	Southern
8003102	84	Gymbowen	138351	100	Northern	67847	150	Southern
8003887	205	Gymbowen	138352	100	Northern	95758	110	Southern
8003888	37	Gymbowen	138353	81	Northern	95759	43	Southern
8003889	81	Gymbowen	140674	60	Northern	104271	12.2	Southern
8004259	28	Gymbowen	140675	60	Northern	104272	51.81	Southern
8004478	86	Gymbowen	140676	60	Northern	105672	21	Southern
60436	107	Little Desert	140936	95	Northern	140490	39	Southern
68434	57	Little Desert	140937	54	Northern	140491	33	Southern
68436	238.55	Little Desert	8001950	66	Northern	8003114	51	Southern
92808	102	Neurapur	8001951	72	Northern	8003890	112	Southern
129745	48	Neurapur	8002008	72	Northern	8003891	105	Southern
140463	30	Neurapur	8003861	90	Northern	8003892	69	Southern
129746	48	Neurapur	8003862	219	Northern	8003893	126	Southern
129751	48	Neurapur	8003864	48	Northern	8003972	33	Southern
129752	45	Neurapur	8003865	75	Northern	8003981	54	Southern
140460	66	Neurapur	8003871	267	Northern	8004258	55	Southern
140487	30	Neurapur	8003872	70	Northern	8004488	26	Southern
140488	60	Neurapur	8003873	108	Northern	WRK064738	38.1	Southern
140489	57	Neurapur	8003875	39	Northern	WRK073518	49	Southern
141273	45	Neurapur	8003876	72	Northern	WRK073519	38	Southern
8001947	48	Neurapur	8003877	230	Northern	WRK073520	66	Southern
8003100	60	Neurapur	8003879	54	Northern	WRK075765	54	Southern
8003880	146	Neurapur	8003884	249.5	Northern	WRK950423	70	Southern
64281	155.3	Northern	8003885	66	Northern	WRK950424	40	Southern
75333	87	Northern	8003886	108	Northern	WRK950425	32	Southern
75651	142	Northern	8003961	72	Northern	WRK950426	63	Southern
75669	240.3	Northern	8004257	110	Northern	WRK950427	67	Southern
79655	170	Northern	8004484	124	Northern	WRK950428	38	Southern
98297	166	Northern	8004485	124	Northern			

*Water Quality - Salinity monitoring locations*

<b>Bore ID</b>	<b>Management Zone</b>
49951	Big Desert
60610	Gymbowen
8004478	Gymbowen
141273	Neuarpur
92808	Neuarpur
8003100	Neuarpur
8003102	Neuarpur
49426	Neuarpur
50946	Neuarpur
75669	Northern
60450	Northern
8004484	Northern
8004487	Northern
WRK064715	Northern
8004489	Northern
8004485	Northern
8004490	Northern
77850	Southern
WRK064738	Southern
8004488	Southern
8004416	Southern
8004258	Southern

### West Wimmera GMA - Observation bores



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## Appendix 3 – Groundwater Level Trend Assessment

### Introduction

In early 2018, consultant GHD completed a technical review of the West Wimmera Groundwater Management Area, which identified an opportunity for GWMWater to further refine its adaptive management response and define triggers for the introduction of restrictions for zones across the West Wimmera Groundwater Management Area.

In the 2018 technical review, consultant GHD's expert hydrogeologists defined "stable" groundwater level trends as a decline or rise of up to 0.2m over 5 years (i.e. equivalent to an average of 0.04m/year).

### Discussion

#### *Identifying changes in groundwater level trends – moderate risk zones*

GHD identified a number of zones and sub-zones as having a "moderate" risk of not meeting the strategy objectives of maintaining or stabilising groundwater level trends into the future, assuming increased extraction and drier climatic conditions. GHD identified the "moderate" risk zones and sub-zones as:

- Neuarpur Sub-zone 2
- Southern Zone- Apsley Sub-zone
- Southern Zone – Langkoop Sub-zone
- Yanipy Sub-zone
- Northern Zone

To address this risk and protect the resource, it was recommended that GWMWater develop a method to identify changes in groundwater level trends and set action triggers for when intervention (restrictions) may be required, where it is evident that extraction is impacting on groundwater levels. GHD suggested creating representative hydrographs for the zones/sub-zones using the same methodology previously applied to Neuarpur Sub-zone 1. The trigger of 0.1m is based on 50% of the Border Zone limit hence represents a conservative indicative annual change threshold.

A groundwater level trend analysis has been completed for the bore groupings within the moderate risk zones identified by GHD. The observation bores used to determine the average annual change in groundwater level grouped by zone are listed in Table A below.

*Table A: Moderate Risk Zone Bore Groupings for Groundwater Trend Analysis*

Zone	Observation bores
<b>Neurapur Sub-zone 1</b>	8001947, 141273, 129751, 129746, 141272, 129744, 140489
<b>Neurapur Sub-zone 2</b>	8003100, 8003102, 8003963, 140460, 140488
<b>Apsley Sub-zone</b>	8003112, 8003111, 140490, 51845, 82778
<b>Langkoop Sub-zone</b>	61930, WRK950424, 105672, 140491
<b>Yanipy Sub-zone</b>	75651, 8001950, 8001951, 8002008, 140676
<b>Northern Zone West</b>	58079, 140936, 8003861, 140675, 138353, 138352, 138351, 116203, 98297, 79655
<b>Northern Zone (rest)</b>	113247, 8003865, 8003886, 110088

Trends of annual change in groundwater level have been graphed (see Attachment). These graphs allow identification of changes in groundwater level trends on an annual, 5- year and long term basis, and monitoring of levels as they approach or exceed warning thresholds or triggers to assess the need for management intervention.

Each annual report for the West Wimmera GMA will include a summary assessment of water level trends, particularly for the moderate risk zones.

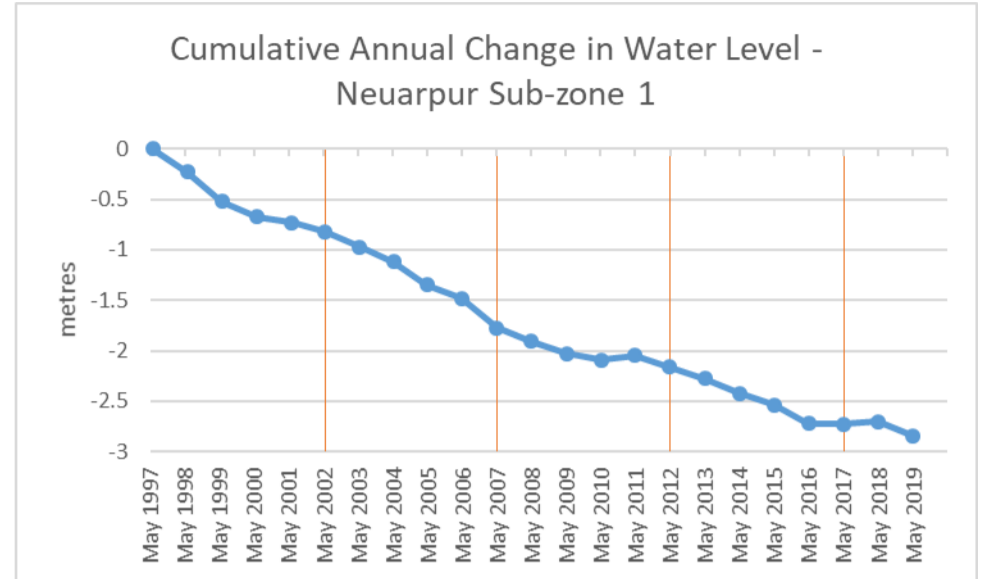
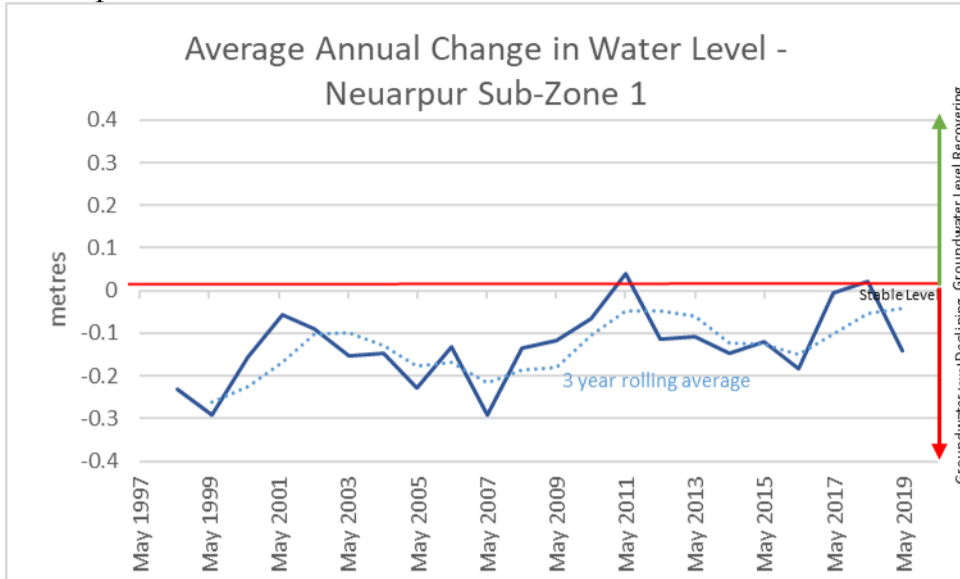
***Interpreting the hydrographs***

The threshold line at -0.1m is included on each of the *Average Annual Change in Water Level* graphs for each of the moderate risk zones in the attachment. The three year rolling average is represented by the dashed blue line on those graphs.

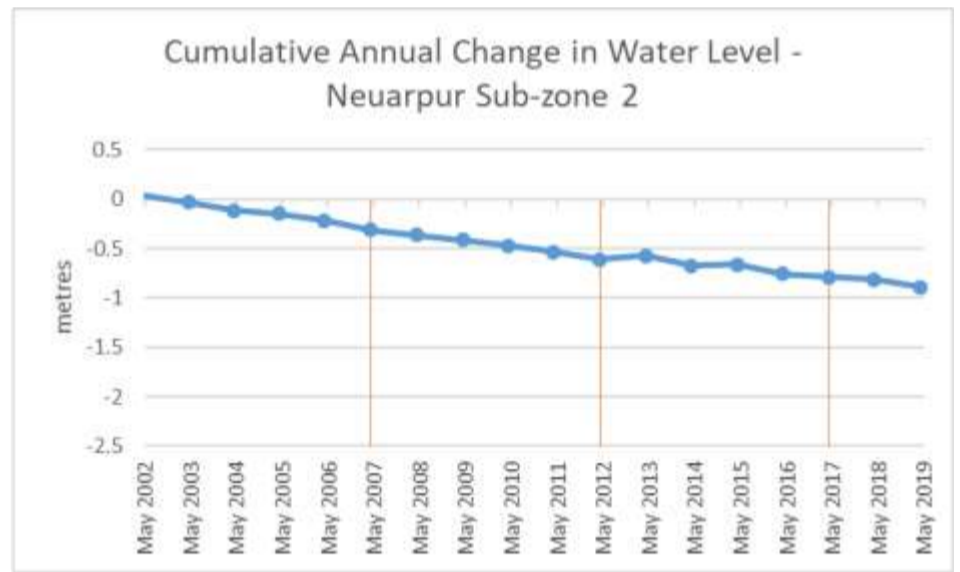
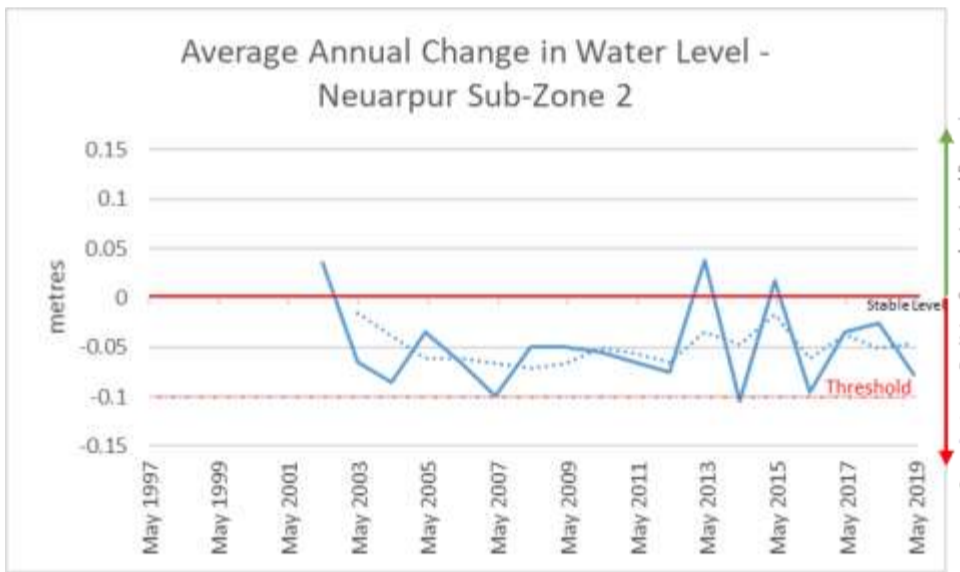
The cumulative change in groundwater level for each zone is represented, with the five year review periods for the West Wimmera Groundwater Management Strategy indicated by the orange vertical lines.

Attachment to Appendix 3 - Representative hydrographs for West Wimmera GMA zones & sub-zones- yearly trend analysis

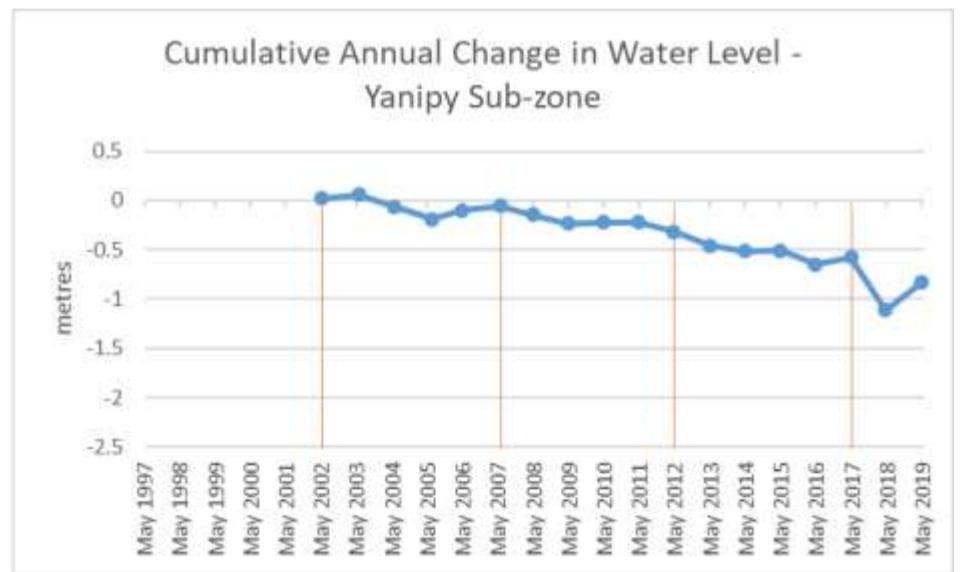
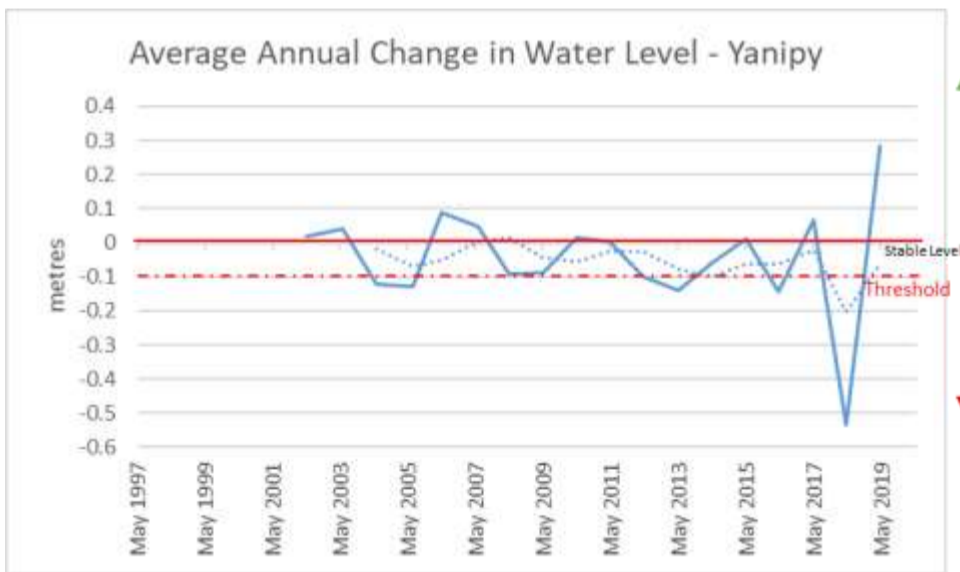
Neuarpur Sub-zone 1



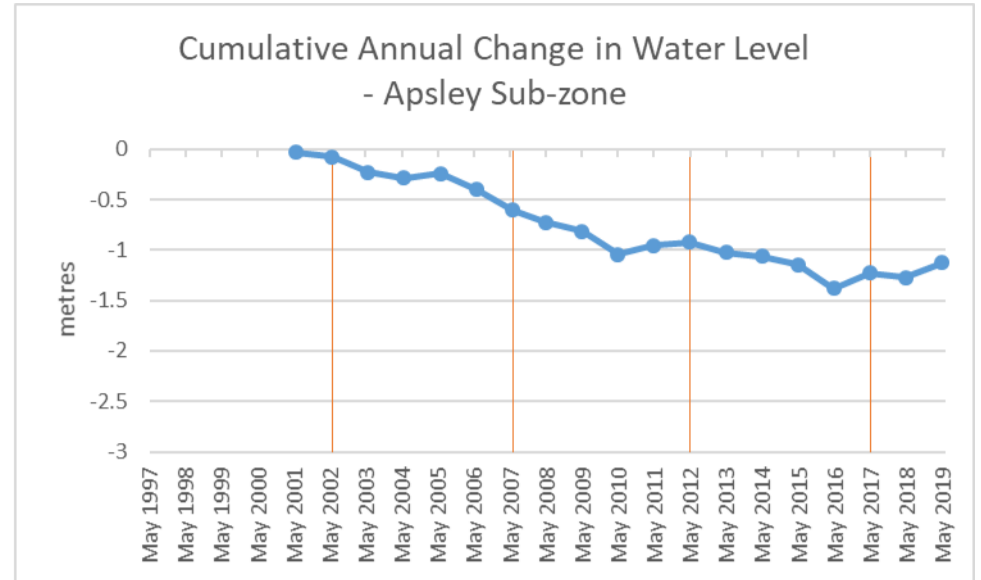
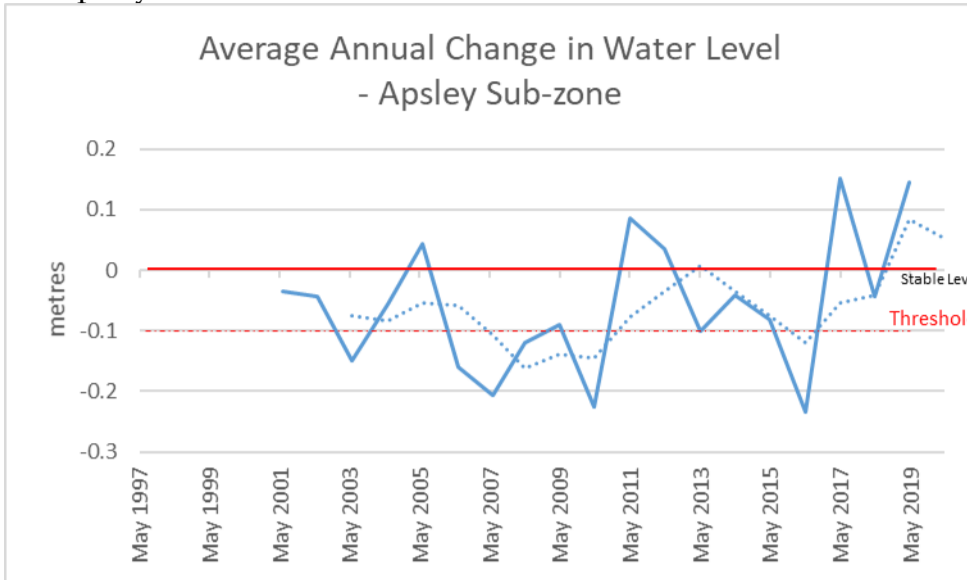
Neuarpur Sub-zone 2



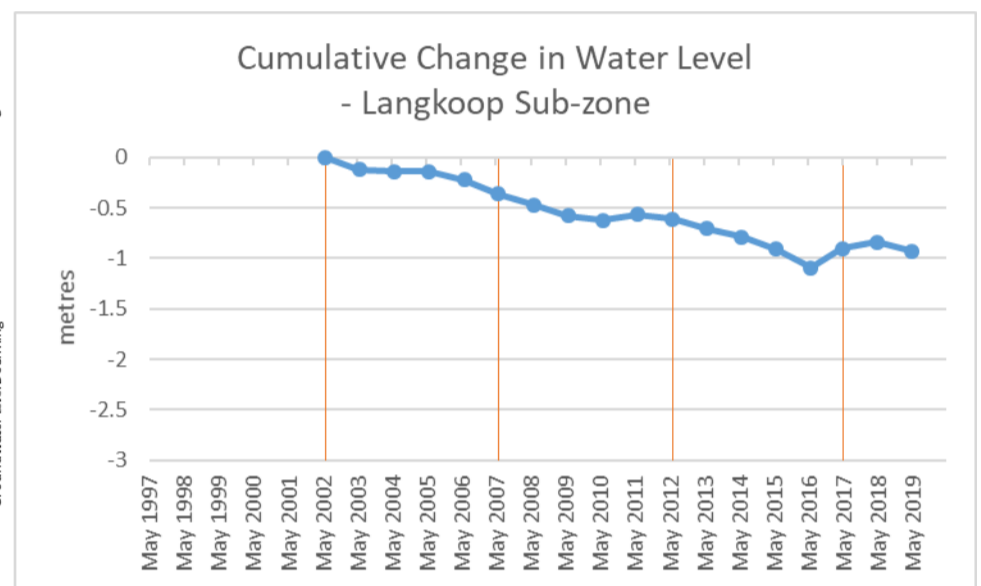
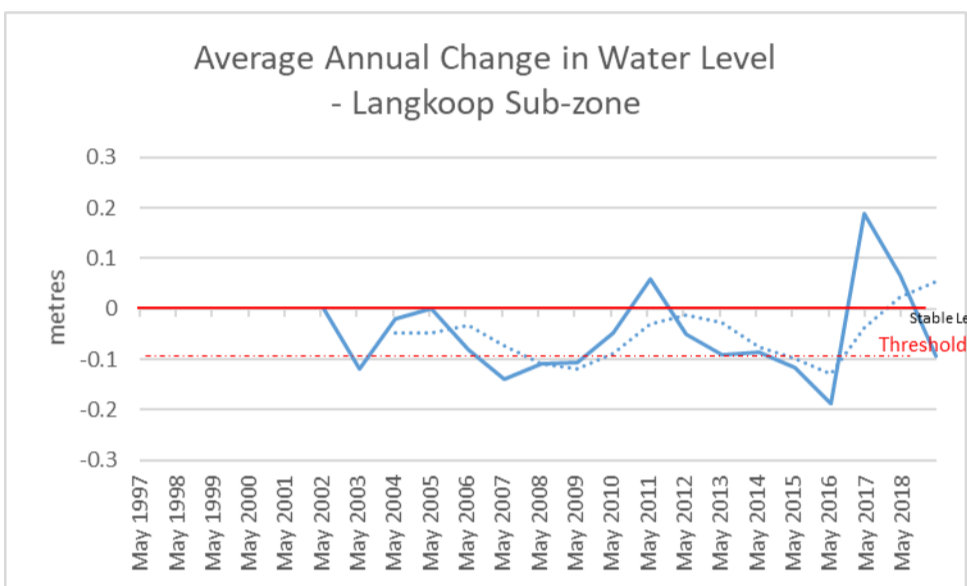
Yanipy Sub-zone



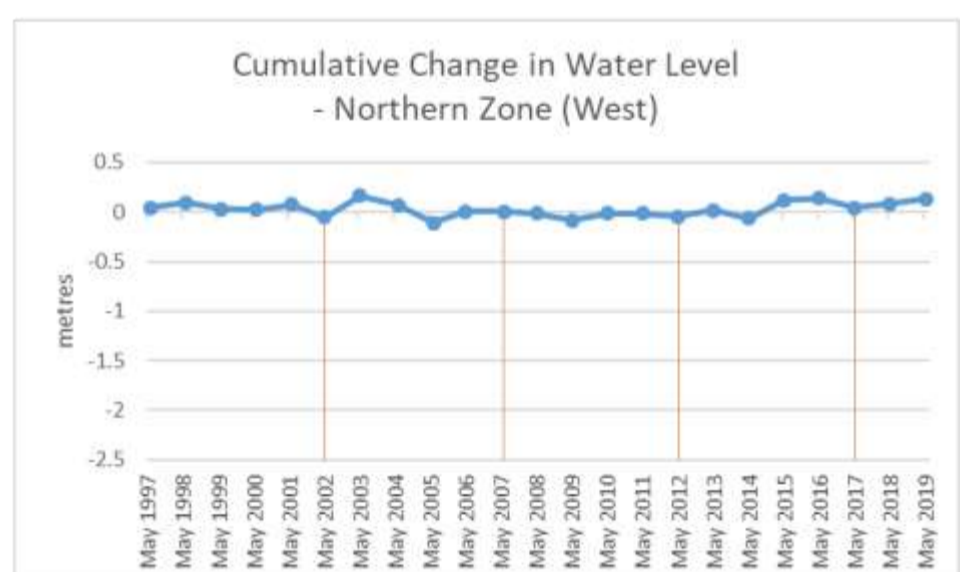
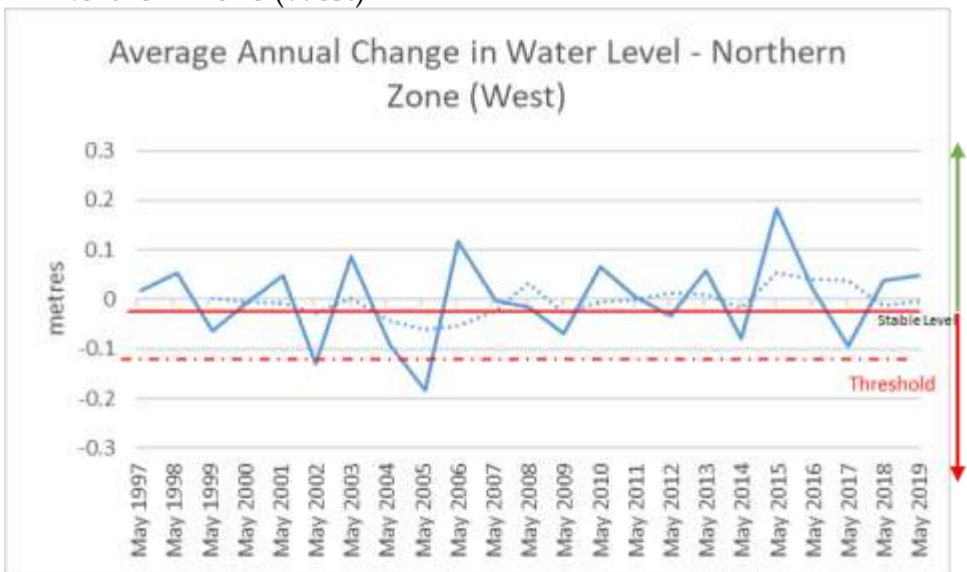
Apsley Sub-zone



Langkoop Sub-zone



Northern Zone (West)



Northern Zone (central and east)

