Goulburn-Murray WATER

Lower Loddon Plains

Groundwater Management Area Local Management Plan October 2026

Water for a thriving northern Victoria

Acknowledgement of Country

GMW recognises Aboriginal and Torres Strait Islander peoples as the First Peoples of Australia and as the proud representatives of the world's oldest living culture.

GMW respectfully acknowledges Elders past, present and emerging as the Traditional Owners of the lands and waters and the rich cultural connections First Peoples have across our region.

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Endorsement

This Local Management Plan (the Plan) has been developed for the Lower Loddon Plains Groundwater Management Area (GMA) to provide a framework for managing groundwater resources. The Plan includes guidance and information to Goulburn-Murray Water's (GMW) existing and potential customers about the take and use of groundwater in this area.

The Plan sets simple rules for the take and use of the resource which are intended to be administered alongside the current Victorian Government's policies recognising Traditional Owners access rights to water.

The Plan seeks to strike a balance between recognising the benefit of taking groundwater while supporting the protection of productive land and high value environmental assets such as wetlands, waterways, and other groundwater dependent ecosystems during critical dry periods. The use of groundwater of varying salinities and how it can provide benefits when incorporated into irrigation plans are also considered throughout the Plan.

The Plan will be periodically reviewed, particularly as changes to Victoria's water legislation and groundwater management framework take effect and as information about groundwater resources and the impacts of climate change improves. GMW will continue to work with our customers, Traditional Owners, local communities and other stakeholders to ensure the Plan is reviewed and updated as necessary.

GMW would like to acknowledge the input of all existing groundwater licence holders, Traditional Owners and agency representatives who have contributed to the development of this plan.

Matthew Pethybridge

Groundwater and Streams Manager

Dale McGraw

Diversions Services Manager (West)

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Glossary

Term/Acronym	Description
Act	Water Act 1989 (Victoria)
AHD	The reference level for groundwater levels is the Australian Height Datum (AHD), the geodetic datum for altitude measurement in Australia. It is the mean sea level for 1966-1968 and is assigned the value of zero.
Aquifer	A geological structure or formation or an artificial land fill permeated or capable of being permeated permanently or intermittently with water.
CMA	North Central Catchment Management Authority
DEECA	Department of Energy, Environment and Climate Action
D&S	Domestic and Stock
GDE	Groundwater Dependant Ecosystem
GMA	Groundwater Management Area
GMW	Goulburn-Murray Water Rural Water Corporation acting as a delegate of the Minister
Groundwater entitlement	Licensed volume of groundwater specified as megalitres per year
Groundwater licence	Licence issued to take and use groundwater under section 51 of the Act
L/sec	Litres per second (1 L/s equals approximately 0.0864 ML/day)
m	Metre
ML	Megalitre or one million litres
PCV	Permissible Consumptive Volume is the volume of groundwater that the Minister has declared may be extracted from a defined area in a season
The Plan	The West Campaspe Groundwater Management Area local management plan
Season	Period of 12 months commencing 1 July
SOBN	State Observation Bore Network
Trade	Transfer of groundwater entitlement (see section 62 of the Act)
Zone	A part of a Groundwater Management Area defined for management purposes

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Salinity converter (DNRE 2006)

Electrical Conductivity (EC units)	Parts Per Million (PPM)
20000	12800
15000	9600
10000	6400
8000	5120
5000	3200
2000	1280
1000	640
500	320
200	128
100	64
50	32
0	0

CAUTION:
Always determine the units your salinity meter measures before using this information.

Also check your retuned salinity sample letter from Goulburn-Murray Water so that you are using consistent units - it will ensure you get your conversion right every time.

SALINITY
Extreme
High
Medium
Low

Remember that EC units are expressed in micro-siemens/cm at 25°C (µS/cm) and that:

1000 EC = 1000 µS/cm = 640 ppm = 1 dS/m

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Quick Reference Guide to Plan rules

Rule 1. Use of saline groundwater for irrigation (page 19)

a) Upon receiving an application for either a new groundwater licence or transfer of a licence for irrigation purposes, GMW will refer the application to Agriculture Victoria for consideration against the Irrigation Development Guidelines (IDGs).

b) Recommendations under the IDG's to GMW will form a cap on the volume that can be applied for at an individual property level, for irrigation purposes.

c) Groundwater licence applications for uses involving desalination or other than irrigation will be assessed on an individual basis.

d) Failure to implement an IDG or any other requirements for the management of saline water associated with a groundwater licence may result in suspension from use, cancellation, or non-renewal of a licence.

Rule 2. Managing entitlement limits to groundwater (page 24)

a) Where an application arises near the GMA boundary, applicants may be required to undertake detailed technical investigation as part of any application.

b) Subject to GMW's consideration of rule 2(a), applicants may be required to purchase licensed groundwater entitlement from an adjoining GMA to establish a licence.

Rule 3. Transfer of licensed entitlements to groundwater (page 24)

a) Transfers of licensed groundwater will be limited to the consideration of "sufficient hydrological connectivity" required by the Murray Darling Basin Plan.

b) Any person looking to purchase additional entitlement will be limited to a maximum property-based limit advised to GMW by the IDG process.

c) Applicants may be required to undertake technical investigation in the same way as applicants for new licences if there are identified risk factors associated with the application.

d) Any application to transfer entitlement may be referred to relevant agencies for advice, depending on the range of risks identified by the authority.

Rule 4. Monitoring groundwater use (page 25)

a) Metering requirements will be consistent with GMW's metering policy.

b) GMW will read flow meters on licensed bores at least once annually and record use in the Victorian Water Register.

Rule 5. Monitoring the impacts of groundwater extraction (page 26)

a) GMW will review the adequacy of existing groundwater level monitoring over time, as development occurs the monitored bores may vary.

Approved: xx Month 202 Review due: Month 202x

1. Introduction

Goulburn-Murray Water (GMW) is responsible for managing and administering groundwater use under delegation from the Victorian Minister for Water. These responsibilities include developing and implementing local management plans.

A local management plan (LMP) is a tool developed by a Rural Water Corporation to communicate and manage risks to the groundwater resource in a defined area. An LMP's aim is to communicate the considerations that will be made by the corporation in making decisions under the *Water Act 1989* (the Act).

This LMP has been developed to provide groundwater users and potential applicants with information about how groundwater is to be managed in the Lower Loddon Plains Groundwater Management Area (the GMA). An LMP is not a Statutory Management Plan within the meaning of sections 27 to 32 of the Act, hence it provides greater flexibility to adapt to changes, policies, or knowledge as required.

Rules in the context of an LMP should be read as how the delegate for the Minister for Water will interpret requirements of the Act when assessing applications for licences, either for bore construction or for take and use of groundwater. The Rules presented in LMPs have been developed in consultation with existing authorised groundwater users, key rights holders and stakeholders including Traditional Owners, the North Central Catchment Management Authority, and Agriculture Victoria.

The Groundwater resource in the Lower Loddon Plains GMA are not highly developed, largely due to the unsuitability for irrigation. This LMP has been developed to protect values within the GMA and the adjacent management areas from the potential impacts of any significant, or inappropriate development within the area. The Plan should be read in conjunction with the Act, in particular, sections 40, 51, 53, 56, 67, 68 and 71.

1.1 Why develop of Local Management Plan?

The Plan has been developed in response to an increasing interest in the use of saline groundwater resources in Northern Victoria. GMW received a sudden influx of applications in the neighbouring West Campaspe GMA for bore construction and associated take and use licences in the Gunbower and Leitchville areas in 2020. This situation highlighted the need for GMW to develop and communicate requirements for new licence applicants and stakeholders to ensure the sustainable and equitable management of resources in unincorporated areas.

The Plan provides opportunity to demonstrate the use of best practice in groundwater management and to highlight the integrated roles of rights and stakeholders in approvals processes.

1.2 Local Management plan objectives

- Establish a Groundwater Management Area and Local Management Plan to cover the full extent of the Lower Loddon area within GMW's management region.
- Establish relevant boundaries, rules and where necessary, resource limits for the new area – see Figure 1.
- Communicate the integrated role of GMW and AgVic in regard to Irrigation Development Guidelines in groundwater approvals.
- Communicate to new developers regarding resource limitations and legislative considerations, namely section 53/40 of the Water Act 1989 associated with impacts of taking groundwater and use of saline water.
- Enact Victorian Government Policy regarding engagement and empowerment of Traditional Owners in natural resource management decision making.

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2. The Lower Loddon Plains Groundwater Management Area

The Lower Loddon Plains GMA is located in the Loddon groundwater catchment in northern Victoria and is within the Murray Darling Basin. The GMA covers an area of 4,634.08 km^2 and extends 144 km from Mitiamo in the south, to Nyah west in the north along the Murray River (Figure 1).

The GMA includes the townships of Mitiamo, Pyramid Hill, Kerang, Lake Boga, Swan Hill, Nyah and Nyah West. The southern boundary of the GMA is the Mid Loddon GMA, the eastern boundary is the West Campaspe GMA and the western boundary is GMW's boundary with Lower Murray Water and Grampians Wimmera Mallee Water.

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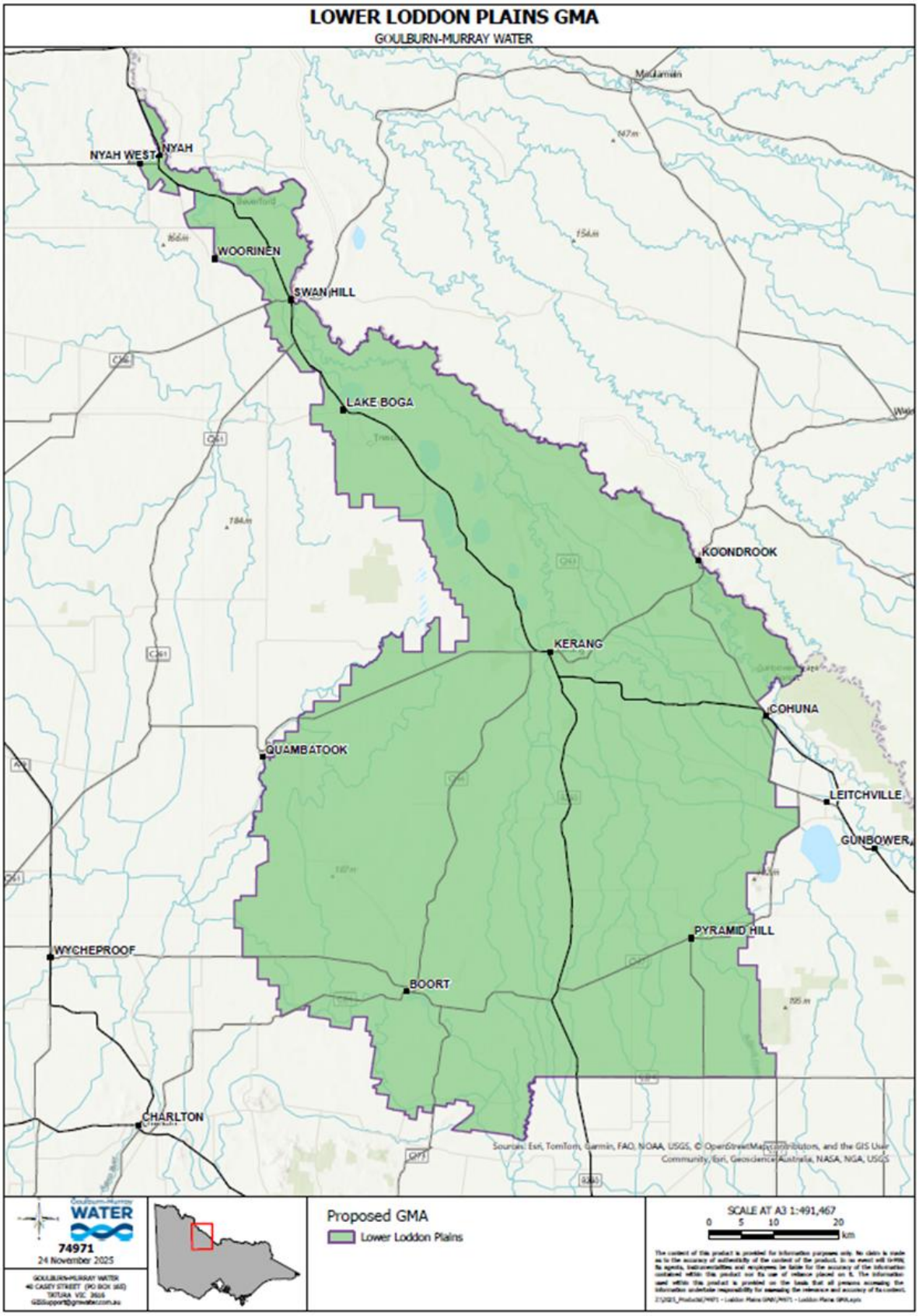


Figure 1 Lower Loddon Plains Groundwater management Area

2.1 Traditional Owners within Plan Area

The Plan boundary covers the traditional areas of three First Nations Groups (known for the purposes of policy as Traditional Owners) which include the following:

- Wamba Wemba
- Dja Dja Wurrung
- Barapa Barapa

Both Wamba Wemba Aboriginal Corporation and Dja Dja Wurrung Clans Aboriginal Corporations are Registered Aboriginal Parties (RAPs) under the Aboriginal Heritage Act 2006 within the GMA. At the time of writing Barapa Barapa have an application with the Victorian Government for recognition of RAP status and have lodged a claim for recognition of Native Title under the Native Title Act 1993 (Cth).

2.2 The groundwater system

Groundwater within the Lower Loddon Plains GMA generally follows the regional topographic and hydraulic gradient moving from the south of the catchment to the north towards the Murray River and into New South Wales. This area mostly overlays significant deep alluvial deposits known as the northern Victorian sedimentary plain. Groundwater is hydraulically connected at depth to both the adjacent West Campaspe GMA and proposed revised Mid Loddon GMAs (Figure 2) overleaf.

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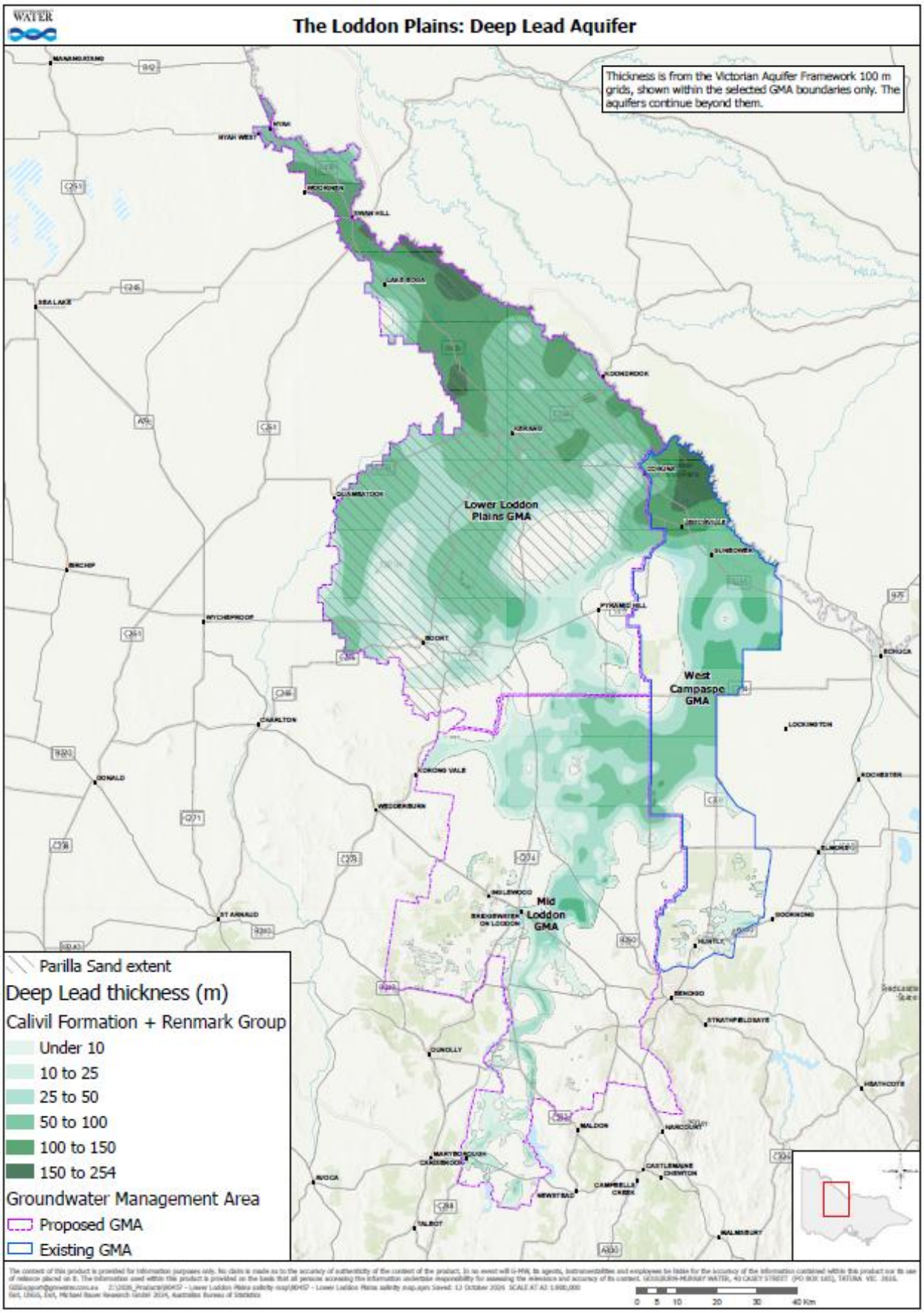


Figure 2 Hydraulic connectivity across the Lower Loddon Plains, West Campaspe and Proposed revised Mid Loddon GMA's.

The groundwater system in the GMA comprises of a series of shallow and deep aquifers separated by clay layers that limit the movement groundwater of different qualities between them. Each aquifer has different resource characteristics such as water quality and yield capacity and risks associated with large scale extraction and use.

Below is a visual representation of the aquifers in the Lower Loddon GMA, noting the aquifers for illustrative purposes only (Figure 3). The presence of the aquifers shown below are not continuous across the entire GMA.

The main four aquifers present across the Lower Loddon Plains GMA are listed below:

- **Shepparton Formation** formally known as the Quaternary and Upper Tertiary – Quaternary aquifers (UTQA 102) which consists of a mix of clays, sands, gravels and silts. These aquifers are those that are generally hydraulically connected to waterways, wetlands and Groundwater Dependent Ecosystems (GDE).
- **Parilla Sands** which are also known as the Upper Tertiary Marine Aquifer (UTAM 104). The Parilla Sands aquifer occurs in areas which were once an inland sea. This aquifer can vary in thickness across the area
- **Deep Lead Formations** also known as the Calivil and Renmark Formations which is the Upper Tertiary Aquifer Fluvial (UTAF 105) and Lower Tertiary Aquifer Fluvial (LTA 111) respectively, which may reach as much as 225 m from the surface. These systems are generally referred to collectively as the 'Deep Leads'. This system consists of buried river – channel sands and gravels which were deposited within ancient paleovallys. These deep leads are generally confined beneath thick clay layers at depth (Figure 4 Calivil Formation and Figure 5 Renmark Group) Groundwater from the deep leads in the Lower Loddon Plains is generally high yielding.
- **Bedrock Aquifer** commonly referred to as just 'Bedrock' the Bedrock aquifer underlies the basin sediments and is generally accessed via weathered zones or fractures within the porous sands. Groundwater is generally of poor quality with low yields and consequently of very limited development.

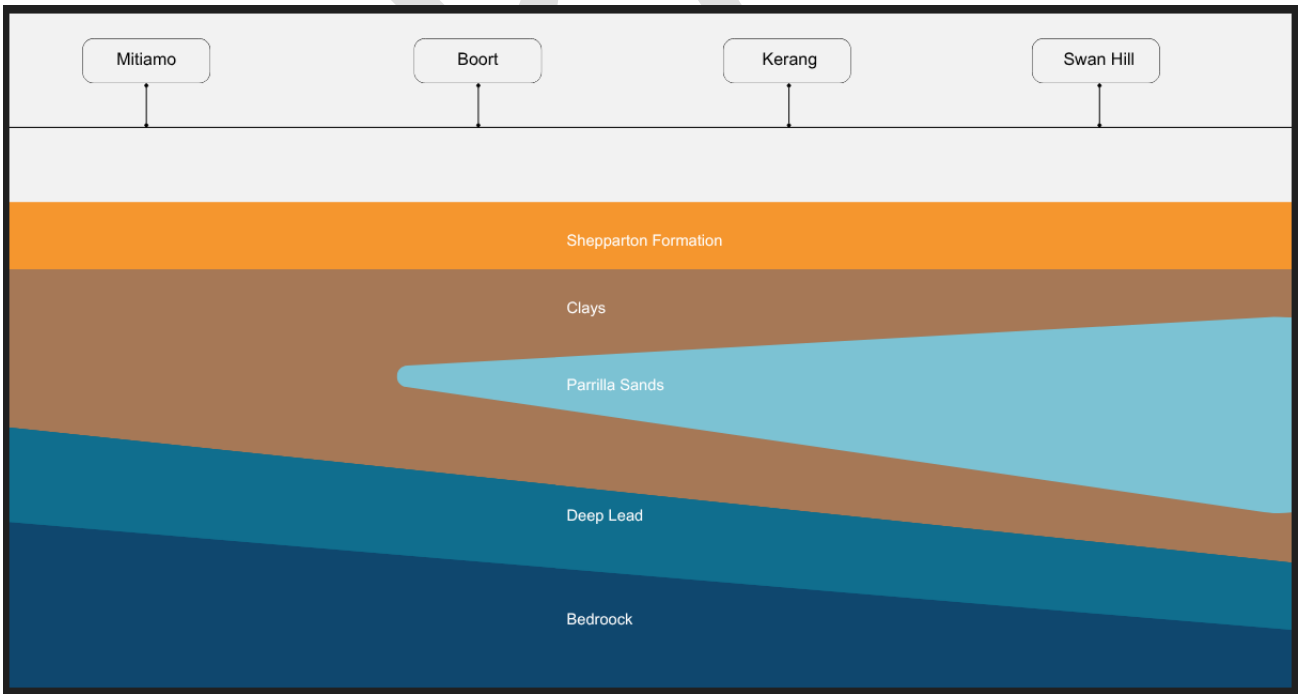


Figure 3 A visual representation of the aquifers of the Lower Loddon Plains

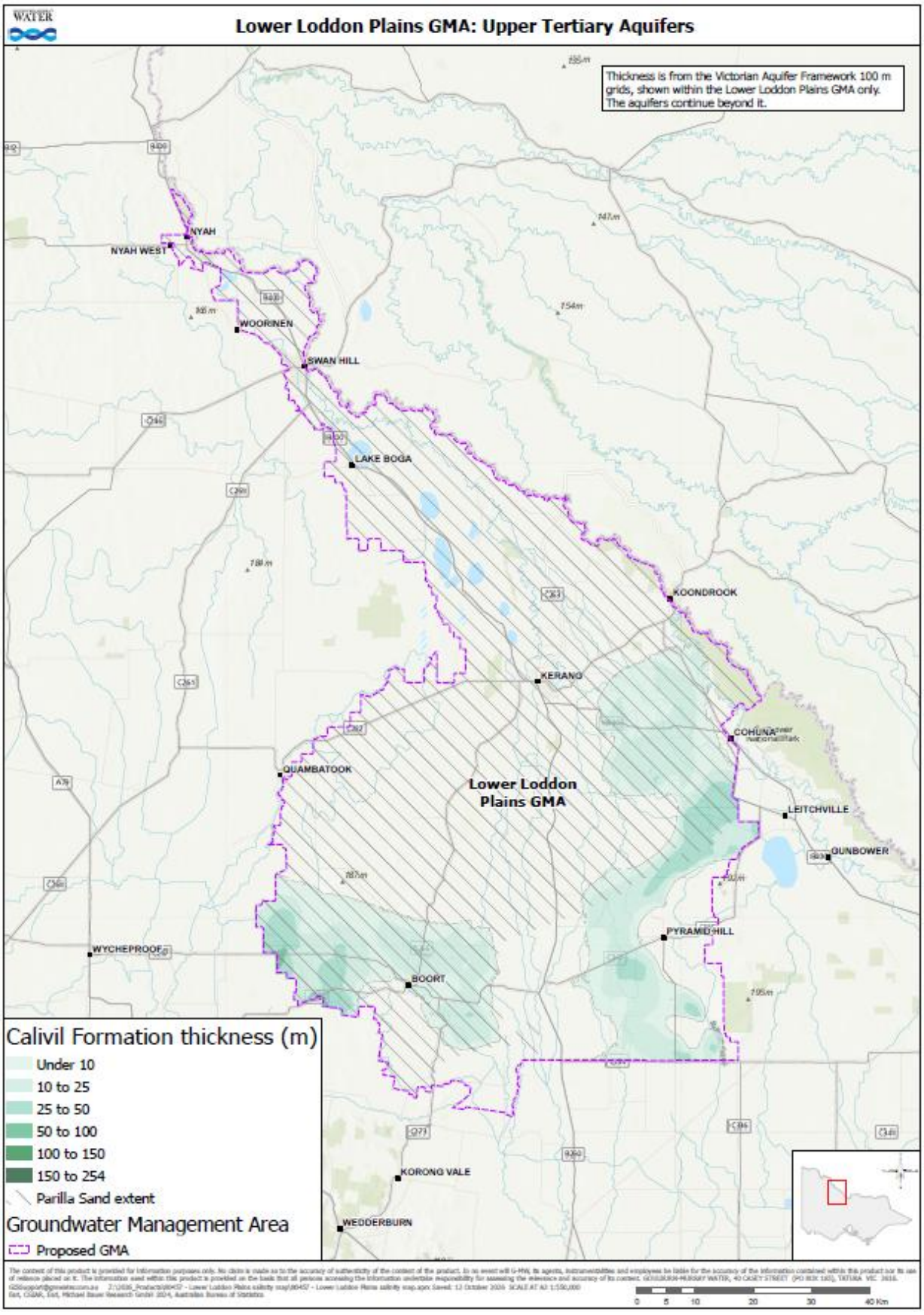


Figure 4 Calivil Formation thickness across the Lower Loddon Plains GMA

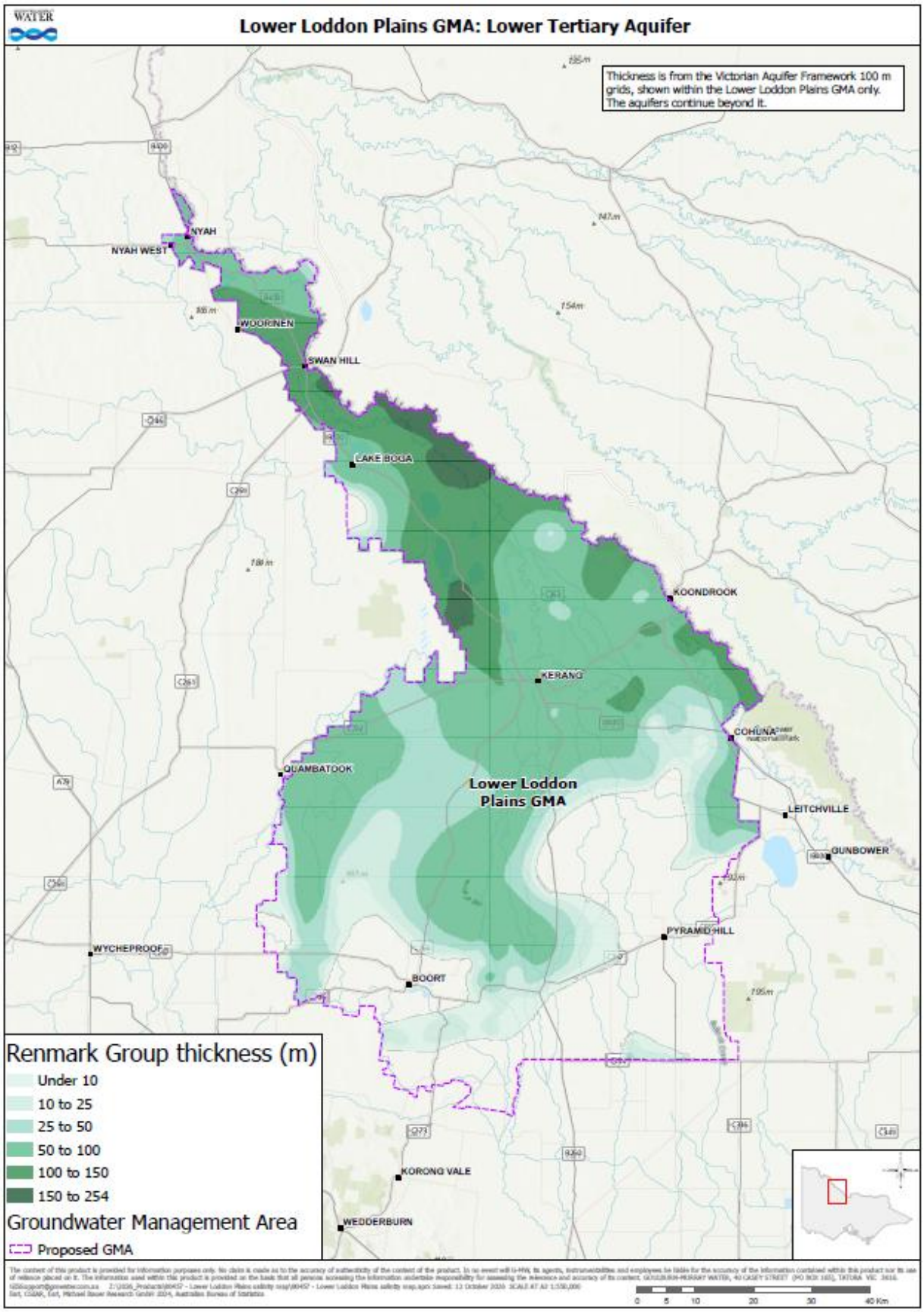


Figure 5 Calivil Formation thickness across the Lower Loddon Plains GMA

2.3 Groundwater salinity

Salinity varies across the GMA and between aquifer formations, although groundwater from all formations is generally too saline to be used as a primary source of irrigation water without treatment to remove salts or blending with fresher water, a practice known as shandying.

Measured salinity can be as high as 65,000 µS/cm in the Shepparton Formation and 20,000 µS/cm in the underlying Calivil Formation (deep lead). For comparison, the average salinity of sea water is approximately 55,000 µS/cm.

Typical salinities found in State Observation Bores located across the GMA are shown for each of the major aquifer sequences in Table 1.

Table 1 Typical Salinity found in each of the major aquifer sequences in the GMA

Aquifer	Minimum (µS/cm)	Maximum (µS/cm)
102 UTQA – Shepparton Formation	3,200	65,200
104 UTAM – Parilla Sand	6,130	39,000
105 UTAF – Calivil Formation	16,038	19,800
111 LTA – Renmark Group	14,650	46,000

Note: A simple salinity converter table can be seen on page 4, this may assist comparing EC to PPM measurements. Other calculators for other units can be found online, and please contact GMW if you require any assistance to understand salinity measurements.

The salinity of shallow groundwater may be lower near waterways (including the Murray and Loddon Rivers), wetlands and channels that receive or convey irrigation water from regulated systems, including water delivered for environmental or cultural purposes. Salinity can be higher in areas subject to seasonal inundation, where evaporation concentrates salts and where there is a history of high-water tables associated with upward pressure from the underlying Parilla Sands aquifer system. This high salinity is particularly notable between Kerang and Swan Hill, south of Lake Boga.

There are numerous State Observation Bores located across the Lower Loddon Plains GMA which have been monitored periodically over approximately the last 40 years. These SOBN bores have been constructed across the Shepparton Formation, Parilla Sands, Calivil Formation, Renmark and Bedrock aquifers. Verified salinity sampling from State Observation Bores in different aquifer sequences in the GMA are shown for reference in Figure 6, which shows the salinity reading for the most recent laboratory measurement recorded as µS/cm (EC). For viewing ease nested sites are offset approx. 1.2 km from their actual location with the shallowest bore located at 12 o'clock and then clockwise by depth.

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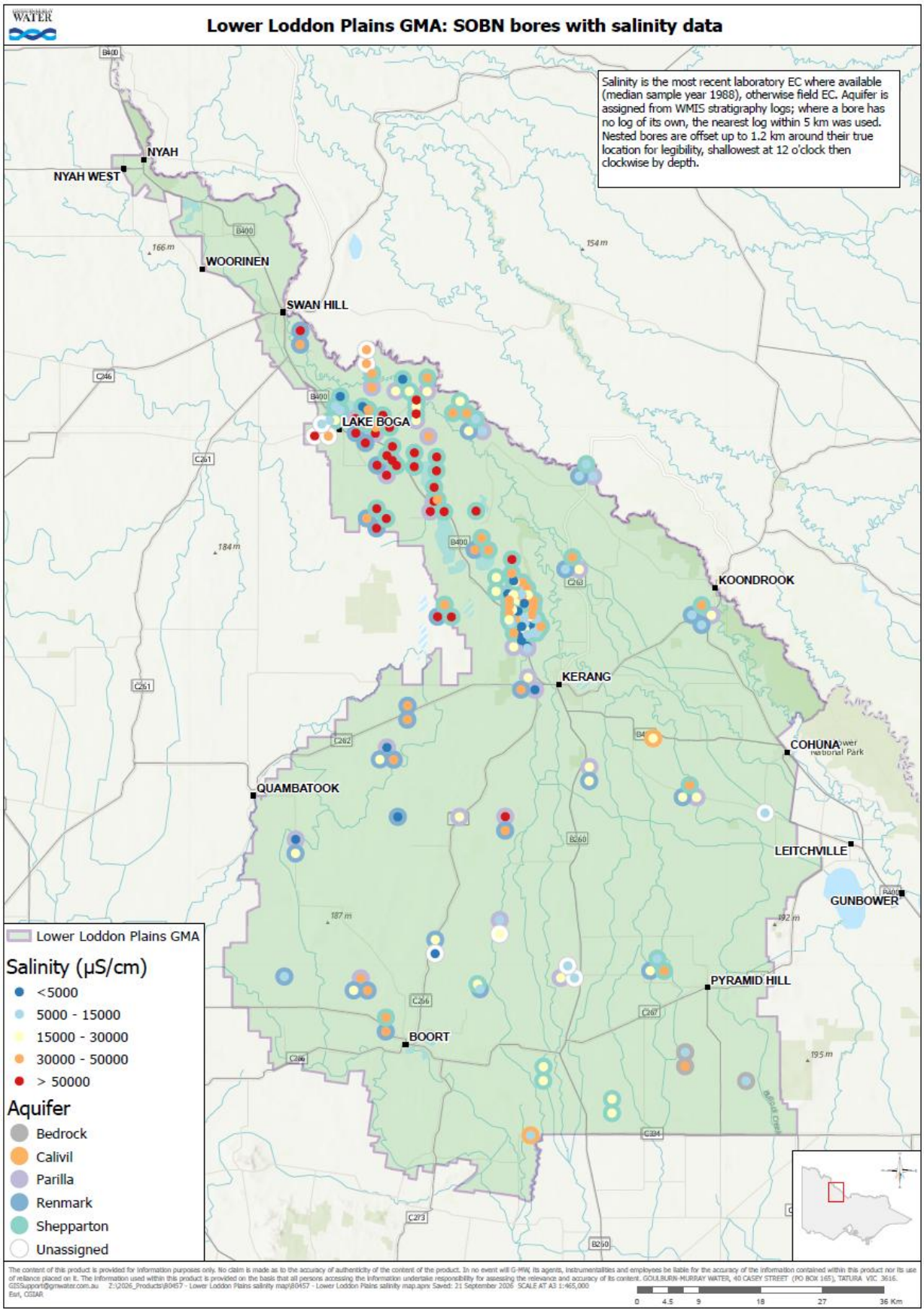


Figure 6 Verified Salinity in State Observation Bores in the Lower Loddon GMA

Note: Licensed groundwater users who would like to test their groundwater for salinity, can contact GMW to request a sample bottle. GMW will test the sample and provide results.

2.4 Use of Saline groundwater and assessment considerations

2.4.1 Context and emerging uses

Despite the practical difficulties associated with managing and using saline groundwater, there has been interest in developing saline groundwater resources in areas adjacent to the Lower Loddon GMA. Current and emerging uses include salt harvesting, dust suppression, cooling, supplementing other irrigation sources, desalination for irrigation. A significant emerging consideration is the potential need for dewatering to support mining and extractive industries, and mineral extraction, including the harvesting of rare earth metals.

2.4.2 Salinity management challenges

The use of saline groundwater presents significant issues relating to appropriate use, storage of saline brine removed from treatment processes, prevention of salt movement to neighbouring properties and the environment. Of particular concern for agriculture is the prevention of salt build up in soils which can permanently reduce agricultural potential. Any process that involves removal of salts from saline groundwater results in concentrated salt byproduct requiring significant investment in engineering to manage.

As an example of the difficulty in using saline water, the salinity of seawater in temperate zones is typically around 50,000 to 55,000 µS/cm, or about 25,000 to 27,500 ppm. Assuming a groundwater salinity of 50,000 µS/cm, achieving a sustainable irrigation water quality by mixing with Murray River water at Swan Hill, at approximately 265 µS/cm, would require a shandying ratio of about 92:1. Alternatively, around 34 tonnes of salt would need to be removed per megalitre of water treated as a brine stream.

Strategies for managing extracted groundwater and brine must be developed on a site-specific basis. Relevant factors include geography, soil type, flood risk, proposed use, and the ongoing capacity to manage salt accumulation. Larger or more complex proposals are likely to require detailed approval processes involving GMW, relevant agencies and council permissions.

When assessing an application for a new groundwater licence, GMW must consider potential impacts on the environment and on other authorised water users. Key risks associated with saline groundwater use in agriculture include salinisation of shallow aquifers, migration of salt to neighbouring properties, and impacts on connected features such as waterways or remnant vegetation.

In situations where an applicant wishes to develop a groundwater licence with lower groundwater salinity than surrounding areas, careful investigation is required into the source of the water and consideration of any other existing beneficial uses associated with that source. This is because large scale extraction of groundwater can change groundwater pressure relationships which in turn could draw in saline water from surrounding aquifers. Changes to the salinity of large aquifer systems, such as deep lead systems, are generally not possible to reverse. A precautionary approach to the level of entitlement granted is therefore required to protect values for future generations.

2.4.3 Irrigation Development Guidelines process

GMW works with relevant agencies, including the North Central Catchment Management Authority and Agriculture Victoria, to assess the potential impacts of saline water use associated with new groundwater licence applications and licence transfers. This process uses the Irrigation Development Guidelines, under which Agriculture Victoria determines requirements for the use of saline water. The outcome is an Irrigation Development Plan, which must be implemented by the developer. The northern Victorian Irrigation Development guidelines can be found at Northern Victoria Irrigation Development Guidelines.

GMW will refer new applications, and transfers from existing licence holders to Agriculture Victoria. Agriculture Victoria who will determine the maximum volume of groundwater that can be applied to a property. This advice will form the cap on the total entitlement that can be considered for an individual property based on the sources of water and how they are used. A review of any such cap can be requested should any on-farm determining factors change.

In general, taking into account other entitlements available to the applicant, the objective will be to maintain a net applied salinity of no more than 800 µS/cm. Higher application levels may be considered where there are additional controls, such as on-farm works to improve salt management and monitoring, use of water over a larger area, or access to additional water sources for shandying.

Failure to develop or implement the requirements of an approved Irrigation Development Plan may result in suspension of licence use, cancellation of the licence, or non-renewal at the end of the licence term.

2.4.4 Applications for use other than direct irrigation

The Irrigation Development Guidelines process applies only to applications where saline groundwater is proposed to be applied directly for irrigation. Applications for commercial use, or those involving desalination of groundwater, will be assessed individually. These applications are often more complex because they require separate approvals for the management of desalinated brine and are outside the scope of this Plan.

2.4.5 Assessing licence applications

GMW conducts both a field-based inspection and a technical assessment against relevant databases to determine the likely potential for interaction for all works licence and groundwater licence applications. GMW uses qualified and experienced staff along with hydrogeological modelling tools to assess potential risks of an application. GMW may require advertising and notification requirements of potentially affected parties, or values which may vary depending on the likely risks of the application. Where necessary, GMW refers applications to relevant agencies, or organisations to determine potential values that may be affected.

Processes used by GMW to develop a high level of confidence regarding the potential impacts of applications include:

- Site based inspections for applications, including identification of key features and risks against relevant sections of the Act;
- Advertising and notifications of applications, including opportunity for submissions from people or organisations whose interests may be affected;
- Referral to relevant agencies regarding environmental values of Groundwater Dependant Ecosystems (GDE)– Compliance with the Ministerial Guidelines for High Value Groundwater Dependant Ecosystems 2015, or its replacement;
- Hydrogeological investigations (Groundwater Pumping Impact Assessments) with emphasis on assessing both real world and theoretical impacts to identified assets;
- Use of conservative entitlement allocations;
- Maintenance of a Pump Testing Database for Aquifer Parameters;
- Employment of qualified and experienced staff;
- Use of expert external review of applications where required;
- Use of an extensive groundwater monitoring network.

When additional information is required for GMW to make a decision, GMW will request further information from the applicant in consideration of sections 51(2)(b)(ii) of the Act, or section 67(2)(b)(ii) in the case of

works (i.e. bore construction). Depending on the circumstances, this may occur at either the application for construction of a bore or at the stage of application for a new groundwater licence or transfer of entitlement (or both together).

Failure to provide required information or to a required standard will result in an application being incomplete and refused. Where risk factors have been identified that require additional analysis and interpretation of technical information, an additional fee may be required by GMW to finalise assessment of the application.

Rule 1. Use of saline groundwater for irrigation (page 19)

a) Upon receiving an application for either a new groundwater licence or transfer of a licence for irrigation purposes, GMW will refer the application to Agriculture Victoria for consideration against the Irrigation Development Guidelines (IDGs).

b) Recommendations under the IDG's to GMW will form a cap on the volume that can be applied for at an individual property level, for irrigation purposes.

c) Groundwater licence applications for uses involving desalination or other than irrigation will be assessed on an individual basis.

d) Failure to implement an IDG or any other requirements for the management of saline water associated with a groundwater licence may result in suspension from use, cancellation, or non-renewal of a licence.

2.5 Considering impacts to values

Groundwater extraction has the potential to impact on a range of values, including environmental features such as wetlands and river flow. The potential impacts of groundwater extraction vary depending on the local geology, the aquifer that water is taken from, proximity to features, and/or the cumulative impacts of extraction. In general, groundwater taken from deep bores which target deep aquifers will have lower risks to surface water features than shallow bores. Applications in proximity to wetlands, waterways or other features and may require complex investigation.

Groundwater from bores targeting deeper aquifers tend to be more likely to have smaller individual impacts across large areas but have different risks, such as the potential to cause long term impacts to the resource or other existing users targeting the same aquifer system. Applications for groundwater to be taken from deep bores are generally constructed to target water in deep lead aquifers and tend to be associated with large licence volumes to take and use groundwater to justify the high cost of bore construction.

Groundwater extraction can alter the water level within wetlands from shallow groundwater extraction by increasing leakage, or by reducing pressures that brings groundwater to the surface. These impacts if they occur can be seasonal or long term. Extraction near surface water features—including rivers, streams and wetlands—may also affect water resources by drawing water deliberately supplied to these systems for consumptive, environmental or cultural purposes, including water from the Environmental Water Reserve, which is an entitlement set aside for the environment. Water from the Environmental Water Reserve is a legal entitlement for the environment which must be protected.

Potential impacts on GDE's relate to the values maintained by groundwater, both at a local and regional scale and the potential interaction between the wetland in question and the aquifer being accessed. Changes to groundwater resources that interacts with water features, or GDEs can alter vegetation communities or change the condition of wetlands.

Key considerations in determining the potential impacts on wetlands and other features affected by groundwater pumping relate to the extent of hydrogeological connection. Key variables include the source

of water (targeted aquifer), clay layering, proximity and scale of extraction and the attributes of the groundwater system that affect how any impacts might occur. The potential impact of extraction from shallow bores is shown in Figure 7 below.

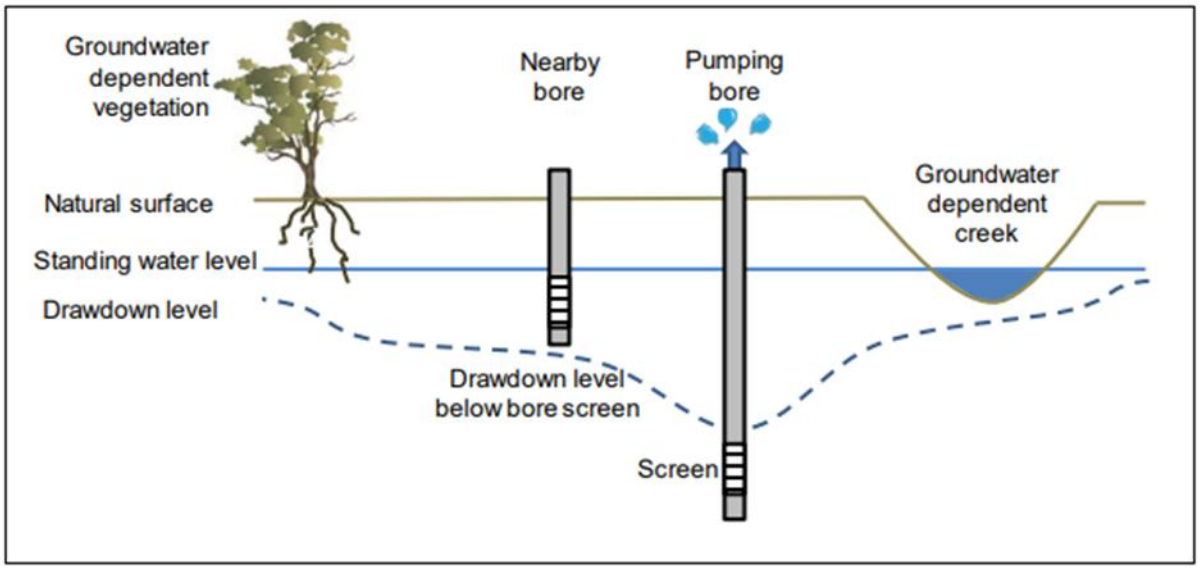


Figure 7 Potential Impact to Groundwater Dependant Values Associated with Pumping from shallow bores

Figure 7 is a representation of how groundwater pumping lowers the groundwater level around the bore being pumped. This decline in groundwater level is referred to as a drawdown cone. The extent of drawdown depends primarily on the properties of the aquifer, as well as the pumping rate and duration. Drawdown decreases with distance from the pumping bore.

In general, groundwater taken from deep lead systems within the GMA at moderate levels of extraction will have limited to negligible interaction with overlying wetlands across the GMA due to significant deep layering of clays that isolate groundwater in what is known as aquitards which result in a confined aquifer system. Impacts could occur in areas of intensive extraction and/or an area where this clay layering may be less developed.

2.6 Groundwater dependent ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems which rely in part or in full on groundwater for their existence or health. Types of GDEs include the following:

- Aquatic GDEs
- Terrestrial GDEs
- Subterranean GDEs

Aquatic GDEs are those such as gaining rivers and streams which obtain groundwater by seepage, contributing to surface water flows. These gaining streams can be observed during drought periods where surface water flows have dried with only pools of water present in the streambed. These pools are often the surface expression of groundwater and are important refuges for aquatic flora and fauna. Long Lake is just one example of a high value aquatic GDE within the Lower Loddon Plains area.

Terrestrial GDEs are often the most obvious, as groundwater supports the growth of flora species such as Eucalypts which can be either located in a riparian environment or further away from rivers and streams in stands of trees. These flora species rely on the sub-surface expression of groundwater to support their growth.

Subterranean GDEs are ecosystems which exist within the aquifers and often contain unique biota that only exist underground.

The Bureau of Meteorology GDE Atlas identified that there are moderate to high potential GDEs across the Lower Loddon Plains area. Some of these GDE's include vegetation types such as Lignum Swampy Woodland, Palustrine: Temporary freshwater swamps and Lacustrine: Temporary saline lakes. Within the Lower Loddon Plains GMA there are numerous surface water features, however those such as Lake Boga have not been classified as a GDE because of their reliance on surface water runoff from flooding and from the delivery of surface water from the irrigation channel network.

In consultation with groundwater users and stakeholders, various groundwater dependent values have been identified within the Lower Loddon Plains GMA. These values have informed the development of the management objectives. Figures 8 and 9 show signs recognising the value of the lakes to the community.

In assessing all applications, GMW will have regard to relevant guidance from the Department of Energy, Environment and Climate Action (DEECA) for assessing impacts to groundwater dependant ecosystems and undertake relevant referrals to relevant agencies and Traditional Owners. Where risks have been identified, GMW may require applicants to provide specialist technical investigation to inform a decision in conjunction with any other technical information required to inform risks relating to the application.



Figure 8 The welcome to sign for the Kerang Lakes within the Lower Loddon Plains GMA

2.7 Waterways and wetlands

There are some well-known waterways and wetlands within the Lower Loddon Plains GMA including the Kerang Lakes, a collective term that describes the 23 lakes and swamps which have been recognised for their ecological values under the Ramsar Convention. These waterways and wetlands are also recognised for their cultural, recreational and commercial values.

Lake Charm is a large freshwater lake and is popular for water sports including swimming, water skiing, fishing and kayaking and regularly hosts the Victorian Ski Racing titles which attracts competitor from all over Australia (Gannawarra Shire).

Lake Boga is another of the freshwater lakes in the area which also attracts visitors for its recreational values but also visitors for its historical significance being the home to the Lake Boga Catalina Flying Boat Museum. This museum show cases artefacts from World War II when Lake Boga was the Number one Flying Boat Repair Depot.

2.8 Shallow groundwater licence applications

Applicants should be aware that groundwater taken from shallow groundwater systems has the highest potential to impact on water features such as wetlands, GDEs or waterways and associated cultural values.

Every application received by GMW is assessed on its merits because the circumstances of every application are different. This means the nature of the proposed extraction, including, distance from water dependant features and other authorised users, hydrogeology, volumes sought and their intended use. Similar considerations apply to both bore construction (section 67) and take and use applications for a licensed entitlement (section 51).

Where the hydrogeology of a site is not well understood, GMW strongly advises applicants to conduct test drilling under the supervision of a qualified hydrogeologist to inform an application for a production bore for irrigation or commercial purposes. GMW may also require the applicant to employ the services of relevant professionals to ascertain any additional information required to decide on an application, for instance, if the construction details of an existing bore intended for irrigation use are not well known.

Note: Licences to construct bores contain a minimum setback requirement from waterways or works such as irrigation channels. GMW does not include arbitrary acceptable distance criteria for applications for taking water, rather the assessment is based on a high level of understanding of the risks an individual application may pose.

GMW may not accept applications where an existing bore has been constructed as a Domestic and Stock bore, given that the bore construction licence conditions are different to those applied to irrigation bores.

During the application process, GMW will advise applicants of potential risks in siting bores, or application for an associated licence to take and use water as part of the application process.

Consideration of impacts to cultural water values

The Plan area overlays the traditional lands of the Wamba Wemba, Barapa Barapa and Dja Dja Wurrung (Djarra) peoples. For Aboriginal peoples, wetlands and rivers connected to groundwater resources are far more than sources of water. They are places of cultural identity and deep spiritual connection, supporting food gathering, resource use, social gathering and knowledge transfer that have sustained life for thousands of years. Ongoing involvement in the management and protection of waterways, including rivers and wetlands, remains central to cultural identity and aspirations for custodianship of Country for future generations.

Wetlands within the GMA include Thirds Lake, Middle Lake and the Reedy Lake complex, which form part of the Kerang Wetlands system and are listed as Ramsar sites with significant environmental and cultural values. Important cultural locations are also known to exist in the area, including mounds, graves, hearths, artefacts, surface scatters and scarred trees (NCCMA).

In developing this Plan, GMW has consulted with Traditional Owners and the North Central Catchment Management Authority (NCCMA). GMW will continue to build on the knowledge, understanding and experience of Traditional Owners to inform natural resource decision-making. While this Plan does not set resource limits and therefore does not create direct resource allocation consequences, it provides an avenue for Traditional Owners to participate in resource decision-making and the broader water industry.

GMW will continue to develop relationships and processes that support Traditional Owner involvement in decision-making. As an example of this commitment, GMW is a member of the Wanggal partnership group, which enables water agencies on Djandak (country) to work collaboratively to deliver outcomes that further Djaara's Gatjin Strategy, Dhelkunyangu Gatjin. Learnings from this process will inform relationship-building and policy outcomes within GMW's control, helping to support broader government strategies.

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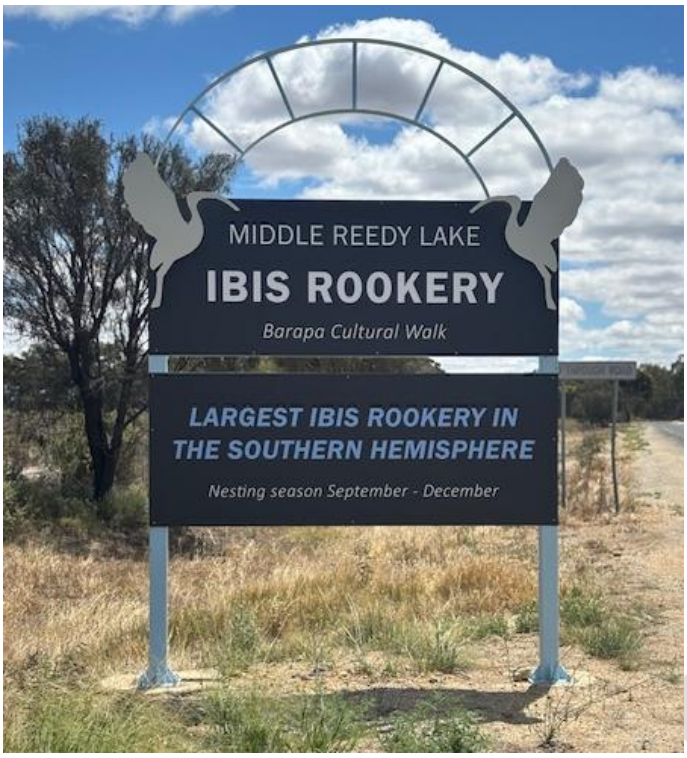


Figure 9 Sign at the entrance to Middle Reedy Lake advertising the Barapa Cultural Walk at the Ibis Rookery

GMW is committed to working with Traditional Owners in the future management of water resources, including by supporting outcomes identified through Water is Life: Traditional Owner Access to Water Roadmap (DELWP 2022).

Water is Life: Traditional Owner Access to Water Roadmap can be viewed here.

Where GMW has identified that risks to other existing groundwater users, surface water features, resources, groundwater dependant ecosystems, or cultural value exist, GMW may require detailed technical information to be provided by the applicant to inform a decision. The complexity of the assessment will depend on the scale, location and issues identified.

2.9 Managing limits to groundwater entitlements

The Lower Loddon Plains GMA covers an area north of the existing Mid Loddon GMA which is an area which currently has low groundwater commitment levels. The potential issues associated with extraction in the GMA centre mostly around the potential for large scale applications, use of saline resources and potential targeting of areas in proximity to waterways including wetlands.

The Plan does not seek to set a resource limit; however, this may change if large applications arise and/or specific issues regarding future management of the resource are identified. Large volume applications, for instance over 1,000 ML/yr may be required to undertake technical assessments with a view of informing future resource management decisions.

At the time of writing, entitlements to groundwater total five take and use licences, for a combined volume of 3,393.4 ML/year. Licences are concentrated mainly on the eastern side of the GMA with the largest licence being operated as a commercial salt harvesting operation, supported by Goulburn Murray Water and the Murray Darling Basin Authority to prevent up to 22,000 tonnes per year of salt from reaching the Murray River.

Applications near adjoining GMA boundaries

Applications near the boundaries of the Mid Loddon and West Campaspe GMAs will be assessed on their individual merits with a view to determining whether the take of groundwater at the proposed site is likely to impact on the groundwater resource in the adjoining area.

Depending on the location, scale and potential impacts of a proposed development, GMW may require a detailed technical assessment before deciding whether to approve a licence. An applicant may be required to purchase a proportion of the entitlement being sought from existing licence holders in the adjoining area to allow for a licence to be established.

This approach is intended to minimise the risk that new development in the Lower Loddon Plains GMA will affect existing users or resource limits in an adjoining management area. This is particularly important for the Mid Loddon GMA, which is highly developed and managed under the Mid Loddon GMA Local Management Plan. A Permissible Consumptive Volume set by the Minister for Water caps the resource in that area and prevents GMW from issuing additional entitlement. At the time of writing, no equivalent limit applies to the West Campaspe GMA.

This boundary-related technical work is additional to any other assessment required by GMW for the application.

Rule 2. Managing entitlement limits to groundwater (page 24)

a) Where an application arises near the GMA boundary, applicants may be required to undertake detailed technical investigation as part of any application.

b) Subject to GMW's consideration of rule 2(a), applicants may be required to purchase licensed groundwater entitlement from an adjoining GMA to establish a licence.

2.10 Transfer of licensed groundwater entitlements

A person who owns or has an interest in land and a bore may apply to transfer licensed groundwater entitlement to, or from another person. All applications must be assessed against relevant sections of the Act, namely section 62, which references sections 53, and 40. A person may apply for a transfer either on a permanent basis, or temporarily, for up to five years.

Given the GMA is not subject to a formal cap (Permissible Consumptive Volume) under section 22 of the Act, the potential exists that the cost of applications to transfer licensed groundwater entitlement from an already licensed user may be less than purchasing new entitlement from GMW. The fee associated with the purchase of entitlement from GMW is referred to as a Capital Charge which is subject to change annually and can be found on GMW's website.

When considering the relative costs of development, potential applicants either for purchase of Capital Charge water, or that from another user, should factor in the potential costs of technical investigations. This is particularly the case if making an application in proximity to water features, other licensed users or if a property is near any other GMA boundary.

In addition to the matters discussed above, all applications will be assessed against the requirements of the Act and the Murray Darling Basin Plan (MDBP). It should be noted that the MDBP requires that transfers only occur from areas that are hydraulically connected. This means that in most cases existing licence holders will be limited to transfer to other applicants with bores within the same aquifer system. For example, where bores access water from the Deep Lead, transfers will be limited to other users with bores accessing water from the Deep Lead. These rules will also apply similarly for licences within the Shepparton Formation or Fractured Bedrock. In most cases this will mean that transfer opportunities may be limited to transfer between licences if the existing entitlement is associated with a different aquifer system.

As has been described, the resource within the GMA is considered to be saline. This means that excessive extraction and use have the potential to impact on both the environment and agricultural production. Potential purchasers should note that applications will be assessed against a volume limit that is considered sustainable, through the IDG process. Assessment of a safe volume for irrigation is conducted by Agriculture Victoria, who provide advice to GMW in any licence consideration.

This means that for most existing groundwater licence holders, in general, no increase in licensed volume for irrigation purposes will be permitted unless there have been significant changes to their operation. This could include changes to the land area that the water is to be used or the treatment of saline water (involving the removal of salt) is incorporated into the irrigation management plans.

The assessment applicable to temporary (limited terms arrangements) or permanent transfers is the same, given the resources is saline. Advertising for all transfers will be required at the applicant's expense.

It is recommended that anyone contemplating the transferring in additional groundwater entitlement contact Agriculture Victoria and GMW prior to making application to discuss opportunities and risks prior to making an application. It is strongly recommended that if a person is contemplating transferring licensed entitlement from another licence holder, that payment be made to that person subject to the outcome of GMW's assessment of any application.

Rule 3. Transfer of licensed entitlements to groundwater (page 25)

a) Transfers of licensed groundwater will be limited to the consideration of "sufficient hydrological connectivity" required by the Murray Darling Basin Plan.

b) Any person looking to purchase additional entitlement will be limited to a maximum property-based limit advised to GMW by the IDG process.

c) Applicants may be required to undertake technical investigation in the same way as applicants for new licences if there are identified risk factors associated with the application.

d) Any application to transfer entitlement may be referred to relevant agencies for advice, depending on the range of risks identified by the authority.

2.11 Monitoring groundwater use

Licensed bores will be metered in consideration of GMW metering policy which can be found on the GMW website. This means that currently any licence to take groundwater of 20 ML/year or more for a licensable purpose such as irrigation, commercial or industrial purposes will be metered at the applicant's expense. The type of meter and design will be determined by a Customer Service Officer who will oversee the meter purchase, installation, and ongoing maintenance and replacement of the meter. Metering may be required below the 20 ML/year threshold at the discretion of the Minister's Delegate.

All meters will be read at least once per year which will generally be at the end of the water year. This provides a start meter reading for the following season. All meter reading and usage information is recorded by GMW and entered into the Victorian Water Register.

Should licence holders use groundwater after the end of season meter reading has been taken, the onus is on the licence holder to report the new end of season meter reading otherwise the use will be recorded as use in against the new season.

Rule 4. Monitoring groundwater use (page 26)

a) Metering requirements will be consistent with GMW's metering policy.

b) GMW will read flow meters on licensed bores at least once annually and record use in the Victorian Water Register.

2.12 Groundwater level monitoring

GMW monitors changes to groundwater levels and quality through use of bores established by the Victorian Government known as the State Observation Bore Network (SOBN).

There are 16 actively monitored SOBN bores located within the Lower Loddon Plains GMA.

Some of these bores are in nested sites where there are multiple bores screened at different depths and in different aquifers which allows observations to be made on aspects of aquifer management including, groundwater levels within each aquifer, hydraulic connectivity between aquifers and/or water quality including salinity. Figure 10 shows an example of a nested monitoring site.



Figure 10 An example of a Nested State Observation Bore site showing bores that monitor different aquifer layers near

The observation bores are either monitored on a quarterly, monthly or hourly basis via telemetering or spot inspections. Baseline information is available for several bores which is sufficient for monitoring any long-term changes to the groundwater resource within the GMA.

The spatial and depth distribution of the existing monitoring network provides the opportunity to monitor changes across the GMA including depth to groundwater levels and where necessary, water quality parameters such as salinity.

GMW will review monitoring coverage on an as needs basis, to address any change in risks, including with any new development. This process will ensure that available funds are spent on the highest priority concerns which can be used to inform management outcomes associated with the use of groundwater. Where an application is in an area where a observation bore is currently not active, GMA may require the

applicant pay for additional monitoring in non-active SOBN bores or contribute to the costs of a new bore to help inform adequate monitoring of the resource.

GMW will report annually on groundwater levels at three sites across the GMA.

These include a bedrock bore at Mitiamo (Figure 11), a nested site at Mitiamo which monitored the Shepparton Formation, Calivil Formation and Parilla sands at Lake Boga (Figure 12) and the Shepparton Formation at Boort (Figure 13).

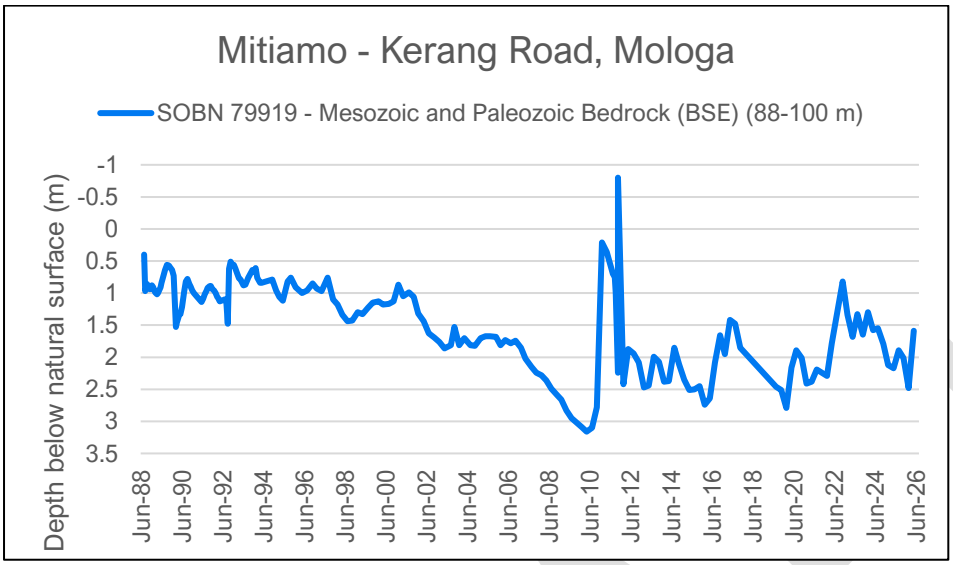


Figure 11 Groundwater level monitoring in the Bedrock at Mologa

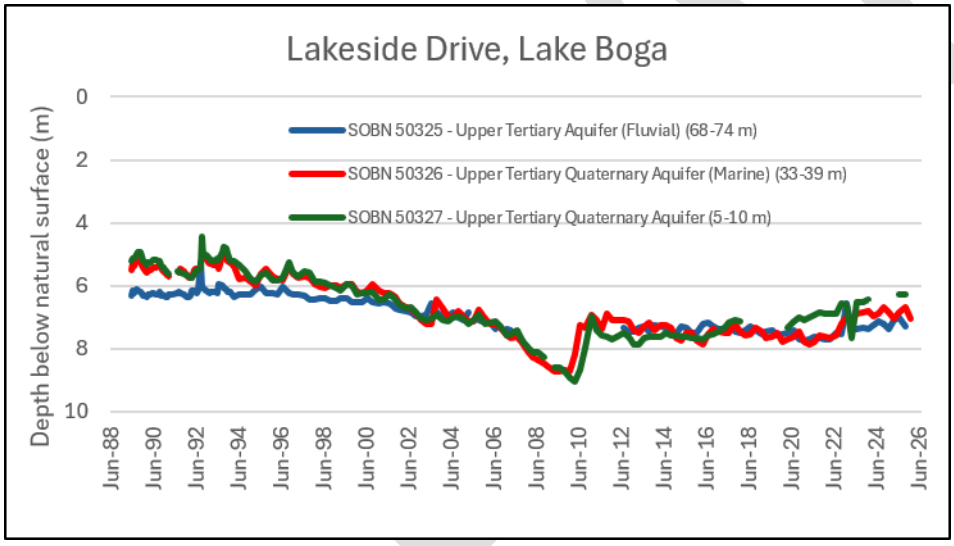


Figure 12 Groundwater level monitoring across the Shepparton Formation, Calivil Formation and Parilla Sands at Lake Boga

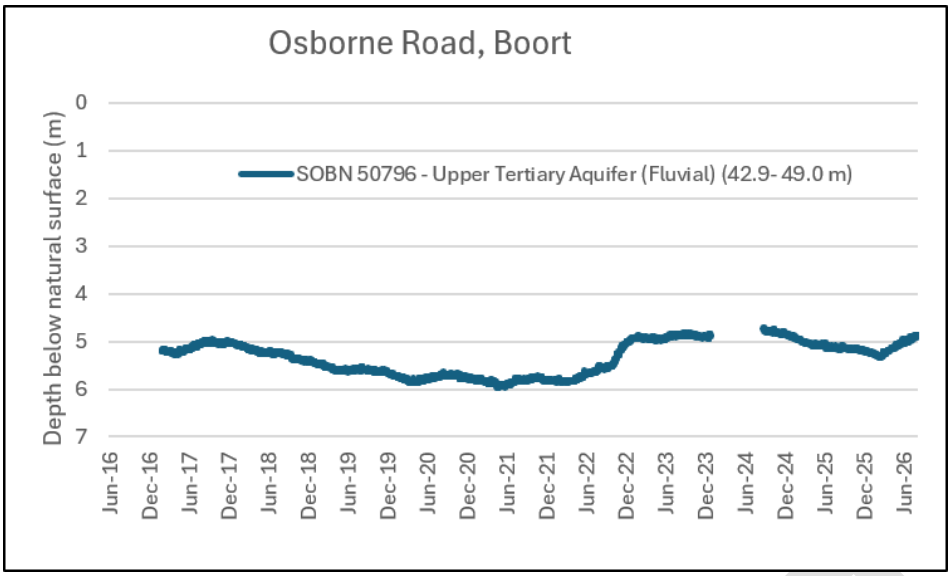


Figure 13 Groundwater level monitoring in the Calivil Formation at Boort

Rule 5. Monitoring the impacts of groundwater extraction (page 28)

a) GMW will review the adequacy of existing groundwater level monitoring over time, as development occurs the monitored bores may vary.

2.13 Groundwater salinity monitoring

Monitoring data is available for a suit of State Observation Bores within the Lower Loddon Plains GMA with salinity levels ranging from 3,200 to 65,200 EC depending on the aquifer sampled (table one). This data was obtained from the water measurement Information System website (WMIS).

Table 2 Salinity data for some bore SOBN bores within Lower Loddon Plains GMA

SOBN Bore	Depth (m)	Screened Level (m)	Aquifer	Salinity Level	Monitoring date
58524	19	16 – 18	Upper Tertiary Quaternary Aquifer (UTQA)	65,200	12/12/2011
50977	18	4 - 16	Upper Tertiary Quaternary Aquifer (UTQA)	37,000	24/11/2011
87944	20	11 - 14	Quaternary Aquifer (QA)	8,750	14/12/2011
50327	11	5 - 11	Upper Tertiary Quaternary Aquifer (UTQA)	3,200	19/09/1989
73487	44	40 - 43	Upper Tertiary Quaternary Aquifer (UTQA)	24,500	15/12/2011

73490	8	5 - 7	Upper Tertiary Quaternary Aquifer (UTQA)	18,700	15/12/2011
WRK117057			Lower Tertiary Aquifer (LTA)	NA	NA
58526	257.6	221 - 224	Lower Tertiary Aquifer (LTA)	46,000	9/12/2011
82757	214	126.1 - 129.4	Lower Tertiary Aquifer (LTA	14,650	5/12/2011
82754	16	9 - 13	Upper Tertiary Quaternary Aquifer (UTQ)	47,000	21/05/1987
76761	80.5	73 – 74.5	Upper Tertiary Aquifer Fluvial (UTAF)	16,038	31/10/2023
75851	42	32 – 38	Upper Tertiary Aquifer Marine (UTAM)	6,130	24/11/2011
50984	76	66 - 72	Lower Tertiary Aquifer (LTA)	39,500	24/11/2011
50980	29	22 – 26	Upper Tertiary Aquifer Marine (UTAM)	39,000	17/12/1986
108354	111	87 – 99	Upper Tertiary Aquifer Fluvial (UTAF)	19,800	28/11/2011
79919	100	88 - 100	Mesozoic and Palaeozoic Bedrock (BSE)	34,700	23/11/2011

2.14 Plan Implementation and reporting

The Lower Loddon Plains GMA LMP is effective immediately from the time the final version is published on the GMW website.

The annual newsletter will be completed at the end of each water year and will be posted on the GMA website prior to 15 November each year. This newsletter will detail the previous water year's licence volume, use and groundwater monitoring program.

Plan review and amendment

Although GMW has used its best efforts to produce an initial plan for implementation in the GMA, GMW acknowledges that the real-world impacts of any large scale groundwater use in the area is relatively untested. Many aspects of the Plan can be considered as benchmarks to assess change. Similarly,

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changes to policies, legislation or other matters that may impact on the Plan may need to be incorporated over time.

As outlined in this document GMW is undertaking a range of monitoring to inform how the system behaves over time within what is a reasonable level of risk and what this may mean for management.

GMW will review available monitoring information and relevant policy over time. Any matters that may indicate a need for change will be highlighted where possible in an annual review through the Annual Newsletter mentioned above, or on GMW's website. Any significant proposed changes to rules will involve consultation with licence holders, customer committees and the broader community prior to implementation.

3. References

Ag Vic https://www.necma.vic.gov.au/Solutions-Resources/Sustainable-Irrigation/Northern-Victoria-Irrigation-Development-Guidelines

DEECA; https://www.water.vic.gov.au/our-programs/aboriginal-water-program/water-is-life-roadmap

Dja Dja Wurrung; https://djandak.com.au/wp-content/uploads/2023/10/Dhelkunyangu-Gatjin-Working-together-to-heal-water-Gatjin-Strategy-2023.pdf

Gannawarra Shire, https://www.visitswanhill.com.au/operator/kerang-lakes/

NCCMA: https://www.nccma.vic.gov.au/media/documents/nccma-43880_-_river_from_an_indigenous_perspective_-_fact_sheet.pdf

WMIS; Water Measurement Information Systems https://data.water.vic.gov.au/

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