



Strathbogie Groundwater Management Area

Local Management Plan

July 2013



Cover images (Left to Right):

Tea-tree swamp with some remnant Mountain Swamp Gums -Spring creek catchment (Bertram Lobert),

Seven Creeks at Polly McQuinns gauging station (North East Region Monitoring Site Summary Report 405234B- Thiess),

Macquarie Perch © MDBA; Photographer Arthur Mostead

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DM# 3486113

Summary of rules in the Strathbogie groundwater local management plan

Rule 1: Cap on groundwater entitlement (Page 17)

Goulburn-Murray Water may issue a groundwater licence under section 51 of the Act provided that in doing so it does not exceed the permissible consumptive volume established for the Strathbogie Groundwater Management Area (Plan LEGL/13-129)

Rule 2: New Entitlement Zonal Limits (Page 17)

Goulburn-Murray Water may issue a new groundwater entitlement under section 51 of the Act provided that in doing so it does not exceed the management zone limits specified in Table 3.

Table 3 - Maximum zonal licence volumes permitted

Management zone	Maximum licence volume permitted (ML)
Castle	349.5
Honeysuckle	69
Hughes	327.5
Pranjip	277
Seven	621
Whiteheads	16
Total	1660

Rule 3: Trade of groundwater entitlement (Page 19)

Goulburn-Murray Water may approve a transfer of groundwater licence entitlement under section 62 of the Act provided that relevant matters under section 53 of the Act have been considered and that the following conditions are satisfied:

- (a) The buyer has a bore with a metered diversion point,
- (b) The approval of a transfer must not cause the sum of total licence entitlement to exceed the Strathbogie Groundwater Management Area (Plan LEGL/13-129) and any cap which applies to a management zone as shown in Table 3.

Rule 4: Record meter readings (Page 22)

Goulburn-Murray Water will:

- (a) Ensure that a flow meter is fitted to all existing licensed operational bores in the Strathbogie Groundwater Management Area which are associated with a licence entitlement equal to or greater than 20 ML/year,
- (b) Ensure that any new licensed bores are fitted with a flow meter,
- (c) Read each meter at least once annually,
- (d) Enter into the Victorian Water Register database, metered groundwater use.

Rule 5: Annual newsletter (Page 23)

Goulburn-Murray Water will, by 1 October of each year, prepare an annual newsletter to 30 June of that year on the Strathbogie GMA which will include reporting and analysis of:

- (a) Groundwater entitlement per zone, including temporary and permanent transfers,
- (b) Groundwater use per zone,
- (c) The overall groundwater resource position,
- (d) The need for any changes to the plan.

Goulburn-Murray Water will post on its website in October of each year the Strathbogie GMA annual newsletter.

Rule 6: Plan review (Page 24)

Goulburn-Murray Water will consider the need for any amendments to the plan on a yearly basis in conjunction with the preparation of the annual newsletter.

If amendments are proposed that directly impact rights of access to water, Goulburn-Murray Water will consult groundwater users in the Strathbogie GMA on the proposed changes to the plan.

Goulburn-Murray Water may undertake consultation on any proposed amendments via a mail out to licence holders, a public meeting, through advertisements placed in local newspapers, and through consultation with the relevant water services committee.

Endorsement

This groundwater Local Management Plan (the 'Plan') has been developed for the newly defined Strathbogie Groundwater Management Area (GMA) and it is a significant step in the management of groundwater resources for the area. The Plan provides a clear operational framework for the management of groundwater resources in the Strathbogie GMA and it provides specific information to Goulburn-Murray Water's customers relating to the take and use of groundwater in this area.

The development of this management plan has relied on guidance and feedback from Goulburn-Murray Water's customers and key stakeholders. The development of this plan fulfils an obligation of the Northern Region Sustainable Water Strategy. The Plan is also consistent with relevant Ministerial policies in that it explains to groundwater users and the broader community the specific management arrangements governing the extraction of groundwater in the Strathbogie Ranges region.

This Plan seeks to strike the right balance between recognising the benefit of using groundwater while also protecting high value environmental assets such as baseflow dependent streams and groundwater dependent ecosystems during critical dry periods. The Plan also seeks to be proactive in its approach, by giving guidance about where groundwater development may occur and documenting rules to manage future development.

This Plan will require periodic review particularly in light of the Murray-Darling Basin Plan, as changes to Victoria's groundwater management framework take effect and as information about groundwater resources in the Strathbogie Groundwater Management Area improves. Goulburn-Murray Water will continue to work with our customers, local communities and other stakeholders to ensure that the Plan is reviewed and updated where necessary.

Simon Cowan
Manager Groundwater and Streams
Goulburn-Murray Water Rural Water Corporation



Date: 20 August 2013

Stephen Gemmill
Customer Services Manager Diversions - East
Goulburn-Murray Water Rural Water Corporation



Date: 05 September 2013

Acknowledgements

Goulburn-Murray Water (GMW) would like to express its appreciation to the Strathbogie Groundwater Reference Group which included customer and community representatives Bertram Lobert, Bill Wells, Alex Rowan, Craig Madden from the Goulburn Broken Regional Water Service Committee, and representatives from the Goulburn Broken Catchment Management Authority (Simon Casanelia) and Department of Environment and Primary Industries (Charlie Showers). Feedback from the Strathbogie Groundwater Reference Group members has been invaluable in helping to test and refine the information contained in this Local Management Plan.

Glossary

Term/Acronym	Description
Act	Water Act 1989 (Victoria)
Aquifer	An underground layer of rock or sand or other geological unit that contains water
D & S	Domestic and stock
Groundwater entitlement	Licensed volume of groundwater specified as megalitres per year
GDE	Groundwater dependent ecosystem. An ecosystem that relies on access to groundwater for some or all of its water needs to maintain function
GMA	Groundwater Management Area
GMW	Goulburn-Murray Water Rural Water Corporation
Groundwater licence	Licence issued to take and use groundwater under section 51 of the Act
Groundwater reference group	A group of stakeholder representatives consulted during the development and implementation of the Plan
km	Kilometre
L/sec	Litres per second
m	Metre
Permissible Consumptive Volume (PCV)	Permissible Consumptive Volume is the total volume of groundwater that the Minister has declared may be taken from a defined area in a period.
the Plan	The Strathbogie Groundwater Management Area Local Management Plan
Trade	The transfer of a groundwater entitlement
ML	Megalitre or one million litres
Season	Period of 12 months commencing 1 July
Zone	A part of the groundwater management area defined for management purposes

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1 Introduction

1.1 Background

The Strathbogie Groundwater Management Area (GMA) Local Management Plan (the Plan) has been prepared to provide groundwater users with a detailed system specific management framework. The Plan has been developed by Goulburn-Murray Rural Water Corporation (GMW) in consultation with a groundwater reference group made up of community members, groundwater licence holders, and representatives from relevant stakeholder agency groups, including:

- The Department of Environment and Primary Industries,
- The Goulburn Broken Catchment Management Authority,
- GMW's Goulburn Broken Regional Water Service Committee.

The development of the Plan is a requirement of Action 4.6 in the Northern Region Sustainable Water Strategy (2009) and it has been developed by GMW as part of a programme to ensure that formal groundwater management rules are developed across all of the GMW area. The Plan will form one of the building blocks for Goulburn Murray Water's future Water Resources Plan, which is part of the Murray Darling Basin Plan requirements for the GMW area. This Plan has also been developed in response to community concerns regarding the security of water supplies (both groundwater and surface water), and to concerns about the impact of diversions and stock and domestic use on stream flows in the Strathbogie Ranges, particularly during the 1997-2009 drought.

Within the past 2 years our knowledge on the groundwater resources of the Upper Goulburn region has improved following the completion of several groundwater resource appraisal projects (GHD, 2010; GHD, 2011). This resource appraisal work has been used to assist with the development of the management rules in the Plan, and has informed the development of a new approach to define acceptable limits on groundwater entitlement (GMW, 2013).

The approach to defining acceptable levels of groundwater entitlement has been endorsed by the stakeholder reference group, and it is focussed on the assessment of the impact of a range of groundwater and surface water diversions on stream flows during periods of low flow. The approach recognises that many of the groundwater dependent values in the catchment are stream flow related, and that after extended periods of dry weather the majority of stream flow is likely to be derived from groundwater discharge.

The rules contained in the Plan have been developed to be adaptive so they can be amended where necessary to incorporate new knowledge or policy changes as they emerge. Further work is recommended in section 6.3 to enable improvements to this Plan to be made over time.

1.2 Guiding principles

The following guiding principles have been adopted in the development of this Plan:

- Existing groundwater licences and entitlement will not be impacted,
- All licensed water use is considered to have equal value (commercial, irrigation, and urban)
- This is a groundwater plan and does not seek to manage surface and groundwater diversions under one set of rules, however consideration of the

potential impact on surface water values from a range of existing diversions has been fundamental to the Plan's development,

- Lack of data is not an excuse for not making decisions,
- Where data is lacking and there is uncertainty over the level of risk posed by take and use of water, a conservative approach has been taken to allowing any increases in groundwater entitlement,
- The management approach taken is commensurate with the data, knowledge and resources available to GMW, and to the level of risk posed by the current level of groundwater development.

1.3 Groundwater management objectives

Management objectives have been developed by considering groundwater values in the catchment and the potential risk to these values from groundwater diversions.

The management objectives for the Strathbogie GMA are to:

- Provide a clear and proactive management framework which enables the benefits of groundwater to be maximised in an equitable and sustainable manner,
- Ensure that future groundwater development does not unacceptably impact on environmental assets such as river flow, springs and groundwater dependent ecosystems,
- Improve community understanding of groundwater management issues through effective communication, consultation and engagement.

1.4 The Strathbogie Groundwater Management Area

The extent of the Strathbogie GMA is shown in Figure 1.

The Strathbogie GMA extends from the Mid Goulburn GMA in the west, up to the ridge of the Strathbogie Ranges in the south and east, with the northern boundary being the junction with the Broken River catchment. This area includes Seven Creeks, as well as Honeysuckle, Hughes, Pranjip, Whiteheads, Creightons and Castle Creeks and their tributaries.

The groundwater resources covered by this Plan are subject to the depth boundaries defined in the Victorian Groundwater Management Framework (DEPI, 2012), as shown in Figure 2.

In the case of the Strathbogie GMA this means that the management plan covers the groundwater resources to a depth of 200 m across the whole area (this is because the deepest Tertiary age alluvial sediments are less than 100 m thick).

If groundwater is extracted at depths greater than 200 m then the requirements of the *Water Act 1989* (the Act) will inform management of this groundwater on a case by case basis. There are currently no licensed bores which exceed 200 m in depth in the GMA.

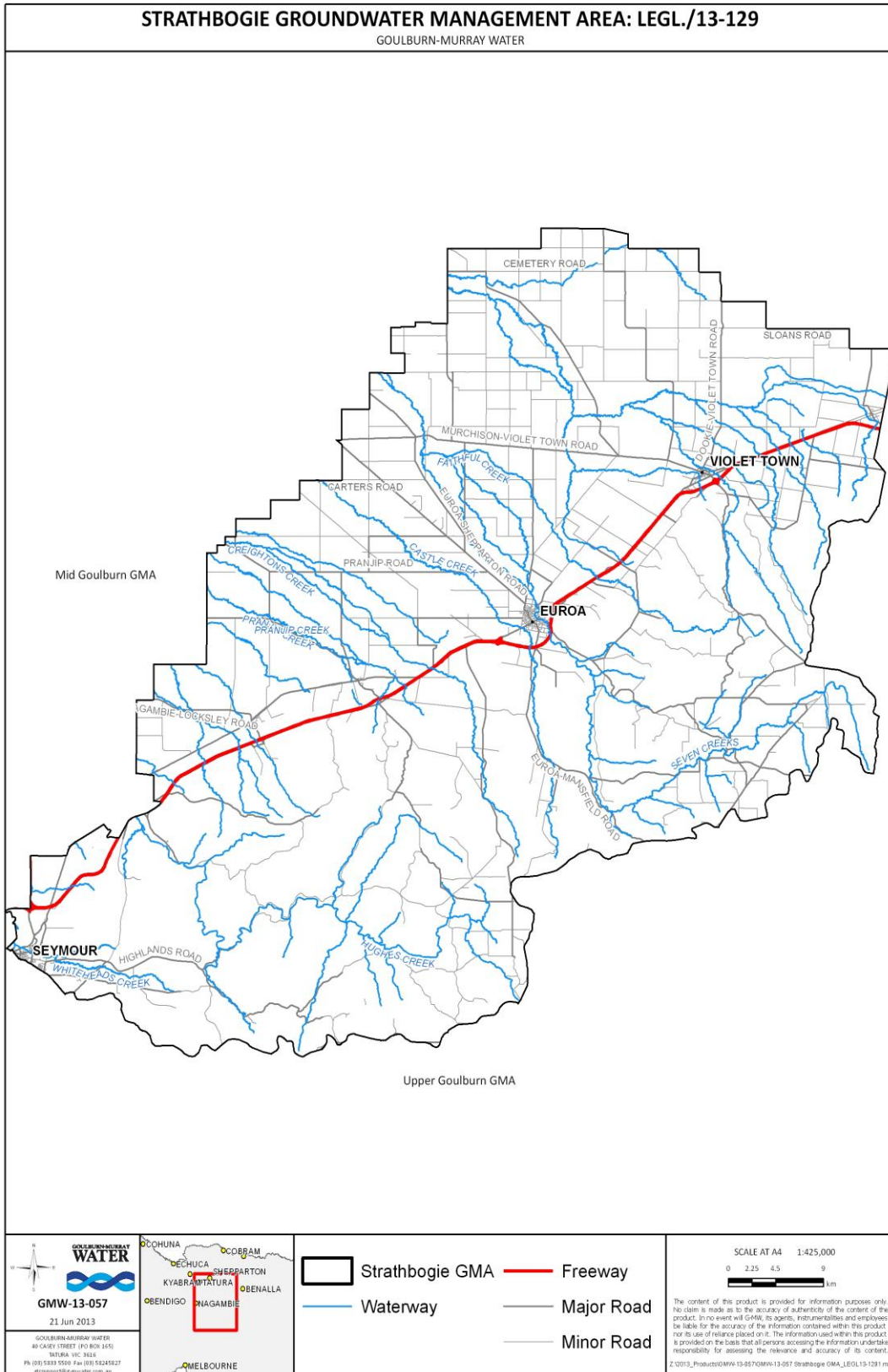


Figure 1 - Strathbogie Groundwater Management Area

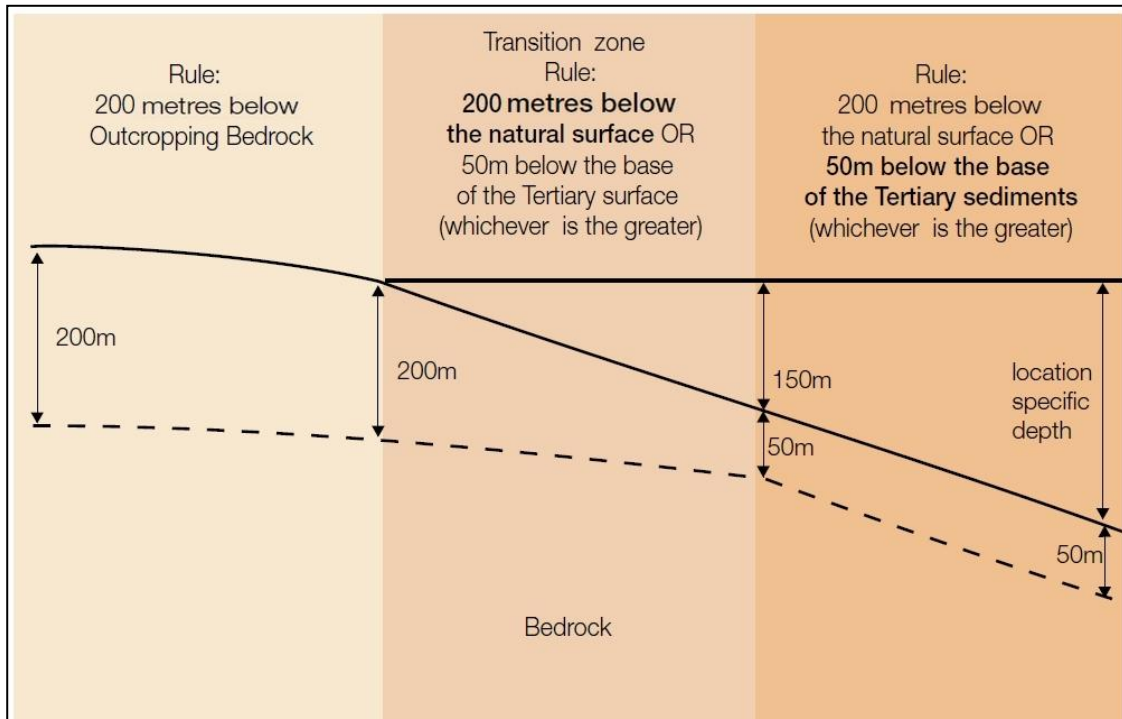


Figure 2 - Groundwater management framework depth boundaries (DSE, 2012)

2 Groundwater system

2.1 Aquifers

Groundwater resources within the Strathbogie GMA occur within three broad aquifer types (GHD, 2010):

- granite (and other volcanic rocks),
- sedimentary bedrock,
- alluvial clay and sand.

The extent of these aquifers are shown in Figure 3, and described below.

2.2 Granite and other volcanic rocks

The granites and other volcanic rocks of the Strathbogie Ranges are a locally important aquifer. Groundwater is stored and moves through fissures (cracks) within the granite, and the local aquifer potential depends on the extent of fissuring and on the amount of weathering that has occurred. Bore yields from the granite are low, typically 0.4 - 0.8 L/sec, and even lower in the volcanic rocks around Violet Town. The aquifer is typically used for stock and domestic supply, although there are also a number of licensed bores. The groundwater in the granite is typically of low to moderate salinity.

2.3 Sedimentary bedrock

The sedimentary bedrock aquifer occurs under the low lying floodplain to the north of the Strathbogie Ranges. The bedrock aquifer is typically buried by alluvial sands and clays, and only occurs at the surface in small areas such as the Honeysuckle and Hughes creek catchments. The aquifer consists mainly of hard, compacted layers of mudstone and siltstone, which have been folded and faulted over millions of years. Groundwater is stored and moves through fractures and faults in the bedrock and the highest yields occur in fracture zones and along faults particularly where these are enhanced by weathering. Relatively few bores have been drilled in the bedrock in this area and it is unlikely that yields above 0.5 L/sec can be sustained. The groundwater in the bedrock is typically of moderate to high salinity.

2.4 Alluvial clay and sand

These unconsolidated sediments overlie the bedrock aquifer on the low lying flood plain to the north of the Strathbogie granite uplands. The sediments are typically between 20 m and 40 m thick, but reach up to 80 m in thickness to the north west of Euroa along the Seven Creeks catchment. The aquifer is dominated by low permeability clays and silts with limited sand deposits and it is developed locally for stock and domestic use, with only a handful of licensed bores. Groundwater yields are likely to be low due to the predominance of clays and silts, and water quality is often poor (elevated salinity).

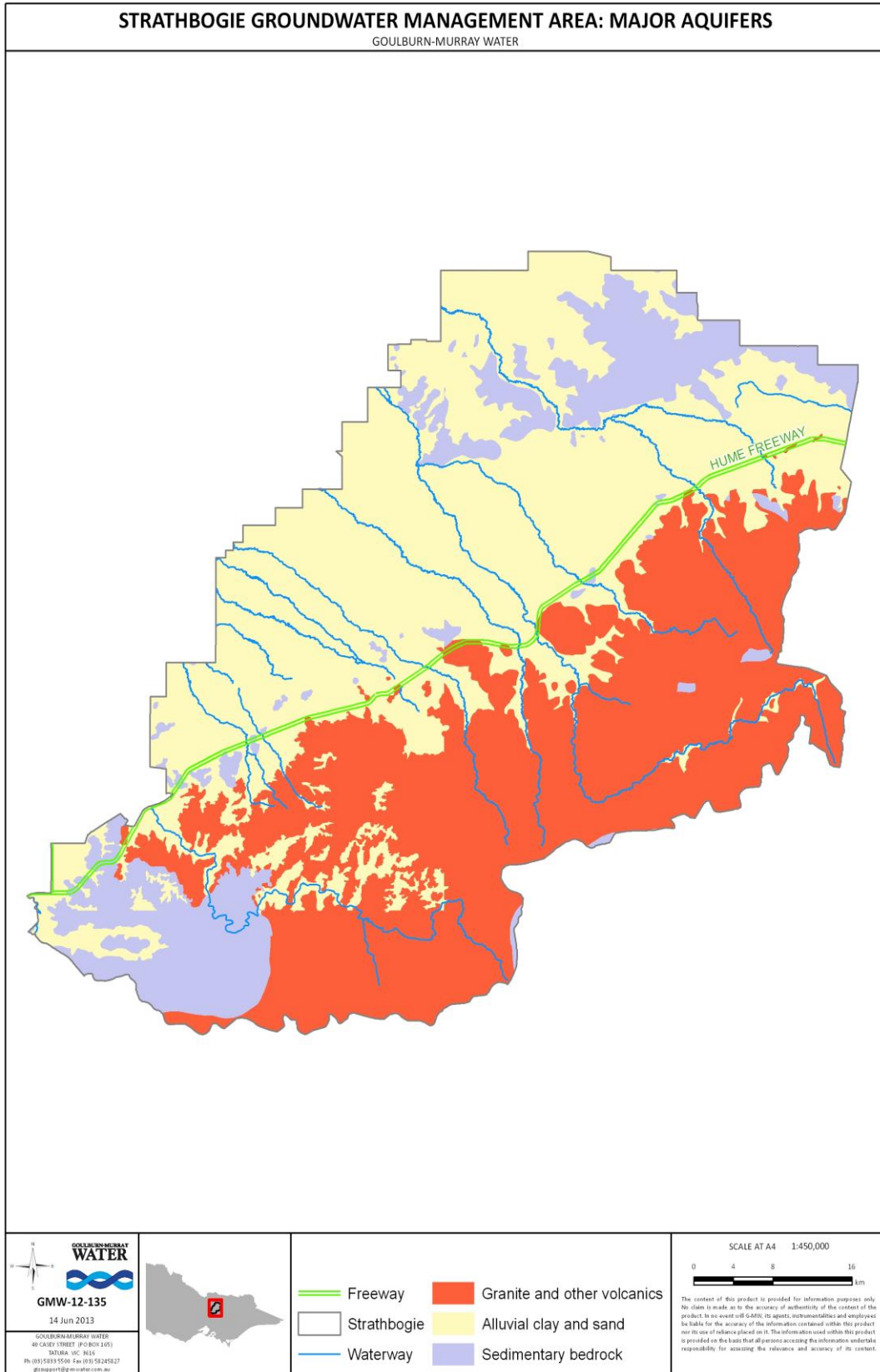


Figure 3- Major aquifers in the Strathbogie GMA

2.5 Groundwater levels

The groundwater resource monitoring network in the Strathbogie GMA consists of 10 State Observation Bores which are all located on the low lying alluvial plain (as shown in

Figure 12). These bores typically monitor groundwater levels in the shallow alluvial deposits, occasionally penetrating a few metres into the bedrock. Groundwater levels are typically between 20 m and 40 m below ground, and most of the bores show a steady but small rising trend over the past 10 to 20 years. Seasonal fluctuations are generally absent, indicating little rainfall recharge reaches the regional watertable and/or that the response to recharge is very slow. There is no evidence of pumping affecting regional groundwater levels in the alluvial bores, which is not surprising given the lack of development in this aquifer.

There are a small number of Department of Environment and Primary Industry bores and private bores on the granite uplands where groundwater level data has been made available to GMW. These bores show that groundwater levels on the granite uplands are typically within 5 to 15 m of the surface, and levels fluctuate by several metres each year in response to rainfall. Groundwater levels declined steadily in the uplands in response to the drought between 1997 and 2009, but have recovered during the subsequent wet years

2.6 Groundwater recharge

The majority of recharge to the aquifers in the GMA originates from rainfall which is greatest in the uplands. A significant proportion of rainfall runs over ground directly into streams or is lost through evapotranspiration. The remaining groundwater reaches the local watertable. It is also likely that some recharge to the aquifers occurs where streams are higher than the watertable and lose water into the groundwater system (such as on the alluvial plain). Annual average recharge in the Strathbogie GMW is approximately 80 mm/year in the Strathbogie uplands, and around 50 mm/year on the alluvial plain.

2.7 Groundwater flow

Groundwater levels and flow in the granite uplands are likely to mirror topography, and flow systems are generally short.

Little is known about the deeper flow system in the sedimentary bedrock, and in the alluvial aquifer however it is assumed that the shallow alluvial aquifer is receiving some groundwater from the underlying bedrock aquifer along a deeper flow system which may originate in the granite uplands to the south.

2.8 Groundwater discharge

The majority of groundwater discharge occurs in the uplands from the granite aquifer. Groundwater discharges into local stream systems, or as springs on the Strathbogie uplands, or is lost through evapotranspiration from the watertable. Where discharge occurs it is typically in valley bottoms where the water table is close to the surface, or at a break of slope, or where faults and fissures in the rock appear at the surface. A small proportion of groundwater is extracted by bores, and this is estimated to be less than 1 % of annual average recharge (as described in section 3.2).

2.9 Groundwater quality

Relatively fresh groundwater is found in the more elevated, higher rainfall parts of the area, on the Strathbogie Ranges. On the alluvial plain the groundwater quality is more

variable and saline groundwater occurs locally where groundwater is perched or near the surface and has picked up salts accumulated in the ground.

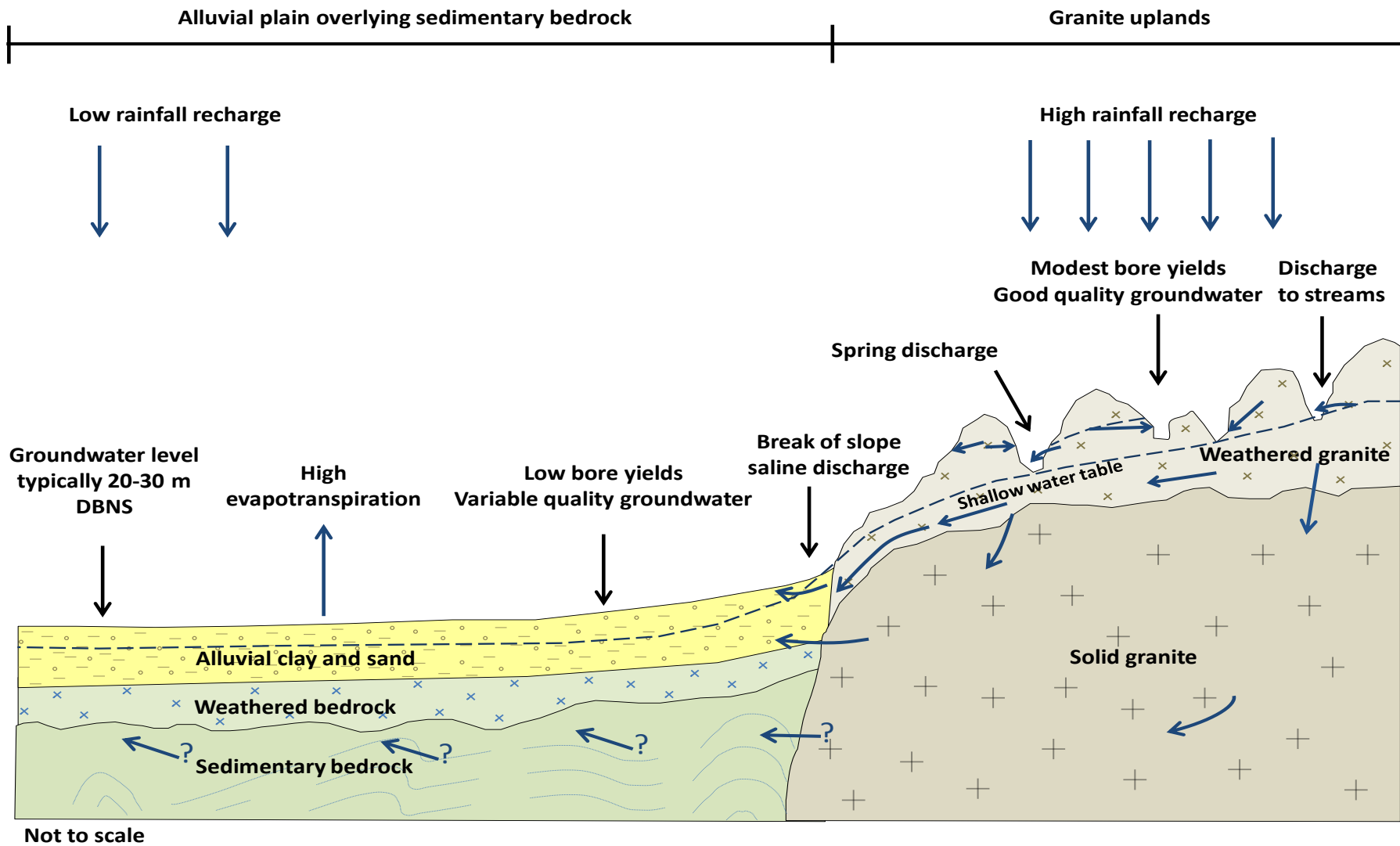


Figure 4- Groundwater features of the Strathbogie GMA

3 Groundwater use and impacts

3.1 Groundwater licensing

A works licence must be obtained from GMW to drill and construct a bore under section 67 of the Act.

A take and use licence is required to extract groundwater for irrigation, commercial, dewatering and urban use under section 51 of the Act. A licence is obtained by submitting an application to GMW which will consider a range of matters when assessing the application, including the potential impacts to existing authorised users, stream flow and the environment.

Licences may be issued for up to 15 years with conditions relating to the exact location and depth from which groundwater can be extracted, the annual volume of water that can be pumped and the rate at which pumping can occur.

If groundwater is used exclusively for domestic and stock purposes, a take and use licence is not required (refer to 3.5).

More information on groundwater licensing, including fees and charges, is available on GMW's website <http://www.g-mwater.com.au/>.

3.2 Volume of groundwater entitlement

There are currently 83 bores (70 groundwater licences) authorised to extract a total of 1,580 ML per year from the Strathbogie GMA. The total volume of entitlement in the GMA makes up less than 1% of average annual groundwater recharge (183,932 ML per year) (GHD, 2011) or 2% of average dry year recharge (70,072 ML per year).

3.3 Distribution of bores use for licensed purposes

The distribution of bores subject to a groundwater licence (s51 licence) is shown in Figure 8. The majority of groundwater entitlement in the Strathbogie GMA is located on the granite aquifer in the southern half of the catchment, most notably in the upper Seven Creeks and Hughes Creek.

3.4 Metered use

Groundwater use varies from season to season, and higher groundwater use tends to correlate with lower rainfall years. Groundwater use is typically a low proportion of total groundwater entitlement, ranging from 20 to 30% in dry years, and dropping to less than 10% in wet years.

Meters were installed between 2007 and 2009 on all licensed operational groundwater bores with an entitlement equal to or greater than 20 ML per year. Currently 60% of all groundwater licenses in the Strathbogie GMA are less than 20 ML. Metered data and groundwater use estimates will continue to improve in the future and will provide valuable information to inform management decisions.

3.5 Domestic and stock use

Domestic and stock bores (D&S) in the Strathbogie GMA are largely found in the granite aquifers in the upper catchment. There are 424 known D&S bores in the Strathbogie GMA (based on State Groundwater Management System records). D&S bores are not metered and there are likely to be a number of unregistered domestic and stock bores; therefore the amount of actual D&S use has been estimated.

As D&S access to groundwater is a statutory right (private right) under section 8 of the Act, new bores may be developed for this purpose. A licence is required to construct a new D&S

bore (section 67 of the Act). GMW registers new bores that are drilled for D&S use, and encourages registration of any currently unregistered bores. Registration of bores will enable GMW to track the growth of D&S bores so that any concerns over significant development can be addressed in future plans if required.

3.6 Groundwater dependent features and values

The development of this Plan has focussed on identifying as far as possible, the key groundwater dependent features in the GMA, and their potential value. This approach has enabled groundwater management objectives to be determined, and it has also ensured that the Plan is focussed on managing those groundwater features that are considered to have the highest values, and are most likely to be at risk.

3.6.1 Groundwater dependent features

Groundwater dependent features can include;

- streams which receive a significant contribution from groundwater in dry periods,
- springs,
- groundwater dependent wetlands and pools,
- riparian and terrestrial vegetation,
- the aquifer itself, and the groundwater resource within it can also be considered a groundwater dependent feature.

All of these features occur within the GMA and are important. However streams are features which support the widest range of significant environmental, social and economic values (the major streams are shown on Figure 1).

Springs are also considered to be a particularly important environmental and cultural feature, with several studies conducted in the region, including reports by Carr et al (2006), and Coates et al (2009). The majority of springs and other groundwater dependant features occur on the granite uplands, where the water table is close to the ground surface. Unfortunately the location of many of these springs and other groundwater dependant ecosystems, such as soaks, pools, and groundwater dependant vegetation, has not been accurately mapped.

More information on the known GDEs is available from the National GDE Atlas at <http://www.bom.gov.au/water/groundwater/gde/>.

3.6.2 Groundwater values

GMW, with the help of our stakeholders has identified environmental, economic and social values that are dependent on groundwater, and which are associated with the groundwater dependent features identified in the previous section. The environmental value of the streams in the GMA is highlighted in the Goulburn Broken CMA River Health Strategy, where the Seven Creeks and Hughes Creek are identified as priority Streams (Goulburn Broken Catchment Management Authority, 2005).

Key environmental values include the Macquarie Perch (Seven Creeks and Hughes Creek) and Trout Cod (Seven Creeks) (Figure 5). These are classified as endangered species in State and Federal legislation.

The creeks also support a wide range of other fauna, including other native fish, platypus, invertebrates and in-stream and riparian vegetation.

Creeks provide a strong community focus and are enjoyed by locals and tourists for their aesthetic and amenity value. Many of the areas indigenous values are also associated with these waterways.

Creeks also provide vital water supplies to domestic and stock users and by irrigators and other users through licensed diversions, supporting the local economy. Seven Creeks is also a significant urban supply resource, providing the public water supply for Euroa and Violet Town, and surrounding population centres like Strathbogie.

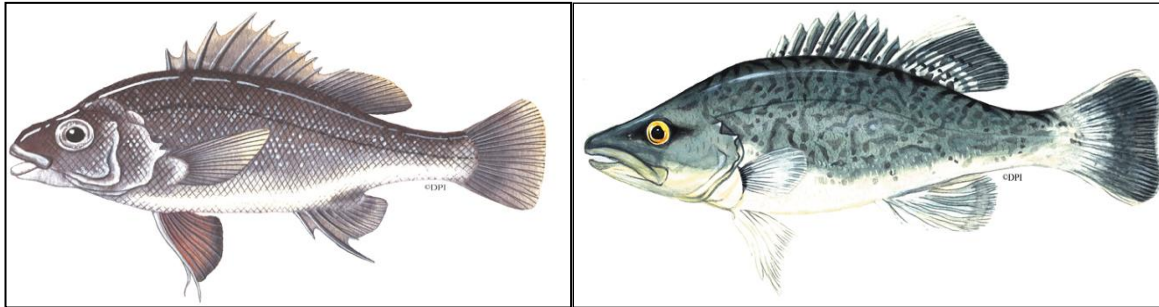


Figure 5 - Macquarie Perch and Trout Cod¹

Springs and soaks (and other groundwater dependent ecosystems) also represent significant catchment values. These features:

- are abundant on the granite tableland,
- support rare and valuable local ecology,
- contribute to stream flow in many cases,
- are sometimes used as a stock and domestic supply,
- can be associated with indigenous values.

The direct economic value of the groundwater resources (via groundwater extraction) is locally important however there are only 83 licensed bores and in general groundwater use from these licences is low.



Figure 6 – Tea-tree swamp with some remnant mountain swamp gums- Spring creek catchment (Bertram Lobert)



Figure 7 – Seven Creeks at Polly McQuinns gauging station (Thiess)

3.7 The impact of diversions on catchment values

The approach taken in this plan has been to determine the potential impacts of groundwater extraction and other diversions such as farm dams and surface water extractions on stream flows, and therefore by association, the stream flow environmental values.

¹ These images are © State of Victoria, Department of Primary Industries. Reproduced with permission. Creator of the Macquarie Perch image is Krystii Melaine

Environmentally acceptable limits on groundwater use have been defined and consideration has been given through consultation with stakeholders to whether these limits support social and economic values.

In the uplands, the nature of the granite aquifer is that it holds relatively small amounts of groundwater and levels can fall quickly during extended periods of low rainfall. As groundwater levels drop, baseflow to streams reduces and stream flows can fall very quickly as a result. On the alluvial plain the streams can naturally lose water into the alluvial aquifer and during dry periods these streams flow more slowly and direct evaporation is high.

These features mean that many of the streams that are the focus of catchment values in the Strathbogie GMA are naturally susceptible to dry periods.

A range of diversions can also reduce stream flow, including extraction from groundwater licensed bores and D&S bores, direct extraction from streams and water harvested from farm dams. In developing this Plan consideration has been given to the potential impact of existing levels of diversions on stream flow, particularly during periods of low flow when catchment values are most at risk. Existing groundwater impacts and future extraction scenarios have been assessed against these baseline low flow conditions (GMW, 2013).

GMW's assessment has indicated that many of the streams in the GMA are already under significant stress during dry periods and the values that rely on these streams could be further impacted if new groundwater entitlement is issued. This assessment approach has enabled catchment based groundwater limits to be identified for the GMA, and these limits are described in section 4.2.

It is widely accepted that pumping from bores can reduce the amount of groundwater that discharges into streams (baseflow), and this can have a significant impact on dry weather stream flow. However, it is recognised that there may be a lag between when groundwater pumping takes place and when the impacts on stream flow occurs. For example the impacts could occur during winter when stream flows are often higher. It is also possible that some of the groundwater extracted will not impact directly on stream flow and that by lowering the watertable evapotranspiration will be reduced instead.

Nevertheless a conservative approach has been taken in this plan which recognises the potential for impact. Groundwater pumping impacts on stream flow are assumed to be on 1:1 ratio, and the impacts are spread evenly across the year. As more information becomes available and our knowledge of the groundwater systems improves this approach can be updated if necessary.

Information on the location and sensitivity of springs and other groundwater dependent ecosystems is currently very limited in the Strathbogie GMA. However it is likely that many of these features are susceptible to dry weather and to groundwater extraction, particularly where bores are located close by. Impacts on groundwater dependant ecosystems will be considered by GMW when an assessment is undertaken following a groundwater licence application.

By limiting groundwater entitlement to existing levels, or allowing only small increases, the Plan will ensure that the social and economic values that rely on stream flow are not unacceptably impacted by growth in new groundwater entitlement.

It is recognised that the catchment based limits are conservative and this may be viewed as a barrier to further groundwater development (and the economic values that may result). However it is also true that in the last 20 years there has been very little demand for new groundwater entitlement in the Strathbogie GMA and historic use is less than 30% of entitlement. In the areas where new licensed bores are most likely to be developed, in the granite uplands of the Hughes, Castle and Seven Creeks, there is a reasonable amount of groundwater entitlement which is available through trade (trading rules are described in section 4.3).

4 Groundwater management

4.1 Groundwater management zones

The Strathbogie GMA includes six catchment based management zones, which are described in Table 1 and illustrated in Figure 8.

Zone	Description
Castle	The Castle zone comprises the Castle Creek surface water catchment. The geology is granite in the uplands, and sedimentary bedrock overlain by shallow alluvial deposits on the plain. Castle Creek is ephemeral.
Honeysuckle	Sheep Pen Creek and Honeysuckle Creek catchments make up the Honeysuckle zone. The geology is volcanic rock (similar to granite) in the uplands, with shallow alluvial deposits downstream of Violet Town. Honeysuckle Creek is ephemeral.
Hughes	The Hughes zone consists of the Hughes Creek catchment. The geology is granite in the uplands with alluvials and fractured bedrock at the surface in the lower catchment. Macquarie Perch are found in the Hughes Creek. There are many springs and soaks on the granite uplands. Hughes Creek is perennial.
Pranjip	The Pranjip zone incorporates the Pranjip, Branjee, Wormangal and Creightons Creek catchments. The geology is fractured sedimentary bedrock, with alluvial deposits in the north of the area. The town of Longwood sources water from Nine Mile Creek, which is within this catchment. Pranjip Creek is ephemeral.
Seven Creeks	The Seven Creeks zone covers the Seven Creeks and its tributaries. The geology is granite in the uplands, and sedimentary bedrock overlain by shallow alluvial deposits on the plain. This creek has a high social, cultural and environmental value and is a habitat for Macquarie Perch and Trout Cod. The towns of Euroa, Violet town and Strathbogie source water from Seven Creeks for urban supply. There are many springs and soaks on the granite uplands. Seven Creeks is perennial (at the Euroa gauge).
Whiteheads	Whiteheads encompasses the Whiteheads Creek catchment. The geology is fractured bedrock, with alluvial deposits in the north of the area. Whiteheads Creek is ephemeral.

Table 1 - Groundwater Management Zones

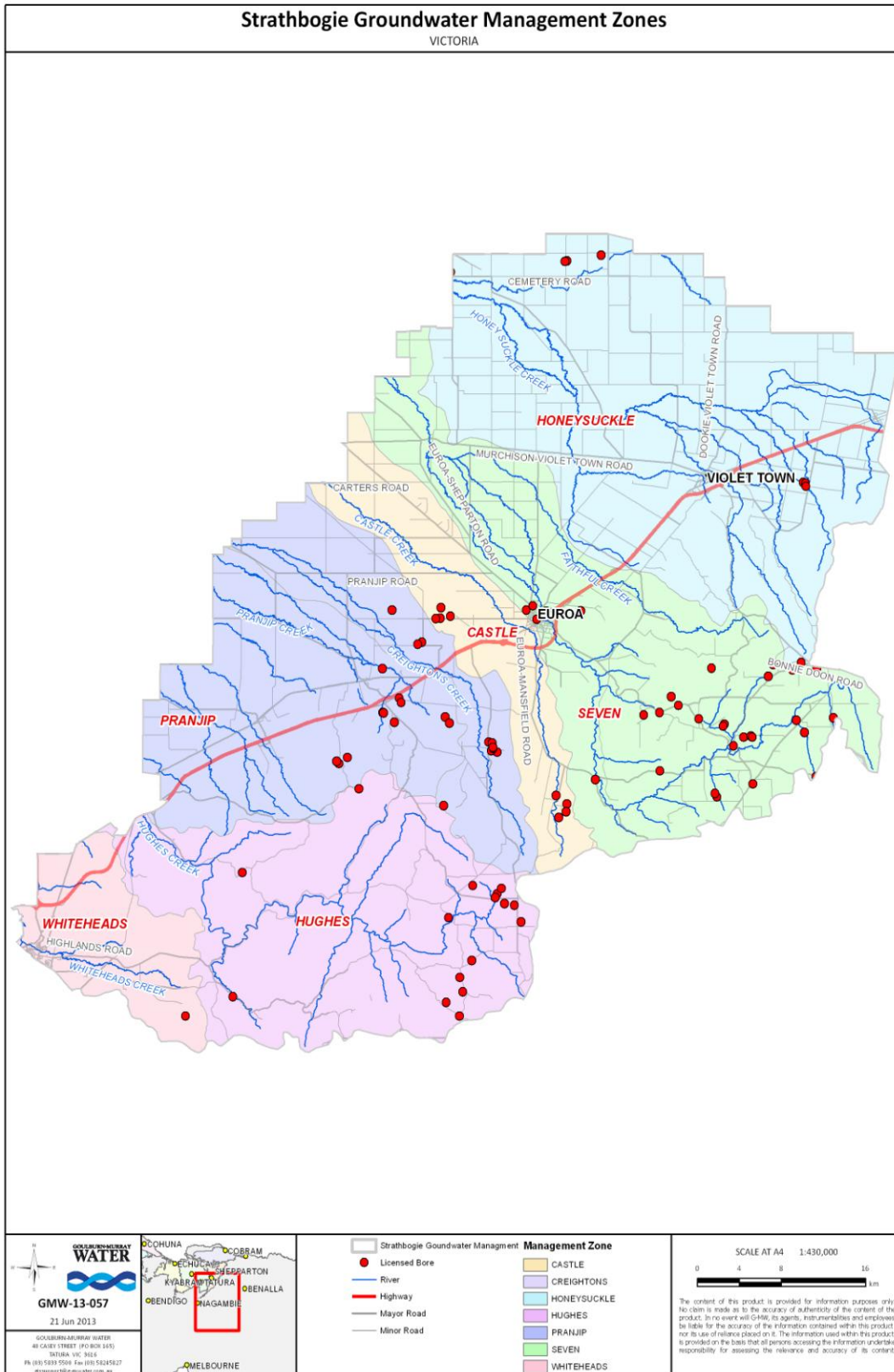


Figure 8 - Strathbogie groundwater management zones and licensed bores

The groundwater management zones, illustrated in Figure 8, are based on the understanding of the hydrogeology of the Strathbogie Ranges. Groundwater flow and the impacts of groundwater pumping are largely contained within each surface catchment; so surface water catchments have been used to define groundwater management zones within

the GMA. This enables the impact of groundwater extraction and the impact from other diversions to be examined, and for groundwater to be managed in line with local catchment values. Figure 8 also shows the distribution of licensed bores within the GMA. Table 2 summarises the number of licensed bores and licence volume by zone.

Management Zone	Number of Licensed bores	Current Licence Volume (ML/yr)	Maximum licence volume permitted (ML)
Castle	8	349.5	349.5
Honeysuckle	6	69	69
Hughes	16	261.5	327.5
Pranjip	21	277	277
Seven	31	621	621
Whiteheads	1	2	16
Total	83	1580	1660

Table 2 - Groundwater entitlement by zone (June 2013)

4.2 Groundwater entitlement availability

In order to protect existing authorised groundwater users, allow development of groundwater to sustainable levels and consider uncertainties associated with the understanding of the groundwater resources, groundwater entitlement for the GMA will be capped through the declaration of the Permissible Consumptive Volume (PCV). The PCV will be set at 1,660 ML/year. GMW will make an application to the Minister for Water to declare the PCV at this volume.

The cap on groundwater entitlement has been derived using the approach described in section 3.7 and is documented in full in a background technical report (GMW, 2013). Groundwater entitlement limits have been set for each management zone by considering local catchment values. These catchment based limits are shown in Table 3. The sum of these catchment limits is equivalent to the proposed PCV.

The PCV does not include domestic and stock use and GMW may seek to amend the PCV to overcome any administrative oversight, error or other anomaly which occurred prior to the approval of this management plan.

When assessing groundwater licence applications, GMW is required to make sure that particular matters, including the PCV, are considered in accordance with section 53 of the *Water Act 1989*. In addition, GMW will take a precautionary approach to its consideration of new groundwater licence applications to protect the resources and have particular regard for:

- a) Any future obligations and requirements set by the Murray-Darling Basin Plan,
- b) Contemporary Victorian Government policy relating to the revision of groundwater management unit boundaries, determination of resource capacity and changes to caps on groundwater entitlement,
- c) Contemporary Victorian Government policy on the preferred method of allocating any new groundwater entitlement.

Rule 1: Cap on groundwater entitlement

Goulburn-Murray Water may issue a groundwater licence under section 51 of the Act provided that in doing so it does not exceed the permissible consumptive volume established for the Strathbogie Groundwater Management Area (Plan LEGL/13-129)

New groundwater entitlement may occur up to the limit specified in the permissible consumptive volume, subject to the zonal limits.

Rule 2: New entitlement zonal limits

Goulburn-Murray Water may issue a new groundwater entitlement under section 51 of the Act provided that in doing so it does not exceed the management zone limits specified in Table 3.

Table 3 - Maximum zonal licence volumes permitted

Management zone	Maximum licence volume permitted (ML)
Castle	349.5
Honeysuckle	69
Hughes	327.5
Pranjip	277
Seven	621
Whiteheads	16
Total	1660

The availability of new groundwater entitlement in each zone is shown spatially in Figure 9. Zones coloured in pink (Castle, Honeysuckle, Seven creeks, and Pranjip) are capped at current levels of entitlement. In the zones coloured in green a small amount of additional groundwater entitlement is allowed (Hughes creek 66 ML and Whiteheads creek 14 ML).

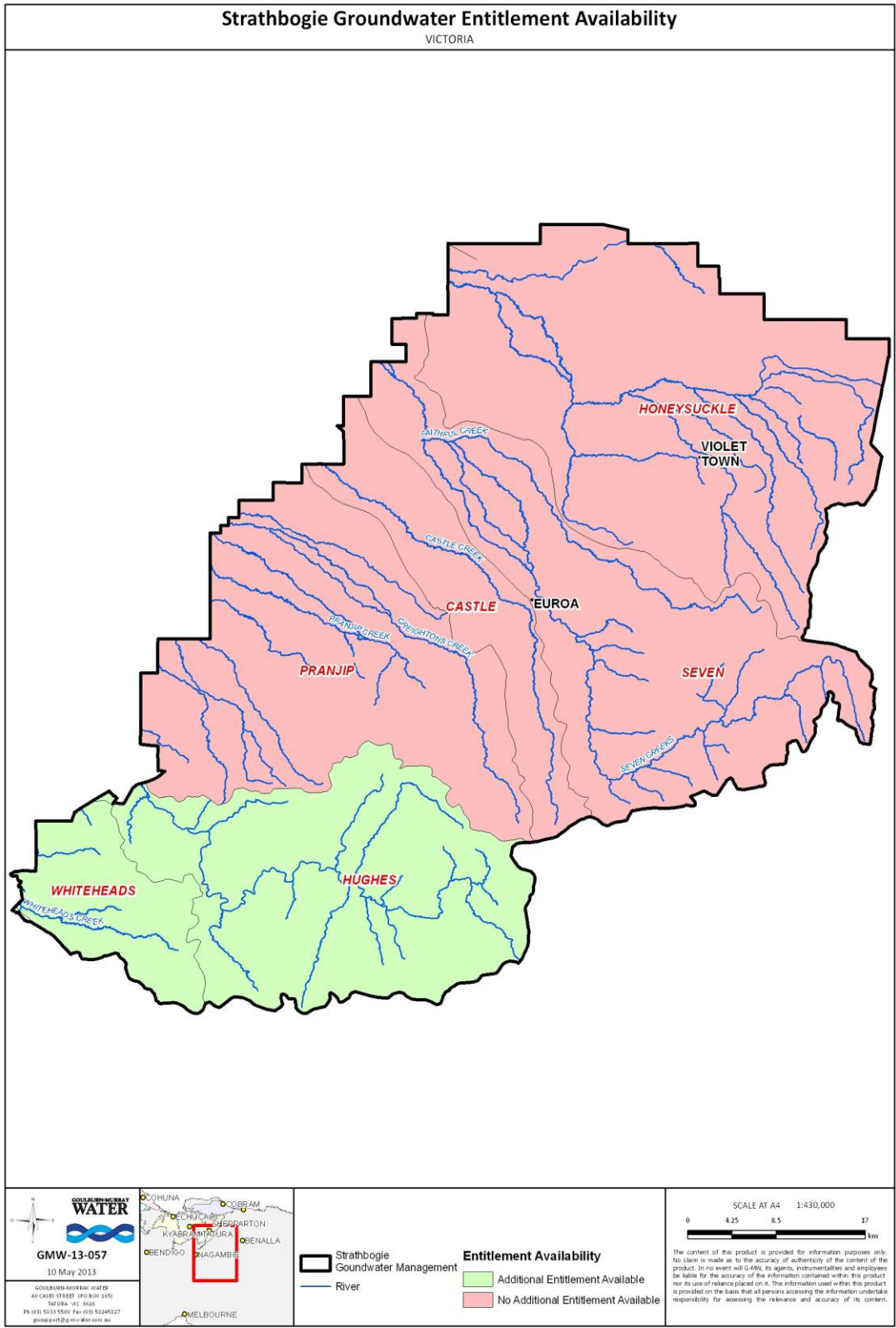


Figure 9 - Groundwater entitlement availability

4.3 Trading of groundwater entitlement

Groundwater trading allows for entitlement to be transferred to develop new opportunities, or to grow existing businesses.

Licence trade rules have been developed to:

- Enable access to groundwater in zones where entitlement is capped,
- Increase flexibility for licensed groundwater users to manage production in response to seasonal or climatic conditions,
- Allow licensed groundwater holders to realise the value of their licence.

Rule 3 relates to groundwater trade.

Rule 3: Trade of groundwater entitlement

Goulburn-Murray Water may approve a transfer of groundwater entitlement under section 62 of the Act provided that relevant matters under section 53 of the Act have been considered and that the following conditions are satisfied:

- (a) The buyer has a bore with a metered diversion point,
- (b) The approval of a transfer must not cause the sum of total entitlement to exceed the Strathbogie Groundwater Management Area (Plan LEGL/13-129) and any cap which applies to a management zone as shown in Table 3.

Temporary and permanent transfer of groundwater entitlement is permitted by GMW subject to a consideration of relevant matters identified in the Act. These matters include the potential impact on local environmental values and nearby groundwater users.

A transfer of groundwater entitlement can occur into a zone up to the limit set in each catchment (management zone).

Licence holders applying to transfer groundwater entitlement must have received written approval from GMW before groundwater is extracted.

4.4 Carryover

Carryover is the ability for licence holders to bank some of their unused allocation from one year and use it in the next. GMW has considered the case for allowing groundwater carryover in the Strathbogie Plan and concluded that this will not be allowed under the Plan. Allowing additional groundwater extraction could compromise stream flows during dry periods and impact on environmental flow objectives. The decision to not allow carryover is also supported by the relatively low levels of groundwater use compared to existing entitlement.

5 Monitoring

Monitoring, evaluation and reporting are important elements which enable adaptive and improved resource management to occur. The results of groundwater and surface water monitoring and evaluation activities will directly shape future management actions and planning.

5.1 Groundwater levels

There are 10 State Observation Bores in the Strathbogie GMA that are monitored quarterly to provide groundwater level data. These bores are all located in the lowland alluvial deposits of the GMA (Figure 12).

G-MW will continue to make use of the ongoing monitoring data available via the State Observation Bore Network.

It is recognised that there are no State Observation Bores in the granite aquifer which is the main source of groundwater discharge to the streams and springs in the uplands. This is the area where the highest catchment values and the greatest level of groundwater development occurs. This is also an area where further work is recommended to identify new groundwater monitoring opportunities to improve our knowledge of groundwater behaviour (recommendations are outlined in section 6.3).



Figure 10- Gauging station at Polly McQuinns weir (Thiess)



Figure 11-State Observation Network Bore – Seven Creeks catchment (Thiess)

5.2 Surface Water Flows

The surface water flow gauges that have been used in the assessment of groundwater entitlement are shown in Figure 12. These gauges are used by different stakeholders including the Bureau of Meteorology, Goulburn Valley Water and GMW to inform a range of surface water management objectives.

From a groundwater resource management perspective this data also enables estimates of groundwater discharge to be made and it provides information on the risk posed to a whole range of environmental, social and economic values from new groundwater licences and from groundwater licence transfers.

Surface water gauging data is available online from the Department of Environment and Primary Industries (currently via the Victorian Data Warehouse). GMW will continue to use this data to estimate groundwater discharge and to assess the status of groundwater and surface water resources across the area.

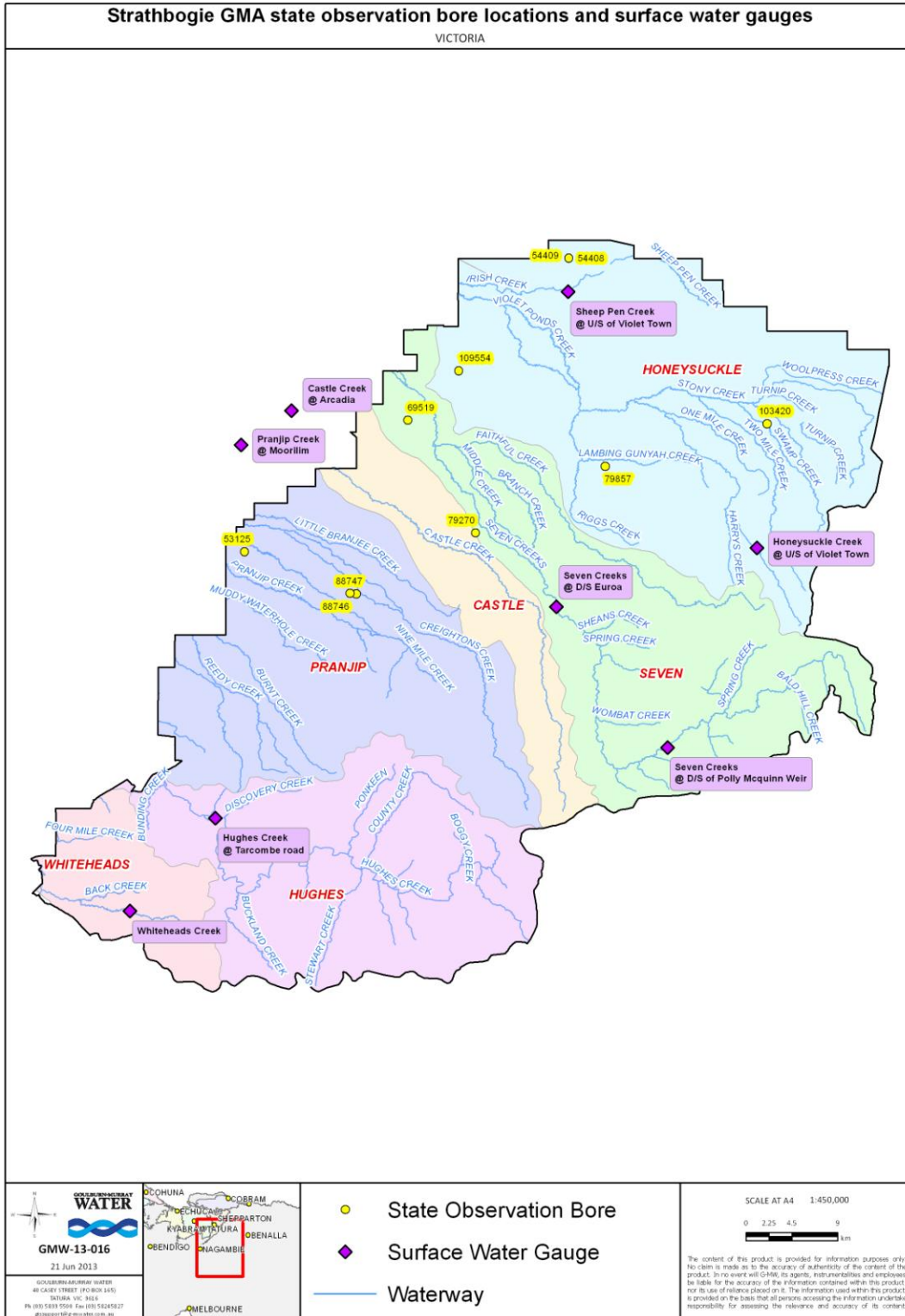


Figure 12 - Strathbogie GMA surface water gauges and State Observation Bore locations

5.3 Meter readings

Recording groundwater usage is an important part of resource management. Under average and wet conditions groundwater usage is a small component of the water budget in

the Strathbogie Ranges, but it can be a more significant component particularly during extended dry periods. Currently there is only a limited amount of metered data for this area as meters were installed by 2009. Recording groundwater use will help to better understand the relationship between groundwater use and climate and gain a clearer indication of the volumes of groundwater pumped in dry periods. This will help us to assess the potential risk of pumping on surface water resources in future plan reviews.

All existing licensed and operational bores, with a licence volume equal to or greater than 20 ML/year are fitted with a flow meter. Existing bores licensed for less than 20 ML/year will be metered at GMW's discretion. Any new licensed bore must also be metered, regardless of the volume of entitlement.

Meters will be read at least once annually. The information will be stored in the Victorian Water Register database to assist with reporting on usage and compliance as well as assisting in improving groundwater knowledge and management over time.

Rule 4: Record meter readings

Goulburn-Murray Water will:

- (a) Ensure that a flow meter is fitted to all existing licensed operational bores in the Strathbogie GMA which are associated with a licence entitlement equal to or greater than 20 ML/year,
- (b) Ensure that any new licensed bores are fitted with a flow meter,
- (c) Read each meter at least once annually,
- (d) Enter into the Victorian Water Register database, metered groundwater use.

6 Plan Implementation

6.1 Annual newsletter

GMW will prepare an annual newsletter for the Plan. This newsletter will summarise groundwater entitlement, usage, and transfers in each management zone, and the overall resource position based on the available monitoring data. The newsletter will enable GMW to keep customers and stakeholders informed and engaged. The newsletter will be posted to all licensed groundwater customers and be available on the GMW website at the link shown below:

www.g-mwater.com.au

Rule 5: Annual newsletter

Goulburn-Murray Water will, by 1 October of each year, prepare an annual newsletter to 30 June of that year on the Strathbogie GMA which will include reporting and analysis of:

- (e) Groundwater entitlement per zone, including temporary and permanent transfers,
- (f) Groundwater use per zone,
- (g) The overall resource position
- (h) The need for any changes to the Plan.

Goulburn-Murray Water will post on its website in October of each year the Strathbogie GMA annual newsletter.

6.2 Review of the Plan

Over time this Plan will need to be adapted in response to policy changes in groundwater resource management, as our understanding of the aquifer system improves and as improvements to management arrangements are identified.

At the time of the development of this Plan, implementation of the Murray Darling basin Plan (MDBP) had commenced. As requirements of the MDBP become clearer, this Plan may need to be reviewed to ensure it is up to date and reflects the requirements of the MDBP.

Each year GMW will consider the need to make amendments to the Plan.

Any significant changes to the Plan must be based on sound technical understanding of the issues and will be subject to consultation.

Rule 6: Review of the Plan

Goulburn-Murray Water will consider the need for any amendments to the Plan on a yearly basis in conjunction with the preparation of the annual newsletter.

If amendments are proposed that directly impact rights of access to water, Goulburn-Murray Water will consult groundwater users in the Strathbogie GMA on the proposed changes to the Plan.

Goulburn-Murray Water may undertake consultation on any proposed amendments via a mail out to licence holders, a public meeting, and through advertisements placed in local newspapers, and through consultation with the relevant water services committee.

6.3 Recommendations for further work

The following recommendations are made for further work which would increase GMW's understanding of groundwater resources and enable improvements to be made to the Plan in future:

- Investigate options to improve current understanding of groundwater behaviour in the granite uplands. This will include considering the installation of new monitoring bores and the identification of existing bores which could be used for monitoring purposes (DEPI dryland salinity bores, private bores),
- Subject to available resources, undertake additional stream flow gauging in priority catchments. The gauging should be conducted during low flow periods and at different locations to create a profile of the stream losses and gains,
- Consider improvements to the method used to assess available groundwater entitlement. In particular there should be some work to see whether a more explicit risk based approach would lead to improvements in management measures.

GMW will pursue these recommendations with the Goulburn Broken CMA and the Department of Environment and Primary Industries.

7 References

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