

Upper Goulburn Groundwater Management Area

Local Management Plan

July 2013

GOULBURN-MURRAY WATER

Cover images (Left to Right): SOBN groundwater monitoring bore near Kinglake, Goulburn River floodplain near Alexandra, Macquarie Perch © MDBA; Photographer Arthur Mostead

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Summary of rules in the Upper Goulburn groundwater local management plan

Rule 1: Cap on groundwater entitlement **(page 19)**

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 Upper Goulburn Groundwater Management Area (Plan LEGL/13-128)

Rule 2: New Entitlement Zone Limits **(page 20)**

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 specifies in Table 4.

Table 4 - Maximum zone licence volumes permitted

Management Zone	Maximum licence volume permitted, ML
Yarck	276
Home	392
Goulburn	3,891
Snobs	88
Rubicon	307
Acheron	876
Lower Yea	863
Upper Yea	789
King Parrot	1,086
Total	8,568

Rule 3: Trade of groundwater entitlement **(page 20)**

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; and,

(b) The approval of a transfer must not cause the sum of total entitlement to exceed the Permissible Consumptive Volume established for the Upper Goulburn Groundwater Management Area (Plan LEGL/13-128) and any cap which applies to a management zone as shown in Table 4.

Rule 4: Monitor groundwater levels **(page 23)**

Goulburn-Murray Water will utilize the groundwater level data collected by the State Observation Bores monitoring network in the Upper Goulburn Groundwater Management Area to inform any review of the Plan and to inform licensing decisions.

Rule 5: Record meter readings **(page 25)**

Goulburn-Murray Water will:

(a) Ensure that a flow meter is fitted to all existing licensed operational bores in the Upper Goulburn 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 metered groundwater use into the Victorian Water Register database.

Rule 6: Annual newsletter **(page 26)**

Goulburn-Murray Water will, by 1 October of each year, prepare an annual newsletter to 30 June of that year on the Upper Goulburn 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 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 Upper Goulburn GMA annual newsletter.

Rule 7: Review of the Plan **(page 26)**

Goulburn-Murray Water will consider the need for any amendments to the Plan on a yearly basis in conjunction with the release 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 Upper Goulburn 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 service committee.

Endorsement

This groundwater Local Management Plan (the Plan) has been developed for the newly defined Upper Goulburn 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 Upper Goulburn GMA and it provides specific guidance and information to Goulburn-Murray Water's customers relating to the take and use of groundwater in this area.

The development of the Plan has relied on guidance and feedback from Goulburn-Murray Water's customers and key stakeholders and fulfils an obligation of the Northern Region Sustainable Water Strategy. The Plan is also consistent with relevant Ministerial guidelines in that it explains to groundwater users and the broader community the specific management arrangements governing the extraction of groundwater in the Upper Goulburn 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 Local Management 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 Upper Goulburn 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: 06 September 2013

Acknowledgements

Goulburn-Murray Water (GMW) would like to express its appreciation to the Upper Goulburn Groundwater Reference Group which included customer representatives David Blackmore (Alexandra) and Anthony Gallenti (Kinglake), Craig Madden from the Goulburn Broken Regional Water Service Committee, domestic and stock representative Trevor Johnson, as well as representatives from agencies including the Goulburn Broken Catchment Management Authority (Simon Casanelia), Department of Environment and Primary Industry (Charlie Showers) and Murrindindi Shire Council (Matt Parsons). Feedback from the Upper Goulburn Groundwater Reference Group members has been invaluable in helping to test and refine the information contained in the Local Management Plan.

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	An underground layer of rock or sand or other geological unit that contains water
D&S	Domestic and Stock
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
Groundwater Reference Group	A group of stakeholder representatives consulted during the development and implementation of the Plan
L/sec	Litres per second
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 Upper Goulburn Groundwater Management Area Local Management Plan
Season	Period of 12 months commencing 1 July
Trade	Transfer of groundwater entitlement
Zone	A part of the groundwater management area defined for management purposes

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1 Introduction

1.1 Background

The Upper Goulburn 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 and groundwater licence holder representatives as well as relevant stakeholder and agency groups, such as:

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

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 will be part of the Murray Darling Basin Plan's 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 concerns about the impact of diversions, and stock and domestic use, on stream flows in the upper catchments, particularly during the 1997-2009 drought.

Within the past 2 years 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.

A new approach has been developed to define acceptable limits on groundwater entitlement (GMW, 2013). The approach 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 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 groundwater use is considered to have equal value (irrigation, commercial, industrial and urban),
- This is a groundwater plan and does not seek to manage surface and groundwater diversions under one set of rules, however the consideration of

potential impacts 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 issuing new groundwater entitlement,
- The management approached 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 the groundwater values in the catchment and the potential risk to these values from groundwater diversions.

The management objectives for the Upper Goulburn 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 Upper Goulburn Groundwater Management Area

The extent of the Upper Goulburn GMA is shown in Figure 1.

The Upper Goulburn GMA comprises the Goulburn River catchment downstream of Lake Eildon to Seymour. This includes King Parrot, Snobs and Home Creek, the Rubicon, Acheron, Murrindindi, and Yea River tributaries and the Goulburn River. This area includes the existing Alexandra and Kinglake GMAs. The Alexandra and Kinglake GMAs will be revoked after the Upper Goulburn GMA is declared.

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

In the case of the Upper Goulburn GMA this means that the management plan covers the groundwater resources to a depth of 200m across the whole area (this is because the deepest Tertiary age alluvial sediments are less than 150m thick).

If groundwater is extracted at depths greater than 200m 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 200m in depth in the GMA.

The GMA is predominantly fractured rock basement aquifer but with significant alluvial silts, sands and gravel deposits associated with the Goulburn River valley.

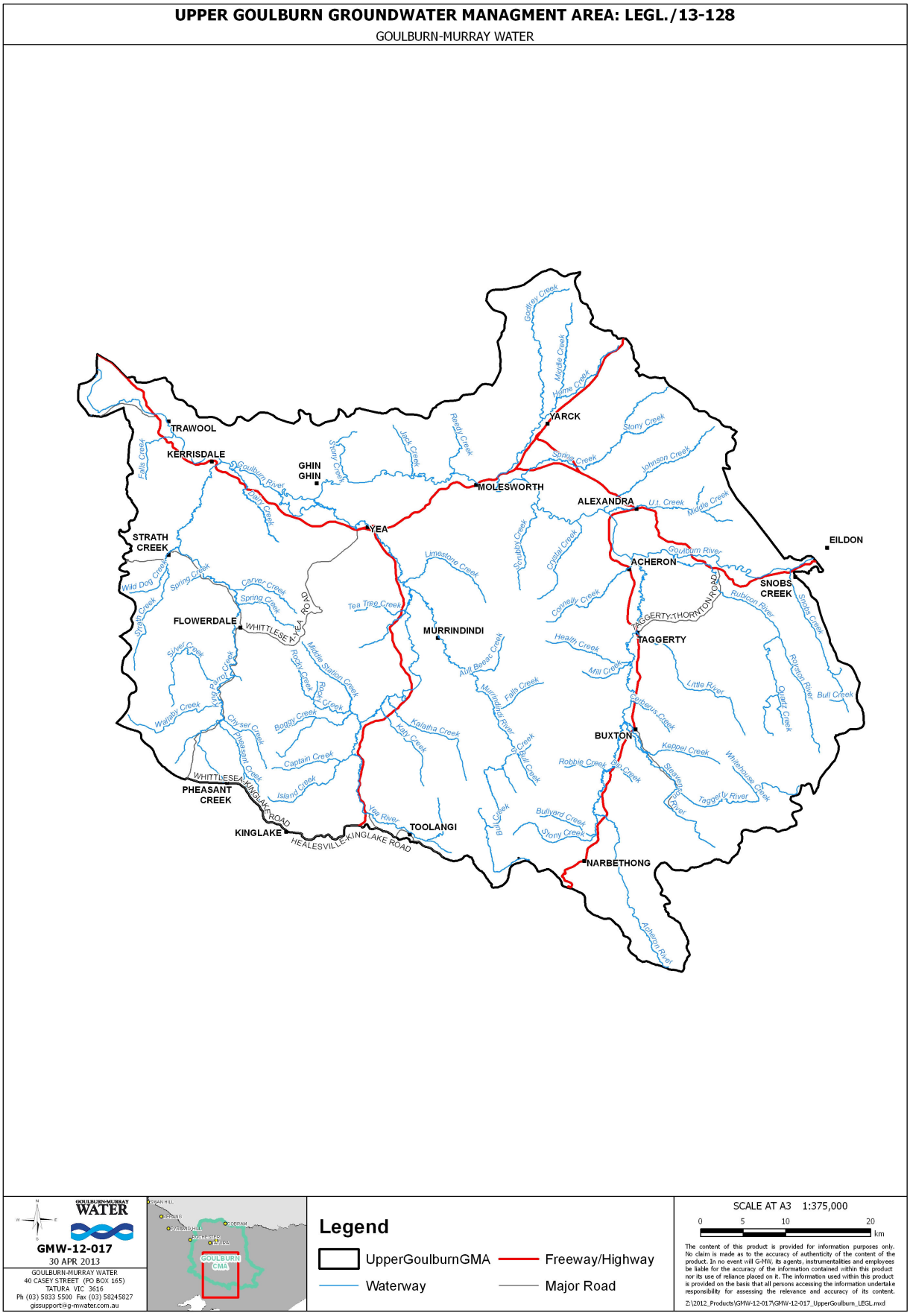

Figure 1 Upper Goulburn Groundwater Management Area

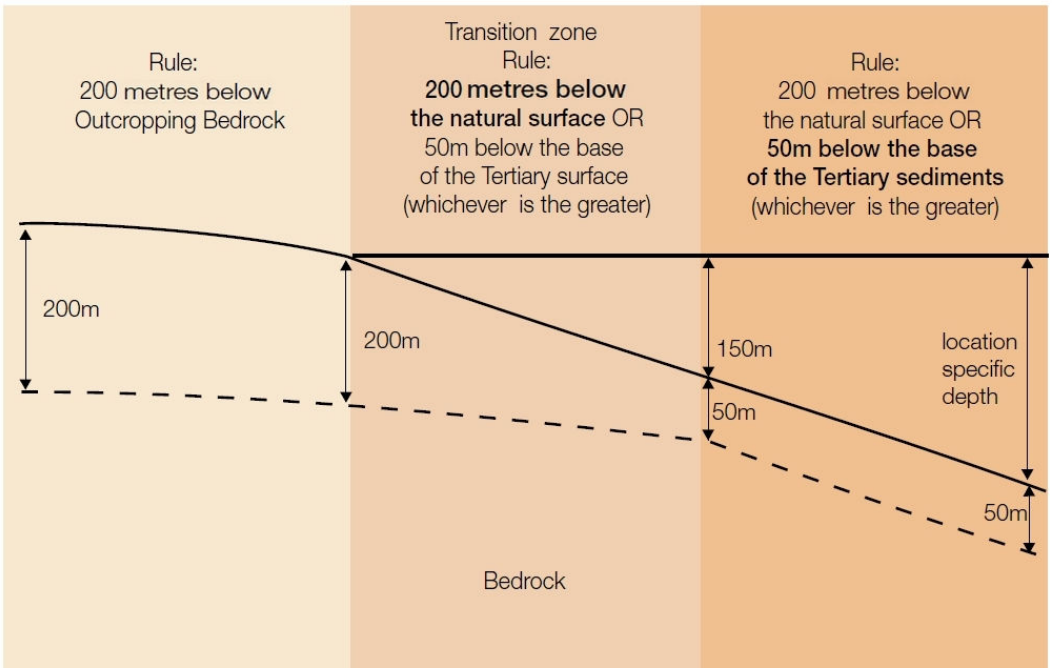

Figure 2 Groundwater management framework depth boundaries (DSE, 2012)

2 Groundwater System

2.1 Aquifers

Groundwater resources within the Upper Goulburn catchment broadly occur within two aquifer types (GHD, 2010):

- sedimentary and granite bedrock,
- alluvial sand and gravel.

2.2 Sedimentary and granite bedrock

The Upper Goulburn catchment is composed predominantly of sedimentary and granite bedrock and these fractured rocks are a locally important aquifer.

The sedimentary rocks consist mainly of hard, compacted layers of mudstone and siltstone, which have been compacted, 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. Individual bore yields from the sedimentary bedrock aquifer are generally low (typically less than 0.5 L/sec) however the aquifer does provide an important local groundwater resource for several upland towns, such as Kinglake, where it is the primary source of domestic water supply, and it is also used to support bottled water and the agricultural (irrigation) industry.

The granitic aquifers are made of hard crystalline volcanic rock. 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. Relatively few bores have been drilled in the granite 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 good quality fresh water.

2.3 Alluvial sand and gravel

The alluvial aquifer consists of gravel, sand and silt sediments deposited along the valley by the ancestral Goulburn River, extending along the river valley down from Lake Eildon to Seymour. The alluvial sands and gravels can store large quantities of good quality water which can move freely through the permeable unconsolidated aquifer. Bore yields above 5-10 L/sec can be obtained from the alluvial aquifer which is typically around 20-40 m thick along the flood plain of the river.

2.4 Groundwater levels

There is a network of 31 state observation bores across the Upper Goulburn GMA which monitor the bedrock and alluvial aquifers (Figure 13).

The majority of bores monitor groundwater in the sedimentary bedrock aquifer, notably around Kinglake, and along the valleys of the King Parrot, Yea, Goulburn and Acheron.

Groundwater levels measured in observation bores within the sedimentary bedrock aquifer in the upper catchment are typically within 3 m to 25 m of the ground

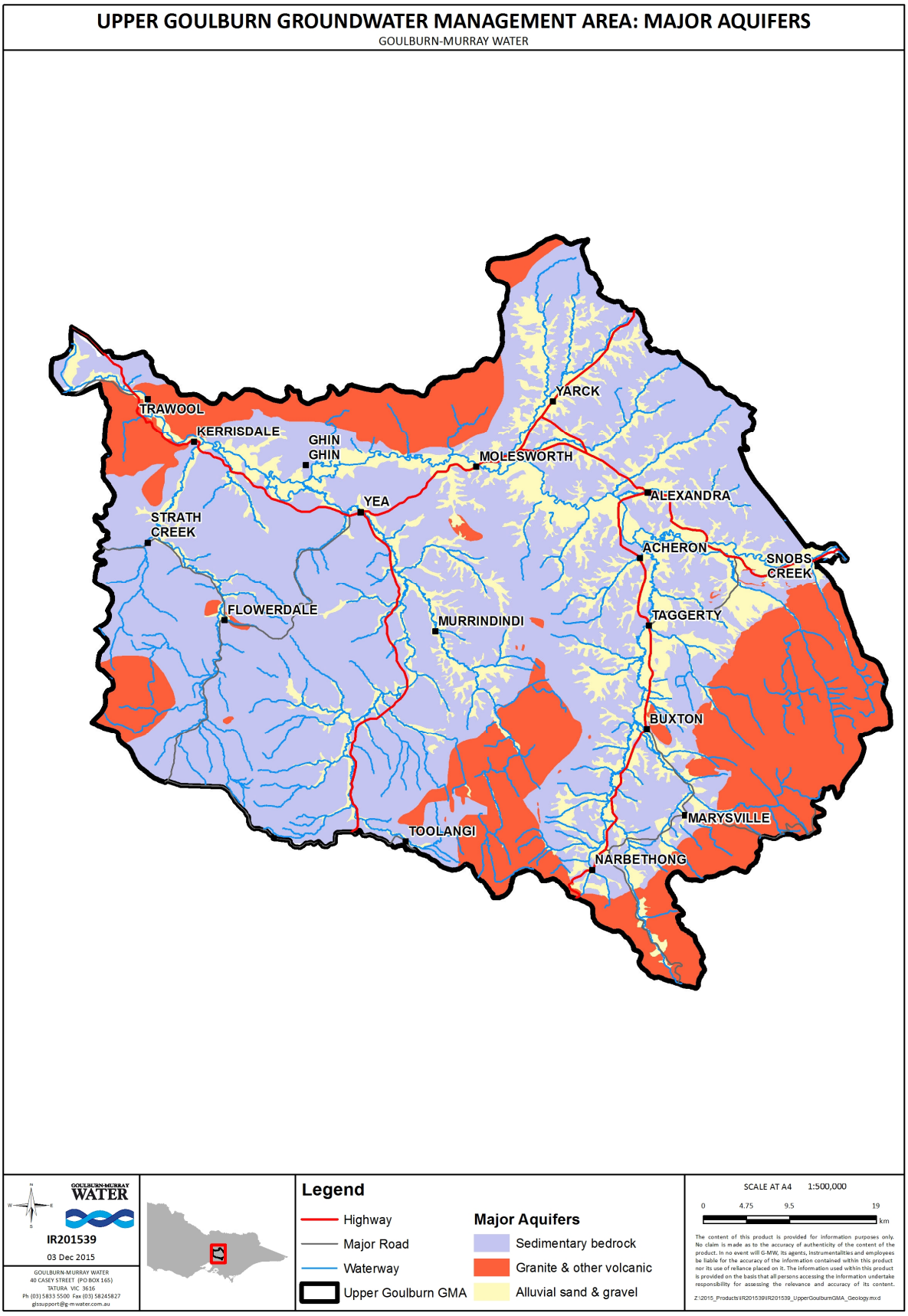

Figure 3 Major aquifers in the Upper Goulburn GMA

surface. A typical groundwater level plot from an observation bore in the Kinglake area is shown below.

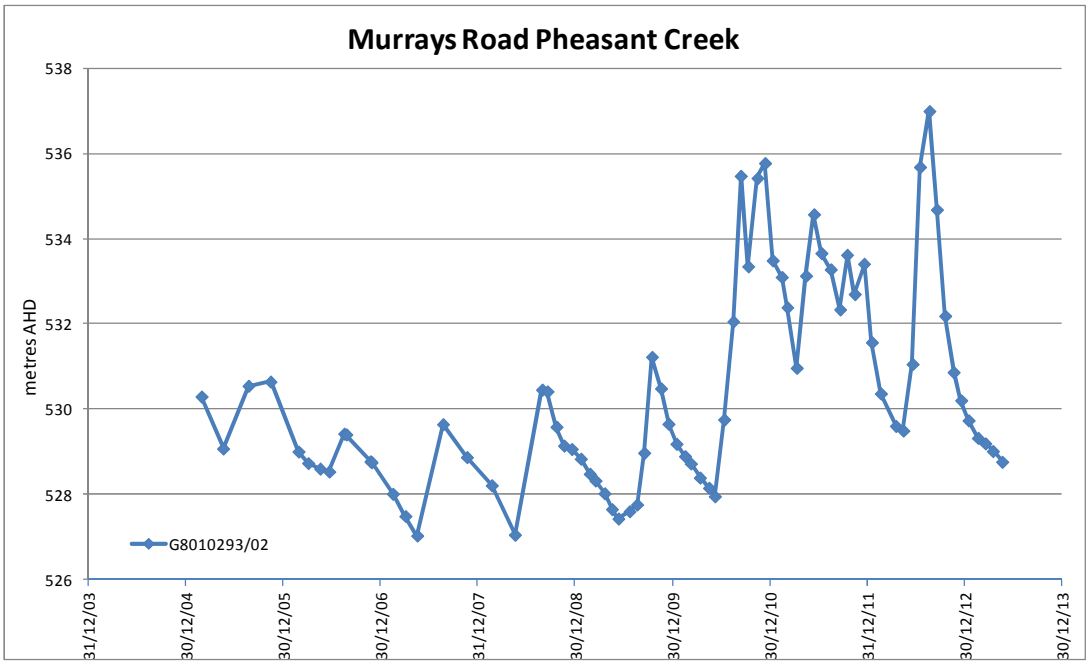

Figure 4 Kinglake groundwater level plot

Figure 4 shows that the seasonal groundwater level change in this area was typically between 3 to 4 m and this is believed to be due mainly to pumping from local stock and domestic and licensed groundwater bores, in conjunction with rainfall.

Overall the groundwater levels remained relatively steady in this area during the later part of the drought (2004-2009), and the aquifer recovered rapidly after the significant wet years of 2010 and 2011.

Away from Kinglake seasonal groundwater levels generally fluctuate by 1-2 m each year. There is also some evidence from observation bores further down the Yea and King Parrot catchments (for example at Flowerdale on the King Parrot Creek) that groundwater levels are at or above the ground surface. This is illustrated by spring activity and pressure levels in artesian bores.

Information from available bores suggests the groundwater levels in the alluvial aquifer are likely to be within 5 m of the ground surface.

2.5 Groundwater recharge

The majority of recharge to the bedrock aquifers in the GMA originates from rainfall which is highest 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.

Where the level of water in a stream is higher than the surrounding groundwater level, some aquifer recharge is likely to occur as the stream loses water to the groundwater system.

Many of the headwaters of the streams at the top of the catchment are fed by groundwater and these streams are known to cease to flow as groundwater levels fall.

Annual average recharge in the Upper Goulburn ranges between approximately 180 mm per year in the Acheron uplands, and around 50 mm per year in the lower King

Parrot Creek catchment. Groundwater entitlement is approximately 3% of 'dry year' annual groundwater recharge across the GMA.

Recharge to the alluvial aquifer occurs through rainfall, runoff from the surrounding upland bedrock, and infiltration from the Goulburn River (mainly during flooding).

2.6 Groundwater flow

The majority of bedrock groundwater flow occurs in the weathered zones, and in fissure and fracture zones, in the uppermost 100 m of bedrock. Groundwater levels and flow in the bedrock aquifer are likely to mirror topography and flow systems are generally short, as illustrated in Figure 5. Groundwater and surface water catchments are largely the same.

Groundwater flow in the shallow alluvial aquifer along the Goulburn River will follow the gradient of the river valley, with groundwater flow locally towards the river, as illustrated in Figure 6.

2.7 Groundwater discharge

The majority of groundwater recharge discharges to local surface water streams as baseflow, or as spring flow, and some loss occurs due to evapotranspiration from the water table.

Depending upon the geology and local groundwater levels, groundwater can discharge into streams, or streams can lose water through their bed into the aquifer system. There is evidence from catchments like the Yea River and King Parrot Creek that the streams in the headwaters often lose water to the aquifer system but gain water from the aquifer further downstream.

Groundwater flow in the alluvial sands and gravels along the Goulburn River will generally discharge into the river, except during times of flood. Work undertaken by GHD (2010) suggests that the groundwater baseflow to the Goulburn River between Eildon and Trawool (upstream of Seymour) is between 215-460 ML/d.

A small proportion of groundwater is extracted by bores, and this is estimated to be less than 2% of annual average recharge over the whole GMA (as described in section 3.2).

2.8 Groundwater quality

Groundwater quality is relatively fresh across much of the Upper Goulburn GMA.

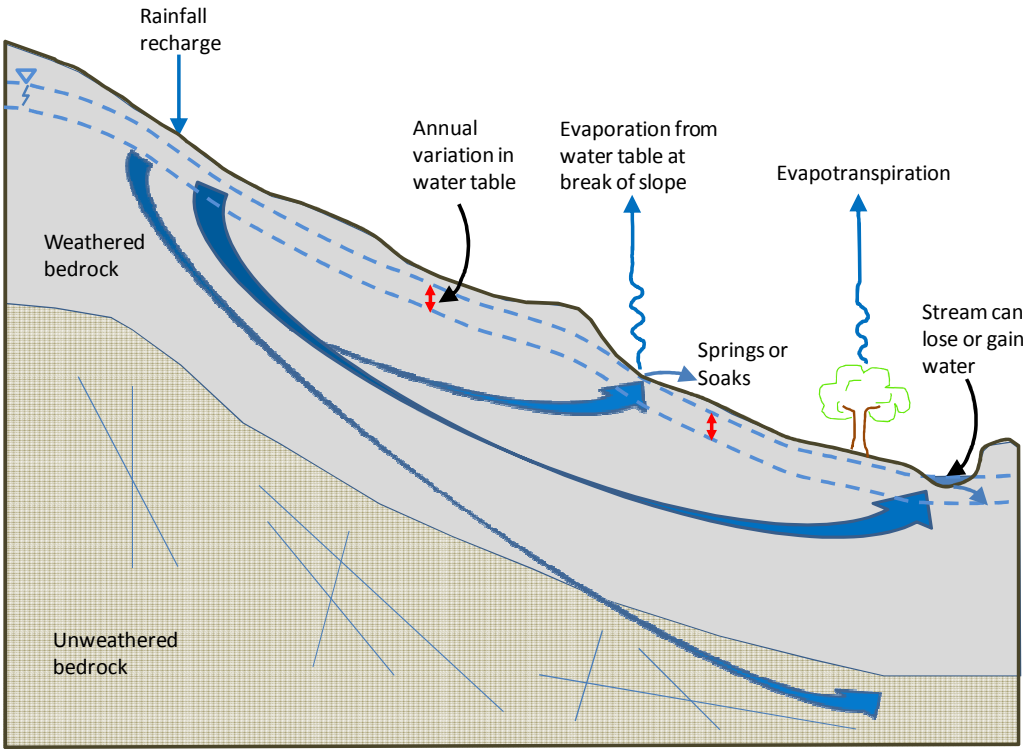

Figure 5 Groundwater flow through the bedrock aquifer

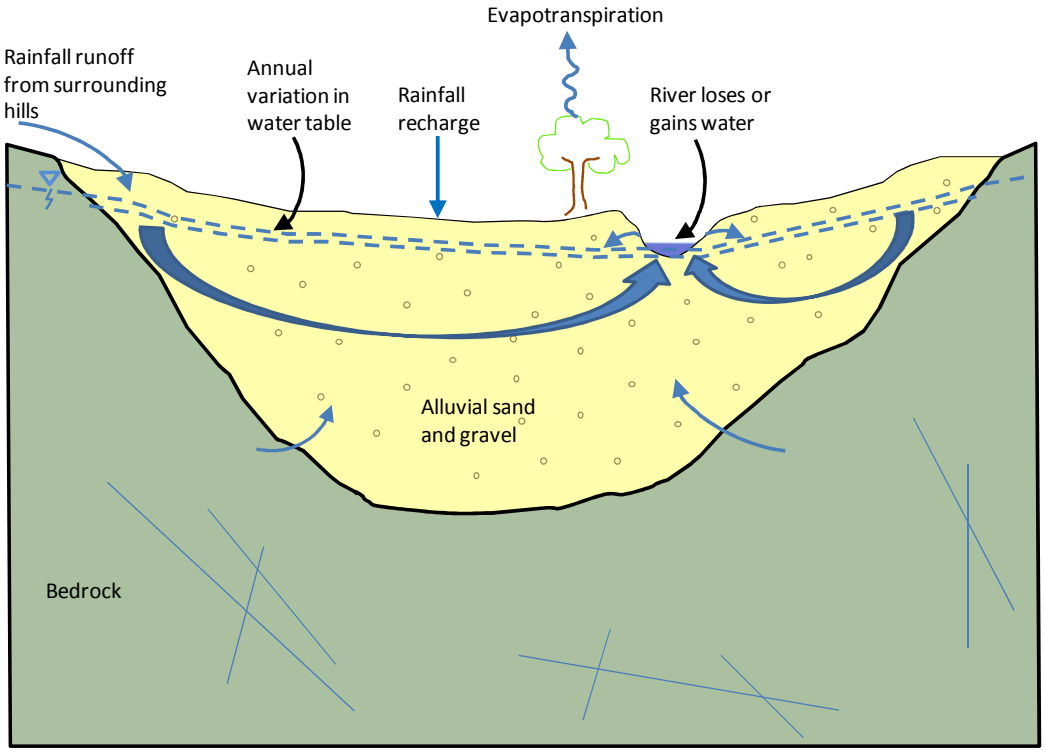

Figure 6 Groundwater flow through the alluvial aquifer

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 140 bores authorised to extract a total of 6,115 ML per year from the Upper Goulburn GMA. The total volume of groundwater entitlement in the GMA makes up 2% of average annual groundwater recharge (360,000 ML per year)[1] or 3% of average dry year recharge (224,000 ML per year).

3.3 Distribution of licensed bores

The distribution of licensed bores is shown in Figure 9. Approximately 50% of groundwater entitlement in the Upper Goulburn GMA is located on the bedrock aquifer and 50% in the alluvial aquifer (Table 1). Of the 140 licensed groundwater bores in the Upper Goulburn GMA, 107 bores extract from the bedrock aquifer and 33 from the alluvial aquifer in the Goulburn zone. Groundwater entitlement is mainly concentrated around Alexandra and Kinglake.

Table 1: Bore and licence distribution by aquifer type

Aquifer	No. of Licensed Bores	Total Licence Volume (ML/year)	Percentage of Total Licence Volume
Bedrock	107	2,953	48%
Alluvial	33	3,162	52%
TOTALS	140	6,115	100%

[1] GHD (2011) Upper Goulburn Groundwater Resource Appraisal (Water Balance)

3.4 Metered Use

Groundwater use varies from season to season, and higher groundwater use tends to correlate with lower rainfall years. Actual groundwater use accounts for 7% to 30% of the total licence volume. This indicates a significant volume of groundwater can be utilised or transferred to support future development.

Meters were installed between 2007 and 2009 on all licensed operational groundwater bores with a groundwater entitlement equal to or greater than 20 ML per year. Currently 25% of all groundwater licenses in the Upper Goulburn 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 allow for informed management decisions.

3.5 Domestic and Stock Use

Domestic and stock (D&S) bores, in the Upper Goulburn GMA, are generally developed in bedrock aquifers to a depth less than 100 m. There are 826 known D&S bores in the Upper Goulburn GMA (based on State Groundwater Management System records). D&S bores are not metered and there are likely to be a number of unregistered D&S bores. Therefore the amount of 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 now 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,
- 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 the most important features are the streams, which support a wide range of environmental social and economic values. Major streams are shown in Figure 1.

Springs and other groundwater dependent features are also considered to be important environmental and cultural features, and the Goulburn River from Lake Eildon to the Murray River is also a declared heritage river. A number of nationally significant peat wetlands also occur in the Upper Goulburn area.

3.6.2 Groundwater values

GMW, with the help of key 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 (Goulburn Broken Catchment Management Authority, 2005). The King Parrot Creek, Yea River, Acheron River and Rubicon Rivers are all listed as Priority Streams in this strategy.

Key environmental values include the Macquarie Perch and Barred Galaxias (Figure 7) which are found in King Parrot Creek, the Yea and the Rubicon Rivers and are classified as endangered species in State and Federal legislation. Environmentally significant peat wetlands are found in the King Parrot Creek and Acheron catchment. The Rubicon and Acheron rivers are classified by the Goulburn-Broken Catchment Management Authority (GBCMA) as near natural environmental sites of significance.

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

They 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 waterways.

The waterways are used to provide vital water supplies to domestic and stock users and by irrigators and other users through licensed diversions, supporting the local economy.

Figure 7 Macquarie Perch and Barred Galaxias

Groundwater has a locally significant social and economic value in Upper Goulburn, particularly in the Kinglake and Alexandra areas where groundwater resources have been developed for domestic and stock, irrigation and commercial use. Examples of groundwater use in the Upper Goulburn are shown in Figure 8.

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, other diversions such as farm dams and surface water extractions on stream flows and therefore by association the stream flow environmental values.

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

Turf farming in Kinglake

Beef farming in the Goulburn Valley

Figure 8 Examples of groundwater use in the Upper Goulburn GMA

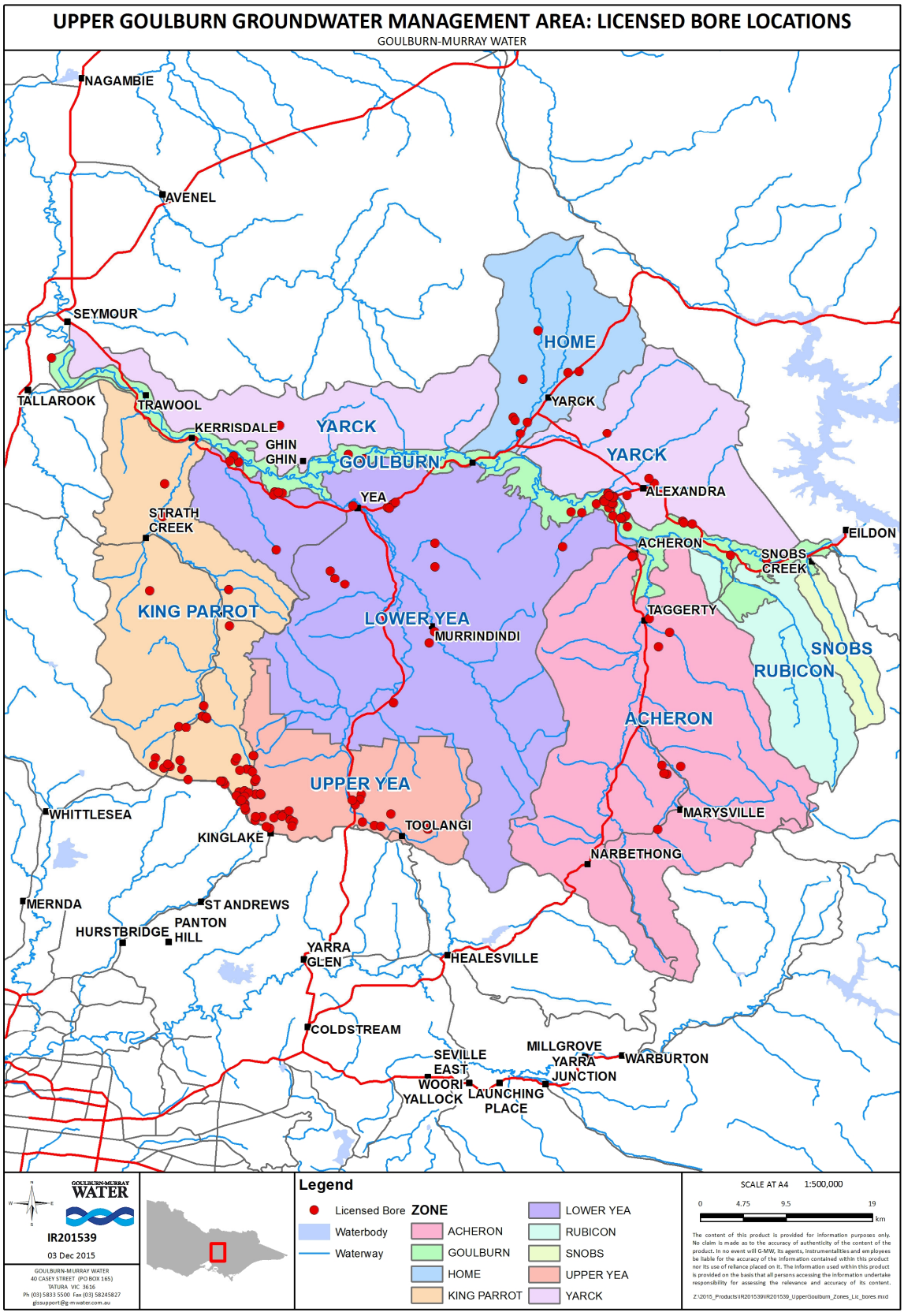

Figure 9 Upper Goulburn GMA Zones and Licensed Bore Locations

A range of diversions can 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 groundwater extraction scenarios have been assessed against these baseline low flow conditions (GMW, 2013).

GMW's assessment indicates that some streams in the GMA (King Parrot, Upper Yea and Home Creek) 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, so these catchments have been capped. In the other catchments the level of surface water, farm dam and groundwater development is low and the catchment characteristics mean that the streams continue to flow even during dry periods.

This assessment approach has enabled groundwater limits to be identified for the GMA based on a catchment specific assessment. The resulting catchment limits on groundwater development are listed in Table 4.

Figure 10 Yea River and King Parrot Creek

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 occur. 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 a 1:1 ratio, and impacts are assumed to be 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 Upper Goulburn GMA. However, where present, these features may be susceptible to dry weather and groundwater extraction, particularly where bores are located close by. Impacts on groundwater dependent ecosystems will be considered by GMW when an assessment is undertaken following a groundwater licence application.

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

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 streams flow are not unacceptably impacted by growth in new groundwater entitlement.

Throughout the majority of the GMA there is no evidence that groundwater extraction is causing any significant reduction in groundwater levels, or is impacting upon the availability of the resource. There are relatively small seasonal changes in groundwater levels in the Kinglake area, but it is considered very unlikely that this will impact upon the ability of users to access the groundwater resource.

It is recognised that the catchment based limits may be seen as conservative and this may be viewed as a barrier to further groundwater development (and the economic values that may result), but it is also true that in the last 20 years there has been little demand for new groundwater entitlement in the Upper Goulburn GMA, and historic use is less than 30% of groundwater entitlement. In the areas where new licensed bores are most likely to be developed, in the uplands of the King Parrot Creek and Yea River and on the Goulburn River around Alexandra, 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 Upper Goulburn GMA includes nine catchment based management zones. These are described in Table 2 and illustrated in Figure 9.

Table 2: Groundwater Management Zones

Zone	Description
Yarck	The Yarck Zone comprises the small ungauged catchments to the north of the Goulburn River. The geology is fractured granite bedrock and groundwater feeds local creeks.
Home	This zone is made up of the Home Creek catchment. The Home zone contains most of the surface water and groundwater entitlement north of the Goulburn River. The geology is fractured granite bedrock and groundwater feeds local creeks.
Goulburn	The Goulburn Zone extends along the alluvial plain adjacent to the Goulburn River. The geology comprises fractured bedrock overlain by alluvial deposits. The Goulburn River is regulated and river flow is maintained by releases from Lake Eildon.
Snobs	The Snobs Zone currently has no groundwater entitlement. The geology is fractured volcanic bedrock that provides baseflow to Snobs Creek.
Rubicon	The Rubicon Zone includes a hydroelectric plant as one of the largest surface water entitlement holders. There is very little groundwater entitlement in the Rubicon Zone. The geology is fractured volcanic bedrock.
Acheron	The Acheron Zone comprises the surface water catchment of the Acheron River. The main source of groundwater in the Acheron Zone is fractured sedimentary bedrock aquifer which is overlain by a thin alluvial aquifer along the river valley.
Lower Yea	The Lower Yea Zone includes the Yea River below Devlins Bridge and the Murrindindi River catchment, which feeds into the Yea River upstream of where the Yea meets the Goulburn River. Groundwater is sourced from the fractured sedimentary bedrock aquifer.
Upper Yea	A majority of entitlement is at the top of the Yea River catchment above Devlins Bridge. Entitlement is capped in the Upper Yea zone. The north boundary of the Upper Yea catchment follows the border of the State forest across to the Murrindindi catchment.
King Parrot	The King Parrot Zone includes the King Parrot Creek and its tributaries, such as Wallaby and Silver Creek. The majority of groundwater entitlement is situated in the fractured sedimentary bedrock aquifer at the head of the catchment around Kinglake. The fractured rock aquifer is an important source of domestic and stock supply for household water in Kinglake and Flowerdale. Melbourne Water also diverts a significant volume of water for Melbourne's urban supply from Wallaby and Silver Creek.

The groundwater management zones, illustrated in Figure 9, are based on the understanding of the hydrogeology of the Upper Goulburn. Groundwater flow and the impacts of groundwater pumping are largely contained within each surface catchment, and 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 9 shows the distribution of licensed bores within the GMA. Table 3 summarises the number of licensed groundwater bores by zone, and the zonal groundwater entitlement.

Table 3 Distribution of Groundwater Entitlement in Management Zones as of July 2013

Management Zone	Number of Licensed Bores	Current Licence Volume (ML/yr)	Maximum licence volume permitted (ML/yr)
Yarck	5	92	276
Home (Yarck)	9	392	392
Goulburn	33	3,106	3,891
Snobs	0	0	88
Rubicon	0	0	307
Acheron	10	288	876
Lower Yea	15	362	863
Upper Yea	30	789	789
King Parrot	38	1,086	1,086
Total	**140**	**6,115**	**8,568**

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 licence entitlement for the GMA will be capped through the declaration of the Permissible Consumptive Volume (PCV). The PCV will be set at 8,568 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 documented in full in a background technical report (GMW, 2013). Groundwater entitlement limits have been set for each management zone based on a consideration of local catchment values. The sum of these groundwater entitlement volumes 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 Plan.

When assessing groundwater licence applications, GMW must make sure that particular matters, including the PCV, are considered in accordance with section 53 of the Act. 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 Upper Goulburn Groundwater Management Area (Plan LEGL/13-128)

New groundwater entitlement may occur up to the limit specified in the proposed cap, subject to the zone limits.

The availability of new groundwater entitlement in each zone is shown spatially in Figure 11. Zones coloured in pink (King Parrot Creek, Home Creek, and Upper Yea River) are capped at current levels of groundwater entitlement. In the Zones coloured in green (Rubicon, Acheron, Lower Yea/Murrindindi, Goulburn and remaining Yarck Zone) some additional new groundwater entitlement is allowed as shown in Table 3.

4.3 Trading of groundwater entitlement

Groundwater trading allows for licence entitlement to be transferred. Rules have been developed to:

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

Rule 3 relates to groundwater trade.

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.

Rule 2: New Entitlement Zone 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 specifies in Table 4.

Management Zone	Maximum licence volume permitted, ML
Yarck	276
Home	392
Goulburn	3,891
Snobs	88
Rubicon	307
Acheron	876
Lower Yea	863
Upper Yea	789
King Parrot	1,086
Total	8,568

Table 4 - Maximum zone licence volumes permitted

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**:**

(c) The buyer has a bore with a metered diversion point; and,

(d) The approval of a transfer must not cause the sum of total entitlement to exceed the Permissible Consumptive Volume established for the Upper Goulburn Groundwater Management Area (Plan LEGL/13-128) and any cap which applies to a management zone as shown in Table 4.

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 Upper Goulburn 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.

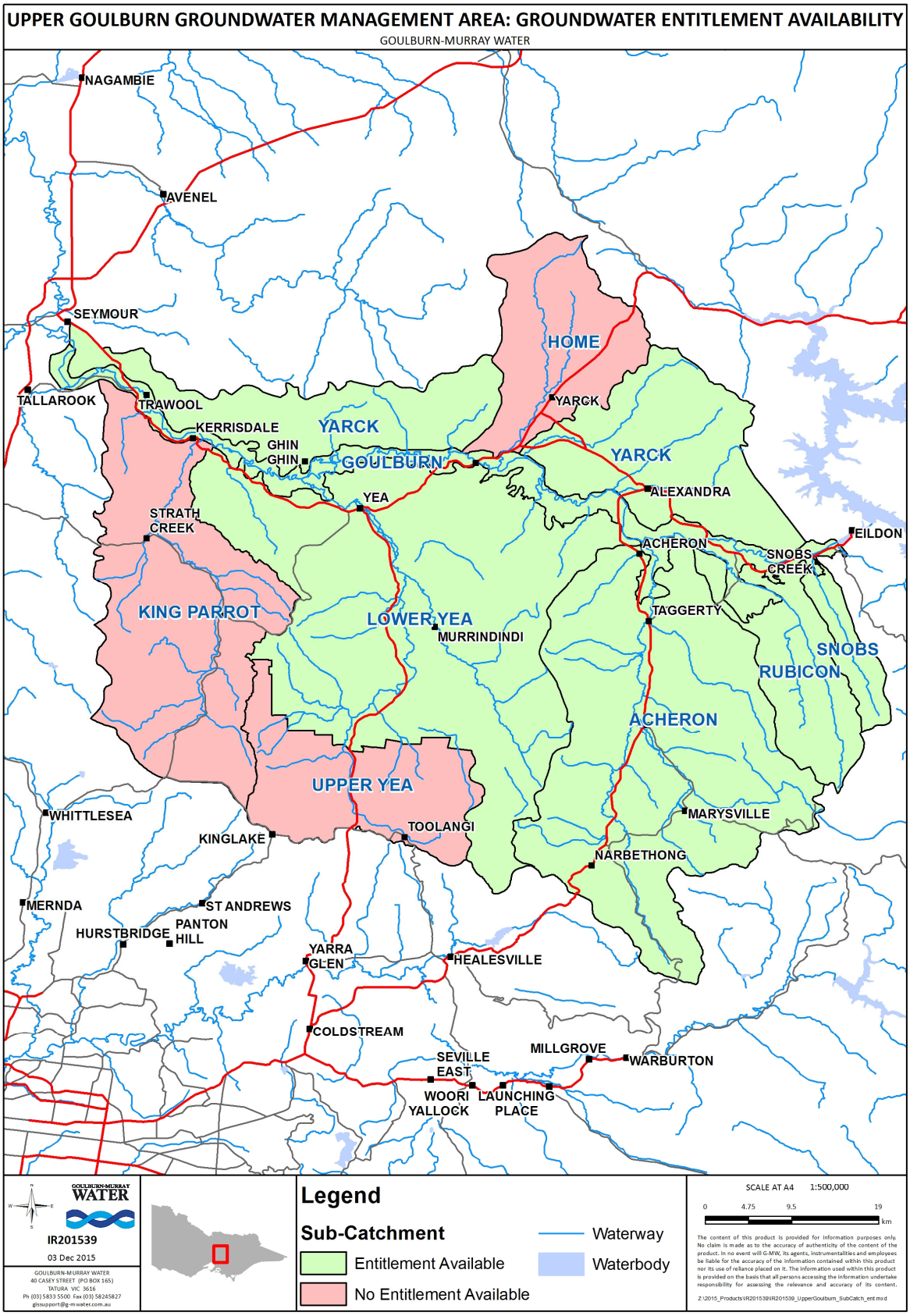

Figure 11: Groundwater licence entitlement availability by management zone

5 Monitoring program

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

5.1 Groundwater levels

The expansion of the State Observation Bore monitoring network in the Upper Goulburn between 2005 and 2010 has greatly improved the monitoring coverage of the region.

There are now 31 strategically located State Observation Bores in the Upper Goulburn GMA (Figure 13) that are monitored at either monthly or quarterly intervals.

The State Observation Bores reflect the groundwater resource condition and provide valuable data on:

- Groundwater interactions with surface water,
- Groundwater dependent ecosystems,
- Groundwater quality,
- Groundwater system response to recharge,
- Local pumping effects.

Figure 12 Yea surface water gauge and groundwater monitoring bore at Devlins Bridge and a King Parrot Creek groundwater monitoring bore

Continued monitoring of groundwater levels is required to improve our understanding of how the groundwater system responds to different stresses, such as changing climatic conditions and shifts in the distribution of groundwater extractions resulting from the transfer of groundwater licences. This in turn supports responsible resource management decision making.

Rule 4: Monitor groundwater levels

Goulburn-Murray Water will utilize the groundwater level data collected by the State Observation Bores monitoring network in the Upper Goulburn Groundwater Management Area to inform any review of the Plan and to inform licensing decisions.

5.2 Surface Water Flows

The surface water flow gauges used in the assessment of groundwater entitlement are shown in Figure 13. These gauges are used by different stakeholders including the Bureau of Meteorology, Goulburn Valley Water and Goulburn-Murray Water to support 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. This data will be used to assist in any future reviews of the Plan.

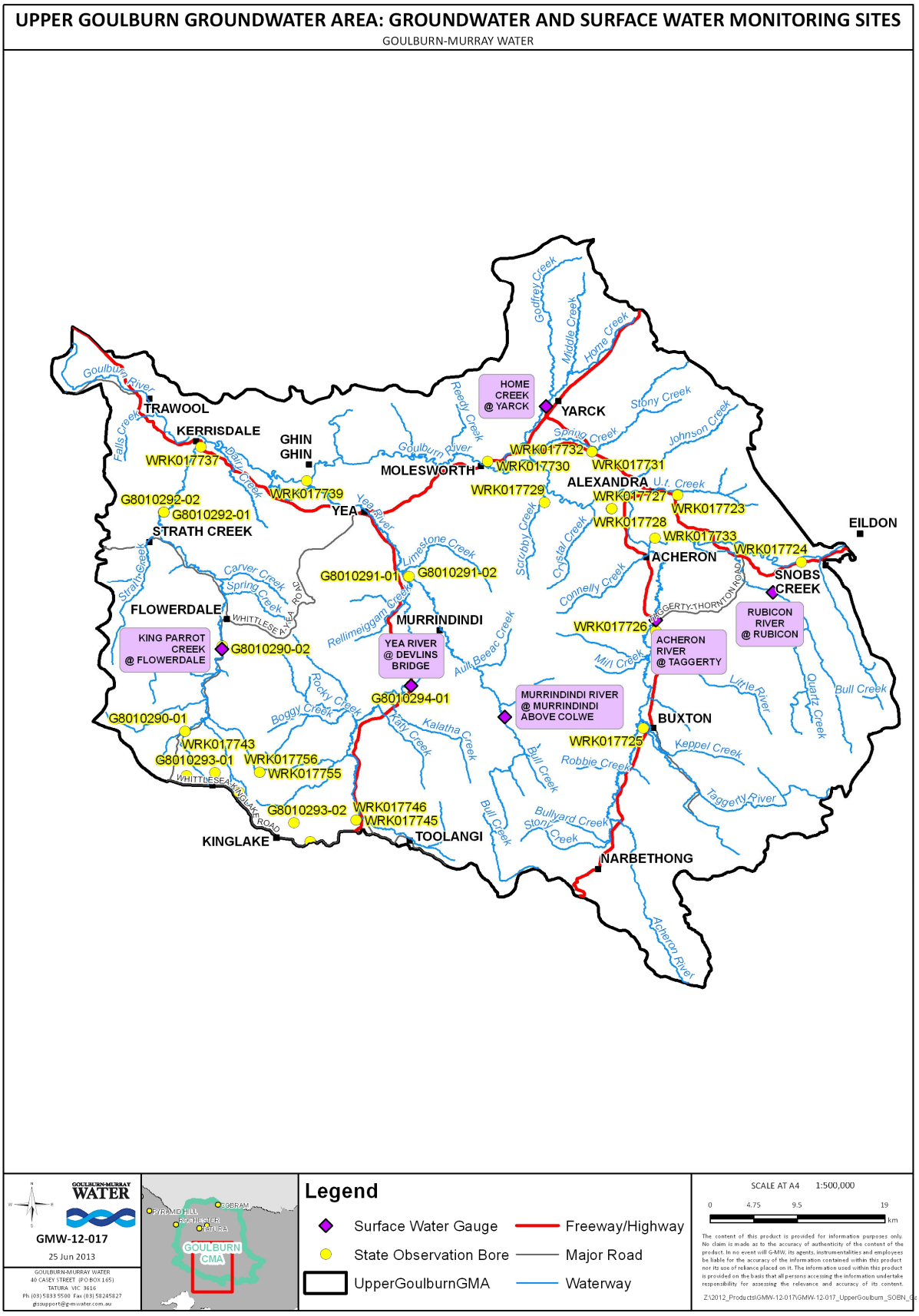

Figure 13 Upper Goulburn GMA surface water gauges and State Observation Bore locations

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 Upper Goulburn GMA but it can be a more significant component 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 groundwater 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 5: Record meter readings

Goulburn-Murray Water will:

(e) Ensure that a flow meter is fitted to all existing licensed operational bores in the Upper Goulburn GMA which are associated with a licence entitlement equal to or greater than 20 ML/year.

(f) Ensure that any new licensed bores are fitted with a flow meter,

(g) Read each meter at least once annually,

(h) Enter metered groundwater use into the Victorian Water Register database.

6 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 help 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 6: Annual newsletter

Goulburn-Murray Water will, by 1 October of each year, prepare an annual newsletter to 30 June of that year for the Upper Goulburn 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 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 Upper Goulburn GMA Plan 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 increases and as management improvements 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 during the preparation of the annual newsletter 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 7: 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 release 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 Upper Goulburn 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 service committee.

6.3 Recommendations for further work

The following recommendation for further work will increase resource understanding and bring about improvements to the Plan. The recommendation is to:

- Monitor groundwater level fluctuations in the alluvial aquifer to improve the current understanding of the interaction between groundwater flow and the Goulburn River. Improved understanding of interactions will assist GMW to licence and manage groundwater in the Goulburn zone.

7 References

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