Methodology for assigning management zones in the Eastern Mount Lofty Ranges Prescribed Water Resources Area to high demand categories

DEWNR Technical note 2015/06

Government of South Australia
Department of Environment, Water and Natural Resources

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Department of Environment, Water and Natural Resources

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Acronyms

ALARP	As low as reasonably practicable
CUL	Consumptive Use Limit
DEWNR	Department of Environment Water and Natural Resources
EMLR	Eastern Mount Lofty Ranges
PWRA	Prescribed Water Resources Area
SAMDB NRM Board	South Australian Murray-Darling Basin Natural Resources Management Board
SMK	Science, Monitoring and Knowledge
SW	Surface water
the Act	*Natural Resources Management Act 2004*
UGW	Underground water
WAP	Water Allocation Plan

Preface

This report, the *Methodology for assigning management zones in the Eastern Mount Lofty Ranges Prescribed Water Resources Area to high demand categories* (categorisation report), is the second of two that together describe how the risk caused by high demand for water in the Eastern Mount Lofty Ranges (EMLR) was categorised and then how specific zones were assigned to risk categories.

Initial studies completed during the EMLR water allocation planning process indicated the volumes of water needed for the existing user allocation process[1] are potentially greater than the resource can support for some underground water and surface water management zones.

The first report the *Eastern Mount Lofty Ranges Prescribed Water Resources Area – Water Allocations for Management Zones Risk Assessment* (risk assessment report, DEWNR 2015) identifies, analyses and evaluates potential risks to EMLR water resources caused by high demand. It determined the level of risk for each underground and surface water management zone if all licence holders use their full proposed water allocations. It also presents recommendations regarding the priority for treatment to reduce the risk level.

This report, the *Methodology for assigning management zones in the Eastern Mount Lofty Ranges Prescribed Water Resources Area to high demand categories* (categorisation report) establishes a method for categorising water resource management zones based on priority for risk treatment. It builds on the risk assessment report by considering additional information about specific management zones and water demand.

The categorisation report shows the risk based on the water demand at a single point in time, it uses the information available to the Department at the time it was written. As the existing user process is finalised and new information about water use in the EMLR becomes available, it may become necessary to update the results of the categorisation.

The categorisation report puts water resource management zones into one of four categories (i.e. low demand, category 1, category 2, and category 3) and were used in the existing user process to issue and manage licences[2]. These categories have been renamed to show the priority for treatment.

Low demand = Low

Category 1 = Medium

Category 2 = High

Category 3 = Very high

Low – *water sources are located in an area where the water demand is within the sustainable limit. The best available science suggests there is a negligible risk that the water resources and/or water users would be negatively impacted if every licence holder in these zones used their full water allocation. In these management zones, water resource condition will be monitored and evaluated as part of the base regional program.*

[1] Existing users are people who either took water from the Eastern Mount Lofty Ranges Prescribed Water Resources during the establishment period (1 July 2000 to 16 October 2003) or who committed significant financial, legal or other resources to a project within this period that would require access to water and applied for a water licence within the statutory application period. This is in accordance with section 164N of the *Natural Resources Management Act 2004*.

[2] It is important to note that water allocations initially granted to existing users were based on the scale and type of water use declared during the establishment period, including any significant commitment (see footnote 1). This means the allocations initially granted to existing users were not changed to consider scientific evidence on the risk of damage to the water resource.

Medium – *water sources are located in an area where water demand is higher than the sustainable limit. However, best available science suggests there is a low risk that the water resources and/or water users would be negatively impacted if every licence holder in these zones used their full water allocation. In these management zones, water resource condition will be monitored and evaluated, allowing assessment of whether further action is required.*

High – *water sources are located in an area where water demand is higher than the sustainable limit. The best available science suggests there is a medium to high risk that the water resource and/or water users would be negatively impacted if every licence holder in these zones used their full water allocation. In these management zones, there will be targeted water resource condition monitoring and evaluation, and licensed water use will be measured more frequently. Action may be taken to address the risk to the water resource if negative impacts come to light or there is an ongoing risk of negative impacts. Water users will be consulted prior to the implementation of any strategy to manage high water demand.*

Very high – *water resources are located in an area where water demand is higher than the sustainable limit. The best available science suggest that the water resources, water users and/or dependent ecosystems are being negatively impacted, or that there is a serious risk that they will be, particularly if every licence holder in these management zones used their full water allocation. In order to sustainably manage the resource in the long term for all users in these areas, there is a need to reduce the demand for water.*

The Department of Environment, Water and Natural Resources and the South Australian Murray-Darling Basin Natural Resources Management Board will actively partner with the community to find solutions to manage water demand.

For further information on the Managing High Water Demand project, please visit the following website: http://www.naturalresources.sa.gov.au/samurraydarlingbasin/water.

Executive summary

A system of water planning and licensing has been introduced to the Eastern Mount Lofty Ranges (EMLR) to support long-term sustainable management of water resources in the region. In some areas, the total demand for water exceeds the sustainable consumptive use limit at a localised scale. These areas are referred to as 'high demand management zones'. A high demand management strategy is being developed to help address the risk posed by high water demand to water resources, users and dependent ecosystems.

A risk assessment has previously been carried out to identify and evaluate the risk posed to the water resources by high water demand in these zones in the EMLR Prescribed Water Resources Area (PWRA) (DEWNR 2015). This risk assessment supports the process for allocating water to existing licensed water users by providing guidance on the need to treat risks and where further analysis is required.

This report builds on the risk assessment work by outlining a method for assigning high water demand management zones to risk treatment categories in the EMLR PWRA, in order to support the high demand management strategy in the area.

Three risk treatment categories for high demand zones have been identified to support the existing user allocation process, as follows:

- Category 1 management zones – level of risk considered acceptable, or tolerable. No immediate treatment of risk required, but risk should continue to be monitored as appropriate.
- Category 2 management zones – level of risk is high enough to warrant concern. More data are required to support permanent action to reduce risk, although short-term action to contain the current level of risk is appropriate.
- Category 3 management zones – level of risk considered intolerable; sufficient evidence to justify action to reduce the level of risk.

Note that these categories only apply to high demand zones, and do not apply to zones where total demand for water is within sustainable limits. The level of risk is based on full use of assumed water demand.

A set of rules have been developed to assign high demand management zones to these three treatment categories, building on the risk assessment work. The rules consider factors such as:

- risk tolerability
- consideration of risks caused by hydrologically connected zones (e.g. between surface water zones and between underground water and surface water zones)
- potential limitations in the ability to extract the full theoretical volume of demand
- likelihood of environmental provisions being supplied from upstream despite local-scale high demand
- potential error margins in the consumptive use limits
- water availability in very low rainfall zones
- potential ecological consequences (further analysis building on the risk assessment)
- likely effectiveness of treating risk arising from licensed use in areas with a low proportion of licensed use.

The categorisation methodology has been applied to the management zones across the EMLR, using demand data and other available information as of October 2013.
There are 194 surface water management zones in the EMLR PWRA. The categorisation approach identifies 59 surface water management zones as having a high demand for water, based on October 2013 data (35 in Category 1, 2 in Category 2 and 22 in Category 3).

There are 27 underground water management zones in the EMLR PWRA. The categorisation approach identifies five underground water management zones as having a high demand for water, based on October 2013 data (1 in Category 1, 1 in Category 2 and 3 in Category 3).

The categorisation approach outlined in this report helps to support development of a risk-based approach to manage high demand in the EMLR by identifying areas where risks are considered acceptable or tolerable, areas where further information needs to be gathered to clarify the level of risk, and areas where agencies need to work in partnership with the community to identify approaches to manage the risks of high water demand.

1 Introduction

Project purpose

The purpose of this report is to outline a method for assigning high water demand management zones to risk treatment categories in the Eastern Mount Lofty Ranges Prescribed Water Resources Area.

The outcomes can help to inform the existing user allocation process and associated management of water licences in the region. The method builds on an earlier risk assessment process that identified and evaluated risks to water resources and water-dependent ecosystems that may arise where total demand for water exceeds sustainable use limits (DEWNR 2015).

Policy context

The water resources of the EMLR PWRA were prescribed in 2005 under the *Natural Resources Management Act 2004* (the Act). Prescription occurred in response to community concern about the impact of water resource development on water sharing and the environment. The prescription included underground water, surface water and water from watercourses. For the purposes of this report, surface water is used as a collective term that includes surface water and water in watercourses.

The prescription process introduces a system of water licensing and allocations to the EMLR, where a water licence and volumetric allocation is required to take and use water for licensed purposes. Licensed purposes in the EMLR include irrigation, industrial use, recreational use and intensive animal keeping. A licence is not required for a range of purposes in the EMLR, including domestic use, watering free-ranging stock, water taken by commercial forestry, and a range of minor purposes.

As part of the prescription process, existing users across the EMLR PWRA using water for licensed purposes are entitled to an allocation that meets their reasonable requirements, subject to the capacity of the resource[3]. The needs of ecosystems that depend on the water resources must also be taken into account[4]. The process for determining existing user entitlements is discussed further below.

A water allocation plan (WAP) has been developed for the EMLR to guide the allocation of water within sustainable limits, once the needs of existing users have been considered. The plan also includes provisions for ongoing management of water licences, policies for water affecting activities such as dam construction and well drilling, and principles for monitoring and reporting to allow water resource condition to be tracked over time.

Sustainable consumptive use limits have been identified for management zones across the EMLR PWRA. These limits have been set to balance social, economic and environmental needs for water, and to maintain water-dependent ecosystems at an acceptable level of risk. The limits are defined in the EMLR WAP, and are also being used to guide the separate existing user allocation process. The limits are discussed further below.

Assessment of the total demand for water, including existing user entitlements, has shown that total water demand exceeds sustainable use limits in some management zones in the EMLR PWRA ('high demand zones'). A risk assessment has previously been carried out to identify, analyse and evaluate water resource risks posed by the total water demand for management zones across the EMLR PWRA (DEWNR 2015). This is referred to as the 'risk assessment' in this report and is discussed further below.

The risk assessment identified risk tolerability and generic risk treatment recommendations for different management zones, based on the level of risk to water resources and water-dependent ecosystems. Broadly, risk tolerability ranges from intolerable, to tolerable subject to the risk being as low as reasonably practicable, to acceptable. The generic recommendations regarding the need to treat risk or undertake further assessment reflect the risk tolerability and confidence in the risk assessment. These recommendations are being used to guide the existing user allocation process and subsequent management of water licences in the region.

[3] As per Section 164N of the Act

[4] As per Section 170 of the Act

In some cases, the risk assessment identified that further work was required for some management zones either to:

- re-evaluate the risk based on further information (for cases where confidence is lower); or
- assess whether a risk is considered to be 'as low as reasonably practicable' (ALARP) in a given management zone and therefore tolerable — or if not then to commit to reducing likelihood and/or consequence of risks that are not as low as reasonably practicable.

This report outlines the methodology used to undertake the further work as above to refine the outcomes of the risk assessment process, in order to assign high demand management zones to treatment categories corresponding to the level of risk. In addition, more recent water demand data have been used to update the identification of high demand zones.

Background information and terminology

Consumptive use limits and management zones
Consumptive use limits have been determined for the water resources of the EMLR PWRA that consider water availability and a balance of social, economic and environmental needs for water. These consumptive use limits are described in the EMLR WAP (SAMDB NRM Board 2013) and are also being used to guide the separate existing user allocation process.

The consumptive use limits set a limit on the volume of water that can be sustainably taken from the water resources of a given location for consumptive purposes, including licensed and non-licensed use and evaporation from dams (where relevant).

Broadly, the consumptive use limits have been calculated by modelling the hydrological and ecological impacts of particular policy settings. The EMLR WAP gives more information on the process used to determine the consumptive use limits.

As part of the process of determining consumptive use limits, the region has been divided into management zones reflecting water resources (underground water management zones and surface water management zones) as well as local-scale characteristics, such as aquifer type, climate, sub-catchment, and environmental assets. Consumptive use limits have been determined for each management zone.

Figures 1 and 2 show the management zones in the EMLR PWRA. The values of the consumptive use limits for management zones are given in Table 4.7 of the EMLR WAP (for underground water management zones) and Table 4.5 of the EMLR WAP (for surface water management zones – called the Evaporation and Consumptive Use Limit as evaporation from dams is also counted against this limit).

There are two types of surface water management zones:

1. headwater zones (which are at the top of their catchment, and do not receive inflow from elsewhere)
2. receiving zones (which potentially receive inflow from headwater zones).

A main watercourse receives inflow from upstream zones. Headwater zones do not have a main watercourse.

There are also two types of surface water limits for zones, being the runoff evaporation and consumptive use limit (which is based on a percentage of runoff from within the zone), and the main watercourse evaporation and consumptive use limit (which is a cumulative limit that considers local runoff as well as inflow from the upstream zones). The runoff limit applies to local demand from within the zone, excluding demand from the main watercourse. The main watercourse limit applies to all demand within the zone, as well as all upstream demand in upstream zones (where relevant).

For the purposes of simplicity for this report, the runoff evaporation and consumptive use limit will be referred to as the 'runoff limit', and the main watercourse evaporation and consumptive use limit will be referred to as the 'main watercourse limit'.

Consumptive demand and high demand
For the purposes of this report, total consumptive demand in a management zone is the sum of the volumes of each of the following in that zone:

- Existing user reasonable requirements
- Stock and domestic water use

- Interception by commercial forestry
- Deemed evaporation from dams (for surface water management zones only).

The process for determining the volume of each of these types of demand is outlined below.

Existing user reasonable requirements
As per Section 164N (10) of the Act, an existing user in the EMLR PWRA is a person:

- who took water from the resource at any time during the establishment period (1 July 2000 – 15 October 2003); or
- who did not take any water during this period but who needs water for a development, project or undertaking to which he or she was legally committed or in respect of which he or she had, in the opinion of the Minister, committed significant financial or other resources during the establishment period.

As per Section 164N (2) of the Act, existing users are entitled to a water allocation that will meet their future requirements, based on their reasonable requirements during the establishment period and/or projects they have committed significant financial or other resources during the establishment period.

The process for determining the water volume of an existing user's reasonable requirements is outlined in Government of South Australia (2013). In summary, these volumes have been determined based on the type and size of existing users' enterprises and/or commitments during the establishment period, together with relevant theoretical enterprise requirement rates (e.g. ML/ha for a particular crop in a given climate band). Dam capacity has also been taken into consideration where relevant. The reasonable requirements volume has been provisionally split between different resources where necessary, subject to consultation with the existing user.

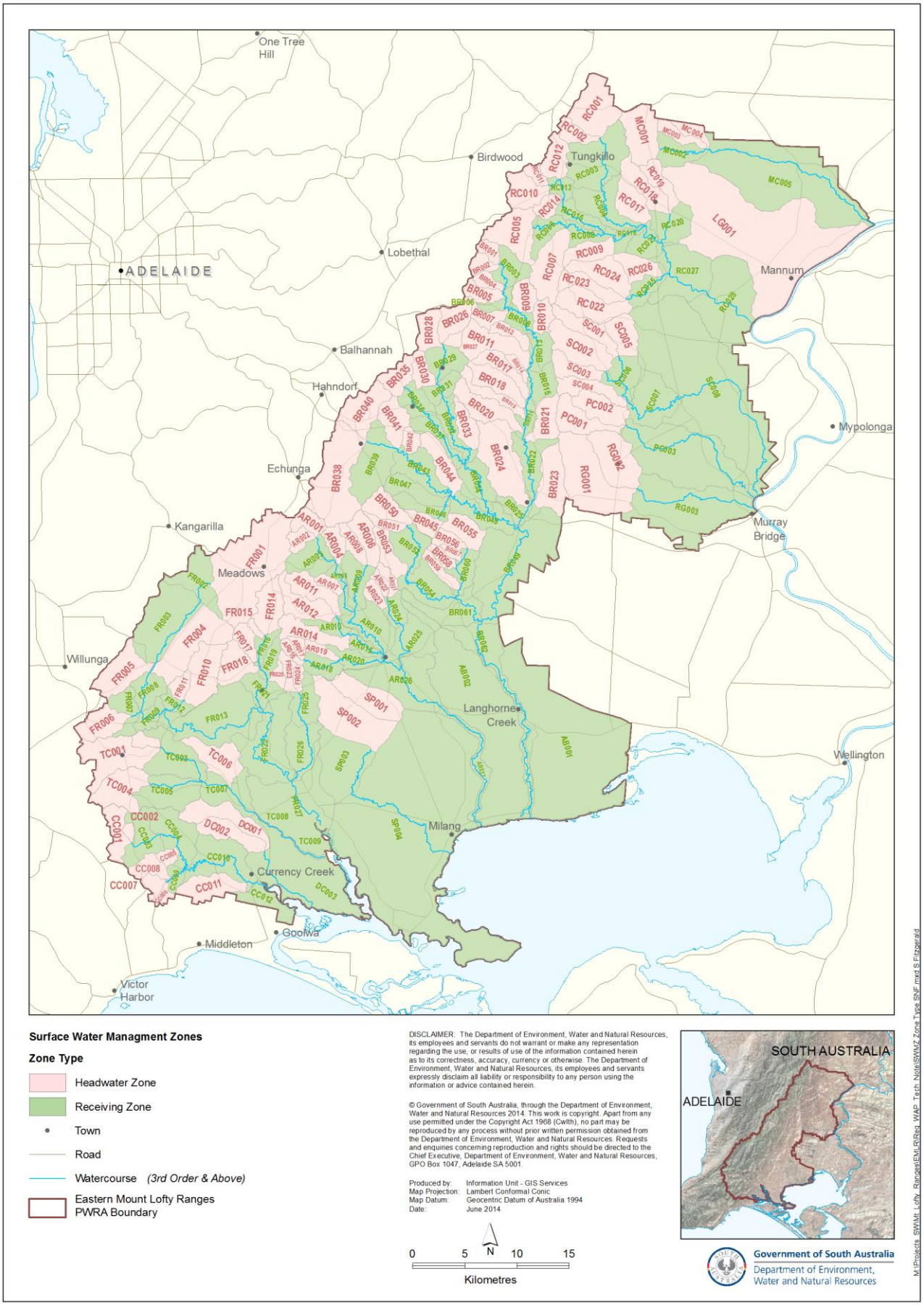
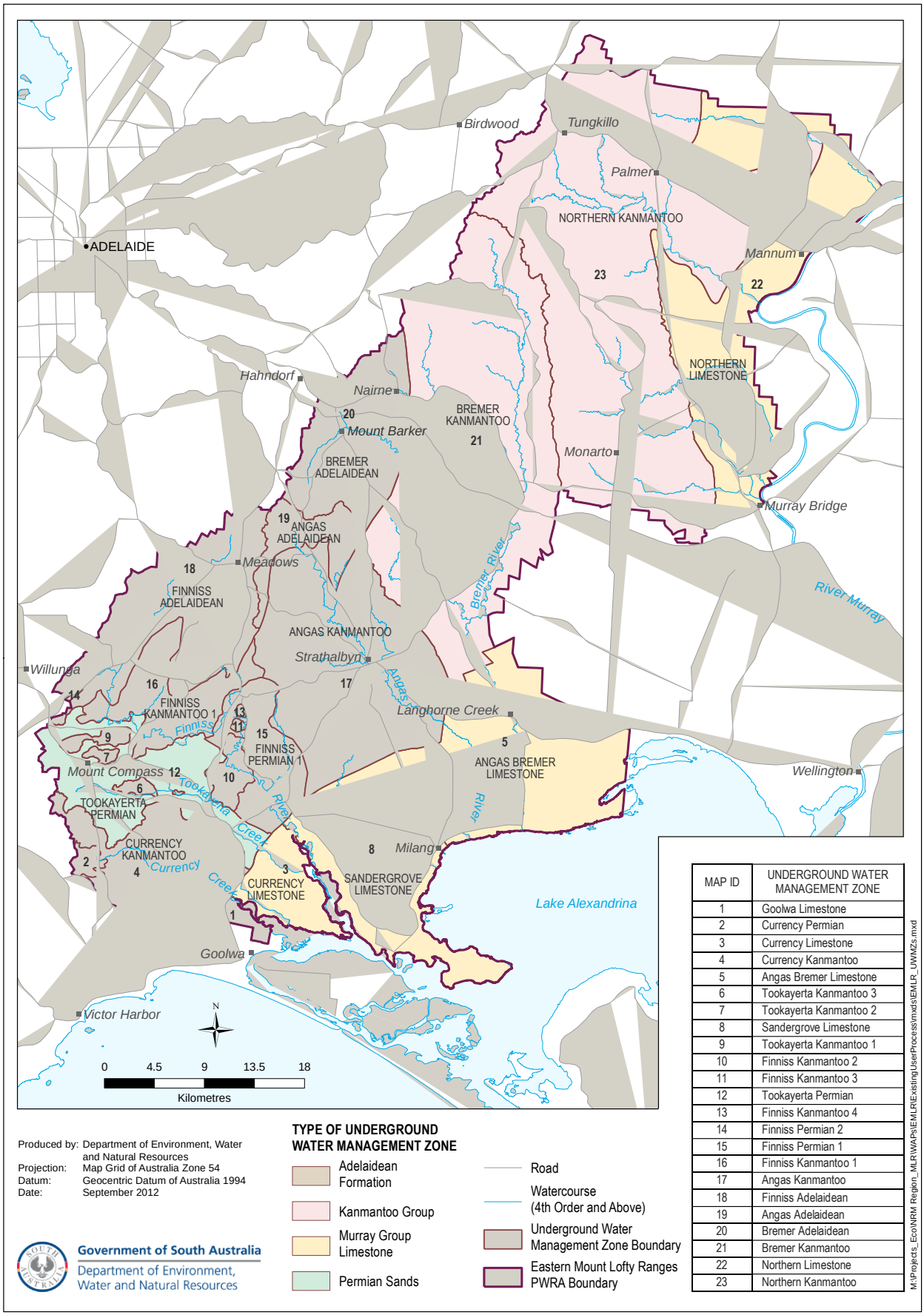


Figure 1. Surface Water Management Zones showing Headwater and Receiving Zones



MAP ID	UNDERGROUND WATER MANAGEMENT ZONE
1	Goolwa Limestone
2	Currency Permian
3	Currency Limestone
4	Currency Kanmantoo
5	Angas Bremer Limestone
6	Tookayerta Kanmantoo 3
7	Tookayerta Kanmantoo 2
8	Sandergrove Limestone
9	Tookayerta Kanmantoo 1
10	Finniss Kanmantoo 2
11	Finniss Kanmantoo 3
12	Tookayerta Permian
13	Finniss Kanmantoo 4
14	Finniss Permian 2
15	Finniss Permian 1
16	Finniss Kanmantoo 1
17	Angas Kanmantoo
18	Finniss Adelaidean
19	Angas Adelaidean
20	Bremer Adelaidean
21	Bremer Kanmantoo
22	Northern Limestone
23	Northern Kanmantoo

Figure 2. Underground Water Water Management Zones showing geology type

Stock and domestic water use
Estimated stock and domestic water use for each underground water management zone is given in Table 4.7 of the EMLR WAP. These values are based on number of dwellings, household water use, projected population increase, stock carrying capacity of grazed areas and standardised stock watering needs.

Estimated stock and domestic water use for surface water is estimated as 30% of the capacity of non-licensed dams in a surface water management zone, as per Section 1.6.2.3 of the EMLR WAP. This value will change over time as dam capacity changes. The volumes as at the date of WAP adoption (and as used in the application of the methodology in this report in the results section) are provided at a catchment scale in Table 1.7 of the EMLR WAP.

Interception by commercial forestry
Plantation forestry is estimated to intercept 85% of surface water runoff and 85% of recharge to underground water in accordance with the state government's policy framework for managing the water resource impacts of plantation forests (Government of South Australia 2009). The actual volumes will change over time as forestry areas change. The average annual interception volumes as at the date of WAP adoption (and as used in the application of the methodology in this report in the results section) are provided:

- at the underground water management zone-scale in Table 4.7 of the EMLR WAP; and
- at the surface water catchment-scale in Table 1.8 of the EMLR WAP.

Deemed evaporation from dams
Net average annual evaporation from dams is estimated as a proportion of dam capacity where that proportion varies between surface water management zones to reflect climate, as defined in Principle 34 b) i) and Table 4.5 in the EMLR WAP.

High demand
A 'high demand management zone' is defined as a zone where total consumptive demand exceeds the consumptive use limit (CUL) for that zone.

Assessment of Risk

The Science, Monitoring and Knowledge (SMK) Branch of DEWNR has completed a risk assessment that identifies, analyses and evaluates water resource risks in the EMLR PWRA (DEWNR 2015). The risk assessment assumes that the proposed water allocations for existing users represent the volume of water that will be extracted from the water resource. The risk statement underlying the report is that 'there is the potential that water allocations given to existing users at a rate exceeding the allocation and consumptive use limits will lead to significant decline/alteration in the condition of water resources and/or water-dependent ecosystems within a management zone'.

The likelihood and consequence of 'existing user water allocations' (demand for water) causing significant decline/alteration in the condition of water resources and/or water-dependent ecosystems within each management zone was analysed.

The surface water risk assessment included consideration of the potential for high demand in linked underground resources to reduce surface water availability, by reducing baseflow from underground water into streams.

Following risk analysis, risks were evaluated to determine if the risk level is acceptable, tolerable subject to being as low as reasonably practicable (ALARP) or intolerable. The risk evaluation process was informed by the risk level and an assessment in the confidence placed in the outcomes of the risk analysis. Generic recommendations on the need to treat risks were made based on both the outcomes of the risk evaluation (i.e. risk tolerability) and the assessment of confidence in the risk assessment.

Each high demand management zone was assigned one of the generic risk treatment recommendations outlined in Table 1 based on the risk evaluation process. In some cases, the treatment recommendation includes further analysis for situations where low to medium confidence in the risk analysis has the potential to influence risk tolerability. The rationale for this approach is to differentiate between intolerable risks that may be re-evaluated as acceptable with additional data and analysis supporting the risk assessment.

Table 1: Risk tolerability and generic treatment recommendations

Tolerability	Recommendation	Minimum requirements
Intolerable	Unconditional treat	Commitment to reduce likelihood and/or consequence of risk
Intolerable	Further analysis (high priority)	Commitment to re-evaluation of risk informed by additional monitoring/analysis as appropriate
Tolerable subject to being as low as reasonably practicable (ALARP)	Conditional treat	Commitment to: 1) Determine if risk is as low as reasonably practicable 2) Reduce likelihood and/or consequence of risks that are not as low as reasonably practicable
Tolerable subject to being ALARP	Further analysis (low priority)	Commitment to re-evaluation of risk informed by additional monitoring/analysis as appropriate
Acceptable	Monitor	Commitment to monitoring of risk as appropriate

Project direction

The generic treatment recommendations outlined in Table 1 above provide guidance for the existing user allocation process on priorities for:

1. treatment of risks to reduce likelihood and/or consequences of declines in the condition of water resources in a management zone

2. priority for further monitoring and analysis and risk re-evaluation to increase confidence in the level of risk for a management zone.

An implication of the approach represented in Table 1 is that, if there is no commitment to undertake further analysis where confidence is less than high AND where high confidence for those risks would result in a tolerable or acceptable risk level, then all management zones with intolerable risks must be treated to reduce the likelihood and/or consequence of decline in water resource condition. Similarly, if there is no commitment to determine whether a risk evaluated as tolerable subject to ALARP is in fact ALARP, then all such risks are intolerable and must be treated.

Thus, to minimise the number of risks requiring treatment, further work is required to re-evaluate risk in some cases, or to determine if the risk is as low as reasonably practicable. This methodology aims to carry out this further work taking a rules-based approach. In addition, current demand data are used to refine the identification of high demand zones following on from the risk assessment.

The source of risk to water resources and dependent ecosystems in a management zone may arise from local demand, and/or from demand from another management zone with linked water resources (e.g. use in an upstream surface water management zone affecting a downstream zone; or use from an underground water management zone affecting provision of baseflow to a linked surface water management zone). This methodology aims to consider key sources of risk to a management zone when assigning management zones to treatment categories, which means that a zone may be assigned to a treatment category in order to help treat the risk it poses to a different management zone.

As outlined in the previous section, total consumptive demand includes licensed purposes, a range of non-licensed purposes and evaporation. This means that the source of risk may include types of water demand that are not included as part of the licensing process. This report is primarily aimed at identifying treatment categories based on the level of risk rather than the type of demand. This report does not make specific treatment recommendations for zones on approaches to treat the risk. Where required, appropriate risk treatment will vary from zone to zone depending on the nature of the resource, demand and environmental assets.

As was the case for the risk assessment, this work is based on the assumption that the full volume of demand will be used. It is possible that in some cases, current use is less than the potential demand and so some high risk zones may not be currently showing signs of stress. In addition, some natural processes operate over long timeframes and can be highly variable over space and time, and so responses to stress may take some time to manifest or occur on a patchy scale.

2 Method

Overview

Three risk treatment categories were identified for high demand zones to support the existing user allocation process, as follows:

- Category 1 management zones – level of risk considered acceptable, or tolerable. No immediate treatment of risk required, but risk should continue to be monitored as appropriate.
- Category 2 management zones – level of risk is high enough to warrant concern. More data is required to support permanent action to reduce risk, although short-term action to contain the current level of risk is appropriate
- Category 3 management zones –level of risk considered intolerable; sufficient evidence to justify action to reduce the level of risk.

Note that these categories only apply to high demand zones, and do not apply to zones where total demand for water is within the sustainable limits. The level of risk is based on full use of assumed water demand.

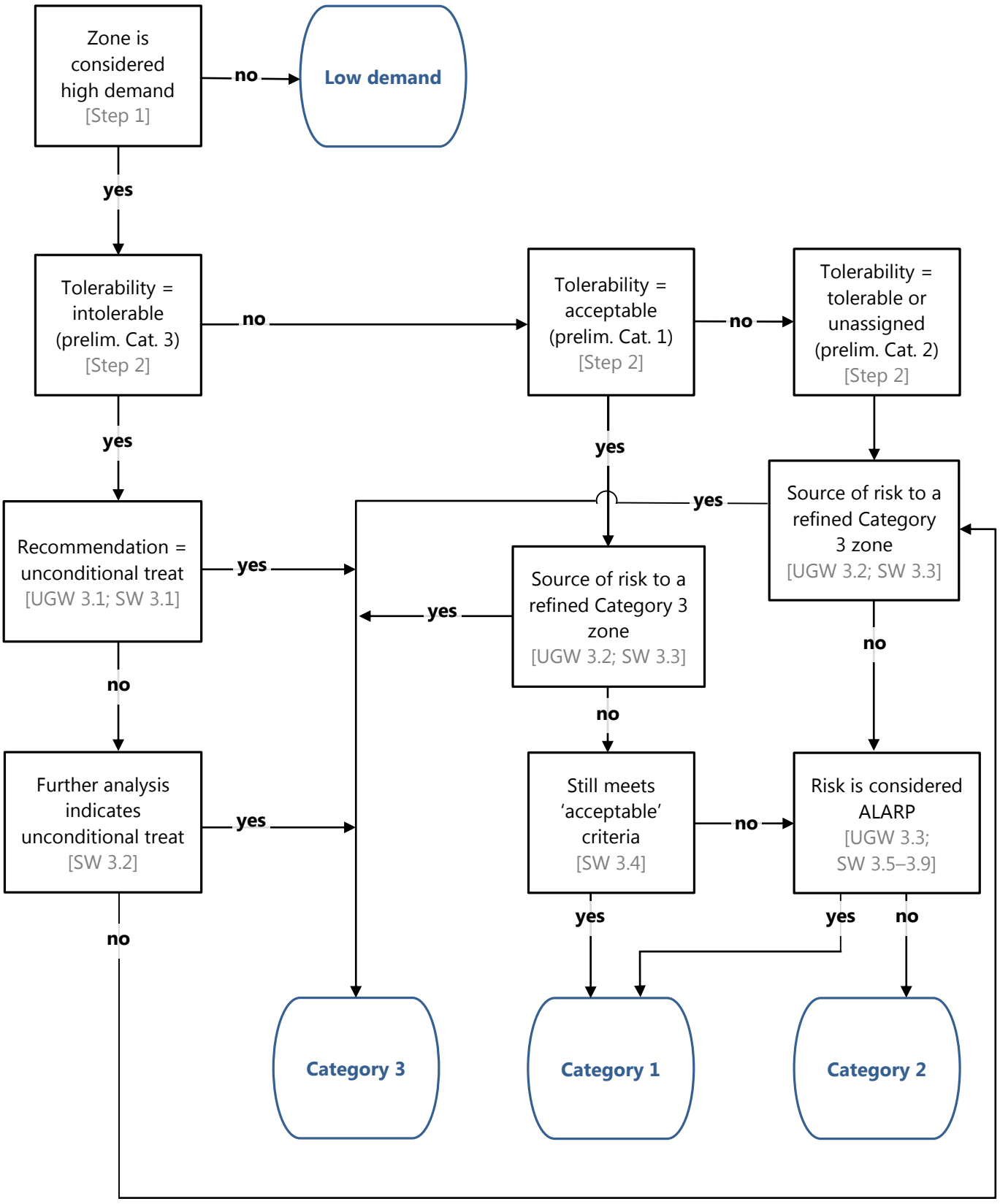
These categories broadly reflect the key types of generic treatment recommendations from the risk assessment (i.e. Category 1 – risk is acceptable, or tolerable because the risk is considered as low as reasonably practicable; Category 2 – further information is required to allow re-evaluation of the risk in order be able to assign the zone to Category 1 or 3 (by improving confidence in the zone's risk analysis; or determining whether or not the risk considered to be as low as reasonably practicable and hence tolerable or intolerable); and Category 3 – risk required unconditional treatment to reduce likelihood and/or consequence of the risk). It should be noted that Category 2 risks may include intolerable risks with the recommendation of "further analysis" or risks that are tolerable subject to being ALARP.

A three step process was used to assign high demand management zones in the EMLR PWRA to the three treatment categories described above. This process was based on the outcomes of the risk assessment, together with updated water demand information and also further analysis to re-evaluate the risk based on further information, and/or to make an assessment whether the risk in a zone is 'as low as reasonably practicable'.

Consideration is also given to whether high demand in a zone is a source of risk to another zone. For example, high demand for underground water may be a source of risk to a surface water zone by reducing the volume of baseflow from the underground water to that surface water zone. Another example is where high demand in a surface water management zone may be a source of risk to a downstream surface water management zone by reducing flow to the downstream zone.

Figure 3: Flow chart outlining the path for moving through steps for categorising high demand zones in the EMLR

Text in grey relates to steps and rules outlined in detail in the following section, where Step 3 rules are identified as UGW 3.x (relating to underground water) or SW 3.x (relating to surface water).



The steps are outlined broadly below and described in more detail in the following sections. Figure 3 gives a flow chart outlining the path for moving through the steps:

Step 1 – Identify high demand zones, taking into account most recent demand data updated since the risk assessment

Step 2 – Preliminary classification of zones into the three treatment categories based on risk tolerability (as assigned in the risk assessment process)

Step 3 – Refine classification from Step 2 by:

- Verifying which zones should be assigned to Category 3, based on:
  - the zone's risk tolerability (as per the risk assessment)
  - further analysis of additional information (where this is identified as a recommendation in the risk assessment)
  - whether the zone is a source of risk to a zone that has already been classified as Category 3 as part of Step 3. Note that this rule may result in a zone provisionally assigned to Category 1 or 2 (in Step 2) being assigned to Category 3 in Step 3 because it is a source of risk to another Category 3 zone.
- Verifying whether zones assigned to Category 1 as part of Step 2 still meet the criteria of having an 'acceptable' risk tolerability under current data.
- Assessment of zones provisionally assigned to Category 2 to determine whether:
  - the risk is 'as low as reasonably practicable' and therefore can be tolerated (so can be assigned to Category 1); or
  - the risk is not considered to be 'as low as reasonably practicable', so short-term action to contain the risk should be considered while further data are collected to assess whether permanent risk treatment is required (so should be assigned to Category 2).

A 'rules-based' approach has been used for these steps, where the specific rules for the different steps are outlined in the following sections.

Steps 1 and 2 are common to underground water and surface water management zones. Step 3 has separate rules for the two resources. Underground and surface water management zones have different Step 3 'refinement' rules as underground water management zones are generally much larger, and underground water processes generally occur more slowly than surface water processes. Each Step 3 rule has a unique number (e.g. UGW 3.1 or SW 3.5) as given in the following section and indicated in grey text on Figure 3.

Management zones are assessed one by one, following the rules in sequence. Once a zone has been assigned to a category, then the subsequent rules are not applied as indicated in Figure 3 (unless otherwise specified in the detailed rule descriptions that follow).

The order of assessment is important because the outcome for one zone may affect the outcome for another linked zone. Therefore:

- For surface water, zones are assessed on a catchment basis, starting at the most downstream zone and working upstream. If a downstream zone is assigned to Category 3, then upstream high demand zones are considered to be a source of risk to that zone and are also assigned to Category 3 (as per rule SW 3.3).
- Assessment of surface water and underground water needs to be iterative as the categorisation of one resource may influence the other. For example:
  - A high demand underground water management zone may be assigned to Category 3 if it is a source of risk to a linked Category 3 surface water management zone (e.g. that underground water management zone provides baseflow to the Category 3 surface water management zone) (as per rule UGW 3.2).
  - The risk assessment identified some surface water management zones as high demand because of the risk posed by a linked high demand underground water zone. For the purposes of this categorisation process, some of these surface water management zones are no longer considered to be high demand if the source of underground water risk is considered to be treated as a result of being assigned to Category 2 or 3 (see the Step 1 rule in the following section for further explanation). Therefore the identification of high demand surface water zones in Step 1 depends in part on linked underground water management zones having been categorised.

Given the interdependence as outlined above, the categorisation rules have been applied by:

- firstly applying the steps to surface water up to rule SW 3.3. (and therefore identifying Category 3 surface water zones);
- secondly applying the full rule set to underground water (including assessment of whether any of the high demand underground water zones are a source of risk to Category 3 surface water management zones); and
- thirdly re-applying the rules to surface water (including re-assessment of whether any high demand surface water zones can be removed from the categorisation based on assumed treatment of sources of risk from linked Category 2 and 3 underground water management zones)

As shown in Figure 3, the Step 3 rules are structured such that a zone can be assigned directly to Category 3 (via rules UGW 3.1 or 3.2, or SW 3.1–3.3), or to Category 1 (via rules UGW 3.3 or SW 3.4–3.9). Any zone not assigned to Category 3 or 1 by these rules is assigned to Category 2.

The focus of rules UGW 3.3 and SW 3.5–3.9 is to determine whether or not a risk can be considered to be as low as reasonably practicable. The nature and background of each rule is explained in the following section but in summary the key elements considered by these rules include:

- potential limitations in the ability to extract the full theoretical volume of demand
- likelihood of environmental provisions being supplied from upstream despite local-scale high demand
- potential error margins in the consumptive use limits
- water availability in very low rainfall zones
- potential ecological consequences (further analysis building on risk assessment)
- effectiveness of treating risk arising from licensed use in areas with a low proportion of licensed use.

Please note that the Step 3 rules have been constructed to reflect the outcomes of the risk assessment. For example, the Step 3 surface water rules include a rule on further analysis of zones with a treatment recommendation of 'Intolerable – further analysis (high priority)' (rule SW 3.2). A similar rule has not been included for underground water, because no underground water management zones were assigned this treatment recommendation in the risk assessment.

Overall, the high demand categorisation approach has been developed in the context of the objects and requirements of the Act, including achieving ecologically sustainable development; seeking a balance between social, economic and environmental needs; and the precautionary principle.

Categorisation Rules

Step 1 – Identify high demand zones

The first step is to update the identification of high demand zones, considering:

- current demand data
- the full range of consumptive use limits included in the EMLR WAP
- anticipated treatment of sources of risk posed by connected high demand management zones.

Rules:
Management zones are considered as being high demand in the following cases:

a) Total consumptive demand from a given resource (based on current data) is higher than the consumptive use limit for that resource. This includes the underground water consumptive use limit, the runoff evaporation and consumptive use limit (zone-scale limit for surface water) and/or the main watercourse evaporation and consumptive use limit (cumulative limit for surface water) where relevant; and
b) Surface water zones identified as high demand when considering the impacts of high demand for underground water on baseflow (as per the risk assessment), for cases where the underground water management zone posing the risk is classed as Category 1 (as per the process outlined in this report).

Explanation
Consumptive demand data have been updated since the risk assessment, so zones are added in to the list of high demand zones where current total demand exceeds the relevant consumptive use limit, or taken out of the list of high demand zones if current total demand is within the relevant consumptive use limit.

This assessment includes the zone-scale runoff limit for surface water, which is identified in the EMLR WAP but was not included in the risk assessment. As a result, a number of surface water management zones are considered to be high demand in this methodology that were not included as part of the risk assessment (i.e. zones that exceed the runoff limit, but not the main watercourse limit).

The risk assessment considered the potential impact of high demand for underground water on the risk to surface water management zones for cases where the two resources are linked. For example, high demand for underground water may reduce discharge of baseflow from underground water to the surface water resource, and therefore reduce surface water availability. That is, high demand for underground water is a source of risk to the surface water in this case.

If the risk posed by high underground water demand is considered to be treated (see below) or no longer present (because the underground water management zone is no longer high demand), then the risk to a surface water zone can be considered on the basis of surface water demand alone.

For the purposes of this methodology, the risk to surface water posed by high demand for underground water is considered to be treated for Category 2 and 3 underground water management zones, given the nature of the treatment recommendation for these two categories. In these cases, the risk to the surface water resources is considered on the basis of the risk posed by surface water high demand alone. Therefore the only cases where the risk to surface water posed by high demand for underground water will be considered in this categorisation process is where the connected high demand underground management zone is classed as Category 1.

Step 2 – Assess tolerability of risk to generate preliminary classification

The 'tolerability' of the risk as identified for a management zone in the risk assessment (DEWNR 2015) is used to place high demand zones identified in Step 1 in one of the three treatment categories, as per Table 2. This is a preliminary classification, to be refined in Step 3.

Any high demand zone identified in Step 1 that does not have a tolerability rating in the risk assessment is provisionally placed in treatment Category 2, pending further refinement as part of Step 3.

The risk assessment only assigned tolerability ratings to management zones identified as high demand zones at that time. Step 1 above has identified some additional high demand zones that were not considered to be high demand in the risk assessment, because either:

- demand has increased under current data, and/or
- the management zone has exceeded the runoff limit, but not the main watercourse limit.

It was considered reasonable to provisionally place such zones into Category 2 because:

- for cases where demand has increased under current data - changes to the demand data since the risk assessment have generally been small, and it is unlikely that they would have changed enough to cause a low demand zone to become a high demand zone with an intolerable risk (i.e. preliminary Category 3 under Step 2). Taking a precautionary approach, it is appropriate to assign these zones to Category 2, subject to further refinement as part of Step 3.
- for cases where the management zone has exceeded the runoff limit but not the main watercourse limit, these zones are assigned to Category 1 as part of Step 3 under rule SW 3.5 – as described later. Therefore it is reasonable to assign these zones to Category 2 for simplicity as part of Step 2, as their category will be appropriately refined as part of Step 3.

Table 2: Preliminary category for high demand zones based on risk tolerability assigned in the risk assessment

Tolerability	Preliminary category
Intolerable	3
Tolerable, subject to risk being as low as reasonably practicable	2
Acceptable	1
Not rated as part of risk assessment	2

Step 3-a – Refine treatment classification

The preliminary classification assigned to high demand zones in Step 2 is further refined in Step 3. These rules are only applied to zones identified as high demand zones in Step 1.

The rules for refining the treatment classification differ for underground water and surface water, as described below. The order for applying the rules is set out in the overview section of this chapter.

Step 3-b – Rules for refining the classification of underground water management zones

UGW 3.1 - Unconditional treat

Rule
If the generic treatment recommendation in the risk assessment is unconditional treat,
then Category = 3

Explanation
The minimum requirement for a zone with an unconditional treat recommendation is a commitment to reduce the likelihood and/or consequence of the risk (DEWNR 2015). These are extreme risk zones with high levels of potential demand. They may have sensitive environmental assets, which may already be under threat, or the resource may have shown signs of stress at times. Therefore it is appropriate to take action to treat the risk.

UGW 3.2 - Source of risk to another Category 3 zone

Rule
If a zone is a source of risk to a 'refined' Category 3 zone,
then Category = 3

Explanation
In this case, a 'refined' Category 3 zone is a zone that has been assigned to Category 3 in underground water rule UGW 3.1, or in surface water rules SW 3.1-3.3.

High demand in a underground water zone may be a source of risk to another underground water zone (through reduced through flow to another aquifer), or to a surface water zone (through reduced baseflow from the underground water to the surface). These linkages have been identified and considered as part of the risk assessment.

It has been identified that Category 3 zones require treatment to reduce the risk. That treatment may be applied in the Category 3 zone itself, and also in linked management zones that contribute to that risk. This rule identifies underground water management zones that are a source of risk to other Category 3 zones and includes them as part of the treatment of the risk to the linked Category 3 zone.

UGW 3.3 - Self-limiting resource

Rule
If the volume able to be extracted from a zone is considered to be self-limiting,
then Category = 1

Explanation
The volume of licensed demand has been determined based on theoretical enterprise requirements. In some resources, particularly fractured rock aquifers with poorly developed fractures, the amount of water that can be extracted is generally limited by the nature of the aquifer. Where the nature of the aquifer and size of the zone means that it is unlikely that the full theoretical demand could be extracted, then the risk is considered to be as low as reasonably practicable (i.e. Category = 1).
Step 3-c – rules for refining the classification of surface water management zones

SW 3.1 - Unconditional treat

Rule
If the generic treatment recommendation in the risk assessment is unconditional treat,
then Category = 3

Explanation
The minimum requirement for a zone with an unconditional treat recommendation is a commitment to reduce the likelihood and/or consequence of the risk. These are extreme risk zones with high levels of potential demand. They have sensitive environmental assets, which may already be under threat. Therefore it is appropriate to action to treat the risk.

SW 3.2 - Intolerable and likely unconditional treat

Rule
If:

- the risk tolerability/generic treatment recommendation in the risk assessment is 'intolerable - further analysis (high priority)'; and
- assessment of available data supports a recommendation of unconditional treat,

then Category = 3

Explanation
These are zones where lower confidence in the risk assessment means that further work is required to determine whether a zone is 'unconditional treat' or 'tolerable subject to risk being as low as reasonably practicable'. As part of this rule, additional information is assessed to make this determination where possible. This assessment considers available information on factors such as monitoring data and classifications of condition of water-dependent ecosystems, or analysing potential outcomes if assumptions are confirmed.

In some cases, further data are required. Taking a precautionary approach, these zones are provisionally assigned to Category 3, pending collection of the required information and re-assessment against these rules.

If current data does not support classification as Category 3, then the zone is provisionally assigned to Category 2, and then the remaining rules applied.

SW 3.3 - Upstream of Category 3

Rule
If a zone is upstream of a 'refined' Category 3 zone,
then Category = 3

Explanation
In this case, a 'refined' Category 3 zone is a zone that has been assigned to Category 3 in rules S3.1 or S3.2.

The nature of surface water flow means that demand in an upstream zone reduces water availability in downstream zones. Hence the risk in a Category 3 zone may arise both from use within the zone, and from upstream use. Treating high demand in an upstream zone contributes to treating the risk in a downstream Category 3 zone. This rule is similar to rule UGW 3.2.

SW 3.4 - Confirm Category 1

Rule
Confirm zones with 'acceptable' tolerability in the risk assessment still meet those criteria under current data

Explanation
There have been some adjustments in demand data since the risk assessment work was done. This may mean that zones previously assigned an 'acceptable' tolerability may no longer be so. If the risk tolerability is still acceptable, it is reasonable to assign the zone to Category 1 (i.e. response is to monitor the risk). If the risk tolerability is no longer acceptable, the zone is to be re-assigned to Category 2, and then the remaining rules applied.

SW 3.5 - Over runoff limit but not main watercourse limit

Rule
If a zone is over the runoff limit, but not the main watercourse limit,
then Category = 1

Explanation
As outlined in the previous section, there are two types of surface water zones, being headwater zones (which are at the top of their catchment, and do not receive inflow from elsewhere) and receiving zones (which potentially receive inflow from headwater zones). A main watercourse receives inflow from upstream zones. Headwater zones do not have a main watercourse.

There are also two types of surface water limits for zones, being the local runoff limit (which is based on a percentage of runoff from within the zone), and the main watercourse limit (which is a cumulative limit that considers local runoff as well as inflow from the upstream zones). The runoff limit applies to local use from within the zone, excluding use from the main watercourse. The main watercourse limit applies to all use within the zone, as well as all upstream use in upstream zones (where relevant).

In a receiving zone, the majority of water-dependent ecosystems are likely to be found in the main watercourse. If the cumulative total demand is within the cumulative main watercourse limit, then it is expected that the majority of water-dependent ecosystems should be receiving their intended environmental water provisions, even if local demand exceeds the local-scale limit (the runoff limit). Hence the risk to the majority of assets is expected to be as low as reasonably practicable in these circumstances so it is considered reasonable to assign such zones to Category 1.

SW 3.6 - Within 10% of limit

Rule
If cumulative total demand is within 10% of the main watercourse limit,
then Category = 1

Explanation
This rule is intended to represent a reasonable error band around determination of the consumptive use limit. The nominal error band has been set at 10%. Note that these rules are only applied to high demand zones, so under this rule, a zone would be classified as Category 1 if demand is more than 100% of the limit, and less than or equal to 110% of the limit.

This rule is assessed using cumulative total demand compared with the main watercourse limit. As outlined for rule SW 3.5, high demand against the local-scale runoff limit is considered to be less critical if cumulative total demand is within the main watercourse limit.

SW 3.7 - Demand against zero limit

Rule
Both rules apply:

If both the runoff and main watercourse limits are zero,
then Category = 1

If runoff limit is zero, and cumulative total demand is within the main watercourse limit,
then Category = 1

Explanation
Some surface water management zones in the EMLR have a runoff limit of zero. These are low rainfall zones that are considered to have a long term average runoff of zero, although there may be some runoff in rare episodic events.

A policy decision has been made that where there is licensed demand that would be counted against a limit of zero, then the full theoretical allocation would be granted as it was not considered reasonable to reduce existing user allocations to zero. That is, these zones are technically considered to be high demand (as demand exceeds the limit), but will not be considered for risk treatment as part of the existing user allocation process at this point.

These are zones in very dry areas, and are likely to have very limited water-dependent ecosystems and few other users to be affected. Hence it is reasonable to consider the risk to be as low as reasonably practicable and hence Category 1.

Note that this rule does not apply in the case where a zone has a runoff limit of zero and a main watercourse of more than zero, where the main watercourse limit has been exceeded. This situation may occur in a catchment which dry downstream zones with a local runoff limit of zero, but wetter headwaters that provide flow to the downstream zones giving rise to a main watercourse limit of more than zero in the downstream zones. Users may take water from the main watercourse in the dry downstream zones that has flowed down from the wetter headwaters. In this case, it is reasonable to expect the demand from the main watercourse to be accounted for against the main watercourse limit, and for the zone to be assessed against the other rules if the main watercourse limit is exceeded.
Also note that the second rule in this set is actually redundant, but has been included for completeness (If runoff limit is zero, and cumulative total demand is within the main watercourse limit, then Category = 1). This is a situation where the runoff limit has been exceeded but the main watercourse limit has not, and such situations are already assigned to Category 1 by rule SW 3.6 above.

SW 3.8 - Low consequence, next zone downstream is within main watercourse limit

Rule
If the consequence rating assigned in the risk assessment is minor or insignificant (and the confidence in assigning the consequence rating is moderate or high), and cumulative demand is within the main watercourse limit for the next zone downstream,
then Category = 1

If the rule above is met, except that the confidence in assigning the consequence rating is low, then continue applying the remaining rules in Step 3. Once that has been done, if rule SW 3.8 is the only rule that assigns a zone to Category 1, then Category = 2 provisionally, subject to collection of further data to improve the confidence of the consequence rating and subsequent assessment against this rule.

Explanation
The 'consequence' rating for surface water zones in the risk assessment represents the nature of the water-dependent ecosystems in the zone, based on available information and interpretation at the time of the risk assessment. Zones with a consequence rating of 'insignificant' or 'minor' are generally zones with no pools, or contain pools with no records of other assets.

If a high demand zone has assets of limited value, but is not causing a downstream zone with potentially more significant assets to become high demand (i.e. cumulative demand is within the main watercourse limit in the downstream zone), then it may be reasonable to accept the local scale risk as being as low as reasonably practicable.

The consequence ratings were assigned using available information at the time of the risk assessment, including ecological survey and monitoring information, dry season pool mapping and interpretation of aerial photography. As part of this process, the confidence in assigning the consequence value was rated as low, medium or high confidence. If the consequence rating has been assigned with a moderate or high confidence, then the consequence value is accepted for a zone for the purposes of this rule. If the confidence of assigning the consequence rating is low, then further information needs to be sought to confirm the consequence rating for the zone if rule SW 3.8 is the only rule that assigns the zone to Category 1.

Note that the structure of the rule set means that a zone provisionally assigned to Category 2 in Step 2 will remain in Category 2, unless assigned to Category 1 or 3 as part of the rules in Step 3. Therefore the process of confirming the consequence rating if there is low confidence is important if rule SW 3.8 is the only rule that assigns a zone to Category 1, as otherwise it would remain in Category 2. However, it should be noted that the zone may be assigned to Category 1 by another rule within Step 3, and if so then this further information may not be required.

SW 3.9 - Low proportion of licensed demand

Rule
If cumulative licensed demand is less than or equal to 20% of cumulative total demand,
then Category = 1

Explanation
Where the risk is conditionally tolerable and licensed demand is a relatively small proportion of total demand, there is likely to be little benefit in only treating the risk posed by licensed use while the majority of the risk arises from non-licensed use.

This methodology considers risk arising from all types of demand (e.g. licensed and non-licensed use and evaporation), but from a practical point of view, is aimed at informing the existing user allocation process and associated management of licensed use. This rule is applied to zones that have been assigned a tolerability rating of 'tolerable, subject to the risk being as low as reasonably practicable (ALARP)'. Part of the consideration on whether a risk is as low as reasonably practicable is whether the cost of treating the risk outweighs the benefit of treating the risk. If the risk is considered tolerable subject to ALARP, and the primary treatment mechanism of managing licensed use is likely to have little benefit, then it may be reasonable to consider that the costs of treatment outweigh the benefit and so the risk is tolerable.

Note that cumulative licensed demand includes 'local' demand as well as demand from the main watercourse, for the zone being assessed as well as all upstream zones.

This rule is assessed using cumulative total demand compared with the main watercourse limit. As outlined for rule SW 3.5, high demand against the local-scale runoff limit is considered to be less critical if cumulative total demand is within the main watercourse limit.

3 Results

Assessment of Zones per Category

The methodology outlined in the previous chapter has been applied to the management zones across the EMLR, using demand data and other available information as of October 2013.

There are 194 surface water management zones in the EMLR PWRA. The categorisation approach identifies 59 surface water management zones as having a high demand for water. As outlined in Table 3, DEWNR has received 233 Licence Applications across these 59 surface water management zones. Almost half of the licence applications are associated with the 35 surface water management zones assigned to Category 1.

There are 27 underground water management zones in the EMLR PWRA. The categorisation approach identifies five underground water management zones as zones where there is a high demand for water. As presented in Table 3, DEWNR has received 329 Licence Applications across these five underground water management zones. More than half of the licence applications are associated with the three underground water management zones assigned to Category 3.

Note that an existing user may be licensed to access both surface water and underground water, so there will be some licence applicants who are included in the numbers of applications received for both surface water and underground water management zones.

These results are based on demand data used in the assessment.

Table 3: Summary of assessment of all high demand zones

Category	Number of high demand *surface water management zones*	Number of high demand *underground water management zones*	Number of licence applications received for high demand surface water management zones	Number of licence applications received for high demand underground water management zones
1	35	1	109	2
2	2	1	43	146
3	21	3	76	181
3*	1	-	5	-
Grand Total	59	5	233	329

* Provisional Category 3, further information is needed to confirm this classification.

Note – An existing user may be licensed to access both surface water and underground water resources.

The result of applying a categorisation approach to surface water and underground water management zones in EMLR PWRA is given in Table 4 and Table 5 respectively. It is important to note that these outcomes are based on the demand dataset used (as of October 2013), and the results may change if the demand against management zone changes.

These tables show high demand zones considered as part of the risk assessment as well as additional high demand zones identified through this categorisation process based on data as of October 2013. Note that some high demand zones identified as part of the risk assessment are no longer considered high demand under current data.

The tables indicate which rule from Step 3 resulted in each of these zones being assigned to their final category, where relevant. As outlined in the previous section, the structure of the rule set is such that the Step 3 rules may directly assign a zone to Category 3 or 1. If a high demand zone is not directly assigned to Category 3 or 1 by one any of the Step 3 rules, then it is assigned to Category 2. Therefore Table 4 and Table 5 do not list which Step 3 rule resulted in a zone being assigned to a category for Category 2 zones.

Table 5 summarises the assessment that was made for individual zones when assessing rule SW 3.2. As outlined in the previous chapter, these are high demand surface water management zones that were assigned a generic risk tolerability and treatment recommendation of 'Intolerable - further analysis (high priority)' in the risk assessment. Table 5 summarises the further desktop analysis that has been made based on existing data.

In some cases, sufficient information is available to assign a zone to Category 3, such as cases where a significant environmental asset is known to be under threat at that location. In other cases, improving the confidence in the data underpinning the risk assessment will not result in the zone being assigned to Category 3. These zones are provisionally assigned to Category 2, and then subjected to the remaining surface water Step 3 rules to determine if they remain as Category 2 or are assigned to Category 1. In the case of management zone 426FR004, further information is required on the nature of water-dependent ecosystems present in the zone, in order to improve the confidence in assigning the consequence rating for the risk assessment. Taking a cautious approach, this zone has been provisionally assigned to Category 3 pending collection of this further information.

Table 4: Classification of surface water management zones (based on demand data as of October 2013)

Management zone	Category	Step 3 rule(s) that led to category
426AB001	1	SW 3.7, 3.9
426AB002	1	SW 3.7, 3.9
426AR002	3	SW 3.3
426AR004	3	SW 3.3
426AR006	3	SW 3.3
426AR007	3	SW 3.3
426AR008	3	SW 3.3
426AR009	3	SW 3.3
426AR010	3	SW 3.3
426AR011	3	SW 3.3
426AR012	3	SW 3.3
426AR014	low demand*	n/a
426AR015	low demand*	n/a
426AR016	3	SW 3.3
426AR019	low demand*	n/a
426AR020	3	SW 3.3
426AR022	3	SW 3.3
426AR023	3	SW 3.3
426AR024	3	SW 3.3
426AR025	3	SW 3.2
426AR026	3	SW 3.1

Management zone	Category	Step 3 rule(s) that led to category
426AR027	3	SW 3.3
426BR001	1	SW 3.8
426BR003	1	SW 3.5
426BR006	1	SW 3.5
426BR008	1	SW 3.5
426BR009	1	SW 3.8, 3.9
426BR014	1	SW 3.9
426BR025	1	SW 3.5
426BR034	1	SW 3.5
426BR035	1	SW 3.8
426BR036	low demand*	n/a
426BR037	1	SW 3.5
426BR038	1	SW 3.6
426BR039	low demand*	n/a
426BR041	1	SW 3.8
426BR043	low demand*	n/a
426BR045	1	SW 3.9
426BR046	1	SW 3.8, 3.9
426BR047	low demand*	n/a
426BR048	1	SW 3.5
426BR049	low demand*	n/a
426BR050	3	SW 3.3
426BR051	3	SW 3.3
426BR052	3	SW 3.3
426BR053	low demand*	n/a
426BR054	3	SW 3.2
426BR055	1	SW 3.8
426BR061	1	SW 3.6
426BR062	2	-
426DC001	2	-
426DC002	low demand*	n/a
426DC003	low demand*	n/a
426FR002	1	SW 3.5
426FR003	low demand*	n/a
426FR004	3*	SW 3.2
426FR020	1	SW 3.6, 3.9
426LG001	1	SW 3.7, 3.9
426MC005	1	SW 3.5, 3.7, 3.9
426PC001	1	SW 3.7, 3.9
426PC002	1	SW 3.7, 3.9
426PC003	1	SW 3.7, 3.9
426RC009	1	SW 3.6, 3.8, 3.9
426RC020	1	SW 3.5, 3.7
426RC026	1	SW 3.4 (also SW 3.8, 3.9)
426RC027	1	SW 3.5, 3.7, 3.9
426RG001	1	SW 3.7
426RG002	1	SW 3.7, 3.9
426RG003	1	SW 3.7
426SC008	1	SW 3.5, 3.7, 3.9

Management zone	Category	Step 3 rule(s) that led to category
426SP004	1	SW 3.4 (also SW 3.5, 3.7, 3.9)
426TC005	low demand*	n/a
426TC006	low demand*	n/a

* High demand in risk assessment; not considered high demand under categorisation Step 1 as source of underground water risk considered treated (Category 2 or 3)

Table 5: Classification of underground water management zones (based on demand data as of October 2013)

Management zone	Category	Step 3 rule(s) leading to category	Comments
Angas Kanmantoo	3	UGW 3.2	Source of risk to Category 3 Angas River catchment surface water
Bremer Adelaidean	2	-	
Currency Limestone	3	UGW 3.1	
Finniss Adelaidean	Low demand	-	Not high demand for October 2013 data – change from risk assessment
Tookayerta Kanmantoo 2	1	UGW 3.3	
Tookayerta Permian	3	UGW 3.1	

Table 6: Application of rule SW 3.2 to relevant zones

Surface water management zone	High demand category	Discussion on why category has been assigned
426AR026	3	The Southern Pygmy Perch population in the Angas River catchment is considered critically endangered (Hammer 2002). Small nearby 'satellite' populations outside the core populations have been lost in the recent past (Hammer 2009). The remaining core population is persisting but is highly vulnerable as there are no other known source populations to allow recolonisation by this genetically distinct sub-population if this last population is lost.
426BR037	2	The risk assessment noted low confidence in assigning likelihood and/or consequence for this zone. If data were collected to improve the confidence and confirm the assigned 'possible' likelihood and 'major' consequence (i.e. to confirm the potential presence of mountain galaxias), then according to Table 15 of the risk assessment report, the risk tolerability and generic treatment recommendation would be 'Tolerable subject to ALARP – conditional treat'. That is, improving the confidence in the risk assessment would not result in this zone being assigned to Category 3.
426BR054	3	This zone contains the only known remaining population of River Blackfish in the Bremer catchment, which was once widespread throughout the catchment and throughout the EMLR (Hammer, Wedderburn and van Weenan 2009). Populations were found in two pools in this zone in 2004 and since then one appears to have been lost (Hammer 2009, and unpublished fish monitoring data). The remaining core population is highly vulnerable and is being actively managed to promote survival (e.g. water level and quality monitoring, topping up refuge pool during low flow periods when required).
426DC001	2	The Tookayerta Permian aquifer is likely to provide baseflow to this surface water management zone. The Tookayerta Permian underground water management zone has been assigned to Category 3, so as per Step 1, the risk posed by high demand for underground water is considered to be treated for linked surface water management zones, and the risk is assessed based on high demand for surface water only. In this case, based on current data, a likelihood of 'possible' and consequence of 'major' would be assigned under risk assessment criteria, with low confidence given the uncertainty about the nature of the ecological assets present in the zone. If further on-ground investigation identified that even the highest consequence rating could be applied with confidence, then combination with the likelihood rating would result in a risk tolerability and generic treatment recommendation of 'Tolerable subject to ALARP – conditional treat'. That is, improving the confidence in the risk assessment would not result in this zone being assigned to Category 3.
426FR004	3* (provisional)	On-ground assessment is required to verify the nature of the water-dependent ecosystems in this management zone, before it can be assigned to a high demand category. If high value significant water-dependent ecosystems are present, then this zone would be assigned a risk tolerability and generic treatment recommendation of 'Intolerable – unconditional treat' and would be assigned to Category 3.
426FR020	2	The risk assessment noted low confidence in assigning likelihood and/or consequence for this zone. If data were collected to improve the confidence and confirm the assigned 'possible' likelihood and 'major' consequence (i.e. to confirm the potential presence of Mountain Galaxias), then according to Table 15 of the risk assessment report, the risk tolerability and generic treatment recommendation would be 'Tolerable subject to ALARP – conditional treat'. That is, improving the confidence in the risk assessment would not result in this zone being assigned to Category 3.

4 Recommendation

It is recommended that the categorisations rules and methodology outlined in this document are used to categorise high demand zones to risk treatment categories.

5 References

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South Australian Murray-Darling Basin Natural Resources Management Board 2013, Water allocation plan for the Eastern Mount Lofty Ranges, South Australian Murray-Darling Basin Natural Resources Management Board, Murray Bridge.

Glossary

Baseflow – the water in a stream that results from underground water discharge to the stream; often maintains flows during seasonal dry periods and has important ecological functions.

Consumptive demand – for the purposes of this report, consists of reasonable requirements of existing users, stock and domestic water use and water use for commercial forestry, and deemed evaporation from dams (for surface water).

Consumptive Use Limit – the consumptive use limit is the volume of water that can be sustainably extracted from the water resource for consumptive purposes, including licensed and non-licensed use and evaporation from dams (where relevant). Consumptive use limits have been determined for the water resources of the EMLR PWRA that consider water availability and a balance of social, economic and environmental needs for water. Consumptive use limits have been calculated by modelling the ecological and hydrological impacts of particular policy settings. Consumptive Use Limits are defined in the Water Allocation Plan.

Headwater Zone – a surface water management zone at the top of its catchment which does not receive inflow from other surface water management zones.

High Demand Management Zone – a management zone where total consumptive demand exceeds the consumptive use limit for that zone or as defined by the risk assessment (DEWNR 2015).

Main watercourse – a watercourse that receives inflow from another surface water management zone.

Main watercourse evaporation and consumptive use limit (or main watercourse limit) – this is a surface water limit. The main watercourse limit is a cumulative limit that applies to evaporation plus consumptive use from surface water and watercourses (including from main watercourses) for the surface water management zone being considered as well as all surface water management zones that drain into it. It has been calculated as the sum of:

1. the runoff evaporation and consumptive use limit from the surface water management zone being considered; and

2. the runoff evaporation and consumptive use limit(s) of all surface water management zones that drain into it.

Receiving Zone – a surface water management zone that potentially receives inflow from an upstream surface water management zone.

Runoff evaporation and consumptive use limit (or 'runoff limit') – is a surface water limit. The runoff limit applies to local demand (evaporation plus consumptive use) from within the zone, excluding demand from the main watercourse. This limit is calculated as a percentage of runoff from within the zone.

Surface water – has the same meaning as in Section 3 (1) of the Act, meaning:
a) water flowing over land (except in a watercourse) — i) after having fallen as rain or hail or having precipitated in any other manner; or ii) after rising to the surface naturally from underground;
b) water of the kind referred to in paragraph a) that has been collected in a dam or reservoir;
c) water of the kind referred to in paragraph a) that is contained in any stormwater infrastructure;
d) water in a watercourse if the watercourse, or particular part of a watercourse, is declared by proclamation under subsection (13) (of the Act) to constitute surface water for the purposes of the Act.

Underground Water – has the same meaning as in Section 3 (1) of the Act, meaning (a) water occurring naturally below ground level; (b) water pumped, diverted or released into a well for storage underground.

Watercourse – has the same meaning as in Section 3 (1) of the Act, meaning a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows whether permanently or from time to time and includes:

a. a dam or reservoir that collects water flowing in a watercourse
b. a lake through which water flows
c. a channel (but not a channel declared by regulation to be excluded from the ambit of this definition
d. (under the Act)) into which the water of a watercourse has been diverted
e. part of a watercourse
f. an estuary through which water flows
g. any other natural resource, or class of natural resource, designated as a watercourses for the purposes
h. of the Act by an NRM plan.

Water-dependent Ecosystem – those parts of the environment, the species composition and natural ecological processes, that are determined by the permanent or temporary presence of flowing or standing water, above or below ground. The in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries, lakes and aquifer ecosystems are all water-dependent ecosystems.

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