South Australian Arid Lands Demand and Supply Statement
2013
Foreword

I am pleased to present the South Australian Arid Lands Demand and Supply Statement, a key commitment in Water for Good – the State Government’s plan to ensure our water future to 2050.

The South Australian Arid Lands Demand and Supply Statement is the fourth of eight regional demand and supply statements. These statements are high level strategic documents that project the available water supply and demands for a region and any possible future demand-supply imbalance. The projections in these statements will then be used to guide the timing and nature of future demand management or supply augmentation options, when needed.

At this stage it has not been possible to prepare demand-supply projections for the South Australian Arid Lands region as there has not been sufficient data available. However, there is work underway to increase our knowledge of the water resources in the South Australian Arid Lands region, including the Finding Long-term Outback Water Solutions initiative and the National Partnership Agreement on Coal Seam Gas and Large Coal Mining Development. Any new data from these or other projects in the region will be incorporated into the Statement during the annual review, and demand-supply projections will be developed if possible.

The South Australian Arid Lands region is heavily dependent on groundwater resources, particularly the groundwater resources of the Great Artesian Basin. It will be critical when moving forward with the Government’s vision that South Australia has a thriving resources industry and is a key mining services hub for Australia and the region, that we manage our use of these resources appropriately. This will need to consider all users of these resources, including our unique outback population centres and the environmental treasures found in the South Australian Arid Lands region that are dependent on the groundwater systems.

Water security remains a challenge for South Australia but I am confident that the South Australian Arid Lands Demand and Supply Statement provides critical information to help us ensure the South Australian Arid Lands Region’s water supply continues to support its culture, economy, lifestyle and environment.

The Hon Ian Hunter MLC
Minister for Water and the River Murray
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1 South Australian Arid Lands Demand and Supply Statement in Summary

This section of the South Australian Arid Lands (SAAL) Demand and Supply Statement (DSS) introduces the context and scope of regional demand and supply statements and summarises the key findings of the SAAL DSS.

The key findings, which are discussed in more detail at the end of this section, relate to:

- The limited level of current knowledge regarding the capacity and quality of the region’s water resources, with the exception of the Great Artesian Basin (GAB);
- The potential for a large increase in water demand from the mining, petroleum and geothermal industries into the future; and
- The development of criteria to guide State Government decision making in relation to identifying who is responsible for supplying a community with water.

South Australia has a vast land area with diverse landscapes and climatic conditions that influence the quantity and source of available water. Beyond the city of Adelaide, the population is scattered widely, with some regional centres, towns and communities without a local and reliable natural water source. In order to determine the best ways to secure the State’s water resources, it is important to first take stock of the water resources available, the current and projected future demands on them, and the likely timing of any potential demand-supply imbalance.

It is also important to recognise that the water industry in South Australia is changing. To achieve a more dynamic water sector, the State Government has enacted the Water Industry Act 2012 that will better reflect the changing environment. The purpose of the Water Industry Act 2012 is to provide a framework to support a contemporary and developing water industry by:

- Providing for an integrated approach to water demand and supply planning; and
- Providing for the regulation of the water industry.

A changing climate, drought, economic development initiatives, and expected population growth have driven this change in what has typically been a relatively stable service sector. South Australia is also a signatory to the National Water Initiative (NWI), Australia’s blueprint for water reform.

The NWI promotes a more cohesive national approach to the way Australia manages, measures, plans for, prices and trades water. It also acknowledges the complex relationship that Aboriginal communities have with water and stipulates that State water plans will account for indigenous access to water resources for social, spiritual and cultural purposes (NWI 2004). The First Peoples’ Water Engagement Council (FPWEC) (2012) have provided advice to the National Water Commission in relation to implementation of the NWI, including definitions of Aboriginal water needs.

Within this context, as stated in Water for Good, the State Government will develop demand and supply statements for all eight Natural Resources Management (NRM) regions throughout the State. The SAAL DSS aims to provide a long-term (40 years) overview of water supply and demand in the SAAL NRM region of South Australia. It applies an adaptive management process with the intention to outline the state of all water resources in the region for drinking and non-drinking water, lists major demands on these water resources, and identifies likely timeframes for any possible future demand-supply imbalance. The SAAL Demand and Supply Statement is based on the SAAL NRM Board region boundary, as shown in Figure 1.
Demand and supply statements provide a desktop assessment based on the best available information, there is no new science or research undertaken to prepare them. The statements do not intend to make recommendations and outline actions to address any current or future demand-supply imbalance.

Water for Good states that the Minister for Water and the River Murray will establish an independent planning process if demand-supply projections indicate a gap is likely to exist in the foreseeable future. Therefore, this Statement will be used to guide planning for the timing and nature of future demand management or supply options, ensuring that long-term solutions are based on a thorough understanding of the state of local resources, the demand for them, and likely future pressures, including the impacts of climate change.

Although identifying solutions to address augmentation or policy issues is not within scope of the SAAL Demand and Supply Statement, the State Government will need to consider how best to address them.

The SAAL Demand and Supply Statement will be reviewed annually. The Statement will also be comprehensively reviewed and updated every five years, unless such a review is triggered earlier based on the findings of the annual review process.

There is no region-wide water distribution network across the SAAL region as could be found in other parts of the State, such as Adelaide or the Eyre Peninsula for example. Supply of water for community use throughout the SAAL region is provided by a diverse range of parties, including SA Water, local government, progress associations and mining companies.

Water for the environment is essential for ecosystem and waterway health, and ultimately the resources’ productivity. The environmental water provisions of the SAAL region are set out in the water allocation plan for the Far North Prescribed Wells Area and the SAAL Natural Resources Management (NRM) Plan. As such they are not explicitly included in this Statement.

When preparing water allocation plans one of the issues considered is the quantity and quality of water needed for dependent ecosystems, and the time periods during which those ecosystems need water. The appropriate proportions are then set aside to meet these demands and the remaining proportion is available for allocation. The SAAL DSS only includes supply from the prescribed wells areas available for allocation, meaning the remainder is available to the environment. Further, the SAAL NRM Plan contains a target that by 2020, the extent and condition of at least 50% of priority aquatic ecosystems is improved and other priority aquatic ecosystems are at least maintained in extent and condition.

1.1 Key Findings

Groundwater resources are the key water source in the SAAL region, for community use as well as for other purposes such as current and potential mining use, petroleum use and pastoral use. With the exception of the GAB, the current level of knowledge regarding the capacity and quality of these resources is limited and has restricted the ability to prepare demand-supply projections for this Statement.

The Department of Environment, Water and Natural Resources (DEWNR) initiative, “Finding Long-term Outback Water Solutions” (FLOWS) aims to increase this knowledge base. DEWNR is also undertaking field investigations to gather information about water resources in areas that may be affected by potential coal seam gas or large coal mining developments, as part of the National Partnership Agreement (NPA) on Coal Seam Gas (CSG) and Large Coal Mining Development.

The information collected will assist in developing a detailed scientific understanding of the surface and groundwater resources associated with coal bearing basins in South Australia, including the SAAL region. The project will provide a more accurate understanding of water related impacts from potential future coal seam gas or coal mining operations in the region.
It is intended that this Statement will be updated based on new information obtained following the completion of the FLOWS and NPA projects and any other new information that may be available.

It is unknown whether the current demand on water from the mining and petroleum sectors is sustainable in the SAAL region. In addition, the coverage of the following production tenements, licences or applications across the SAAL region (see figures 7, 8 and 9) highlights the potential growth in demand for water resources from this sector, which has the potential to place further pressure on these water resources:

- mining production tenements;
- mining production tenement applications;
- mineral exploration licences;
- mineral exploration licence applications;
- petroleum production licences;
- petroleum exploration licences;
- petroleum exploration licence applications;
- geothermal exploration licences; and
- geothermal exploration licence application.

Realising the benefits of the mining boom is a key strategy for the State Government, and in order to achieve this in a sustainable manner, further research into the volumes of water available for use is required. The DEWNR FLOWS project will contribute towards increasing our understanding of the capacity of the water resources in the SAAL region to ensure the most appropriate management decisions can be made.

The management of community water supplies presents a challenge in the SAAL region due to the number of different parties supplying water to communities and that most of the community water supplies are geographically isolated in addition to being sourced from differing water resources. This has implications in terms of governance and management arrangements, isolation and differences in water quality characteristics.

The development of robust and transparent criteria with which to guide the State Government in making consistent decisions in relation to when the State Government should or shouldn’t be responsible for supplying a community with water would be beneficial. Such criteria would need to answer whether the State Government should commence supplying a community with water, continue supplying a community with water, whether to augment a community’s water supply, or whether it should be the responsibility of another party (e.g. a mining company, progress association, local government etc.). This would help provide certainty to communities about who is responsible for their water supply, as well as to developers (e.g. mining companies) who are considering investing in the region. Any criteria developed would need to be consistent with current policies, such as Water for Good action 48 which requires mining ventures to provide their own water supplies for operational purposes.
Figure 1: South Australian Arid Lands Natural Resources Management Region
2 Current Resources

This section of the SAAL DSS provides an overview of the region, including the area covered, population, council areas and townships and land uses. It also provides an outline of the region’s climatic characteristics and uses the best available information to describe the region’s water resources, what the water resources are and their quantity and quality if known.

2.1 Regional Overview

The SAAL NRM region is the largest NRM region in South Australia, covering almost 55% of the State. The region covers approximately 520,000 km² and supports approximately 10,100 people. Nearly half of the region’s population lives in Roxby Downs (47%), followed by 17% of the population living in Coober Pedy. The majority of the remainder of the population live throughout the 19 unincorporated areas of the region (20%).

Table 1: Local government areas and unincorporated townships and their populations of the SAAL NRM region

<table>
<thead>
<tr>
<th>Council Area</th>
<th>Population (2011 Census)</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Council of Coober Pedy</td>
<td>1699</td>
</tr>
<tr>
<td>Roxby Downs Council</td>
<td>4701</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unincorporated Township</th>
<th>Population (2011 Census)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andamooka</td>
<td>2007</td>
</tr>
<tr>
<td>Beltana</td>
<td></td>
</tr>
<tr>
<td>Blinman</td>
<td></td>
</tr>
<tr>
<td>Copley</td>
<td></td>
</tr>
<tr>
<td>Gawler Ranges</td>
<td></td>
</tr>
<tr>
<td>Glendambo</td>
<td></td>
</tr>
<tr>
<td>Innamincka</td>
<td></td>
</tr>
<tr>
<td>Iron Knob</td>
<td></td>
</tr>
<tr>
<td>Kingoonya</td>
<td></td>
</tr>
<tr>
<td>Leigh Creek</td>
<td></td>
</tr>
<tr>
<td>Lyndhurst</td>
<td></td>
</tr>
<tr>
<td>Marla</td>
<td></td>
</tr>
<tr>
<td>Marree</td>
<td></td>
</tr>
<tr>
<td>Oodnadatta</td>
<td></td>
</tr>
<tr>
<td>Parachilna</td>
<td></td>
</tr>
<tr>
<td>Pimba</td>
<td></td>
</tr>
<tr>
<td>Tarcoola</td>
<td></td>
</tr>
<tr>
<td>William Creek</td>
<td></td>
</tr>
<tr>
<td>Woomera</td>
<td></td>
</tr>
</tbody>
</table>

The predominant industries in the region are mining, petroleum, pastoralism and tourism. As of 2010, the SAAL region accounted for 70% of South Australia’s mining outputs and generated $3 billion annually to the State economy (SAAL NRMB 2010). Gas and oil production and exploration, centering on the Cooper and Eromanga Basins, is expanding and from the 1970s until 2010, the cumulative petroleum sales from the SAAL region have totalled $21.3
billion (SAAL NRMB 2010). The expansion of Olympic Dam would also significantly increase growth in the region should it progress.

The value of output generated directly by agriculture in the region in 2006/07 was estimated to be $83 million which is 2% of the total output for regional South Australia and 1.8% of output for South Australia as a whole. The value of Gross State Product for the SAAL region in 2006-07 for agricultural activities (sheep, beef cattle and grain farming) was estimated to have contributed $46 million or 1.8% of South Australia’s Gross State Product (South Australian Government (SAG) 2007).

Tourism is an important industry to the SAAL region for both economic stimulation and retention of resident population. In 2009, there was an estimated 524,000 overnight visitors to the Flinders Ranges and Outback tourism region, who stayed over 2.3 million nights in the region (South Australian Tourism Commission 2010).

The climatic characteristics of the region are hot summers and cool to cold winters. Temperatures are cooler in the Flinders Ranges and hotter in the sand hills, rising to above 50°C in summer (SAAL NRMB 2010). Rainfall is low and unpredictable with evaporation rates far exceeding rainfall.

The temperature gradient in the SAAL region increases from the south to the north. The mean maximum temperature during the summer months (December to February) ranges from 32°C in the south of the region to 37°C in the north of the region (see table 2). The mean summer minimum temperature ranges from around 15°C in the south to 23°C in the north of the region (see table 2). Mean maximum temperature during the winter months (June to August) ranges from around 16°C in the south of the region to almost 21°C in the north of the region (see table 2). Mean winter minimum temperature ranges from around 3°C in the south to 7°C in the north of the region (see table 2).

The summer months are the wettest in the SAAL region. Average annual rainfall ranges from around 165-205 mm (see table 2), however rainfall in the arid areas of the State is unpredictable and consequently, averages can be misleading. Rainfall occurrence and intensity is episodic, sometimes without significant rainfall for years, while intense rainfall can deliver annual rainfalls in a single event (Watt et al 2012).

<table>
<thead>
<tr>
<th>Locality</th>
<th>Mean annual maximum temp (°C)</th>
<th>Mean annual minimum temp (°C)</th>
<th>Mean summer maximum temp (°C)</th>
<th>Mean summer minimum temp (°C)</th>
<th>Mean winter maximum temp (°C)</th>
<th>Mean winter minimum temp (°C)</th>
<th>Period of record</th>
</tr>
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<td>Oodnadatta</td>
<td>29</td>
<td>14.6</td>
<td>36.9</td>
<td>22.2</td>
<td>20.5</td>
<td>6.6</td>
<td>1940-2012</td>
</tr>
<tr>
<td>Moomba</td>
<td>29.3</td>
<td>15.5</td>
<td>37.1</td>
<td>23.4</td>
<td>20.7</td>
<td>7.3</td>
<td>1995-2012</td>
</tr>
<tr>
<td>Andamooka</td>
<td>27.5</td>
<td>13.7</td>
<td>35.5</td>
<td>20.6</td>
<td>19.2</td>
<td>6.7</td>
<td>1969-2012</td>
</tr>
<tr>
<td>Tarcoola</td>
<td>27.5</td>
<td>12.1</td>
<td>35.1</td>
<td>18.8</td>
<td>19.6</td>
<td>5.2</td>
<td>1997-2012</td>
</tr>
<tr>
<td>Yunta</td>
<td>24.4</td>
<td>9.4</td>
<td>32.2</td>
<td>15.6</td>
<td>16.3</td>
<td>3.6</td>
<td>1998-2012</td>
</tr>
<tr>
<td>Locality</td>
<td>Mean annual rainfall (mm)</td>
<td>Mean summer rainfall (mm)</td>
<td>Highest summer rainfall (mm)</td>
<td>Lowest summer rainfall (mm)</td>
<td>Mean winter rainfall (mm)</td>
<td>Highest winter rainfall (mm)</td>
<td>Lowest winter rainfall (mm)</td>
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<td>----------</td>
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<td>----------------------------</td>
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<td>-----------------------------</td>
</tr>
<tr>
<td>Oodnadatta</td>
<td>168.5</td>
<td>22.9</td>
<td>130</td>
<td>0</td>
<td>9.4</td>
<td>107.8</td>
<td>0</td>
</tr>
<tr>
<td>Moomba</td>
<td>193</td>
<td>21.6</td>
<td>239.6</td>
<td>0</td>
<td>11.5</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Andamooka</td>
<td>196.4</td>
<td>20.7</td>
<td>125.1</td>
<td>0</td>
<td>14.3</td>
<td>79.9</td>
<td>0</td>
</tr>
<tr>
<td>Tarcoola</td>
<td>189.2</td>
<td>29.3</td>
<td>138.6</td>
<td>0</td>
<td>11.8</td>
<td>42.4</td>
<td>0</td>
</tr>
<tr>
<td>Yunta</td>
<td>206</td>
<td>21.7</td>
<td>148.4</td>
<td>0</td>
<td>13.9</td>
<td>55.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

2.2 Water Resources

The water resources of the SAAL region have many environmental, economic, social and cultural attributes that are extremely valuable. The major water resources of the SAAL region include:

- Groundwater
- Great Artesian Basin (GAB) springs
- Other (non GAB) springs
- Seeps
- Waterholes
- Permanent rivers and creeks
- Ephemeral rivers and creeks
- Wetlands
- Salt lakes
- Freshwater lakes.

Groundwater

Groundwater is the major water source in the SAAL region. Groundwater underlies most of the region but is highly variable in quality and quantity (Arid Areas Catchment Water Management Board (AACWMB) 2006a). There are four main aquifer types in the region:

- Sedimentary basins
- Fractured rock
- Palaeochannel
- Surficial aquifers.
Great Artesian Basin

The GAB is by far the largest single source of fresh water in the arid zone, and supports significant social, economic and environmental assets (AACWMB 2006a). It is an extensive groundwater system underlying 22% of the Australian continent, including 310,000 km² within South Australia (AACWMB 2006a). The estimated storage capacity of the GAB (Australia wide) is approximately 65 million GL, which is the equivalent of 130,000 Sydney Harbours (AACWMB 2006a). It should be noted that the extractable component of the GAB is only a small fraction of the volume in storage (AACWMB 2006a).

The vast majority of the South Australian component of the GAB is prescribed in accordance with the NRM Act 2004 and managed through the Water Allocation Plan for the Far North Prescribed Wells Area (FNPWA). All other groundwater resources within the boundary of the FNPWA are also prescribed and extractions from them are licenced. The FNPWA was prescribed in March 2003 and the Water Allocation Plan was finalised in February 2009.

The total licensed volume of water allocated for extraction from the FNPWA in 2010-11, including the BHP Olympic Dam special license, was approximately 62,100 ML. Figure 2 shows that over a third of this volume (35.3% or 21,900 ML) was licensed for petroleum co-produced water purposes. The second largest licensed volume was allocated under a special license for BHP Olympic Dam (24.7% or 15,330 ML), the third largest licensed volume was allocated for mining purposes (19.2% or 11,903.4 ML) and the fourth largest licensed volume was allocated for stock purposes (14.2% or 8804.8 ML).

Figure 2: Licensed allocation volumes for groundwater extraction in the FNPWA for 2010-2011

Note: The petroleum co-produced water volume includes an estimated volume available to supply the township of Moomba and associated outposts.
Water quality is highly variable across the GAB. Groundwater salinity (total dissolved solids) within the South Australian portion of the GAB is relatively high and increases towards the south-west of the basin (SAAL NRMB 2010).

The water quality characteristics of the groundwater limit its potential uses without further treatment. Water is suitable for stock and in some areas for town water supplies, however other townships, such as Coober Pedy and Roxby Downs, desalinate their drinking water.

The groundwater elevation of the GAB aquifer in the FNPWA has remained relatively stable over a long period of time (SAG 2011a). While there have been small fluctuations in groundwater elevation over the years, current values are similar to historical measurements (SAG 2011a).

The salinity of the GAB aquifer has remained relatively stable since 1900 (SAG 2011a). While there have been small fluctuations in groundwater quality over the years, current values are similar to historical measurements (SAG 2011a).

Other Groundwater Resources

This section discusses the other groundwater resources in the SAAL NRM region. Some of these resources are within the boundary of the FNPWA and are therefore prescribed but the majority fall outside the boundary of the FNPWA and are not prescribed (see figures 3a and 3b).

There have been few assessments of the non-prescribed groundwater resources in the SAAL region. Groundwater is known to be available in most locations but it is highly variable in quality and quantity. Martin, Sereda and Clarke (1998) provided estimates of total groundwater storages within each province (see table 3), however these could potentially be over-estimated (Watt et al 2012). Any estimates should be treated with caution until a more detailed and reliable assessment of groundwater resources is undertaken (Watt et al 2012).

<table>
<thead>
<tr>
<th>Groundwater province</th>
<th>Total GW resource * (GL)</th>
<th>Estimated GW use (GL/y)</th>
<th>Comments and additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pirie-Torrens Basin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh (0–1500 mg/L)</td>
<td>3425</td>
<td>1.4</td>
<td>EP, NY and SAAL NRM Regions. Considers Tertiary and Quaternary sequences only. Potential aquifer sequences include the Tertiary age Kanaka Beds, Melton Limestone, Gibbon Beds and Neuroodla and Cotabena Formation and the Quaternary-age Hindmarsh Clay, Telford Gravel and Pooraka Formation.</td>
</tr>
<tr>
<td>Brackish (1500–7 000 mg/L)</td>
<td>9500</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Saline (&gt;7 000 mg/L)</td>
<td>45 250</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Adelaide Geosyncline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh (0–1500 mg/L)</td>
<td>200 000</td>
<td>20</td>
<td>SAAL, MLR and NY NRM Regions. Aquifers consist of Neoproterozoic (Adelaidean) metasediments, including the ABC Range Quartzite, Elatina and Balcanoona Formations, overlain by Cambrian limestones and dolomites of the Arrowie Basin. Due to the variable nature of hard/fractured rock aquifers, estimates may be a gross over-estimate.</td>
</tr>
<tr>
<td>Brackish (1500–7 000 mg/L)</td>
<td>462 500</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Saline (&gt;7 000 mg/L)</td>
<td>650 000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Groundwater province</td>
<td>Total GW resource * (GL)</td>
<td>Estimated GW use (GL/y)</td>
<td>Comments and additional information</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td><strong>Palaeovalleys</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh (0–1500 mg/L)</td>
<td>-</td>
<td>-</td>
<td>EP, AW, NY and SAAL NRM Regions. An extensive region of palaeodrainage that drained the Musgrave Block, Stuart and Gawler Ranges exist within the Gawler Craton, Far West and Mid North of the state. They have the potential to contain large quantities of water (albeit of high salinity) and can be of vital importance to the mining industry. Estimates presented in this table are for the whole State.</td>
</tr>
<tr>
<td>Brackish (1500–7 000 mg/L)</td>
<td>6 000</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Saline (&gt;7 000 mg/L)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Great Artesian Basin</strong></td>
<td>43 500 000</td>
<td>155</td>
<td>The total resource of the GAB is extremely large and estimates vary depending on the number of basins and sub-basins included. A volume of water in storage estimate of 64.9 x 106 GL (Far North PWA WAP) is for major, basin-wide GAB aquifers. The South Australian GAB region (comprising entirely Eromanga Basin sediments) is largely within the Far North PWA. The limited occurrence within the non-prescribed areas of the AW and SAAL NRM Regions are at the basin margins where thinner non-artesian aquifers occur; the most significant aquifer is the Algebuckina Sandstone and Cadna-owie Formation, where water quality is generally good.</td>
</tr>
<tr>
<td>Fresh (0–1500 mg/L)</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Brackish (1500–7 000 mg/L)</td>
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<td>Saline (&gt;7 000 mg/L)</td>
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</tr>
<tr>
<td><strong>Gawler Craton</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater within the Gawler Craton province occurs in weathered and fractured Precambrian basement rocks (Watt et al 2012). These groundwater resources are not highly utilised and not well understood (Watt et al 2012). Groundwater salinities range from fresh to hyper-saline but the majority of groundwater in these fractured rock aquifer systems is highly saline (Watt et al 2012).</td>
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</tr>
<tr>
<td><strong>Cumamona Province</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater supplies in the Cumamona Province are poorly understood (Australian Groundwater Technologies (AGT) 2010). Both low and high-salinity groundwater has been found in the southern Cumamona Province (Watt et al 2012).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cariewerloo Basin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generally, all groundwater is too saline for stock supplies, with many wells abandoned due to pumping-induced salinity increases from deeper groundwater (Kellet et al. 1999). There are some wells with low to medium salinity groundwater.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adelaide Geosyncline</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater from the Adelaide Geosyncline is used mainly for stock and for water supplies at Arkaroola, Hawker and Wilpena as well as providing baseflow to waterholes or springs (AAC WMB 2006a). Nearly all groundwaters are</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Based on a matrix porosity of 0.1.
suitable for sheep and while potable groundwater exists in most parts of the Flinders Ranges, volumes are generally insufficient for large-scale development (Read 1987). Good quality groundwater is generally more common in the southern, higher rainfall areas (Read 1987). Groundwater within the fractured rock aquifers of the Olay Ranges is relatively fresh and is the main source of water for stock (Watt et al 2012).

Stuart Shelf

The extensive Tent Hill aquifer forms the main aquifer system in the southern portion of the Stuart Shelf (BHP Billiton 2009a) and comprises the lower part of the Arcoona Quartzite and the Coraberra Sandstone units of the Tent Hill Formation. High well yields have been discovered around Woomera and in the vicinity of Olympic Dam (Watt et al 2012). Groundwater salinity in the Tent Hill aquifer ranges from 35,000 to more than 100,000 mg/L in the vicinity of Olympic Dam, reaching up to 200,000 mg/L closer to Lake Torrens (BHP Billiton 2009a).

Arrowie Basin

The Arrowie Basin onlaps the Stuart Shelf and Torrens Hinge Zone and includes the Andamooka Limestone aquifer. Groundwater yields throughout the Andamooka Limestone aquifer are variable. Groundwater salinity generally ranges between 20,000 and 60,000 mg/L, increasing to as much as 200,000 mg/L closer to Lake Torrens (BHP Billiton 2009a).

Arckaringa Basin

The Arckaringa Basin aquifers are only well understood in areas of specific investigations by mining companies and beyond these areas, the groundwater supply capacity of the basin is completely untested, with no estimates of sustainable yield available (AGT 2010).

OZ Minerals (2009) observed salinities from the Boorthanna Formation ranging from brackish (~5000 mg/L) to saline (>30,000 mg/L) and currently extract approximately 6200 ML/a.

Eromanga Basin

The entire artesian component of the Eromanga Basin is within the FNPWA. Information about the non-artesian aquifers of the GAB is not well documented and is generally limited to specific mining projects (Watt et al 2012).

Groundwater quality in the J-K aquifer is generally good, with salinities ranging between 700 mg/L in the north and north-east to more than 40,000 mg/L in the southwest, but generally between 1000 and 5000 mg/L (Sampson 1996). Groundwater of salinity less than 3000 mg/L occurs in the unconfined Algebuckina Sandstone aquifer around the townships of Kingoonya and Glendambo (Watt et al 2012). North of these towns, large parts of the Algebuckina Sandstone aquifer contain groundwater between 3000 and 7000 mg/L (Watt et al 2012). The Cadna-owie Formation also contains groundwater of salinity less than 3000 mg/L north of Glendambo (Watt et al 2012).

The Cadna-owie Formation crops out at the township of Andamooka and provides a small but locally important source of drinking-quality water (AACWMB 2006a).

In the south-west of the basin, groundwater is too saline for stock, without further treatment, but fresher groundwater can occur after recharge from rainfall (Watt et al 2012).
Torrens Basin

Martin et al (1998) estimated the sustainable yield of the combined Pirie-Torrens Basin to be 3600 ML/a (the Pirie Basin is to the south of Port Augusta and outside of the SAAL region). A rough estimate of sustainable yield for the Torrens Basin might be 1800 ML/a (AGT 2010). Large supplies of poor quality groundwater may be available from the deeper Cotabena Formation, however, well yields and groundwater quality is largely unknown and the basin's potential for large volume, poor quality groundwater supplies is untested (AGT 2010).

Lake Eyre Basin

Investigations in the Callabonna Sub-basin of the Lake Eyre Basin by URS (2009) have identified the Eyre Formation as able to yield supplies of moderately saline to very saline groundwater depending on the proximity to recharge sources in adjacent ranges. Well yields range from less than 1 L/s to around 10 L/s (AGT 2010). The salinity close to the Flinders Ranges is around 2500 mg/L (URS 2009) and increases with distance from recharge sources.

Groundwater suitable for stock watering has been intersected in the Tertiary-Quaternary age Willawortina Formation overlying the Namba Formation (Heathgate 1998).

Murray Basin

To the south of the Olary Ranges, groundwater can be found in the sediments of the Murray Basin at a depth of about 100m below ground (AACWMBA 2006a). The Lower Renmark Group confined sand aquifer has been developed for stock and domestic supplies only around the basin margin, where it is relatively shallow and contains groundwater that is usually fresher than the sometimes saline groundwater in the overlying limestone aquifer (Rogers et al 1995).

Palaeovalleys

Palaeovalleys are present in the north-east, north-west and west of the SAAL region and have the potential to contain large quantities of often saline groundwater (Watt et al 2012). In the Gawler Ranges, palaeovalleys could provide a significant source of saline groundwater for use in the mining industry (Martin et al 1998). The township of Kingoonya has one of the few satisfactory water supplies in the area, which is derived from a palaeovalley with a salinity of 3010 mg/L (AACWMBA 2006a).

The Garford Palaeovalley contains saline groundwater with potentially up to 300,000 ML in storage and the Tallaringa Palaeovalley contains an estimated 900,000 ML of groundwater in storage (Watt et al 2012). No estimates of storage have been made for the Narlaby and Thurlga Palaeovalleys to the south (Watt et al 2012). Groundwater quality ranges from around 5000 mg/L to more than 100,000 mg/L and yields are not well known (Watt et al 2012).

Quaternary Sediments

Fresh groundwater can be found in shallower unconsolidated sediments such as alluvial fans or stream beds and are generally recharged by localised rainfall (Watt et al 2012). In areas of low rainfall, such as the Gawler Ranges region, there are few such aquifers, but in areas of relatively higher rainfall, such as in the Flinders Ranges, these aquifers are recharged more often and are used extensively by pastoralists in the region (AACWMBA 2006b).
Figure 3a: Groundwater provinces in the South Australian Arid Lands NRM region
Figure 3b: Groundwater provinces in the South Australian Arid Lands NRM region
Surface Water

Surface Drainage Divisions

There are three major surface drainage divisions in the SAAL region, the Lake Eyre Drainage Division, the Western Plateau Drainage Division and the South Australian Gulf Drainage Division (SAAL NRMB 2010).

Drainage in the Lake Eyre Drainage Division ultimately ends at Lake Eyre. The major rivers that drain into Lake Eyre from the west are the Macumba, the Arckaringa and the Neales (SAAL NRMB 2010). These rivers are normally dry yet they are capable of carrying large volumes of water in times of flood and dissect the country west of Lake Eyre (SAAL NRMB 2010). Semi-permanent waterholes are supplied from flood events (SAAL NRMB 2010).

Rivers more likely to fill Lake Eyre lie to the east and drain a vast area extending to the highlands of central Queensland (SAAL NRMB 2010). These rivers include the Warburton (from the Diamantina River) and Cooper Creek. In South Australia, these river systems approach Lake Eyre through the interconnected river courses of the Channel Country (SAAL NRMB 2010). Annual run-off from the Great Dividing Range and the Barkley Tablelands of Queensland into the river systems fills some waterholes close to the borders, which are considered permanent (SAAL NRMB 2010).

The Western Plateau Drainage Division is vast, covering large portions of Western Australia, Northern Territory and South Australia (SAAL NRMB 2010). It is divided into nine basins, of which only one (the Gairdner Basin) lies within the SAAL region (SAAL NRMB 2010). There are no true riverine systems within the Gairdner Basin, resulting in many large salt lakes (SAAL NRMB 2010). Lake Gairdner is the largest salt lake in the sub-basin at 8884 km² (SAAL NRMB 2010).

The South Australian Gulf Drainage Division is divided into 13 basins of which two, the Mambray Coast Basin and the Torrens Basin, lie within the SAAL region (SAAL NRMB 2010). Drainage in the Torrens Basin is directed towards Lake Torrens mostly from the western flank of the northern Flinders Ranges (SAAL NRMB 2010).

Table 4 provides a summary of stream flow data compiled by the AACWMB (2006) from data published by the Department of Water, Land and Biodiversity Conservation for stations with over five years of data in the SAAL region and updated with data published by DEWNR where data was available. The table highlights the extreme variability in stream flow from one year to the next (SAAL NRMB 2010). Median flows are typically less than a third of the mean, while minimum annual flows are all less than 1% of the mean with the exceptions of Cooper Creek and Windy Creek at Maynards Well (SAAL NRMB 2010).

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Location</th>
<th>Years of Record</th>
<th>Max</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Median as Proportion of Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamantina River at Birdsville</td>
<td>Far North</td>
<td>47</td>
<td>10,990,000</td>
<td>1,425,000</td>
<td>357,900</td>
<td>6022</td>
<td>25</td>
</tr>
<tr>
<td>Cooper Ck at Cullyamurra Waterhole</td>
<td>Far North</td>
<td>40</td>
<td>14,340,000</td>
<td>1,580,000</td>
<td>429,800</td>
<td>47,380</td>
<td>27</td>
</tr>
<tr>
<td>Mt McKinley Ck at Wertaloona</td>
<td>Nth East &amp; Flinders</td>
<td>17</td>
<td>96,680</td>
<td>8966</td>
<td>1200</td>
<td>15.2</td>
<td>13</td>
</tr>
<tr>
<td>Station Name</td>
<td>Location</td>
<td>Years of Record</td>
<td>Max</td>
<td>Mean</td>
<td>Median</td>
<td>Min</td>
<td>Median as Proportion of mean (%)</td>
</tr>
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<td>-------------------------------</td>
</tr>
<tr>
<td>Arcoona Ck at Gammon Ranges Nat Pk</td>
<td>Nth East &amp; Flinders</td>
<td>9</td>
<td>618.6</td>
<td>124.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arcoona Ck at Aroona Dam</td>
<td>Nth East &amp; Flinders</td>
<td>19</td>
<td>17,020</td>
<td>2835</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Windy Ck at Maynards Well</td>
<td>Nth East &amp; Flinders</td>
<td>17</td>
<td>6483</td>
<td>909.2</td>
<td>340.7</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>Windy Ck at Leigh Ck</td>
<td>Nth East &amp; Flinders</td>
<td>18</td>
<td>8846</td>
<td>2062</td>
<td>597.9</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>Emu Ck at Leigh Ck</td>
<td>Nth East &amp; Flinders</td>
<td>18</td>
<td>37,260</td>
<td>6484</td>
<td>2120</td>
<td>55.3</td>
<td>33</td>
</tr>
</tbody>
</table>

**Springs**

There are GAB springs and non-GAB springs in the SAAL region. The GAB springs are unique natural springs and surface water seepages that hold great ecological, social and economic value, and are listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) as an endangered ecosystem (AACWMB 2006). The GAB springs are the only permanent source of naturally occurring water in arid South Australia (AACWMB 2006). The springs are considered to be entirely dependent on groundwater (AACWMB 2006).

Little is known about the number and nature of non-GAB springs. The watercourses of the Flinders Ranges are characterised by many springs and waterholes, which are of a permanent or semi-permanent nature (AACWMB 2006). There are also a number of freshwater soaks on the surface of Lake Gairdner (AACWMB 2006).

**Wetlands**

There are both natural and bore-fed wetlands throughout the SAAL region. The wetlands of Cooper Creek, Coongie Lakes, Warburton River and Lake Eyre cover large expanses of the SAAL region and support a vast array of fauna and flora. There are also bore-fed wetlands that are man-made habitats resulting from flowing artesian bores (AACWMB 2006). A number of these bore-fed wetlands have developed ecological and cultural attributes that are valued by the community and ongoing water supply to them is managed through the water allocation plan for the FNPWA (AACWMB 2006).

**Waterholes**

The majority of pools within the arid areas are of a shallow and temporary nature, but a small number are considered to be permanent (AACWMB 2006). Relatively large freshwater internal drainage systems (e.g. Lake Phillipson and Millers Creek in the west), and many smaller lakes and swamps can supply water for up to four years (although they rarely catch water). Many natural waterholes have been enlarged or banked in these areas to increase capacity for stock and domestic use (AACWMB 2006).

The capture of rainfall run-off in rocky ranges provides an important water source for many species of birds, reptiles and mammals (AACWMB 2006).
Although rockholes and waterholes are known to exist in watercourses and creeks throughout the SAAL region, very little has been documented about them (AAC WMB 2006).

**Alternative Water Sources**

**River Murray water**

SA Water supplies a small volume of water to Iron Knob from a branch off the Morgan Whyalla pipeline. Woomera is supplied via a private pipeline that extends from the Morgan to Whyalla pipeline at Port Augusta. It is difficult to isolate the volumes supplied to these communities and as such the volume supplied to Iron Knob was incorporated in the Eyre Peninsula Demand and Supply Statement and the volume supplied to Woomera was incorporated in the Northern and Yorke Demand and Supply Statement.

**Stormwater**

Capture of rainwater in rainwater tanks is utilised throughout the SAAL region. Some settlements rely on rainwater, and dams and rainwater tanks are often used in the absence of suitable bore water to support stock on pastoral leases (SAAL NRMB 2010). The effectiveness of surface water storage in dams however is severely limited by the high evaporation rates which can cause losses of up to 90% (SAAL NRMB 2010).

**Wastewater**

There are five community wastewater management schemes in the SAAL region (see figure 4). These schemes currently have a combined total volume of treated wastewater of approximately 179 ML/a available for reuse and approximately 174 ML/a is reused.

The size of a community will determine whether it is feasible to have a community wastewater management scheme and whether there would be a sufficient volume of water for the scheme to function appropriately or whether there was enough water for reuse. For many of the communities in the SAAL region community size is a limiting factor.

**Figure 4: Volume of treated wastewater available for reuse and reused from community wastewater management schemes in the SAAL region**
3 Community Water Supply

This section of the SAAL DSS provides a summary of the water supplied and used by the communities in the SAAL region for those townships where data is available.

There is no region-wide water distribution network across the SAAL region as could be found in other parts of the State, such as Adelaide or the Eyre Peninsula for example. Responsibility for the supply of water for community use throughout the SAAL region is diverse. The key groups responsible for community water supplies include:

- SA Water;
- Roxby Downs Council;
- District Council of Coober Pedy;
- Progress Associations; and
- Mining companies.

3.1 SA Water

SA Water are responsible for the supply of water to the following communities on a town-by-town basis:

- Blinman;
- Cockburn;
- Mannahill;
- Marla;
- Marree;
- Olary;
- Oodnadatta;
- Parachilna; and
- Yunta.

On behalf of the local community, SA Water also operates the supply of water to Nepabunna.

SA Water supply the townships of Oodnadatta, Marree, Marla, Parachilna, Blinman, Cockburn, Mannahill, Yunta and Olary from groundwater aquifers or diverted water from creeks into settling dams (Watt et al. 2012). Table 5 (below) provides average annual water use volumes for those townships listed above, where data was available.
Table 5: Average annual water use for townships supplied by SA Water

<table>
<thead>
<tr>
<th>Township</th>
<th>Average Annual Water Use (ML)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinman</td>
<td>3.27</td>
</tr>
<tr>
<td>Marla</td>
<td>7.03</td>
</tr>
<tr>
<td>Marree</td>
<td>16</td>
</tr>
<tr>
<td>Oodnadatta</td>
<td>42.5</td>
</tr>
<tr>
<td>Parachilna</td>
<td>12.1</td>
</tr>
<tr>
<td>Total</td>
<td>80.9</td>
</tr>
</tbody>
</table>

Note: This table only lists the townships supplied by SA Water, where data was available. The water use volumes are based on multi-year averages to June 2012. Water usage from Marree is estimated based on 2 years of data.

SA Water also supplies River Murray water to a private pipeline from the Morgan-Whyalla pipeline to supply Woomera and the nearby town of Pimba (Watt et al. 2012). The reticulation system that supplies these towns is privately owned and operated.

**Nepabunna**

The water infrastructure and assets of Nepabunna are owned by the Aboriginal Lands Trust, however SA Water is responsible for water supply infrastructure planning, construction, operations and maintenance. Due to the quality of groundwater in the area, Nepabunna have a dual water supply where a community rainwater catchment and storage is used for drinking water supplies and groundwater is used for non-drinking purposes (SA Water 2007).

SA Water data shows that average consumption from the period 14 March 2012 to 31 Dec 2012 was 0.48kL/d of treated rainwater and 25.8kL/d of untreated groundwater. If average consumption is consistent across the year it is expected that the combined total annual average consumption of treated rainwater would be approximately 175kL and untreated groundwater would be 9.4 ML. However, it is important to note that average daily consumption figures were calculated from a period that did not include the peak summer period and as such total annual average consumption from treated rainwater and untreated groundwater is likely to be slightly higher than outlined above.

SA Water advise that Nepabunna’s water supply has been augmented with the addition of a new well in the last 2 years. AGT (2008) states that there is no clear recharge effect from the moderate rainfall observed at Nepabunna.

### 3.2 Roxby Downs Council

As stated in the Roxby Downs (Indenture Ratification) Act 1982, the township of Roxby Downs is permitted a minimum allowance of 650 litres of potable water per head of population per day plus a reasonably sufficient quantity of potable and non-potable water for public and community parks, gardens and recreational uses, after having made due allowance for the use of recycled water wherever reasonably practical or economic to do so.

Roxby Downs’ water consumption for 2010-11 was estimated to be 355L/head/day (the equivalent of approximately 640 ML/a), which is a decrease from the volume consumed in 2008-09 and 2009-10 (see figure 5 below).
Figure 5: Comparisons of water consumption from 2008-09 to 2010-11 for the Roxby Downs community

Note: The graph above should be used as a guide only as it is based on estimated population figures.

3.3 District Council of Coober Pedy

The District Council of Coober Pedy extracts water from the GAB, which is desalinated prior to supplying it to properties in the town of Coober Pedy through their reticulation system. The entire infrastructure required to pump water from their two groundwater wells is owned, operated and continually maintained by the District Council of Coober Pedy.

The licensed volume of water allocated to the Council for use is 530.4 ML/a. In the 2010-11 financial year, Council pumped 329.8 ML from their bore field that, following desalination, produced 261.9 ML of drinking quality water. This correlates to a desalinated water recovery rate of nearly 80%.

Figure 6: District Council of Coober Pedy Bore Shed Compound
3.4 Mining Companies

Alinta Energy

Alinta Energy is responsible for the supply of water to the townships of Copley, Leigh Creek and Lyndhurst.

In 1955, Aroona Dam was built to supply water for the Leigh Creek township and for use by the coal mine. Since then, the town and coal mine use water from the nearby dam, south-west of the township. A reverse osmosis plant also provides water drawn from bores when the water level in Aroona Dam is too low. The wastewater from the town is used to water the ovals, parks and trees around the town as well as watering the local golf club during winter months1.

SANTOS

SANTOS is responsible for the supply of water to the township of Moomba and associated outposts. The water allocation plan for the FNPWA (2009) estimates that approximately 1500 ML/a is used in the township of Moomba for processing petroleum products as well as community use within the township and associated outposts.

3.5 Progress Associations

In the unincorporated areas of South Australia, the Outback Communities Authority (OCA) fulfils the following legislative functions as outlined in the Outback Communities (Administration and Management) Act 2009:

- Managing the provision of public services and facilities to outback communities;
- Promote improvements in the provision of public services and facilities to outback communities; and
- Articulate the views, interests and aspirations of outback communities.

There are many small communities throughout the SAAL region that fall within these unincorporated areas. The OCA supplies water to some of these communities and/or works with local progress associations to assist them to provide water supplies to their communities. However, there is no statutory obligation for the OCA to supply these communities with water.

Innamincka

The town of Innamincka sources its water from the nearby Cooper Creek. The public toilet, shower and laundering facilities are supplied with water directly from Cooper Creek without any treatment2. The residents generally have private settling tanks that are used to improve the quality of the Cooper Creek water prior to use but it is not classified as drinking quality water3.

**Kingoonya**

The Kingoonya Progress Association bore has water but without further treatment it is not suitable for township use and current infrastructure is not appropriate for accessing the water\(^4\). The water may be suitable for use by the mining sector\(^5\). Currently the town is unable to provide water for public showers or drinking water\(^6\).

**William Creek**

The William Creek town water supply is owned and operated by the William Creek Hotel which sources water from the GAB aquifer. The William Creek Community Plan (2001) outlines that it would be beneficial for an alternative water supply to be owned and operated by the Progress Association.

### 3.6 Other Communities

**Beltana**

Water collection in Beltana is the responsibility of each landowner, and is sourced either from bores or by the collection of rainwater (SAG 2012).

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4 Future Demand and Supply

This section of the SAAL DSS describes the key issues that are, or have the potential to, influence current and future demand for water resources in the SAAL region or the supply of water to the region.

4.1 Demands

Key issues with the potential to influence future demand in the SAAL region include:

- Mining, petroleum, gas and geothermal energy demand and expansion
- Pastoral demand
- Population growth
- Tourism growth
- Road building and maintenance demand

Mining, Petroleum, Gas and Geothermal Demand and Expansion

The State Government has released its “Seven Strategic Priorities” with the aim to focus our efforts and drive the work of Government. One of these priorities is to realise the benefits of the mining boom for all, with the vision that South Australia has a thriving resources industry and is a key mining services hub for Australia and the region.

South Australia’s Strategic Plan further supports this priority, containing targets for exploration, production and processing in the mining sector that will drive significant growth in the future.

The 2011 Resources and Energy Sector Infrastructure Council (RESIC) Infrastructure Demand Study shows that demand for water from the mining sector in the Upper North region in the years 2011-2013 is expected to be approximately 7.1 GL, increasing to 12.6 GL from 2021. It must be noted, however, that the Upper North region described in the RESIC study does not align exactly with the SAAL region. In addition, the study is based on voluntary responses by mining companies and may not capture all current mines, or all mines at an advanced stage of approval, and therefore may be an underestimate of the volumes of water currently or projected to be demanded from the mining sector.

The level of activity in this sector can vary quickly; there are currently 518 mineral exploration licences, 211 mineral exploration licence applications, 195 petroleum production licences, 40 petroleum exploration licences, 33 petroleum exploration licence applications, 184 geothermal exploration licences and 21 geothermal exploration licence applications held within the SAAL region (Watt et al. 2012) (see figures 7, 8, and 9).
Figure 7: Mining production tenements, mining production tenement applications, mineral exploration licences and mineral exploration licence applications in the South Australian Arid Lands region.
Figure 8: Petroleum production licences, petroleum exploration licences and petroleum exploration licence applications in the South Australian Arid Lands region.
Figure 9: Geothermal exploration licences and geothermal exploration licence applications in the South Australian Arid Lands region
In addition to the volume of water utilised during the mining, petroleum, gas and geothermal energy production, the process of mineral extraction can require mine “de-watering” to lower the water table around the target resource to allow access. In addition, other mining activities including coal seam gas, underground coal gasification, and shale gas and petroleum production can “co-produce” water during their extraction processes. Volumes of water extracted through mine de-watering and co-produced water can be large, with only a small proportion reused in operations or in town or camp water supply. This has the potential to place a large demand on the SAAL region’s resources into the future. For example, the RESIC study (2011) suggests that Altona’s Arckaringa Coal to Liquids (CTL) Project has indicated their potential to co-produce up to approximately 100 ML/day (30-40 GL/a) from 2017.

The BHP Olympic Dam mine has a special license to extract 42 ML/day (approximately 15.3 GL/a). The current operation uses an average 37 ML/day (approximately 13.5 GL/a) (BHP Billiton 2009b). Should the Olympic Dam Expansion proceed, it is anticipated that an additional 216 ML/day (approximately 78.8 GL/a) would be required (BHP Billiton 2009b). It is suggested that a small proportion of the additional demand (25 ML/day for dust suppression) could come from saline groundwater about 30km from Olympic Dam (BHP Billiton 2009b). It is suggested that the remainder of the additional water demand could be met through desalinated seawater (BHP Billiton 2009b), with no additional demand on the GAB.

Other operational or developing mines in the SAAL region, as listed in the Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITE) website7 include:

- Ankata (Prominent Hill underground) and Malu (Prominent Hill open cut);
- Beltana: Flinders Zinc;
- Beverley;
- Beverley North;
- Cairn Hill;
- Challenger;
- Honeymoon Uranium Mine;
- Leigh Creek; and
- Peculiar Knob.

**Pastoral Demand**

In terms of geographic extent, pastoralism is by far the dominant land use. There are 328 pastoral leases in the SAAL NRM Region, configured into 222 pastoral properties and covering 409,000 km² (SAAL NRMB 2010). The Australian Bureau of Statistics (ABS) (2012a) reported that in 2010-11 there were 3,875,339 Dry Sheep Equivalent (DSE) in the SAAL region, which required approximately 4.6 GL/a of water.

The Department of Primary Industries and Regions South Australia advised that it was difficult to provide a projected trend in future growth or decline in stock water use within the SAAL region due to the hot arid climate. However, stock numbers are expected to closely follow seasonal climate variability as witnessed during the recent dry period during 2004-10.

**Population Growth**

The population in the SAAL region in 2011 was 10,100 people (2012b). It can be difficult projecting the SAAL region’s population into the future as there are a number of Aboriginal communities whose numbers are liable to fluctuate dramatically within the year and from one year to the next, due to the mobile and fluctuating nature of Aboriginal communities.

In addition, a unique feature of the SAAL region is that its future population trends will be largely influenced by the timing of BHP Billiton’s decision on when to proceed with the expansion of its mine at Olympic Dam. The details and timing of this decision are uncertain at the present time, but there is no doubt that it will directly impact on the future size of the resident population at Roxby Downs and of surroundings areas. In 2011, Roxby Downs accounted for 4701 or 47% of the population of the SAAL region.

The uncertain nature of future population growth in the SAAL region is further emphasised by the trend towards increased fly-in and fly-out labour movements in the mining sector, which could result in minimal growth in the usual resident population of many mining sites.

Based on the best available information to date, the Department of Planning, Transport and Infrastructure advise that the median series population projection (most likely scenario) out to 2036 is for a population of 15,565 people in the SAAL region. The high series population projection out to 2036 is for a population of 16,807 people in the SAAL region. Both the medium (most likely scenario) and the high series population projections assume that the expansion to Olympic Dam will proceed, with the high series assuming a slightly more rapid growth rate in the next 8-10 years than the medium series.

**Tourism Growth**

In 2009, there was an estimated 524,000 overnight visitors to the Flinders Ranges and Outback tourism region, who stayed over 2.3 million nights in the region in total (South Australian Tourism Commission 2010). Over 17% of all overnight visitors to regional SA (excludes Adelaide tourism region) included a stay in the Flinders Ranges and Outback and the region accounted for almost 20% of visitor nights to regional SA (South Australian Tourism Commission 2010).

The vision in the Flinders Ranges and Outback Regional Strategic Plan (2009) is for a 10% per annum increase in tourism expenditure over the period 2009/10 to 2013/14. Although there is not a specific target for growth in tourist numbers, it is reasonable to suggest that much of the growth in tourism expenditure would come from growth in tourist numbers.

Assuming the majority of tourism water usage is used for showers or baths and toilet flushing, which is approximately 30% of household water use (SA Water 2012), and the State’s daily water consumption per capita is 385 litres (ABS 2011), then if there were 2.3 million overnight stays in the Flinders Ranges and Outback region, approximately 265 ML of water would have been used by the tourism sector in 2009. If the vision of a 10% per annum increase in tourism expenditure was matched by a 10% per annum increase in overnight tourist stays, then it could be assumed that approximately 428 ML of water would be used by the tourism sector in 2014.

Anecdotal evidence suggests that tourism numbers have plateaued in recent times. However, large surges in tourist numbers are evident following periods of high rainfall. These high rainfall events attract people who come to witness Lake Eyre, and the creeks and rivers that feed it, when they contain water and have associated booms in flora and fauna.
**Road Building and Maintenance Demand**

The Department of Planning, Transport and Infrastructure (DPTI) advised that it manages around 9,500 km of sealed and unsealed roads in the South Australian Arid Lands NRM Region. DPTI estimate that the annual water usage for road building and maintenance activities in this area is approximately 140 ML.

The Department of Planning, Transport and Infrastructure has concerns about the impact of the mining expansion in the region and the potential requirement for additional road maintenance activities and water resources.

### 4.2 Supplies

Groundwater resources account for the vast majority of water in the SAAL region. However, there have been few assessments of the SAAL regions groundwater resources, with the exception of the groundwater resources of the main artesian aquifer of the GAB (the Cadna-Owie – Algebuckina aquifer). Any estimates of the remaining GAB aquifers and of the non-prescribed groundwater resources should be treated with caution until a more detailed and reliable assessment of groundwater resources is undertaken (Watt et al 2012).

DEWNR, in partnership with the Goyder Institute for Water Research is currently undertaking the FLOWS project. This project aims to increase the knowledge base and options for long-term water solutions for the outback to support mining, energy, and industry development and community water supplies.

DEWNR, the Department for Manufacturing, Innovation, Trade, Resources and Energy and the Environment Protection Authority (South Australia) are also undertaking field investigations to gather information about water resources in areas that may be affected by potential coal seam gas or large coal mining developments, as part of the NPA on Coal Seam Gas (CSG) and Large Coal Mining Development.

The information collected will assist in developing a detailed scientific understanding of the surface and groundwater resources associated with coal bearing basins in South Australia, including the SAAL region. The project will provide a more accurate understanding of water related impacts from potential future coal seam gas or coal mining operations in the region.

It is intended that this Statement will be updated based on new information obtained following the completion of the FLOWS and NPA projects and any other new information that may be available.

Surface water across the SAAL region can not be considered a reliable water source with extreme variability in stream flow from one year to the next. Although extreme events cause significant flood waters, median flows are typically less than a third of the mean, while minimum annual flows are all less than 1% of the mean with the exceptions of Cooper Creek and Windy Creek at Maynards Well (SAAL NRMB 2010). In addition, any attempt to capture flood waters in dams for later use is severely limited by the high evaporation rates which can cause losses of up to 90% (SAAL NRMB 2010).

### Climate Change

Several studies report that a majority of climate models project a greater warming under climate change conditions for the SAAL region than for other regions in SA (Suppiah et al. 2006; CSIRO-BoM 2007; Gibbs et al. 2013). These reports also indicate a wide range of possible changes to rainfall in the region, with the majority of models predicting a significantly drier climate in the future. For example, the majority of the 13 climate models selected by
Suppiah et al. (2006) for projections of climate in South Australia indicate that mean annual rainfall in the SAAL region is likely to decrease significantly, although some of the models indicate small percentage increases. Furthermore, there are strong seasonal differences in these projected changes, with decreases in spring and winter rainfall projected to be greater than summer and autumn decreases (Table 6) (Suppiah et al. 2006).

Table 6: Projected average range of temperature and rainfall change in the SAAL region for 2030 and 2070 (Suppiah et al. 2006)

<table>
<thead>
<tr>
<th>Climatic Characteristic</th>
<th>2030</th>
<th>2070</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual</td>
<td>Summer</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>0.6-1.5</td>
<td>0.6-1.7</td>
</tr>
<tr>
<td>Rainfall (%)</td>
<td>-9 - +1</td>
<td>-7 - +8</td>
</tr>
</tbody>
</table>

While the report of Suppiah et al (2006) provides projections of the likely range of future changes in mean annual and seasonal rainfall, it is important to note that in arid areas rainfall tends to be inconsistent and episodic. Consequently, mean rainfall statistics may provide a poor indication of the capacity of water resources and care should be taken in their interpretation.

A more recent DEWNR report, titled “Impacts of Climate Change on Water Resources, Phase 3, Volume 4, South Australian Arid Lands Natural Resources Management Region” (Gibbs et al. 2013), evaluates the projections of a range of climate models for rainfall and temperature changes in the SAAL region and identifies models that provide the ‘worst’, ‘best’ and ‘most-likely’ climate scenarios. The rainfall projections of these selected climate models were analysed for three rainfall metrics to provide indications of the potential impacts of climate change on the water resources of the SAAL region. The metrics selected were the change in:

- average annual rainfall, as an indicator of the overall projected change;
- first percentile daily rainfall amount, as an indicator of the change in the intensity of the largest (extreme) rainfall events; and
- frequency of rainfall events of greater than 100 mm/month, as an indicator of episodic large rainfall events that generate groundwater recharge in the arid areas of the SAAL region.

Non-prescribed groundwater resources that may have economic, social or environmental significance and may also be vulnerable to impacts from climate change in the short to medium term (i.e. shallow or unconfined aquifers that are likely to respond to contemporary rainfall) have been summarised in Table 7.
Table 7: Economically and/or socially significant groundwater systems that are likely to respond to impacts from climate change (Gibbs et al. 2013)

<table>
<thead>
<tr>
<th>Region</th>
<th>Aquifer type(s)</th>
<th>Comment</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poontana Trough (Callabona Sub-basin)</td>
<td>Alluvium</td>
<td>East and north of the Northern Flinders Ranges, creek catchments recharge shallow Tertiary / Quaternary aquifers. The Willawortina Formation being an important aquifer</td>
<td>Heathgate Resources (2008)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electromagnetic surveys conducted by Geoscience Australia / DMITRE (and validated by water bore salinity) confirm the Hamilton, Arkaroola and Four Mile Creek as significant contributors of shallow recharge to Poontana Trough sediments.</td>
<td>Michaelsen et al. (2012).</td>
</tr>
<tr>
<td>Olary Spur</td>
<td>Alluvium</td>
<td>Freshwater can be obtained from sediment filled watercourses and valleys (TDS &lt; 5000 mg/L).</td>
<td>SAALNRMB (2010)</td>
</tr>
<tr>
<td>Torrens Basin</td>
<td>Alluvium</td>
<td>Shallow Quaternary sediments recharged by surface water runoff from Ranges to the east. Parachilna town water supply sourced from these sediments.</td>
<td>AGT (2010); Costar and Howles (2011)</td>
</tr>
<tr>
<td>Northern Flinders Ranges</td>
<td>Fractured Rock</td>
<td>Fractured rock aquifers are present in the Northern Flinders Ranges, with highest yields occurring near faults, where most springs occur. Recharge is via direct infiltration from rainfall. Discharge from fractured rock aquifers occurs in numerous ephemeral creeks and along the range front at springs.</td>
<td>SAALNRMB (2010)</td>
</tr>
<tr>
<td>Far North Prescribed Wells Area</td>
<td>Great Artesian Basin confined sandstone</td>
<td>The economically significant confined aquifers of the western GAB receive minimal recharge within South Australia, however aquifer pressure levels in the GAB in SA are sensitive to changes in recharge that may occur at the eastern side of the basin in Queensland and New South Wales.</td>
<td>CSIRO (in prep.); Love et al. (in prep.)</td>
</tr>
</tbody>
</table>

Results reported by Gibbs et al. (2013) for the extreme rainfall events (i.e. the first percentile daily rainfall) compared to the 1990 historic baseline period, show that the direction of changes varies among the climate models applied. With the ‘best’ case model, under both low and high emissions scenarios, increases of up to approximately 5% in extreme rainfall events are projected across the entire SAAL region. With the ‘most-likely’ and ‘worst’ case climate models, reductions of up to 26.6% and 50% respectively are projected for the 2070 time horizon under the high-emissions scenario (Gibbs et al. 2013).

Results reported by Gibbs et al. (2013) on projected changes to the frequency of episodic recharge-generating rainfall events (greater than 100mm/month) using the ‘most likely’ climate model for the SAAL region, suggest average decreases in the frequency of these events to be 18 - 21% in 2030, 30 - 33% in 2050 and 35 - 47% in 2070, under low and high-emissions scenarios respectively.

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The projected decreases in the frequency of episodic recharge-generating rainfall events are widespread, but vary spatially across the region. There is no clear spatial bias or trend, but the percentage reductions are generally greatest in the west of the region at the 2030, 2050 and 2070 time horizons (Gibbs et al. 2013). Around the northern Flinders Ranges, under the low-emissions scenario, there is little change in the frequency of these events across the three time horizons. However, under the high-emissions scenario, the frequency of recharge events in this area reduces from four to five years between events at the 2030 and 2050 time horizons, to greater than nine years between events by the 2070 time horizon (Gibbs et al. 2013).

Gibbs et al. (2013) also reported on the potential for climate change to affect the future availability of Great Artesian Basin groundwater for extraction. Due to its extremely large scale, the vulnerability to climate change of the groundwater resource of GAB within South Australia is markedly different to the more localised aquifer systems of the region. The capacity of the GAB as a water resource is largely dependent on the amount of groundwater in storage in the system and that which flows across the state border from the east, rather than on recharge occurring in South Australia.

The volume of groundwater available for extraction from the GAB in South Australia is currently controlled by aquifer drawdown limits imposed by the FNPWA Water Allocation Plan. In the long term (2050 - 2070), Gibbs et al. (2013) suggests the amount of water available for extraction from the GAB aquifers within the FNPWA will be dependent on:

- the recovery in aquifer pressures that may result from ongoing rehabilitation of uncontrolled flowing bores;
- the decline in aquifer pressures that may result from 1) natural rises and falls in water levels that occur over long periods in very large-scale aquifer systems such as the GAB, and 2) the impacts of 21st century climate change on contemporary recharge of the aquifers;
- the amount of groundwater pressure change that may be considered acceptable under future regulatory frameworks.

Gibbs et al. (2013) further suggest that it is unlikely that climate change impacts on GAB recharge occurring in South Australia will cause a reduction in water availability, however an increase is possible if the wetter or ‘best-case’ future climate scenarios eventuate. The impacts of climate change on recharge that occurs at the eastern side of the GAB, primarily in Queensland, may result in significant positive or negative impacts on aquifer pressures in the western GAB, however the modelling of these impacts to date is inconclusive.

Assessments of future water availability in the western GAB should take account of the drivers of groundwater level change discussed here as well as future changes in regulatory frameworks, which may have at least as much influence as climate change on the future availability of groundwater from the GAB in South Australia (Gibbs et al. 2013).
5 Findings

This section of the SAAL DSS outlines the key findings. Some of the findings identified in this Statement warrant further discussion, which may lead to specific recommendations. It is not within the scope of this Statement to provide recommendations. However, if deemed necessary, the South Australian Minister for Water and the River Murray will determine how to address the findings of the Statement by establishing an independent planning process to consider and recommend options.

The key findings identified in this Statement relate to:

- Data availability;
- Mining, petroleum, gas and geothermal energy demand and expansion; and
- Community water supplies.

5.1 Data Availability

One of the key aims of this Statement is to prepare demand-supply projections, identifying when demand is expected to exceed supply out to 2050. It has not been possible to prepare such projections for the SAAL region due to the lack of data available and the scientific advice that any estimated data should be treated with caution until a more detailed and reliable assessment of groundwater resources is undertaken (Watt et al 2012).

It is anticipated that the outcomes of the FLOWS and NPA projects will increase our knowledge about the water resources in the SAAL region. When available, any new information will be used to update this Statement and contribute towards the preparation of demand-supply projections.

5.2 Mining, Petroleum, Gas and Geothermal Energy Demand and Expansion

The coverage of mining production tenements, mining production tenement applications, mineral exploration licences, mineral exploration licence applications, petroleum production licences, petroleum exploration licences, petroleum exploration licence applications, geothermal exploration licences and geothermal exploration licence applications across the SAAL region highlights the potential growth in demand for water resources from this sector.

Realising the benefits of the mining boom is a key strategy for the State Government, and in order to achieve this in a sustainable manner, further research into the volumes of water available for use is required.

The DEWNR and Goyder Institute for Water Research FLOWS project will contribute towards increasing our understanding of the capacity of the water resources in the SAAL region. The NPA on CSG and Large Coal Mining Development will also provide a more accurate understanding of water related impacts from potential future coal seam gas or coal mining operations in the region. These projects will contribute towards ensuring the most appropriate decisions can be made.
5.3 Community Water Supplies

There are a number of different parties responsible for the supply of water to communities across the SAAL region. Most of these community water supplies are also geographically isolated in addition to being sourced from differing water resources. The combination of these factors makes the management of the supplies challenging.

There is anecdotal evidence that the quality of some of these community water supplies are not of drinking quality. In addition, there are community water supplies which are the responsibility of progress associations or on a property-by-property basis, who unsurprisingly are not trained suppliers.

It is a reality that there are going to be isolated communities, when considering it is such a vast region and the nature of the predominant industries in the region. This then inevitably raises the issue of when the State Government should or shouldn’t be responsible for supplying a community with water. The development of robust and transparent criteria with which to guide the State Government in making consistent decisions in relation to community water supply would be beneficial.

Such criteria would need to answer whether the State Government should commence supplying a community with water, continue supplying a community with water, whether to augment a community’s water supply, or whether it should be the responsibility of another party (e.g. a mining company, progress association, local government etc.). This would help provide certainty to communities about who is responsible for their water supply, as well as to developers (e.g. mining companies) who are considering investing in the region. Any criteria developed would need to be consistent with current policies, such as Water for Good action 48 which requires mining ventures to provide their own water supplies for operational purposes.
6 Staying on Track – Annual Review

This section of the SAAL DSS discusses the Adaptive Management Framework within which the demand and supply statements operate. It outlines the requirements for the statements to be annually reviewed as well as comprehensively reviewed every five years.

Water for Good outlines that regional demand and supply statements will be annually reviewed as an integral part of an Adaptive Management Framework, shown in Figure 10. This commitment is further enhanced through the Water Industry Act 2012, which states that the Minister for Water and the River Murray will produce an annual report providing information about the demand and supply status of the various regions of the State.

Figure 10: Adaptive Management Framework

6.1 Demand and Supply Statement Projections

No demand-supply projections have been included in this Statement due to the limited data available about water sources and demands in the SAAL region. It is intended that this Statement will be updated based on new information obtained following the completion of the FLOWS project, at which time it is anticipated that sufficient data will be available to prepare demand-supply projections.

6.2 Review of Regional Demand and Supply Statements

The annual review of this Statement will differ to the standard annual review process given that no demand-supply projections have been produced to date.

Traditionally the review process would assess the demand and supply assumptions underlying the demand-supply projections, based on the most recent data provided by State agencies. Nevertheless, this Statement will still be reviewed in the sense that any new data will be sought and if sufficient data of an acceptable quality is available,
demand-supply projections will be prepared. A qualitative assessment of the regions demand-supply status will be prepared if no new data is available.

When triggers are reached decisions must be made on whether or not to take corrective action. Trigger points help to ensure that decisions are cost-effective and timely. In particular they:

- Reduce risk and identify opportunities;
- Encourage a large range of innovative solutions;
- Reduce the risk of making high-cost investments that prove to be redundant, or are delivered earlier than needed; and
- Ensure demand and supply is continually monitored.

It should not be assumed that all identified demand and supply gaps will necessarily be filled by the Government. Should the Minister decide corrective action is needed, an Independent Planning Process will be established to review options and recommend a solution.

Details of the annual review will appear in the Minister’s Annual Review, expected to be released by 31 March each year.

Water for Good also proposes a more thorough review of the regional demand and supply statements is conducted every five years, which may involve field visits, stakeholder consultation and investigative studies.
7 Glossary

**Aquifer** — Underground sediments or fractured rock that hold water and allow water to flow through them. Aquifers include confined, unconfined and artesian types.

**Bore-fed wetlands** — Wetlands that were originally fed from free flowing bores, which are now controlled and licensed under the water allocation plan for the Far North Prescribed Wells Area.

**Catchment** — An area of land that collects rainfall and contributes to surface water (streams, rivers, wetlands) or to groundwater.

**Climate change** — A change in the long-term, average pattern of weather. Greenhouse gases such as carbon dioxide and methane play an important role in governing climate, and changes in their atmospheric concentration cause climate change.

**Demand management** — An approach that is used to intentionally reduce the consumption of water through specific initiatives, normally either to conserve supplies or defer augmentations.

**Desalination** — The process of removing dissolved salts from seawater (or brackish water) so that it becomes suitable for drinking or other productive uses.

**Drinking quality water** — Water that is fit for human consumption.

**Groundwater** — Sub-surface water, particularly that which is held in aquifers.

**J-K Aquifer** — Within the non-prescribed area of the SAAL NRM region, the Algebuckina Sandstone and Cadna-owie Formation form the major water-bearing aquifer system (often referred to as the J-K aquifer). J-K refers to the age of the Algebuckina Formation (Jurassic) and Cadna-owie Formation (Cretaceous (K)).

**Prescribed Water Resource** — A prescribed water resource may be surface water, groundwater, watercourse water, or a combination of these.

**Prescription** — Prescription establishes a framework for the sustainable management of water resources, provides more secure access to water for all water users, establishes a potentially tradable statutory water right, and recognises the environment as a legitimate user of water.

**Recharge** — The infiltration of water into an aquifer from the surface (rainfall, stream flow, irrigation etc.).

**Resource capacity** — The total volume of water produced by a catchment.

**Run-off** — Precipitation that flows from a catchment area into rivers, lakes, watercourses, reservoirs or dams.

**Security of supply** — Reliability or surety of meeting water supply demand. Storages provide the capability to ensure a certain level of supply is available despite seasonal variations in stream flow.

**Surface water** — Water flowing over land or collected in a dam or reservoir.
Wastewater — Contaminated water before it undergoes any form of treatment. The water may be contaminated with solids, chemicals, or changes in temperature.

Water allocation plan — A legal document detailing the rules for the allocation, use and transfer of water from prescribed water resources, as well as the water-affecting activities that require permits.

Watercourse water — Water which is contained or flows, whether permanently or from time to time, in a river, creek or other natural watercourse (whether modified or not).
8 Abbreviations

**GL** — gigalitre (1 GL = 1 000 000 000 L)

**GL/a** — gigalitres per annum

**L** — Litre

**ML** — megalitre (1 ML = 1 000 000 L)

**ML/a** — megalitres per annum

**ML/d** — megalitres per day
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