Great Artesian Basin

Strategic Management Plan

September 2000
This Plan has been prepared with all diligence and care, based on the best available information available at the time of publication. The Department holds no responsibility for any errors or omissions within this document. Any decisions made by other parties based on this Plan are solely the responsibility of those parties.

Copies of the Great Artesian Basin Strategic Management Plan and the Great Artesian Basin Resources Study, and other information on the Basin or the Consultative Council, can be obtained from:

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Foreword

The wellbeing of present and future generations of Australians depends on sound use and management of our natural resources. In particular, sustainable management of our groundwater resources is one of the greatest challenges confronting us in the new century and is critical to the long-term productivity and profitability of Basin enterprises, the viability of rural communities and the protection of associated biodiversity and heritage values.

For more than 100 years, groundwater from the Great Artesian Basin has contributed to pastoral, mining and community development needs over a fifth of Australia’s landmass. For thousands of years natural discharge from springs around the Basin has been of significance to indigenous Australians. A number of these springs also support nationally significant environment and heritage values.

Previous generations have contributed considerably to Basin development using the technology of the day. It is now clear, however, that unsustainable extraction from uncontrolled bore discharge and inefficient water distribution via bore drains has led to falling artesian pressures across much of the Basin and in many areas increased erosion, land degradation and spread of pest plants and animals. In some cases, natural discharge has actually ceased, causing the loss of associated biodiversity and heritage values and increased costs of pastoral production.

This Strategic Management Plan is an historic achievement because for the first time there is an agreed framework for ensuring a water supply for present and future uses. These opportunities will be realised through existing users applying modern technology and improved management methods for sustaining use of the Basin’s groundwater resources. The Great Artesian Basin Consultative Council developed this Plan with the assistance of all major stakeholder groups. The Plan is comprehensive, using an integrated, strategic approach in which Government-community partnerships are central.

The Plan highlights the relationships between the technological, social, environmental, physical and financial issues in the Great Artesian Basin, requiring cooperation and unified strategies between all stakeholders. Importantly, all stakeholders are able to contribute to sustainable management of the Great Artesian Basin, knowing that their efforts and investments – financial, intellectual, emotional or physical – are being matched by others across the Basin.

We congratulate the Great Artesian Basin Consultative Council for their considerable efforts in developing this Strategic Management Plan and formally endorse it on behalf of our respective Governments.
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Preface

The Great Artesian Basin (Basin) Consultative Council was established in 1997 to bring together the disparate and geographically diverse stakeholders in the Basin and to promote the sustainable use of its groundwater resources.

The Great Artesian Basin Strategic Management Plan (the Plan) was developed under Council’s auspices. It represents a combination of views and needs from across the Basin and is a comprehensive framework within which State and Northern Territory jurisdictions can manage the Basin resources.

Council commenced development of the Plan in 1997. The draft Plan was launched for public comment in November 1998 by the relevant Commonwealth and State Ministers. The public consultation process was promoted widely and extended to almost six months.

Now two and a half years in the making, this Plan represents input from the public consultation process and identifies a ‘whole-of-Basin’ strategy to redress previous unsustainable management practices.

While the detail of the Plan is generally consistent with the draft released in 1998 it is more focused on outcomes. There is also greater emphasis on deriving maximum nett community benefit from access to the resource without losing the need for fixing the ‘plumbing’ of the Basin. In addition, much of the contextual and explanatory material has been placed in Appendices.

The Great Artesian Basin Consultative Council is grateful to the many people who contributed to the development of the Plan. In particular, the Queensland Department of Natural Resources deserves special credit for its continued commitment to fine-tuning and editing the document and coordinating the views and material gathered for the task.

This Plan is historic in that it represents the first ‘whole-of-Basin’ Management Plan adopted by all Governments responsible for Great Artesian Basin management.

JOHN SECCOMBE

Chairman
Great Artesian Basin Consultative Council
INTRODUCTION

Figure 1: Location - Great Artesian Basin

LEGEND

GAB Area

0 500 KILOMETRES
Introduction

Purpose
This Plan is a strategic framework for responsible groundwater and related natural resource management in the Great Artesian Basin (Basin). It guides Governments, water users and other stakeholders on policies, programs and actions necessary to attain optimum economic, environmental and social benefits from the existence and use of Basin groundwater resources.

Vision
To manage the Great Artesian Basin, as a natural resource of national importance, in a coordinated way to optimise values of a sustainable and productive artesian groundwater resource for present and future generations.

Scope
The Basin underlies 22% of Australia’s land area (Figure 1). The States of New South Wales, South Australia and Queensland, and the Northern Territory manage it. The Basin is primarily a sedimentary basin comprising a complex multilayered system of water-bearing and non-water-bearing strata.

For the purposes of this Plan the spatial extent of the Basin refers to:

• areas able to be supplied with artesian groundwater by natural discharge or constructed bores;
• areas able to be supplied with subartesian groundwater from parts of the artesian aquifers such as intake beds where bores do not flow;
• areas where bores were once artesian but which have stopped flowing; and
• areas where springs have stopped flowing but may begin to flow when artesian pressures recover.

Shallow subartesian aquifers that overlie the artesian aquifers of the Basin are not included in this Plan.

This Plan for improved and responsible management of the artesian groundwater resources has a life of 15 years and also addresses land management issues related to use and distribution of artesian water. While this Plan is limited to the Basin, there are overlapping natural resource planning and management processes to be considered. The Great Artesian Basin Consultative Council will work cooperatively with other natural resource programs and bodies to implement this Plan. The Plan is not specific to the needs of any industry but because of the dominance of bores in the Basin related to the pastoral industry, many of the initiatives proposed under this Plan will directly affect this industry although they will be relevant to all users.

Background
In the early 1900s it was recognised that control over groundwater extraction in the Basin was inadequate. By 1918, more than 1,500 bores had been drilled into the Basin to provide artesian flows. It soon became evident that a reduction in water volume and pressure was emerging across the Basin.

In 1912, the first Interstate Conference on Artesian Water was held to address legislative control of groundwater use. Between 1912 and 1928, five Interstate Conferences on Artesian Waters were held. The 1939 Conference recognised water wastage from free-flowing bores was a major problem. The 1939 Conference commissioned a report to investigate the nature and structure of the Basin. This report was
completed in 1945 but it was not until 1954 that the Artesian Waters Investigations Committee provided a published report which was addressed separately in each State.

Although some gains were made over the first half of the twentieth century, pressures in many regions continued to diminish and many bores stopped flowing. Poor understanding of Basin characteristics, too little legislative control over water extraction and ineffective infrastructure technology and management practices meant valuable water resources continued to be wasted. Since then, improvements in technology, management practice and legislation, together with bore rehabilitation and bore drain replacement programs, have brought some incremental improvements. Lasting solutions to Basin-wide problems have proven difficult to achieve.

Despite previous efforts the Basin’s core problem of declining artesian pressure brought about by uncontrolled discharge and related degradation of dependent economic, social and environmental values persists. Inefficient distribution of water through bore drains has led to unacceptable consequences for a number of values associated with the groundwater resource. Much of the waste relates to ageing and inadequate infrastructure and poor water management practices, reinforced by insufficient investment and little recognition of the value of water resources or the principles of sound environmental management.

Failure to address water waste, even at current rates of infrastructure renewal, will continue the decline in artesian pressures in most regions, ultimately leading to the detriment of many existing water users and lost opportunities for new water use. There will also be continuing negative impacts on natural discharge points such as mound springs, the spread of woody weeds and feral animals and ongoing harsh environmental impacts from the use of bore drains.

Further details on Basin characteristics and issues are provided in Appendices 1 and 2.

**Roadmap for the Plan**

This Plan is organised in the following steps.

1. **Identifying the Key Issues**
2. **Addressing the Key Issues**
3. **Framework for Action**
4. **Objectives**
5. **Strategies**
6. **Outcomes and Indicative Targets**
7. **Framework for Implementation**
Identifying the Key Issues

Basin stakeholders have identified the following key issues for resolution to ensure Basin sustainability:

**Issue 1. Water users, Government and community generally lack an adequate appreciation of the economic, social, cultural and environmental values of the Basin and its current condition.**

Past attempts to improve resource management and use have been compromised through a lack of appreciation of the value of the Basin – that it is a limited resource. There has been failure to place appropriate value on availability of an artesian water supply and other Basin values. Consequently, resource managers, Government, water users and community have not fully appreciated the long-term threat to Basin values from continuation of current conditions and practices.

**Issue 2. Artesian pressure is declining.**

Pressure is a key attribute of any artesian groundwater resource providing a relatively low-cost supply in remote areas. Excessive extraction of water through uncontrolled discharge from artesian bores, both above and below ground level, has resulted in the continuing decline in artesian pressures in parts of the Basin, causing a loss of access to artesian water by an increasing number of water users. Reduced natural discharge in response to declining artesian pressure is also causing detrimental impact on groundwater-dependent ecosystems and associated biodiversity values.

**Issue 3. Water waste and environmental degradation are caused by use of bore drains.**

Discharge to bore drains is causing environmental degradation, contributing to the spread of feral animals, weeds and pests, wasting water which could otherwise be used to maintain pressure in the aquifer and to provide for other uses. Uncontrolled access to water by stock, feral and native animals through bore drains is resulting in grazing pressures in some areas to the detriment of the pastoral industry and biodiversity of the Basin.

**Issue 4. Key policies and practices being used to manage the Basin are not coordinated.**

The Basin lies within the boundaries of four State/Territory jurisdictions which each operate under different legislative frameworks, policies and resource management approaches. Actions in one State have the potential to impact on other States because of the hydraulic continuity of Basin aquifers. A higher level of consistent policy and practice between and within jurisdictions is required to achieve optimum level and mix of benefits from the resource.

**Issue 5. Water users do not always have secure access to Basin water or a clear understanding of their rights and responsibilities.**

There are many water users who do not have a secure entitlement to a specified volume of water, nor are water users’ responsibilities always clear. Competition for access to the artesian groundwater resource is likely to increase. Water users will need greater certainty of access to a long-term supply to justify long-term investments in both infrastructure and enterprise development. Water management, institutional and legislative reforms are needed to secure access to water and clarify water users’ responsibilities.

**Issue 6. Basin values tend to be managed in isolation from other values.**

Resource allocation and management decisions are often made without consideration of other natural resource values which may depend on the groundwater resource. The presence or absence of water has
impacts on biodiversity in arid regions. Basin management focused on a single value, to the exclusion of other values, is unlikely to result in the optimum level and mix of benefits from the resource. A multi-objective management approach is essential if optimum outcomes are to be achieved.

**Issue 7. A lack of investment by some water users in maintenance of infrastructure, caused by the belief that bore maintenance and bore drain replacement costs are not justified, exists and there is insufficient (regulatory) incentive to incur such expenditure.**

Some water users believe there is limited private benefit to be gained from investing in infrastructure renewal and maintenance. Poorly defined water user responsibilities for infrastructure maintenance have reinforced this and contributed to inadequate investment in maintenance and renewal. In the past, technological deficiencies may have acted as a barrier to infrastructure renewal. This is no longer valid for inadequate investment in renewal.

**Issue 8. The quality of critical management decisions is sometimes limited by the quality and extent of available information.**

Robust management decisions by resource managers and water users need to be based on reliable and readily accessible information. There are some aspects of the Basin where information needed to support critical decisions is unavailable. In other situations, inadequate understanding of the Basin undermines decisions on investments. Information on Indigenous, social, environmental and cultural heritage values is not always available and so these values are not always appropriately considered in water resource allocation and management decisions.

Further discussion of the various characteristics, values, issues, current policies and programs in the Basin is presented in Appendices 1, 2 and 3. Implementation planning for the Plan is discussed in Appendix 4.
Addressing the Key Issues

General

The Basin's long-term health and its capacity to support community values and benefits depend on the implementation of sustainable natural resource management practices to address the key issues identified. All stakeholders need to work cooperatively and share in the considerable investment needed to achieve sustainable use of the Basin. Such cooperation and shared investment can only be based on clear roles and responsibilities of all parties (Appendix 4).

Strategies to address Basin management issues need to be built on:

- stakeholder cooperation and willingness to share in the investment;
- Government participation to provide the impetus and support;
- institutional and regulatory reform;
- commitment to resource management partnerships to accelerate change; and
- stakeholders understanding and acceptance of their obligations and responsibilities.

Variability in Basin character, legislative frameworks, social, environmental and economic values contributes to inconsistent Basin management (Appendices 1 and 3). A Basin-wide approach (Appendix 2) that involves consideration of all Basin values provides a mechanism to accommodate Basin complexity.

While most of the responsibility for sustainable Basin management rests with water users, State and Commonwealth Governments and other stakeholders have key roles in reforming current management practices. State Governments have a constitutional responsibility to protect natural and cultural heritage values and to ensure water is used judiciously to support community values and benefits (Appendix 3). Governments may also become involved when market or regulatory frameworks fail and where current investment is insufficient to achieve best outcomes. Governments may also participate where a public good or benefit can be shown (Appendix 3).

Active participation by Government agencies is needed to support knowledge transfer, assist with planning, community education, regulation and research of key knowledge gaps. Governments may also help to set up and take part in partnerships to bring about changes in sustainable management practices.

A partnership approach to groundwater and related aspects of natural resource management offers real opportunities to overcome major barriers to sustainable resource management. Resource management partnerships (Appendix 2) are fundamental to accelerate changes needed to address key issues and provide an effective way to tap into local knowledge and make sure the views of people most affected are incorporated into decision-making processes. Such partnerships will create a sense of ownership among user groups and provide a forum where these groups and Government authorities can negotiate institutional arrangements for sustainable Basin management. These partnerships should be organised regionally between those who jointly share in the benefits and costs. This may include water users, industry, community and all levels of Government. A broad understanding of the benefits to be achieved from improved Basin management is important in developing such partnerships. They should be based on agreed objectives and mutual obligations and be beneficial to all parties. All parties who participate in resource management partnerships need to become advocates for the outcomes of the partnerships.
Sustainable use of the Basin depends on judicious water use supported by institutional arrangements and regulatory frameworks (including water entitlement systems) that effectively address water users’ rights and responsibilities. The regulatory frameworks need to include a duty of care for all stakeholders based on the true costs and benefits of managing the Basin and, where appropriate, a pricing system that discourages waste and enhances the flow of benefits to the community.

**Principles**

Basin management should be guided by the following principles:

- **Integrated management for sustainable use** – The Basin is a finite artesian resource supporting nationally important values and providing a range of benefits essential to the economic, social and environmental wellbeing of Basin communities. Management of Basin water should continue to provide these benefits while protecting important values for current and future generations. The use of bore drains for distribution of groundwater to water livestock is an unacceptable management practice due to their detrimental impacts and excessive amount of water required. Water managers will need to eliminate waste and find ways to make sure allocated water gives the greatest benefit for the region and nation. A comprehensive Basin-wide approach to resource management practices is required to guarantee sustainability. Water savings made from improved management should be retained in the aquifer system where necessary to provide pressure recovery in artesian aquifers. Some savings should be directed towards high-value uses that give enhanced social, economic and environmental outcomes.

- **Recognise stakeholder rights and values in Basin management** – Management of the Basin will recognise and respect both Indigenous and non-Indigenous rights attached to or dependent on Basin groundwater resources. All stakeholders in the Basin have particular values and aspirations that are important and need to be identified. These values need to be acknowledged and respected in management of the Basin. Measures to prevent or minimise undue impact on cultural, spiritual, economic (including non-market uses), land and social values need to be instituted.

- **Recognition of the worth of the water resource** – Water allocation policy and water use management practices should be based on agreed understanding of the worth of the water resource. Water users have a major management responsibility to make sure water is used judiciously and sustainably. Governments also have a role in providing regulatory frameworks needed to support water allocation and management policy. Nationally and regionally, important values and community benefits need to be protected by both Government and water users.

- **Resource management partnerships and shared investment** – Partnerships are required to quickly foster the essential joint action needed to achieve effective change. Partners may include water users, community groups, industry and Government. Partnerships ensure that knowledge and expertise of water users and other stakeholders are valued and utilised, and that the views of the people most affected are included in decision-making processes. Governments that take part in partnerships can provide impetus for the changes needed to implement sustainable management practices and may share in investment in Basin management.

- **Current and future users’ security of access** – Resource users need confidence in the security of resource access entitlements which is essential to ongoing investment in use of the Basin’s groundwater resource. A water entitlement regime that recognises investment in water infrastructure and minimises water wastage (once reasonable opportunity has been provided for users to control bore discharge and to pipe bore water) needs to be established.

- **Water for the environment** – Allocation of the Basin’s groundwater resources needs to make provision for the water needs of groundwater-dependent ecosystems. Environmental requirements for Basin water
need to be properly assessed and appropriate provision made for environmental flows to maintain natural spring ecosystems and, where appropriate, those key ecosystems that have developed as a result of artificial sources of water. Water allocation decisions and management practices need to be consistent with environmental requirements of national policies such as *The National Strategy for Ecologically Sustainable Development* (1992) and the National Water Reform Framework (incorporating the Agriculture and Resource Management Council of Australia and New Zealand policy position paper on *Allocation and Use of Groundwater – a National Framework* for Improved Groundwater Management in Australia, 1996).

- **Water for social, cultural and heritage values** – Many important values related to the culture and economy of the entire community living in the Basin are tied to Basin access and flows. Cultural, heritage and lifestyle impacts need to be considered in making water allocation decisions and management practices, rather than these being made in isolation. An integrated approach to Basin resource decision making is vital to deal with the relationships between the range of Basin values.

- **Decisions based on best available information** – Quality information needs to be accessible for decision makers. An assessment of the adequacy of available information needs to be made before decisions are made. An up-to-date information bank of available and relevant technical, scientific, environmental, social and local knowledge should be maintained and readily accessible. Research of key knowledge gaps directly relating to Basin management issues should be supported where benefits outweigh costs and where strategic responses can be supported. Development of technologies to improve water use management of artesian water resources should also be supported and applied.

- **Benefit of investment in Basin management outweighs its cost** – Much of the investment in Basin management will be used for on-ground works and studies directly related to the delivery of measurable benefits. Public and private resources invested in Basin management and water infrastructure need measurable improvements in the water use while protecting cultural, environmental and heritage values. Transparent monitoring, reporting and auditing of the effectiveness and efficiency of investments and derived benefits need to be emphasised in the management process. Water managers should keep the public informed about management of this community resource.
The Plan - A Framework for Action

Strategic Focus
The sheer size of the Basin, the vast public and private investments needed to achieve better management and use of the Basin's resources and the time span for projected activities dictate that the Plan adopt a highly strategic focus to address:

- fundamental causes of unsustainable use of the Basin's groundwater;
- major barriers to technology adoption, changes in attitudes and practices, and achievement of long-term change to the Basin's condition;
- return on public and private investments; and
- accountability for public investments.

The Plan has been developed around this strategic focus and proposes:

- programs to change attitudes and achieve agreed understanding of the worth of the water resource;
- expanded infrastructure renewal programs underpinned by public investments in water infrastructure renewal to stimulate private investments, to minimise water loss and wastage, and to provide a platform for further public and private investments for environmental social and economic objectives;
- changes to institutional arrangements and water entitlement systems to provide security of access to water (including water supply to priority groundwater-dependent ecosystems), opportunities for new higher value uses and clear responsibility for bore and reticulation systems maintenance;
- promotion of the socioeconomic, environmental and heritage values of the Basin and the need to sustain stakeholders' commitments to infrastructure renewal, maintenance and improved management;
- programs to improve knowledge and technology base; and
- monitoring and evaluation to assess progress towards specific natural resource management outcomes sought through the Plan, including partial recovery of artesian pressures.

These programs will support each other to achieve sustainable use of the Basin's groundwater resources.

While all outcomes sought by this Plan are needed, most depend on some crucial intermediate outcomes to achieve the vision. These involve:

- reduction of water wastage;
- control of Basin discharge; and
- restoration of pressure.

Without these, many other aspects of the Plan will achieve little.

Objectives and Strategies
The objectives and strategies are summarised in Appendix 5. The detailed strategies and the results sought by these strategies are provided in Table 1.
Table 1: Objectives, Strategies and Expected Results

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<thead>
<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
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<tbody>
<tr>
<td>Objective 1: Change attitudes and behaviour to improve Basin management and stimulate investment</td>
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<tr>
<td>1.1: Develop communication and education activities on environmental, social and economic values and limitations to increase understanding and recognition of the need for improved Basin management.</td>
<td>• communication strategies and materials are available and targeted at appropriate audience.</td>
</tr>
<tr>
<td>1.2: Implement targeted extension and education activities to increase understanding and recognition of need for improved management; increase water user investment in water management and infrastructure maintenance.</td>
<td>• changes in attitude and behaviour to address specific failures in adoption of relevant technology and water use and infrastructure maintenance practices; • water users make decisions on basis of appreciation of value of water and resource limitations; • water users comply with water infrastructure licence conditions and invest in infrastructure maintenance.</td>
</tr>
<tr>
<td>1.3: Promote understanding of Indigenous values and knowledge relating to Basin groundwater resources.</td>
<td>• recognition of Indigenous interests in Basin groundwater and related natural resources, based on appreciation by groundwater users and management of these interests in, and their values associated with, Basin groundwater and related natural resources.</td>
</tr>
<tr>
<td>1.4: Assist opinion leaders and key decision makers to clearly understand the Basin’s importance and the support needed to properly manage it.</td>
<td>• shared understanding by resource users and resource managers of the value and management and investment needs of the Basin groundwater resources.</td>
</tr>
<tr>
<td>1.5: Monitor and evaluate effectiveness of communication, education and attitudinal change strategies.</td>
<td>• communication and education activities directed at understanding the characteristics, values and management needs of groundwater management are coordinated.</td>
</tr>
<tr>
<td>Objective 2: Manage quantity, quality and pressure of Basin flows to maximise socioeconomic, environmental and cultural heritage values</td>
<td></td>
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<tr>
<td>2.1: Control all artificial outflows by: • renewal, rehabilitation and maintenance of bore casings and headworks, and plugging unwanted bores; and • replacing bore drains with piped water distribution systems.</td>
<td>• all artesian bores tapping Basin aquifers are controllable and discharge is controlled; • all unwanted, abandoned or surplus bores are plugged; • all Basin water distribution systems are controlled through pipes, tanks and troughs; • a partial recovery of pressure and opportunities for reallocation of water saved through elimination of waste; and • reduced impact on the environment and production systems.</td>
</tr>
<tr>
<td>2.2: Develop and implement a monitoring and maintenance schedule for bore casing, headworks and water reticulation systems by ensuring that all water infrastructure complies with regulatory requirements.</td>
<td>• all bore casings, headworks and water reticulation systems are maintained and operated; and • timely identification and rectification of inappropriate and unacceptable management and operation of extraction infrastructure.</td>
</tr>
<tr>
<td>2.3: Develop and implement a bore and piped water reticulation maintenance training program for bore owners and operators.</td>
<td>• all bore owners and operators are appropriately trained and skilled in operation and maintenance of artesian bores; • all water distribution system owners or operators are appropriately trained and skilled in operation and maintenance of piped water reticulation systems; and • maintenance of infrastructure for on-farm water extraction and reticulation is considered part of farm management.</td>
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<tr>
<td>2.4: Develop a groundwater protection strategy for Basin recharge zones.</td>
<td>• recharge zones are identified and protected from inappropriate land uses or land use change through land use planning mechanisms; and • recharge water is of acceptable quality.</td>
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### Objective 3: Establish legislative and administrative frameworks for sustainable water management and use

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<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
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<tr>
<td>2.5: Develop and implement a monitoring schedule for water levels and quality in recharge zones.</td>
<td>• resource managers understand recharge processes and rates to assist adaptive management; and • timely identification and rectification of unacceptable change in recharge.</td>
</tr>
<tr>
<td>2.6: Establish appropriate codes of practice for judicious use of Basin groundwater and for the design, construction and operation of bores and distribution systems.</td>
<td>• agreed guidelines for groundwater management set up and promoted and relevant to specified zones where appropriate; • groundwater management guidelines are adapted to best use of water where appropriate; and • codes of practice for bore construction, headworks and water distribution systems are set up and promoted.</td>
</tr>
<tr>
<td>2.7: Monitor and evaluate: • pressure, quality, quantity and values of Basin bore discharge and natural surface discharge; and • extent of access for new uses.</td>
<td>• information on water quality, quantity and pressure at strategic discharge and extraction points is accessible and up to date; • data is available to identify priority investment requirements; • analysis of information on natural and artificial discharge to support management at the Basin, jurisdictional and property scales is up to date; and • information on extent of new uses available.</td>
</tr>
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#### Table 1 continued

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<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
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<tr>
<td>3.1: Develop institutional arrangements to establish security of access and entitlement for users.</td>
<td>• effective and efficient institutional arrangements are in place in each State to manage access and entitlements to groundwater.</td>
</tr>
<tr>
<td>3.2: Establish groundwater management zones and objectives to indicate pressure targets for the Basin.</td>
<td>• groundwater management objectives and zones are developed and agreed; and • rational basis for targeting public investments in infrastructure renewal is established.</td>
</tr>
<tr>
<td>3.3: Develop groundwater management plans to involve a whole-of-resource approach and integrate Indigenous, economic, social, environmental and cultural values.</td>
<td>• groundwater management plans reflect an integrated, whole-of-Basin approach.</td>
</tr>
<tr>
<td>3.4: Develop and implement compatible systems of water allocation, in line with national policy frameworks for groundwater management.</td>
<td>• available resource is apportioned among competing users to the greatest public benefit; • clear rights and responsibilities associated with entitlements to groundwater; • opportunities for future uses maintained; and • water allocated for the environment.</td>
</tr>
<tr>
<td>3.5: Build on existing financial instruments to foster water use efficiency and to create clear incentives for sustainable use of Basin groundwater resources.</td>
<td>• clear market-driven signals for increased economy of water use; • opportunities for new uses; and • government participates in partnerships with resource users to remedy specific market failures (specifically in investments infrastructure renewal).</td>
</tr>
<tr>
<td>3.6: Integrate Indigenous values and knowledge in groundwater management plans.</td>
<td>• Indigenous values and knowledge associated with Basin groundwater are recognised and incorporated into the planning and management process; and • groundwater management is informed and based on the best available information.</td>
</tr>
<tr>
<td>3.7: Monitor and evaluate institutional arrangements including resource legislation, administration structures, taxation and incentives.</td>
<td>• timely advice provided to Ministers on appropriate changes to legislation, institutional structures, taxation and incentives needed to promote management of Basin groundwater on a sustainable basis; and • consideration and, where appropriate, adoption of this advice by relevant Ministers.</td>
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Table 1 continued

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<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 4: Maintain and enhance environmental and cultural heritage values affected by use of Basin</strong></td>
<td></td>
</tr>
<tr>
<td>4.1: Promote understanding of Basin environmental and cultural heritage values to increase recognition and protection.</td>
<td>• management of the Basin groundwater based on recognition and understanding of associated environmental and cultural heritage values.</td>
</tr>
<tr>
<td>4.2: Ensure that environmental and cultural heritage values are key factors in management of Basin groundwater.</td>
<td>• management of extraction, distribution and use of Basin groundwater based on consideration of implications for priority groundwater dependent and water-remote ecosystems; and • management of extraction, distribution and use of Basin groundwater based on consideration of implications for dependent or affected cultural heritage values.</td>
</tr>
<tr>
<td>4.3: Work collaboratively with other resource management groups to: • actively manage and maintain groundwater-dependent environmental and cultural heritage values; and • ensure extraction, distribution and use of Basin water do not lead to unacceptable environmental and cultural heritage impacts.</td>
<td>• adverse impacts of groundwater extraction on groundwater-dependent environmental and cultural heritage values managed and maintained within acceptable levels; • adverse impacts of groundwater extraction, distribution and use maintained within acceptable levels; and • cooperative actions are utilised rather than prescriptive approaches.</td>
</tr>
<tr>
<td>4.4: Ensure that changes in use and management practice do not result in unacceptable impacts on indigenous or non-Indigenous cultural values.</td>
<td>• adverse impacts of groundwater extraction, distribution and use are maintained within acceptable levels.</td>
</tr>
<tr>
<td>4.5: Monitor and evaluate impact on environmental and heritage values affected by use of Basin groundwater.</td>
<td>• information on environmental and cultural heritage values affected by Basin water extraction, distribution and use is collated, accessible and utilised; and • management of extraction, distribution and use of Basin water responds in a timely and appropriate manner to changes in the condition of affected priority groundwater-dependent and water-remote ecosystems.</td>
</tr>
<tr>
<td><strong>Objective 5: Maintain and enhance socio-economic values affected by use of Basin groundwater</strong></td>
<td></td>
</tr>
<tr>
<td>5.1: Promote an understanding of the relationship between Basin groundwater and socio-economic values of the Basin dependent on the groundwater resource.</td>
<td>• natural resource management and investment are based on a clear understanding that maintenance of socio-economic values in the Basin depends on sustainable management of Basin groundwater resources.</td>
</tr>
<tr>
<td>5.2: Work collaboratively with resource users and managers to improve socioeconomic outcomes through better Basin groundwater management practices.</td>
<td>• water users and resource managers invest in groundwater management to achieve positive socioeconomic benefits; and • groups and partnerships use improvement of socioeconomic outcomes as a justification for investment in infrastructure renewal and improving groundwater management practices.</td>
</tr>
<tr>
<td>5.3: Monitor and evaluate impact of changing groundwater management practices on socioeconomic values in regions of the Basin.</td>
<td>• resource managers informed on changes in regional social and economic values resulting from changes in Basin water management practice; and • analysis of information to support Basin management is up to date and accurate.</td>
</tr>
</tbody>
</table>
6.3: Coordinate and manage research and development trials to identify and fill strategically important knowledge gaps relating to Basin groundwater resource management.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>6.3:</td>
<td>Coordinate and manage research and development trials to identify and fill strategically important knowledge gaps relating to Basin groundwater resource management.</td>
</tr>
<tr>
<td></td>
<td>groundwater management is based on sound and researched advice; strategic research programs are directed towards priority issues; important emerging gaps in knowledge are addressed and duplication avoided; and improved understanding of the Basin.</td>
</tr>
</tbody>
</table>

6.4: Develop an information base on the relationship between use and management of Basin groundwater and the value of social and economic capital and infrastructure in the Basin.

<table>
<thead>
<tr>
<th>STRATEGY</th>
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</thead>
<tbody>
<tr>
<td>6.4:</td>
<td>Develop an information base on the relationship between use and management of Basin groundwater and the value of social and economic capital and infrastructure in the Basin.</td>
</tr>
<tr>
<td></td>
<td>information on interrelationships, interdependencies and networks that constitute local cultures is accessible, accurate and up to date; information on social and economic impacts of alternative water uses and management strategies in each region of the Basin is available; and analysis of information to support Basin management, jurisdictional and property scales is up to date.</td>
</tr>
</tbody>
</table>

6.5: Work collaboratively with Indigenous groups to identify Indigenous knowledge and values in the Basin.

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5:</td>
<td>Work collaboratively with Indigenous groups to identify Indigenous knowledge and values in the Basin.</td>
</tr>
<tr>
<td></td>
<td>Indigenous interests, knowledge and values in the Basin are identified, accurate and up to date; and analysis of the information to support Basin management is up to date.</td>
</tr>
</tbody>
</table>

6.6: Work collaboratively with industry groups to encourage research and development of technology to contribute to management of Basin groundwater resources.

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6:</td>
<td>Work collaboratively with industry groups to encourage research and development of technology to contribute to management of Basin groundwater resources.</td>
</tr>
<tr>
<td></td>
<td>partnerships formed to develop new technology for groundwater management are set up; research is targeted at priority gaps in technology; and appropriate technology to support groundwater management is available.</td>
</tr>
</tbody>
</table>

6.7: Work collaboratively with other resource management groups to ensure the best natural resource outcomes from Basin resources and its use.

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
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</thead>
<tbody>
<tr>
<td>6.7:</td>
<td>Work collaboratively with other resource management groups to ensure the best natural resource outcomes from Basin resources and its use.</td>
</tr>
<tr>
<td></td>
<td>implementation outcomes will be enhanced through active cooperation between groups involved in Basin resource management; and legitimate interests of other parties in the Basin are not constrained by implementation of the Plan.</td>
</tr>
</tbody>
</table>

6.8: Coordinate development and management of strategically important information systems to support management of Basin groundwater resources.

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>EXPECTED RESULTS</th>
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<tbody>
<tr>
<td>6.8:</td>
<td>Coordinate development and management of strategically important information systems to support management of Basin groundwater resources.</td>
</tr>
<tr>
<td></td>
<td>information to support Basin groundwater management is relevant and up to date; and an effective and accessible system is developed for managing and disseminating relevant information.</td>
</tr>
</tbody>
</table>

6.9: Monitor and evaluate decision-making processes and management practices to identify inefficiencies and barriers caused by insufficient information or inadequate technology.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>6.9:</td>
<td>Monitor and evaluate decision-making processes and management practices to identify inefficiencies and barriers caused by insufficient information or inadequate technology.</td>
</tr>
<tr>
<td></td>
<td>timely identification and development of new technology and practices in groundwater management; and timely adoption of relevant and appropriate new technology and practices.</td>
</tr>
</tbody>
</table>
Outcomes and Indicative Targets

The key outcome sought through implementation of this Plan over the next 15 years is sustainable use of Great Artesian Basin groundwater resources, with management aimed at achieving optimum economic, social and environmental benefits. However there are a number of more specific outcomes (Table 2) to be achieved within the timeframe before the key outcome can be achieved. These outcomes include a marked change in attitudes and approaches used to extract and distribute water, waste elimination and partial recovery of artesian water pressure. Many users who have lost access to artesian pressure will again be able to gain access to some level of artesian pressure. Priority environmental and heritage assets will be appropriately managed and valued and current water users and groundwater-dependent ecosystems will be able to access the resource with new opportunities for high-value uses. Changes to regulatory and institutional frameworks will give water users secure entitlement to water and clear responsibilities for infrastructure maintenance. By considering the full range of values in resource management, decision making will achieve protection and maintenance of Indigenous, social, economic, environmental and heritage values. Cross-border issues will be solved in a coordinated and cooperative way.

The way Basin resources are used must change. Water users and Government need a new vision for sustaining access to the Basin's assets – to involve water users more closely in partnership with Government, to adopt a more proactive role in sustaining the resource and to value the Basin. If the way the Basin is currently valued and managed does not change, opportunities for more productive rangelands farming and improved environmental values will be lost. Higher-value uses will continue to find it difficult to access water resources and opportunities for social and economic development in rural areas will be lost. Existing water users will face increasing risk of losing access to an artesian resource.

Benefits from adopting the vision of this Plan and the expected outcomes include:

- sustained, in many cases improved, access to artesian supplies and reduced water distribution costs;
- secure supply to groundwater-dependent ecosystems;
- secure entitlement to a specified volume of water;
- opportunities for new uses of water;
- reduced environmental damage associated with the use of bore drains;
- improved protection and management of cultural heritage values;
- improved property management options;
- improvements in quality of life for land owners dependent on artesian water;
- improved stock health through access to better quality water;
- improved social and economic outcomes for water users, Government and the community;
- improved understanding and cooperative arrangements between water users, Government and industry; and
- improved institutional and legislative frameworks.

The specific outcomes and indicative targets sought are provided in Table 2.
Table 2: Desired Outcomes and Indicative Targets

<table>
<thead>
<tr>
<th>Desired Outcomes</th>
<th>Explanation</th>
<th>Indicative Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 1.</strong> Water users, government and community appreciate the full economic, social, environmental and cultural value of the Basin and its current condition.</td>
<td>An adequate knowledge base needs to be provided and Basin values promoted to achieve an understanding of the importance and character of the Basin together with an appreciation of the current state of the Basin. Management approaches and investment partnerships will focus on deriving optimum benefit and reduced business risk.</td>
<td>• Surveys of resource users and water managers identify a higher level of appreciation; private investment level matches available public funds within five years.</td>
</tr>
<tr>
<td><strong>Outcome 2.</strong> The Basin provides water users with a sustainable water source.</td>
<td>Controlling waste together with changes to attitudes and resource management approaches will secure access to the resource and result in partial recovery of artesian pressure and protection of natural groundwater-dependent ecosystems and other Basin values.</td>
<td>• Within 15 years all artesian bores tapping the Basin controlled and piped unless specifically exempted; within the first 5 years 30% of bores rehabilitated and 30% of bore drains will be replaced. There is partial recovery of artesian pressure and protection of natural groundwater-dependent ecosystems and other Basin values.</td>
</tr>
<tr>
<td><strong>Outcome 3.</strong> Indigenous interests in the Basin are recognised and protected.</td>
<td>Indigenous interests in groundwater will be identified and protected, knowledge and values will be promoted and understood by water users, government and community.</td>
<td>• Within 5 years Indigenous interests in the Basin identified and integrated into the management and planning process where appropriate.</td>
</tr>
<tr>
<td><strong>Outcome 4.</strong> Significant environmental assets and cultural heritage are protected, maintained and restored where appropriate.</td>
<td>Controls over excessive extraction and improved water management practices and an appreciation of the value of the Basin will protect significant environmental and heritage assets. Current water users and groundwater-dependent ecosystems will have access to a common resource.</td>
<td>• Extent to which natural groundwater-dependent and water-remote ecosystems and associated biodiversity values are protected and/or restored. No net loss of natural groundwater dependent ecosystems within this period.</td>
</tr>
<tr>
<td><strong>Outcome 5.</strong> Opportunities for access to groundwater for new uses are provided.</td>
<td>Control of discharge and improved approach to resource management will achieve partial recovery of artesian pressure and make water available for new uses.</td>
<td>• Water available from water saved after pressure targets are achieved exceeds demand at that locality.</td>
</tr>
<tr>
<td><strong>Outcome 6.</strong> Adverse impacts of water distribution and use are minimised.</td>
<td>Controlling waste, eliminating bore drains and improving water use and stock management practices will reduce adverse environmental impacts and be accompanied by an appreciation of the benefits of efficient water use practices.</td>
<td>• Within 15 years all bore drains replaced unless specifically exempted; 30% of bore drains replaced and reduced salt load to surface water systems within 5 years.</td>
</tr>
<tr>
<td><strong>Outcome 7.</strong> Water users use groundwater efficiently.</td>
<td>Efficient use practices and regulatory arrangements will realise economy in water use because the resource is appropriately valued. Benefits will flow to other parts of the business enterprise and other values in the Basin.</td>
<td>• Water use efficiency (=Consumptive use/bore discharge) exceeds 0.75.</td>
</tr>
<tr>
<td><strong>Outcome 8.</strong> Water users have clear rights and responsibilities associated with access to groundwater.</td>
<td>Institutional arrangements in each jurisdiction will provide water users with entitlements and a clear understanding of the responsibilities for infrastructure maintenance attached to accessing the groundwater resource. Market-driven signals will achieve economies in water use.</td>
<td>• Within 5 years, water entitlement systems in place including water for the environment; opportunities for integrated groundwater/surface water management realised where appropriate; groundwater management plans prepared; market-based systems operating where appropriate; costs of groundwater management identified.</td>
</tr>
<tr>
<td>Desired Outcomes</td>
<td>Explanation</td>
<td>Indicative Targets</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Outcome 9.</strong> Appropriate level of ongoing investment in rehabilitation and Basin management achieved.</td>
<td>Appreciation of the Basin value and value of artesian water, acceptance of the need to manage the Basin and water use in a sustainable way and acceptance of responsibilities attached to resource use, investment in infrastructure renewal and maintenance will be stimulated through partnerships.</td>
<td>• The investment level matches the level required to renew and maintain infrastructure.</td>
</tr>
<tr>
<td><strong>Outcome 10.</strong> Water users maintain their own infrastructure.</td>
<td>Promotion, training and readily available information will achieve an acceptance of the need to maintain water infrastructure.</td>
<td>• Appropriate arrangements for ongoing maintenance and renewal of water infrastructure in place evidenced by the number of training programs completed and an increasing trend of compliance with licensing conditions.</td>
</tr>
<tr>
<td><strong>Outcome 11.</strong> Relevant new technology, knowledge and values are applied.</td>
<td>Resource management decisions need to be based on better quality information on Basin values and characteristics. Key technologies need to be improved. Management approaches will be flexible enough and information dissemination process efficient enough to allow timely adaptation of management approaches.</td>
<td>• Examples of new technology, information and planning processes implemented.</td>
</tr>
<tr>
<td><strong>Outcome 12.</strong> Net socio-economic benefits supported by the Basin are maintained and enhanced.</td>
<td>Recognition and understanding that social and economic benefits exceed the costs of maintaining these values will ensure these values are not considered in isolation and will provide incentive to enter investment partnerships to renew and maintain infrastructure.</td>
<td>• Within 5 years net social and economic benefits identified and are positive.</td>
</tr>
<tr>
<td><strong>Outcome 13.</strong> Basin managed holistically and at a regional level with integrated management of all Basin values.</td>
<td>Integrated resource management decision-making approach will provide a rational and coordinated basis for accounting for variability in Basin characteristics and values, and the relationships between these values. Approach will recognise differences between the States and Territory in policies, management approaches and legislative frameworks by achieving close coordination on cross-border matters.</td>
<td>• All jurisdictions participate in a coordinated way; State management plans reflect an integrated approach.</td>
</tr>
</tbody>
</table>
Framework for Implementation

Introduction
This section provides an overview of implementation issues for the Plan. Further detail is provided in Appendix 4.

This Plan provides a consistent framework to achieve the Basin’s vision for the next 15 years. This timeframe is necessary to provide all water users with the opportunity to be involved and for all outcomes to be achieved but will require considerable cooperation and commitment by all stakeholders.

Successful implementation of this plan relies on:
• identification of priority actions and clear definition;
• assignment of responsibility and an action timeframe;
• quantifiable targets for each action; and
• recognition that partnerships involving active participation by water users are crucial and need to be underpinned by a regulatory framework.

Those involved in Basin management and management of business enterprises in the Basin and those charged with making decisions about investment will need to make judgements about how and when the Plan’s strategies and actions are implemented.

Stakeholder Responsibilities
Key Basin stakeholder groups include water users, State and Territory Advisory Committees, the Great Artesian Basin Consultative Council (Council), State, Territory and Commonwealth Governments and other groups with an interest in the Basin. A schematic diagram (Figure 2) of the main communication links and responsibilities of stakeholders is presented below.

Water users have a key responsibility to achieve sustainable management of the Basin (Appendix 3) and its water infrastructure. They will have, for a period, the opportunity to engage in partnerships for refurbishing water infrastructure. They will also have a key role in planning, construction and operation of water infrastructure. It is essential that water users can actively participate in ongoing improvement of management practices.

State Advisory Committees will be important in identifying and developing partnerships, in particular with State agencies for developing management plans, providing information to groups, marketing the Plan and providing advice to Government.

Council will monitor and report to stakeholders on implementation, facilitate communication between Government and key stakeholders and facilitate strategic partnerships.

State and Territory Governments have a clear responsibility to provide regulatory and statutory frameworks to support their natural resource management policies in the Basin. They will support the improvement of Basin management through an appropriate mix of programs to implement this Plan.

The Commonwealth has a clear responsibility to set national goals and to make sure matters of national interest are considered. The Commonwealth also will have a leadership role in Basin-wide policy development and may make strategic investments for specific purposes (Appendix 3).
Partnerships

The formation of partnerships will be crucial to implementation of this Plan (Appendices 1 and 3). Partnerships will be formed on an as-needs basis and may take various forms, for example, partnerships may involve groups of water users, individual water users and Government, or any other combination of stakeholders to achieve an outcome consistent with this Plan.

Partnerships between Government and water users are central to much of the planning, decision making and analysis involved in infrastructure renewal. Development of these partnerships requires clear obligations and responsibilities of each partner.

Investment Required

Implementation of this Plan will be achieved through investment in a range of strategies. Bore renewal and bore drain replacement programs are common to the achievement of most objectives. Other programs will include community education, extension, institutional reform, monitoring, and research and development as they relate to key issues. Much of the benefit from this Plan will be achieved through investment in partnerships and the effort and commitment of individual water users to achieving the vision.

The minimum cost of Plan implementation is estimated to be $286 million. This estimated cost excludes the cost of past programs.

The cost of rehabilitating 880 bores known to require refurbishment (Table 3) is estimated to be $40 million.
Conversion of 34,000 km of bore drain to piping systems is estimated to cost $172 million, with the cost of rehabilitating bores that may again flow once pressure rises is estimated to be $10 million. The investment of $222 million in infrastructure renewal is estimated to save 200,000 megalitres per year (ML/year) or over 50% of current use. These infrastructure costs include administering the refurbishment programs, planning and design, and post-construction monitoring of performance against design. These costs of infrastructure renewal are minimum costs, since there are estimated to be 318 controlled bores of uncertain status, of which up to 200 bores may require rehabilitation at an additional $10 million. Further refinement of this estimate is impossible until additional data become available. Of the 30,000 known subartesian bores tapping Great Artesian Basin aquifers, an unknown number may be leaking below ground surface, resulting in pressure loss or aquifer contamination.

Other strategies such as communication, extension, monitoring and research activities necessary to achieve the non-infrastructure objectives are estimated to cost $64 million, with 15 years to implement.

Management zones will provide the basis for strategic investment and resource management (Appendix 4, Figure 8).

### State Implementation Plans

State and Territory Governments, in consultation with Advisory Committees, are responsible for the development of Implementation Plans consistent with this Plan. State and Territory Implementation Plans will consider all objectives and strategies, establish priorities and incorporate necessary monitoring arrangements. The formulation of each State Implementation Plan will reflect the outcomes and indicative targets outlined in Table 2 and will recognise the relationships among the various objectives and strategies. While the various State Plans are likely to vary in their content and the elements of their approach, there are broad areas for which each Plan should adopt a consistent approach. These broad areas of consistency include monitoring network guidelines and reporting frameworks, data formats, resource management targets in cross-border areas, construction standards and codes of practice for the use and management of Basin groundwater.

Implementation Plans are expected to evolve in stages due to the nature of the investment cycle and the uncertainty attached to a plan of this magnitude and scope. Each State and Territory is expected to develop Implementation Plans for the first 5-year stage of the 15-year program. A 5-year timeframe for the first stage is considered appropriate to allow for implementation of the various programs and to begin achieving some

### Table 3: Summary of Bore Status

<table>
<thead>
<tr>
<th>Bore Status</th>
<th>Number of Bores</th>
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<tbody>
<tr>
<td>Approximate number of controlled bores in Queensland</td>
<td>1773</td>
</tr>
<tr>
<td>Approximate number of controlled bores in New South Wales</td>
<td>469</td>
</tr>
<tr>
<td>Approximate number of controlled bores in South Australia</td>
<td>236</td>
</tr>
<tr>
<td>Approximate number of controlled bores in Northern Territory</td>
<td>0</td>
</tr>
<tr>
<td>Number of bores known to require rehabilitation</td>
<td>880</td>
</tr>
<tr>
<td><strong>Total number of bores still flowing</strong></td>
<td><strong>3358</strong></td>
</tr>
<tr>
<td>Total number of bores still flowing</td>
<td>3358</td>
</tr>
<tr>
<td>Number of bores ceased to flow</td>
<td>1368</td>
</tr>
<tr>
<td><strong>Total number of artesian bores drilled</strong></td>
<td><strong>4726</strong></td>
</tr>
</tbody>
</table>
outcomes. It should be noted that the various activities comprising action plans will run for varying periods of time, may not exist for the life of the Plan, and may be dependent on completion of other activities.

Monitoring and reporting arrangements to funding bodies, State Advisory Committees and Council are to be established to measure progress towards objectives and to determine the effectiveness of Plan implementation. Regular release of information reports will allow those who have an interest in the Basin to be kept informed of progress. As well as regular reporting arrangements for the program, mid-term and end-of-stage audits will be undertaken by the Commonwealth. These audits are an important way to maintain an effective Plan.

Through such monitoring, review and auditing processes the Plan will be refined to maintain its relevance to the vision and to incorporate emerging circumstances and new knowledge. Further implementation details are provided in Appendix 4.
Glossary

**Adaptive Management System** – a dynamic management approach responsive to changes in knowledge, resource condition and trend, and/or changing management priorities.

**Aquifer** – part of a geological formation or group of formations containing sufficient saturated material to transmit and yield significant quantities of water to bores or springs.

**Artesian Aquifer** – an aquifer where beds above and below the aquifer are impervious and where the water is confined under pressure, so the water level in bores penetrating the aquifer will rise above the top of the aquifer and reach ground level. These bores become flowing bores.

**Artesian Bore (also flowing bore)** – a bore where water rises up the bore column to a point above the land surface.

**Artificial Outflows** – includes flows from all bores accessing Basin aquifers (flowing or pumped).

**Assurance** – in the context of bore maintenance, a guarantee or certainty that water infrastructure is maintained after the payment of a fee or premium against loss or failure.

**Benefit (Public and Private)** – investments in on-ground works across the Basin will lead to a range of benefits. Private benefits are those enjoyed by a private individual or body corporate, while public benefits are those enjoyed by all or in the public interest.

**Biodiversity** – assemblage of different species of plants and animals.

**Biodiversity Outcomes** – biological consequences of specific actions.

**Bore Column** – bore lining used to stabilise the drill hole and to seal off undesirable material.

**Bore Drains** – small earth channels used to distribute water from an artesian bore to other parts of a pastoral property.

**Capital Investments** – investments made in water infrastructure to produce a product.

**Ceased-to-Flow Bore** – a bore, once artesian but due to the fallen aquifer pressure, the water level in the bore no longer rises to land surface.

**Consumptive Use** – water used for a purpose (for example, living plants, animals, irrigated crops, manufacturing and mining) not returned directly to groundwater storage.

**Controllable Bore** – a bore with headworks and a control valve installed and where that device is in working order.

**Controlled Bore** – a bore that has been rehabilitated and has a control valve installed to control discharge or a bore that has a control valve installed during construction. The valves may or may not be in working order.

**Duty of Care** – Common Law duty of care applies to everyone who may harm another as a consequence of their actions. Duty of care applies to harm that may be caused to both: (a) those who are living at present;
and (b) those who are not yet born. In a natural resources context, it relates to the need to not impact on natural resources when damage could have been foreseen.

**Ecosystem Health** - state and functionality of ecological processes within an ecosystem normally expressed in terms of one or more indicators.

**Entitlement** - authority issued under a particular legislative system representing the share of the water resource issued to the holder.

**Environmental Flows** - water required to maintain ecological processes within an ecosystem which may be temporally, spatially and volumetrically variable.

**Extractive Flows** - water discharged through a bore either under its own pressure or by a pump.

**Groundwater dependent Ecosystems** - biological systems dependent on groundwater for existence. Includes ecosystems dependent on mound springs, springs and soaks.

**Head** - energy stored in a water mass, produced by elevation, pressure or velocity.

**Head Reversal** - where the water level falls below ground level or some previous level at an earlier time.

**Headworks** - structure including various valves installed at ground level and attached to the top of the bore column used to control discharge from artesian bores.

**Higher Value Uses** - uses of groundwater which derive the best economic value.

**Infrastructure Renewal** - rehabilitation or replacement of bore headworks and casing, and replacement of bore drains with piping networks and troughs.

**In-kind Contributions** - non-financial contributions.

**Institutional Arrangements** - measures, practices established under law, guidelines or principles by a Government agency.

**Institutional Failure** - failure by a Government agency or institution in its role, responsibilities or policy implementation.

**Institutional Reform** - reform or review of processes and practices used by a Government agency or institution to carry out its responsibilities.

**Intake Beds** - areas where an aquifer intercepts or is close to the ground surface and where surface water or rainfall can move from the surface to the aquifer.

**Integrated Resource Management** - management approach considering, in the decision-making process, interdependencies among land, water and vegetation variables.

**Investment (Public and Private)** - public investment is a financial outlay by Government (public monies). Private investment is a financial outlay by individuals or privately owned corporate bodies.

**Management Zones** - management tool to differentiate between different areas of the Basin with different hydrogeological and bioregional attributes and issues.

**Market Failure** - when the market does not constrain the allocation or use of resources to a level that maximises social, environmental and economic benefits. It results when an economic factor is ignored or overlooked and so remains without a price or value.
Megalitre – measure of volume, being one million litres or one thousand cubic metres.

Monitoring Network – a network of bores used to measure the pressure, water levels or water quality of an aquifer.

Mound Spring – geomorphic formations raised above the surrounding land surface formed by a deposit of minerals and sediment brought up from artesian aquifers or confining beds by water at certain natural discharge points in the Basin. Mound springs are generally confined to the southwestern corner of the Basin. Note: Other spring systems not raised above the surrounding land surface occur throughout the Basin. See also groundwater-dependent ecosystems.


Partnership – an association of persons, companies, organisations or Government agencies that share the risks and benefits from the association or alliance based on clear objectives and responsibilities.

Priority Environmental and Cultural Heritage Assets – groundwater-dependent and water-remote ecosystems and cultural heritage features identified and generally agreed to be of sufficient value to warrant their protection and management ahead of other competing values.

Rangelands – open land where rainfall is too low for agricultural cropping or improved pasture and where livestock graze on native pastures.

Reactivated Bores – bores which recommence flowing from pressure increases due to infrastructure renewal.

Recharge – process where groundwater is replenished, usually by infiltration of surface water or rainfall entering an aquifer; also occurs by water intentionally added to an aquifer, usually via a bore or excavation that exposes the aquifer.

Recharge Rate – rate or volume per unit time at which water is recharged to an aquifer.

Recharge Zones – see intake beds.

Regulatory and Statutory Instruments – instruments made under an Act, another statutory instrument, or a power conferred by an Act or statutory instrument and also under power conferred otherwise by law. Examples of statutory instruments include a regulation, an order-in-council, a rule or a guideline of a public nature.

Regulatory Framework – applicable legislation and regulatory and statutory instruments.

Bore Rehabilitation – relining of existing bore with new casing and replacement of bore headworks.

Reticulation Systems – system of bore drains or pipes which may cross one or more properties to distribute water across the landscape.

Social Capital – characteristics of social organisation such as networks, norms and social trust, or bonds which help coordination and cooperation for mutual benefit. Evidence suggests cohesiveness in societies is crucial for societies to prosper economically and for sustainable development. It measures the ability to deal with challenge or change.

Shared Investment – where two or more parties invest financially or inkind to achieve a mutually beneficial outcome.
**Stock Water Demand** – volume of water required by stock at a property scale. May be calculated in reference to a specific time period, such as an hour, day or year.

**Subartesian Bore** – a bore in an aquifer where the water does not rise above the ground surface and does not flow. Water must be pumped to the surface. Note: In some parts of the Basin the term “non-flowing artesian bore” is used in preference to “subartesian bore”. In these instances “subartesian” refers only to bores in non-artesian aquifers.

**Sustainable Use** – use of the Basin’s resources so its condition is maintained within specified limits and its social, economic and environmental values remain within bounds acceptable to the community into the future.

**Total Grazing Pressure** – net demand grazing animals place on vegetation cover of the land.

**Traditional Knowledge** – Indigenous people’s knowledge and understanding, generally supported by oral history.

**Uncontrolled Discharge** – discharge from bores which cannot be constrained or shut off with a control valve or similar device.

**Water Infrastructure** – bores, bore headworks, piping, troughs and tanks related to extraction and distribution of water. Also includes bore drains.

**Water remote Ecosystems** – ecosystems made up of plants and animals which have adapted to very arid environments.

**Water Use Efficiency** – a comparative figure, generally the fraction of total discharge used to produce benefits. Calculated as the ratio of consumptive use to total discharge or the value or extent of production per water unit consumed assessed against a nominated standard or norm. For example, efficiency of water use from a bore is the volume of water consumed by stock divided by the total bore discharge.

**Watering Points** – troughs, tanks or other structures used to provide water. Includes bore drains.
Appendix 1: Basin Features and Characteristics

Structure of the Great Artesian Basin

The Basin is a hydrogeological basin that in simple terms consists of a vertical succession of sediments, which form sheet-like layers. This multilayered system has the main aquifers occurring in formations or layers dominated by sandstones. The confining layers are made up of formations dominated by fine sediments such as mudstones and siltstones. Near Basin margins, sediments become thinner and shallower and at times outcrop at the surface. Outcrops of sandstone layers provide intake points for recharge to the aquifer. These recharge or intake areas are mainly located along the Great Dividing Range on the eastern margin of the Basin and also along the west and southwest margins. Figure 3 shows general features of the Basin in schematic form.

Water is stored in pore spaces of the sandstone and transmitted along the aquifer layer by interconnected pores and fractures. The confining layers retain water within the aquifer. Thickness of the sediments range from less than 100 metres at the margins to over 3,000 metres in the Basin centre. Although layers are continuous over large areas of the Basin, at the local scale rapid changes in sediment type, folding and faulting can change the character of aquifers.

Figure 3: Features of an Artesian Aquifer


Hydrology of the Great Artesian Basin

Recharge of Basin aquifers is derived from rainfall and streamflow in intake areas. The percentage of rainfall entering sandstones is estimated to be less than 2% because of the limited capacity of intake beds to transmit water. Most of recharge occurs in higher rainfall areas in the east, from which groundwater generally flows westerly to southwesterly. A groundwater divide in the northern part of the Basin near
Figure 4: Recharge Areas, Groundwater Flow Paths and Spring Groups

LEGEND
- GAB Area
- Potential Intake/Recharge Area
- Spring Locality
- Spring Group
- Direction of Flow

KILOMETRES
0  600

after:-
Habermehl, M.A. & Lau, J.E. 1997 - Hydrogeology of the Great Artesian Basin, Australia (Map at scale 1:2 500 000)
Australian Geological Survey Organisation, Canberra
Hughenden directs flow north toward the Gulf of Carpentaria and south toward Lake Eyre. Most natural discharge occurs through vertical leakage to springs and soaks in the southwestern area of the Basin. Discharge also occurs at spring groups in New South Wales and Queensland. Figure 4 shows Basin recharge areas, groundwater flow paths and spring groups.

Water flow through sandstones is extremely slow – ranging from 0.1 to 5 metres per year. At this rate, the time taken for water to travel from the aquifer in the eastern recharge zone of Queensland to the discharge springs in South Australia can be up to two million years.

Water quality is generally good in major artesian aquifers, with total dissolved solids (TDS) ranging from 500 to 1,500 milligrams per litre (mg/L), but generally increasing towards the southwest margin of the Basin. Generally, salinity increases in shallower subartesian aquifers where TDS can exceed 10,000 mg/L. Salinity within each aquifer increases along flow lines from the recharge to discharge areas. Water temperature ranges from 30°C, where aquifers are shallow near intake areas, to greater than 100°C in the Basin centre where aquifers are deep.

**Basin People**

Although the Basin covers around 22% of Australia, much of the area is arid and sparsely populated. The majority of people live in the higher rainfall eastern areas in Queensland and New South Wales. More than 100,000 people live in the Basin and depend on its waters for domestic, industry and commercial needs and about half of these live in towns and small communities. Several towns such as Narrabri and Moree in NSW and Longreach and Charleville in Queensland are quite large, while others such as Innamincka or Marree in South Australia have an extremely small population. The remainder of people in the Basin live on farms, pastoral stations, mining settlements, or Indigenous homelands. More than 10 percent of Basin population is Indigenous.

An estimated 90,000 people earn their living in the Basin. Around 24,000 work in agriculture, 2,500 work in the minerals and petroleum industries and an additional 27,000 work in service industries. Some urban centres are growing and small to medium sized industries are being attracted to these areas. Tourism is increasing and tourists and other visitors support the infrastructure in sparsely populated areas of the Basin, offering additional employment opportunities for those who live in these areas. Figure 5 shows how people are employed in the Basin.

*Figure 5: Employment in the Basin*
Water Use

Total Basin extraction for consumptive uses is around 570,000 ML/year, with about 500,000 ML/year extracted by the pastoral industry - much of this is lost through seepage and evaporation from bore drains. It is estimated a saving of 200,000 ML/year could be achieved over 15 years. There are 4,700 artesian bores in the Basin and more than 880 flow uncontrollably and need control and repair. There are approximately 34,000 km of bore drains carrying water from the borehead to grazing lands in the Basin. These drains require replacement with piping systems to deliver water more efficiently, reduce associated environmental impacts and provide other advantages in pastoral management.

The minerals industry consumes about 11,000 ML/year. Mining developments are increasingly important users of Basin groundwater, with current developments anticipated to bring total use by mining activities to 30,000 ML/year by 2002. About 20,000 ML/year is extracted involuntarily by the petroleum industry as part of its production process. Water for towns and other domestic supplies is another important consumptive use of the Basin, with seven towns each extracting more than 1,000 ML/year of water from the Basin and 70 towns relying on it as a water source. Figure 6 summarises water extraction from the Basin by sector.

Natural discharges through springs and soaks account for more than 50,000 ML/year, making the environment an important “user” of Basin groundwater resources. There are more than 1,000 recorded Basin springs and soaks. Some springs have stopped flowing or have been adversely affected by consumptive uses. The remainder of natural discharge is from vertical leakage up through confining beds. This is estimated to be about 45% of natural discharge from the Basin; however, the quantity and significance of vertical leakage in the Basin is not well understood.

Figure 6: Water Use from the Basin


Note: 500,000 ML/year is extracted by the pastoral industry, with much lost through seepage and evaporation from bore drains. A saving of 200,000 ML/year could be achieved over 15 years.

Importance of the Basin

General

The Basin is one of Australia’s most important water resources, with estimated water storage of 8,700 million megalitres. In arid areas covering much of the Basin, Basin groundwater is the only reliable source of water to support human activity. Basin groundwater provides environmental flows to protect important natural and cultural heritage values, as well as consumptive flows, providing many economic and social benefits.
The availability of Basin water, originally from natural springs and later from bores, has had a major influence on the natural and cultural history of the Basin. Basin water has been essential for development and maintenance of pastoral enterprises since the turn of the century and recently for mining industries and for the growing outback tourist industry.

**Economic Values**

The gross value of production supported by Basin water resources is the most obvious measure of economic value (Fig. 7). Consideration of this figure in isolation ignores the economic value of regional environment and social infrastructure and the critical role of the Basin in maintaining the long-term environmental and social health of the region. Changes impacting on environmental and heritage values, or affecting social or economic benefits that accrue from the existence and use of the Basin, can have major economic consequences.

Productive values in the Basin are based on primary production, mining, petroleum and tourism. Viability of these industries depends on sustaining natural resources, infrastructure and the social fabric of this sparsely populated region. Availability of groundwater is particularly important because much of the area is arid or semi-arid, and other sources of water are either unavailable or unreliable.

Basin groundwater resources support more than $3.5 billion of production in regional Australia each year\(^1\). Figure 7 shows the estimated annual gross value of production from Basin groundwater based on ABARE data from 1996/97. The largest value of production is from the pastoral industry. Increased mining activity, particularly in western Queensland, New South Wales and expansion of the Olympic Dam mine at Roxby Downs in South Australia, is likely to significantly increase the gross value of mining production relying on Basin groundwater resources.

**Environment and Heritage Values**

Basin water from mound springs and other natural discharge areas supports important ecosystems containing rare and endangered flora and fauna. These natural discharges can also provide important drought refuge areas in arid parts of the Basin. A number of Basin mound springs are listed as being nationally important in A Directory of Important Wetlands in Australia. Many of these are protected in conservation reserves or directly by landholders. Maintaining the important biodiversity values associated with natural discharge areas must be a key consideration in Basin management.

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\(^1\) Gross value of production from the area of the Basin now amounts to $4.81 billion. The gross value comprises $1.788 million from mining in 1999 (Farrington, pers. com.), oil and gas production of $1,000 million (Mues, C. and Hardcastle, S. (1998)), broadacre farming of $2,000 million (ABARE, 1996/97) and tourism of $25 million. These data include production for which Basin water is not an input. In some cases production may be partially dependent on Basin water.
Other important biodiversity values depend on maintaining parts of the landscape free from permanent surface water. The frequency and pattern of water distribution from Basin wells can have a significant impact on the natural biodiversity of these water-remote parts of the Basin.

Indigenous people throughout the Basin have a long association with natural flows and some communities continue to rely on the Basin as an essential water source. The Basin supplied water from natural discharges, allowing more intensive settlement of some parts, and was also incorporated into the spiritual and cultural beliefs of some communities inhabiting the area. The water – through natural discharges and upward leakage – had value as it provided emergency water during drought and an important trade route through the line of mound springs on the southwestern margin.

Social Values

Much of the social fabric and human endeavour in the Basin is dependent on access to Basin water. This is particularly the case in the sparsely populated arid parts of the Basin. People living in more than 70 towns, as well as most pastoral stations and mining operations in the region, rely on Basin water. Access to a reliable supply of good quality water is a key factor to the long-term viability of the pastoral, mining and tourist industries and to the communities that service these industries and maintain the roads and other infrastructure in the region. Loss of access to the Basin would cause social disruption and threaten the maintenance of even a reduced level of services, industry and infrastructure, resulting in considerable reduction in benefits and increase in costs. In the broader Australian community, the existence of the Basin is an integral part of the Australian ‘outback’ and germane to the conservation of the cultural and natural history of this nationally important region.

Management Considerations

Some management considerations important to natural, social and cultural values are:

- **ecosystem protection** – Basin management has a direct impact on the health of mound springs and other groundwater-dependent ecosystems, including wetlands developed from uncapped bores.

- **land degradation reduction** – improved Basin management, including bore capping and piping programs, can enable grazing pressures to be managed more closely, which means grazing pressure near existing linear watering points can be reduced. Replacement of bore drains with piping systems will help reduce erosion and other land impacts of this form of water distribution in some land types;

- **pest plant and animal reductions** – water from uncapped bores provides habitat for feral and pest animals which compete with stock for food and prey on native animals. Pest plants unpalatable to stock, or which displace native plants and animals, are also a problem near uncontrolled bores and bore drains;

- **tourism opportunities** – visitors travel Australia’s arid areas to visit a diversity of natural and cultural attractions. Human history and cultural diversity of the Basin are of great interest to urban Australians and international visitors. Diverse ecosystems in the Basin, especially those related to water in arid regions, are also attractive to visitors. How extraction and distribution of Basin water impact on tourist attractions needs consideration. Growth in the tourist industry depends on the Basin’s capacity to supply sufficient water for infrastructure and services;

- **cultural heritage protection** – areas such as mound springs form an integral part of the cultural heritage of the Indigenous people of the Basin. Better Basin management will help to preserve this heritage and enhance cultural links. Access to Basin features and water is essential for the culture and lifestyles of many Indigenous people currently living in the Basin. The history of European
settlement in the arid portion has grown around access to Basin water. Initially, trade routes were established between springs, followed by settlement occurred around natural springs and soaks and then around Basin bores. The costs and benefits of conserving cultural heritage are an integral part of Basin management. Identifying and protecting those places with cultural and heritage values impacted by Basin water use are important. The Register of the National Estate already recognises many of these places;

- **integrity of social fabric** – population is sparse over much of the arid part of the Basin. Access to a reliable supply of high-quality water is a key factor to long-term viability of pastoral, mining and tourist industries and to communities servicing these industries and maintaining regional infrastructure. Loss of Basin access would cause social disruption and threaten the maintenance of reduced levels of services, industry and infrastructure; and

- **“icon” status** – the Basin is an integral part of the Australian ‘outback’ and cultural and natural history of the region.

### Current Action to Address Threats

For most of the past 100 years a range of institutional arrangements and management programs have been implemented in different regions of the Basin to improve outcomes from use of Basin water but, in many regions, pressures continued to diminish and many bores stopped flowing. Initially inadequate knowledge of the Basin, too little legislative control over water extraction and ineffective infrastructure technology and management practices meant water resources continued to be wasted. During the past several decades, improvements in technology, management practice and legislation have meant there have been some incremental improvements, but lasting solutions for Basin-wide problems have proven extremely difficult.

In recent years, efforts have concentrated on bore rehabilitation and bore drain conversion. The South Australian bore repair project started in 1977. In 1989, the Commonwealth and State Governments initiated the Great Artesian Basin Rehabilitation Program for implementation in Queensland, New South Wales and South Australia. Bore capping and piping programs have been co-financed by water users (mostly pastoralists), State Governments and the Commonwealth Government. Table 4 summarises cost-sharing arrangements negotiated for past and current programs.

<table>
<thead>
<tr>
<th>Program</th>
<th>Water Users</th>
<th>State Government</th>
<th>Commonwealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAB Rehabilitation Project (QLD)</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Bore Drain Replacement Projects (QLD)</td>
<td>40%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Cap and Pipe The Bores (NSW) – bores</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Cap and Pipe The Bores (NSW) – piping</td>
<td>60%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Bore Drain Replacement (SA)</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Bore Rehabilitation Program (SA) – most bores are Government-owned</td>
<td>0%</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

The range of arrangements reflects:

- significant property right differences for groundwater infrastructure between Basin States (for example, most bores are owned by Government in South Australia, but in Queensland and New South Wales are owned by water users);
• impact of special circumstances – for example, drought conditions in some Queensland regions had special support from the Commonwealth; and

• different nature of program investments – for example, Queensland implementation of the piping program is funded 20:40:40 (landholder: State:Commonwealth) covering materials only. Installation was funded 100% by the water user giving an overall investment of 40:30:30. The equivalent New South Wales program works on cost sharing of the total costs of supply and installation. South Australian bore drain replacement programs are 100% funded by water users.

Since starting infrastructure renewal programs, nearly 500 bores have been rehabilitated, about 38% of known bores needing repair. This is the result of over $33 million in joint investment; $11 million invested by the Commonwealth, almost $11 million invested by the Governments of South Australia, Queensland and New South Wales and the remainder representing landowner investment. As well as joint investment schemes, there are additional schemes funded solely by private investment. In the rehabilitation program, those bores no longer needed are permanently plugged and the bores abandoned. Bore casing of useful bores has been renewed and headworks installed. This work is estimated to save more than 78,500 ML of groundwater each year. Once bores have been rehabilitated, flows can be distributed more efficiently to reduce waste and improve management of total grazing pressure in rangelands. The introduction of high-density polyethylene pipe has reduced the cost and increased opportunities for locating stock watering points for optimal management of livestock grazing.

Some uncontrolled bores have been capped and more efficient water delivery systems installed, but less than half the bores needing repair have been rehabilitated and not all rehabilitated bores are being used efficiently. Industrial practices, local cultures and institutional arrangements have not been responsive enough to implement policy change and incorporate the opportunities offered by the changing economic environment, new technologies or improved understanding of water resources. State agencies are working to improve institutional arrangements to address issues concerning Basin water use. The current approach, while useful and making significant contributions to eliminating waste from pastoral uses of the Basin, is inadequate for Basin management. Current programs will continue, but are to be incorporated in partnerships for shared investment, reflecting a more comprehensive and focused set of management arrangements, where the ‘duty of care’ and statutory responsibilities of those with a stake in the Basin are clear (Appendix 3).
Appendix 2:  
Discussion of Issues, Benefits and Conditions

Resource Management Issues and Context

Threats to Basin Values

The Basin supports a range of nationally important socioeconomic, natural and cultural values. The biggest threat to these values is water waste through uncontrolled discharge and distribution through open bore drains. Uncontrolled extraction and inefficient use of Basin water threaten groundwater-dependent ecosystems and biodiversity values, cause land degradation and threaten other cultural and heritage values, as well as limiting economic and social benefits from Basin water usage.

Basin values are under threat because decisions concerning Basin water extraction have failed to recognise the true values of access to the resource and have not considered the benefits realised from extraction of Basin water. The particular values at risk cannot be considered in isolation because of the interdependencies involved in the Basin’s operation.

For example, economic benefits that develop from use of Basin water cannot be considered in isolation from cultural and heritage values that may be impacted by the water extraction and distribution practices used to get these benefits. Basin values are threatened by the way water is extracted from the Basin and distributed and the amount of water extracted. Uncontrolled and poorly managed use of Basin water has caused regional reduction in artesian pressure. Extraction of water continues in many areas with little consideration of other values which depend on water pressure and quantity. Further information on important Basin values is presented in Appendix 1.

Unless an environment for improving water use is created, such unacceptable impacts will severely degrade current values and future options for high value.

The quantity of water extracted is not the only issue concerning sustainable Basin use. The way Basin water is distributed and used can result in disastrous environmental and cultural impacts. These can result from:

- loss of flow to groundwater-dependent ecosystems, and loss of biodiversity values; and
- bore drains may cause soil erosion and the spread of woody weeds and feral animals and other biodiversity impacts.

Key factors in current unsustainable use of groundwater are:

- most bores and reticulation systems were designed and installed in previous decades, without the benefit of modern technology and with different understandings of the dimensions of the groundwater resource, and in an era with different environmental management expectations;
- institutional arrangements and regulatory frameworks (including water entitlement systems) are often ineffective for the rights and responsibilities of water users and consequently do little to encourage water use economy; and
- limited capacity of many water users (primarily pastoralists) to finance capital works of bore rehabilitation and bore drain replacement with piped reticulation and trough systems.
If current water resource management practices and associated attitudes continue, private and public benefits from the Basin will be significantly reduced.

**Consequences of “Doing Nothing”**

The need for a Strategic Management Plan and its potential achievements and benefits need consideration in light of the current management regime compared with a “do nothing” scenario.

A strict “do nothing” scenario would mean ceasing current bore rehabilitation and bore drain replacement programs. Artesian pressures may, at best, stabilise at current levels or may fall further. Opportunities for future uses of Basin water would be lost or realised only with significant hardship by current or incoming users. Groundwater-dependent ecosystems would decline further, although the extent would depend upon certain thresholds of pressure being breached. Many other potential benefits of improved groundwater management, particularly in pastoral production enterprises, may be lost and groundwater assets would continue to deteriorate. Potential future economic development dependent on availability of water may be lost. Further social dislocation would be inevitable from increased costs of primary production and reduced opportunities for positive biodiversity and cultural heritage management and associated economic outcomes.

A “do nothing more than current activity” scenario (current management), with no further deterioration in the condition of bore columns, would require 20 years of bore rehabilitation works and even longer to complete the bore drain replacement. Artesian pressures may recover slowly over extensive parts of the Basin, depending upon the concentration of rehabilitation/replacement works. Opportunities for future uses of Basin water would still be lost or realised only with significant hardship by the current or incoming users.

**Need for Government Participation**

Substantial Government activity is needed if the Plan is to be successful. Activity may be through institutional and regulatory change, investments in knowledge and technology, education and awareness programs, monitoring and evaluation, or direct investment in works programs. Governments take part in these investments to fulfil their constitutional or statutory obligations, or where there is a failure in market-driven investments or regulatory frameworks and where current investment is insufficient to achieve best outcomes (Appendix 3). A public good or benefit is a precondition for Government investment but it alone is insufficient reason for Government involvement.

Government investment in groundwater extraction and distribution infrastructure will address some of the key issues identified earlier but not all the failures identified. Government participation is also needed to support transfer of knowledge, community education, regulation and research of key knowledge gaps to make sure that the underlying causes are dealt with. These activities will be needed to make sure key issues in the Basin are addressed.

**Need for a Partnership Approach**

Resource management partnerships are a good way to accelerate change. These partnerships may be organised as needed and may include industry, community interests and all levels of Government, who jointly share in the benefits and costs (Appendix 3). It is important to understand the benefits that can be achieved by improving Basin management developed through partnerships. Partnerships should be based on agreed objectives and mutual obligations and have benefits for all parties.

Partnerships, including user groups and other stakeholders, are an effective way of tapping into local knowledge and ensuring the views of the people most affected are included in decision making. These
partnerships will create a sense of ownership among user groups and provide a forum where user groups and Government authorities can negotiate institutional arrangements to ensure sustainable Basin management.

These partnerships will be:

- community-centred;
- pro-active in identifying alternatives and options;
- adaptive and interactive; and
- operated to include conflict management and negotiated outcomes as appropriate.

This approach to groundwater management and related aspects of natural resource management in the Basin provide many opportunities to overcome two major barriers to sustainable resource management:

- limited ability of some water users to finance infrastructure renewal from their own resources; and
- limited ability of community groups to commit to improved water and resource management of the Basin.

All parties taking part in Basin partnerships will need to clearly acknowledge their obligations and responsibilities and become advocates for the outcomes of the partnership. Outcomes need to:

- help create a forum for open communication and mutual support;
- accept their share of investment needed;
- comply with agreed management practices; and
- sustain commitment until partnership objectives are achieved.

**Need for a Basin-Wide Management Plan**

The Basin is a single resource crossing State boundaries with regional management practices impacting across the Basin. To deal with many of the issues identified, a Basin-wide approach is needed because:

- States have adopted differing policies and practices for groundwater management in the Basin. These policies can cause different outcomes across State and Territory borders. What happens in one State (reflecting the resource management objectives of that State) can adversely or beneficially affect another State. These outcomes may not be in the best interests of natural resource management;
- a whole-of-resource approach is needed that integrates groundwater and surface water management where appropriate, as well as land and water management. This is unlikely to occur without a common management framework across States; and
- there is a need to optimise outcomes for the whole Basin from limited investments. Actions required to get the greatest community benefit across the Basin may need to occur in one part of the Basin. Coordinated action to obtain these benefits is unlikely to occur without a common management framework.

The Basin-wide approach should be flexible enough to accommodate regional differences. There are variations in the importance of various values, issues and aquifer characteristics. For example, the Basin has defined recharge and discharge zones, regional differences in hydrology, biophysical regions and water-dependent values, each with a different mix of characteristics.

Current approaches to management do not always recognise the importance of some values and so are unlikely to resolve threats to those values unless a different approach is adopted. The management of
flows and pressures in particular regions of the Basin to preserve current values and maximise community benefits may need a variety of different approaches within a Basin-wide management framework.

Potential Benefits of Investment
If stakeholders adopt a new vision for the Basin and actively engage in achieving the Plan outcomes, there will be considerable benefit for water users, Government and the community from partnerships. Stakeholders need a clear understanding of the benefits if they are to take part in implementing this Plan.

Benefits may be:

• reduced maintenance and labour costs for bores and water reticulation systems;
• greater security of water supply, improvements to the quality and pressure of supply, and consequent improvements in human health and personal satisfaction;
• improved agricultural production through greater capacity to manage grazing pressure and stock health;
• improved property management options through improved water reticulation;
• improved amenity around rural homesteads;
• reduction of environmental impact related to bore drains;
• improved water availability for new high-value uses, tourism and domestic reticulation and increased economic activity from new uses;
• maintained and improved access to artesian supply;
• greater security and opportunities for rural communities through increased sustainability of agricultural industries and improved family and community-based resiliency;
• reduced environmental and biodiversity damage related to water extraction and reticulation;
• maintenance and enhancement of Indigenous heritage values;
• maintenance and enhancement of tourism opportunities;
• more effective institutional and legislative frameworks;
• maintenance and enhancement of natural heritage and ecosystem values, including more secure environmental flows to groundwater-dependent ecosystems; and
• maintenance of ‘icon values’ – for example, the Basin’s value as a national icon.

The Objectives of Management
There are a number of aspects of Plan objectives that are considered to warrant additional comment. The text in italics refers to the most relevant objective.

Managing Quantity, Quality and Pressure of Basin Flows
Manage quantity, quality and pressure of Basin flows to maximise socioeconomic, environmental and cultural heritage values.

Plans for Basin management must protect water quality and make sure water extraction for consumptive uses does not cause unacceptable impacts. Key strategies for protecting groundwater quality and managing quantity and pressure of flows include:
• renewal and maintenance of bore casings and headworks and plugging of unwanted bores and piping of artesian water within 15 years;
• development and implementation of a maintenance and monitoring schedule for ongoing management of bore-casings and headworks; and
• development of groundwater pollution and contamination management planning practices for Basin recharge zones.

**Basin Water Quantity**

Artesian and subartesian water resources of the Basin are located in an environment where there are few reliable alternative water sources. It is crucial that responsible existing water users can continue to obtain access to the resource. The most basic need for management of flows from artesian bores in the Basin is to have casings and headworks with valves in good repair.

At the current rate of extraction (approximately 570,000 ML/year), artesian pressure will continue to fall although it has levelled off or is approaching stabilisation over some Basin areas. If pressures continue to fall, the cost of maintaining supply will rise for existing users, and future options for high-value use and regional development will be diminished.

Persistent efforts to reduce levels of water waste by current users are a key strategy to allow for the entry of new users. Special arrangements may be made to facilitate the entry of new users while also pursuing other Basin management objectives. These could include resource trading or trade-offs.

Bore drains are open drains distributing artesian flow from bore headworks to stock. Individual drain systems can be more than 100 km long, and there are about 34,000 km of drains throughout the Basin. More than 200,000 ML/year of Basin water evaporates or seeps from these drains. This represents more than 50% of artesian aquifer discharge. A key strategy to maintain access to artesian supply is the reduction of waste from uncontrollable artesian bores or bores leaking below ground surface due to corroded or uncemented casings and replacement of inefficient bore drain systems with piped systems. A related strategy is to prevent water movement from higher pressure beds to lower pressure beds through corrosion holes in bore casing.

While access to artesian supply is an objective in Basin management, this does not imply a need to maintain artesian pressures at current or higher levels throughout the whole Basin. Water management issues vary from region to region and management decisions will be made in response to local issues. Artesian pressures should be managed at levels to maintain sustainable environmental, social and economic outcomes as well as future options. These outcomes may involve a planned reduction in pressure in some districts. Within any such arrangements, access to supply for existing responsible users should be maintained.

**Basin Water Quality**

The quality of Basin water resources can be diminished through land and water management decisions. Plans to manage Basin water quality need to protect the resource from:

• contaminated recharge;
• cross-contamination between aquifers; and
• pressure reversals at discharge points.
Contaminated Recharge
Land use management plans in the Basin should not permit any land use or management practice causing deep leaching of contaminants in recharge areas.

The artesian system is recharged by rainfall on Basin margins (principally the eastern margin). Less than 2% of rain falling in recharge areas eventually recharges the Basin. This means land use and other activities are unlikely to affect the amount of water entering the flow system. However, inappropriate land use practices could introduce contaminants that move with recharge water into Basin aquifers. Practices posing contamination risk are those with a significant waste stream. Conventional broadacre farming is not seen to pose a significant risk in recharge areas.

Natural resource management and land use planning agencies, research groups and landholders need to work collaboratively to adequately define the extent of recharge areas, protect recharge areas and ensure that quality of recharge water is maintained. Those involved in making land-use decisions in recharge areas should understand the need for unimpeded and uncontaminated recharge water to enter the Basin. The integrity of the quantity and quality of Basin water supply must be the overriding consideration in all land-use decisions that may affect recharge areas.

Cross-contamination of Aquifers
Basin management plans should ensure bores are maintained in sound condition to avoid cross-contamination between aquifers. Codes of practice for bore construction and maintenance need to support this.

The Basin consists of sandstone aquifers separated by impermeable beds. Water quality and pressure vary between aquifers. If bore casing is corroded, water can move from aquifers containing poorer quality water into aquifers containing better quality water and vice versa. Cross-contamination can be a problem where bores have stopped flowing naturally because of falling pressure and on Basin margins where bores tapping the Basin have always been subartesian. Such contamination becomes a greater risk where the pressure in a better quality aquifer is lowered relative to other poorer quality aquifers from unsustainable extraction.

Improved Water Management
Basin management plans should develop a more appropriate management approach to sustain and enhance productive uses of Basin groundwater. Key strategies for sustaining and enhancing productive uses of Basin groundwater include:

• reducing waste in the pastoral industry by replacing bore drains with piped water distribution infrastructure;

• fostering collaborative relationships incorporating scientific information with local values and actions to improve management; and

• establishing values and codes of practice appropriate to the judicious use of Basin groundwater in management zones.

Improved water management through adoption of more appropriate management practices can improve the productivity of industries where water is an input as well as increasing economic returns on Basin groundwater use. Opportunities for improving productivity will enable greater investment in water management by water users which will in turn bring about opportunities to advance a number of objectives for Basin management. Improvements in water use efficiency through such things as innovative water treatment and reuse technologies are already being used by a number of mining companies. In the pastoral
industry substantial improvements can be made by replacing bore drains with a water delivery system providing greater flexibility in water use to manage stock. Improvements in on-farm management of water give important opportunities and links for improving land management practice.

Improved water management can improve productivity in the pastoral industry in a number of ways including:

- costs of stock management can be reduced - if water distribution is controlled, then, in the absence of other water sources, water can be turned off or on to self-muster stock;

- costs of controlling pests (both plants and animal) can be lowered. Some weeds are spread by bore drain systems. By removing drains weeds will not be spread by this means. Uncontrolled water sources support feral animals. By controlling water, feral animals can be trapped at watering points;

- total grazing pressure can be managed - controlled watering points can be located and turned on and off to make sure paddocks are grazed strategically and sustainably. This process needs to operate within an appropriate stocking rate regime if overgrazing is to be avoided. Checks are needed to make sure the location of watering points does not cause new impacts on areas of valuable biodiversity;

- stock health can be improved - bore drains flow for tens of kilometres, becoming turbid, increasingly saline and concentrated in elements such as fluoride, which can affect stock health. These problems do not occur with controlled water sources. Controlled water sources also bring the potential to supply food supplements and medication to stock through drinking water; and

- pasture production can be improved - bore drains can cause soil erosion and salinisation, making landscapes unproductive. Controlled water management systems avoid these problems. Bore drains also capture valuable overland flows resulting from limited rainfall events, reducing infiltration into the soil moisture store for the growing of range forage.

**Collaborative Working Relationships**

One of the most difficult tasks in developing more appropriate management approaches involves finding practical and feasible ways to change long-standing water management practices and institutions that are not providing the best outcomes. Scientific and technological developments do not automatically translate into practical on-ground solutions. People who live on the land and who use living resources for their livelihood develop an intimate knowledge of natural cycles upon which productivity depends. Their management practices are often based on practical knowledge developed through experience and an understanding of the land. Plans need to foster more appropriate management through a productive working partnership focusing on integrating science and technology with local knowledge and practice in a collaborative approach, resulting in positive and practical on-ground changes.

**Management Zones**

The Basin has defined recharge and discharge areas, biophysical regions and other characteristics. Management of flows and pressures in particular regions of the Basin to preserve current values and maximise community benefits may need a variety of different approaches within the Basin-wide management framework. The development of management zones, each with zone-specific management objectives consistent with global management objectives, will be one of the key strategies for productive and sustainable use of Basin water. Management zones that could form a basis for implementation of activities to achieve sustainable use are presented in Appendix 4, Figure 8.
Future Certainty and Security

Establish legislative and administrative frameworks for sustainable water management and use.

Baseline management plans need to maintain access to groundwater for consumptive, environmental and other users of the water resource, as well as secure options for development and future generations. Key strategies for maintaining access to Basin water supplies and securing future use options include:

- development of institutional arrangements to establish security of access and entitlement for users and the environment;
- establishment of groundwater management zones and objectives for the Basin;
- developing and implementing compatible systems of water allocation in line with national policy frameworks for groundwater management; and
- building on existing economic instruments to create clear incentives for sustainable Basin groundwater resources.

As the sustainable volume available for extraction is relatively small, competition for access will continue to grow. At the same time, growing awareness of the need to protect environmental values is likely to cause some tension between consumptive users and environmental demands.

There will be an increasing expectation that water extraction by users is restricted to levels that sustain Basin values at socially acceptable levels. Water users make investment decisions based on long-term supply and need secure entitlements to take water for definite periods, to secure their investments and facilitate planning.

New industries have emerged in more recent times. The allocation of artesian water resources for sustainable high-value developments that consider current users and provide the best economic and social return to the community, without jeopardising future options or impacting on natural systems or biodiversity, will be supported. Opportunities presented to the community by new industries such as royalties, export earnings and employment need to be accommodated in management arrangements for the Basin. The allocation of artesian water must allow for useful reserves to accommodate new industries and the potential to shift from lower to higher-value uses of Basin water.

Currently, water entitlements vary between jurisdictions. Formal entitlements of some form exist for most industrial uses. Stock bore owners generally have no formal entitlement to a specific volume of water and some have no constraint on the way water is taken or used.

It is recognised that:

- four jurisdictions are involved in Basin management;
- each jurisdiction manages the Basin within an entitlement system that services extensive resources outside the Basin; and
- each jurisdiction has its own priorities for water resource management legislation and administration.

Movement toward a system of formal water entitlements is in the interests of water users, those impacted by water use and the broader community that financially supports management systems. Such a system provides a greater degree of security and underpins investments in specific enterprises. This is consistent with the Council of Australian Governments National Water Reform Framework.
Indigenous Values and Knowledge

Indigenous values and knowledge are related to four objectives, namely:

- Change attitudes and behaviour needed to improve Basin management and stimulate investment;
- Establish legislative and administrative frameworks for sustainable water management and use;
- Maintain and enhance environmental and cultural heritage values affected by use of Basin groundwater; and
- Enhance the knowledge and technology base to improve resource management practices and support better decision making.

Basin management should recognise and incorporate Indigenous values and knowledge. Management plans developed should acknowledge the understanding and needs of Indigenous people and develop management practices which work for them. While recognising cultural values may require a different approach to water management to fit their needs, Indigenous enterprises which pursue pastoral, domestic and amenity uses of water have water requirements similar to non-Indigenous enterprises.

Key strategies for recognising and incorporating Indigenous values and knowledge include:

- promoting understanding of Indigenous values and knowledge relating to Basin groundwater resources; and
- integrating Indigenous values and knowledge into Basin management plans.

Indigenous groups have relied on water from the Basin for thousands of years. Many of the natural springs and soaks are of particular importance to Indigenous people. Their intimate association with natural flows from the Basin has resulted in important insights into the nature of these flows. The maintenance and development of Indigenous culture in much of the Basin depends on sustainable access to Basin water. The values, interests and knowledge of traditional landholders in the Basin require recognition, as these will differ in many respects from other stakeholders. Once recognised, they need to be incorporated in Basin planning and management processes.

Environmental and Heritage Values

Maintain and enhance environmental and cultural heritage values affected by use of Basin groundwater.

Basin water supports a range of aquatic and other ecosystems of which many have significant biodiversity values requiring protection or restoration. The extraction, distribution and use of groundwater from the Basin can impact on the wider environment. Basin management plans need to maintain and enhance environmental and heritage values and recognise rare and threatened species. Impacts that need management include:

- regional drawdown, grazing impacts or contamination effects on springs;
- land degradation from bore drains and other distribution systems; and
- introduction of artificial water sources and their effect on biodiversity.

Key strategies for maintaining or enhancing environmental and heritage values include:

- developing and promoting understanding of Basin environmental and heritage values to increase recognition and protection;
- making sure environment and cultural heritage values are considered in the management of other uses of Basin groundwater; and
- working collaboratively with other resource management groups to make sure the use and distribution of Basin water does not lead to unacceptable impacts.
Springs

Spring flows are at risk in some locations and need protection. Water discharges naturally from the Basin through springs located around Basin margins. Although the dynamic hydrological nature of springs causes significant differences in flows over time, unique ecological systems have developed around many of them. Springs are also an important aspect of Indigenous culture. Although there is no current evidence of any mound springs being major ritual centres, they have played an important part in traditional economies as they are a reliable water source. Spring values also support tourism.

Spring flows have been reduced by water extraction. For example, the Elizabeth Springs near Boulia flowed at 23,650 ML/year in 1896, covered an area of about 121 hectares and ran water 32 km down a nearby creek. As a result of water extraction by bores, the flow rate fell to 4,380 ML/year by 1914. Available evidence does not indicate any significant loss of biodiversity values associated with the spring complex. However, if the area of the complex were reduced, it would be reasonable to expect that the resilience of the biodiversity would be diminished.

Basin spring flow is still some 50,000 ML/year and remains an important natural feature of the Basin.

Land Impacts

Bore drains can cause environmental degradation. During rain events they collect overland flow, which grows to exceed drain capacity, eventually eroding the drains. Saline swamps form at the tail end of bore drains. Grazing stock tend to concentrate around drains, causing overgrazing. Bore drains are a major factor in the spread of some environmental weeds, such as Prickly Acacia (Acacia nilotica), and also feral animals.

Biodiversity Impacts

The importance of Basin groundwater resources on the maintenance of biodiversity values should be considered when assessing priorities for water development decisions.

The introduction of permanent artificial water sources to supply stock has impacted on the mix of native species. Some have flourished under the influence of permanent water supplies and grazing supported by artificial water sources. Other species have suffered as a result of such competition. Water distribution by piping to tanks and troughs has less impact on natural species distribution than bore drains because piped systems can be managed. For example, water can be turned off when paddocks are destocked during drought. Some long-standing artificial water sources may have significant ecological values due to the regional impacts of changes in natural water flows. On a local basis it may be appropriate to keep some portion of uncontrolled flow to support small artificial wetlands.

Communicating Basin Importance and Improved Management

Change attitudes and behaviour needed to improve Basin management and stimulate investment.

Basin management plans should communicate the importance of Basin values and the need for their management. Key strategies include:

• providing an information-rich environment for Basin users and managers to encourage more appropriate management;

• coordinating and managing communication and education activities to increase understanding of Basin values and the need for their management; and

• assisting opinion leaders and key decision makers to clearly understand the Basin's importance and the support needed to manage it.
Changing Attitudes

The development and implementation of a comprehensive communication strategy is an essential element in planning and implementing successful Basin management. The remoteness and distribution of natural and productive flows from the Basin compromise a realistic perception of Basin values and issues for political leaders and people who live outside the Basin. Some Basin users have difficulty grasping a Basin-wide perspective of the relative value and impact of their groundwater extraction activities.

One of the most difficult tasks in Basin management is to create an information-rich environment which challenges traditional attitudes and institutions contributing to inefficient and non-productive uses of water. Basin users should understand the long-term costs and benefits of various water extraction and distribution systems before they invest in change. This information will allow all Basin users to negotiate trade-offs between conflicting uses of land and water resources in the Basin. Decision makers need to understand the magnitude and importance of Basin issues to justify the expenditure of resources to support the development of better management practices across the Basin. Programs to encourage appropriate valuation of water are needed to support this Plan and Basin management.

Accessible Knowledge Base

*Enhance the knowledge and technology base to improve resource management practices and support better decision making.*

Management of the Basin needs to be based on adequate and reliable information. Basin implementation plans should support research and development trials to expand the Basin knowledge base in areas of key deficiencies. Key strategies for supporting research and development for management of Basin groundwater resources include:

- coordinating and managing research and development to identify and fill strategically important knowledge gaps relating to management of Basin groundwater resources;
- working collaboratively with industry groups to encourage the development of technology that contributes to the Basin groundwater management; and
- coordinating development and management of information systems needed to support management of Basin groundwater resources.

In recent years much has been learned about the Basin, although knowledge gaps still limit the certainty of some management decisions. Additional investment should be encouraged to provide the understanding needed for proper management of the Basin resource. Those involved in decision making need easy access to the best scientific and technical information available. Research and development must be complemented by extension activities so new knowledge is available to resource managers to enhance the effectiveness and efficiency of Basin resource use.

While many opportunities for increased productivity are well understood, in other areas, research and development need to clearly identify opportunities for better management of the Basin. The mix of opportunities for productivity improvements varies greatly from property to property. Achieving more productive outcomes will involve considering research and development needs in planning processes.

Monitoring the Effectiveness of Groundwater Management

Monitoring is relevant to all objectives.

This Plan stresses the importance of accounting for all costs and benefits that accrue as a result of Basin management and operation and a cost sharing-arrangement for all users that reflects those costs and
benefits. It emphasises the importance of accountability in the investment of public resources. Management actions must show measurable and obvious benefits. A robust system to monitor the efficiency and effectiveness of Basin management is required. Key strategies for achieving this objective are:

• monitoring the quality, quantity and values of Basin productive flows and natural surface discharge;
• monitoring resource management practices including bore and water distribution infrastructure, water allocation and research and development;
• monitoring institutional arrangements including resource legislation, bureaucratic structures, taxation and incentives;
• monitoring implications for groundwater-dependent and water-remote ecosystems; and
• monitoring management practices to ensure ongoing compliance with requirements.

The advantage of hindsight shows that Basin decision-making and management processes can be flawed and can result in unacceptable impacts. In the past, these impacts have not always been easily recognised nor quickly rectified, even when the understanding and technology existed to do so. A primary reason was the absence of measurable management goals and monitoring instruments to review outcomes. Monitoring, evaluation and review should be an integral part of the water industry’s operations Basin-wide.
Appendix 3
Current Policy, Institutional and Program Arrangements

Policy Context for Great Artesian Basin Management

Natural Resource Management Framework
Natural resource management is guided by strategies and policies at national and regional (State and Territory) levels, although Constitutional responsibility rests with the States and Territory. The national policy context for natural resource management in the Basin comes from three key policy statements:

- National Strategy for Ecologically Sustainable Development – establishes the need to develop and manage, in an integrated way, the quality and quantity of surface and groundwater resources, and to develop mechanisms for water resource management that aim to maintain ecological systems while meeting economic, social and community needs. Implementation of the plan intends to meet these requirements by adopting a more integrated approach to groundwater resource management;
- Decade of Landcare Plan – provides a national approach to the development and implementation of systems of land use and management, sustaining individual and community benefits now and in the future. The Plan provides a framework for individuals, community organisations and Governments for the future and works towards sustainable natural resource use. Within this broad framework, more detailed proposals for coordinated and cooperative actions are developed and implemented at appropriate levels; and
- National Strategy for Conservation of Australia’s Biological Diversity – commits Governments to improving knowledge of biological diversity, protecting ecosystems by introducing effective legislative and policy frameworks and stresses the importance of activities of Governments, the private sector and the community as a whole in being consistent with conservation of biological diversity.

The above policy statements are supported by other subordinate national strategies, such as the Commonwealth Wetlands Policy and National Principles and Guidelines for Rangelands Management; various State and Territory strategies and policies reflecting State and Territory legislation and priorities; and international agreements such as the Rio Declaration on Environment and Development (Agenda 21), the Convention on Wetlands (Ramsar, Iran, 1971), the Convention on Biological Diversity and the Council of Australian Governments’ National Water Reform Framework.

Water Reform Framework
From an operational perspective, the National Water Reform Framework has the most direct influence on Basin groundwater management.

In 1994 the Council of Australian Governments (COAG) endorsed a comprehensive strategic framework for the efficient and sustainable reform of the Australian water industry to be fully implemented by 2001. This framework provides guidance for advancing changes in water resource management needed to meet national and international policy commitments. Certain aspects of this are applicable to all water resource management and include:

- recovery of water management costs;
• development of water allocation and entitlement systems to facilitate water trading, with provision
for environmental needs; and
• integration of natural resource management, integrated catchment approaches and consultative
mechanisms.

Additional groundwater management aspects of the framework are established in Allocation and Use of
Groundwater – A National Framework for Improved Groundwater Management in Australia prepared by the
Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). Key aspects are:
• commitment to a policy of sustainable use of the water resources;
• establishment of property rights to water, with clear entitlements and allocations and the opportunity
to trade water where appropriate;
• specific allocations of water for the environment;
• use of market-based signals to encourage efficient and effective use of water;
• greater integration of surface and groundwater management with other aspects of natural resource
management;
• transparent decision-making processes and involvement of water users in decision-making processes;
and
• use of the best available information in planning, with additional research to provide essential
information on priority issues.

Two further documents endorsed by all jurisdictions in Australia provide more detailed guidance for
implementation of specific aspects of the framework:
• Water Allocations and Entitlements - A National Framework for the Implementation of Property Rights
in Water; and
• National Principles for the Provision of Water for Ecosystems.

Changes to institutional and regulatory arrangements, combined with appropriate changes to the current
approach to water management and planning, are needed to comply with Water Reform Framework
requirements in some jurisdictions. These changes are being progressively introduced by jurisdictions.

Legislative Framework

There are a number of regulatory and statutory instruments that provide the authority and framework for
Governments, State and Commonwealth, to fulfil their responsibilities in the Basin and to support many
policies applicable to the Basin.

Each jurisdiction has established a range of legislative mechanisms for controlling the management,
allocation and development of groundwater resources. Many of these are or have been changed to satisfy
provisions in the National Water Reform Framework. There are also various legislative tools in each
jurisdiction to protect the environment.

The SCARM Framework for Shared Investments

The Standing Committee on Agriculture and Natural Resource Management (SCARM) has agreed to guidelines
for public investments in natural resource management and mitigation of environmental degradation.
These guide the development of natural resource management partnerships in which Governments are
partners in the Basin. While there has previously been an emphasis on on-ground works in shared

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2 This section is summarised from the Sustainable Land and Water Resource Management Committee Discussion Paper: Principles for Shared Investment to Achieve Sustainable Natural Resource Management Practices, currently being prepared for publication and subject to minor modification.
investments, this paper canvasses a wider number of possible policy instruments that might be used to encourage improved natural resource management. SCARM distinguishes between ‘shared investments’ (recognising that there are many factors considered in making investments and including in-kind work, education, research, development and planning), and ‘cost sharing’. ‘Cost sharing’ describes the division of funding contributions to the action.

Public investments are not appropriate where there is a clear duty of care for natural resource management. Essentially, resource managers have a duty to take all “reasonable and practical” steps to prevent their actions causing foreseeable harm to others. A duty of care is the common law duty of care, which applies to everyone who may harm another as a consequence of their actions. Duty of care applies to harm that may be caused to (a) those presently living; and (b) those who are not yet born. While duty of care in the context of natural resource management has limited statutory backing in Australia at present, this may change in the future along with common understanding of its meaning.

The framework identifies where Government capital investments may be relevant:

- where regulatory or legal solutions alone may not be cost-effective and joint investment in the short term may be preferred;
- where Government contributions can facilitate a faster change in management practices towards a more sustainable system; and
- when additional investment is required to further improve an on-site or off-site environmental value, when the on-site benefits may be insufficient to make the investment attractive to the resource user.

However, the general approach in assessing opportunities for Government investments should be:

- to determine who has the responsibility within the scope of the project for improved resource management;
- to determine the minimum time-bound Government intervention needed to bring about behavioural change to meet public expectations;
- to determine the most appropriate instrument to ensure behavioural change; and
- to determine whether a financial subsidy would be the most appropriate instrument and the best way to deliver it.

Where Government capital investment is not appropriate:

- A duty of care applies:
  Landholders and other resource users have a duty of care to take all fair and reasonable measures to make sure they do not damage the natural resource base.
- Private benefits are sufficient incentive:

Where resource users invest in on-ground works providing site-specific financial benefits sufficient to make the investment attractive, then investment by Government is not applicable.

- There are more appropriate approaches:
  In some cases, Governments have preferred forms of investments. It may be more desirable for Government to use legal, regulatory or market-based solutions to generate public benefits than to invest in remedial activities.
• There are too few benefits:

Sometimes public benefits are insufficient to justify significant expense by Government and others to support the activity.

Principles determining whether an activity should be considered eligible for Government funding:

• Government should contribute to activities or parts of projects only where there are significant public benefits. Users, both existing and future, are expected to pay for activities increasing their wealth or expected income stream:

  Public benefit alone may be insufficient reason for Government investment, particularly in cases where there is a clear responsibility or duty of care for particular activities. Public benefit is a condition of Government funding, not a purpose.

• Government should contribute to works only up to a level sufficient to trigger the necessary investment towards self-correcting, self-perpetuating natural resource management systems that operate effectively:

  Public funds should not be applied in a way that substitutes for the responsibility of others and weakens others' perception about their own resource management responsibilities.

• Before Government will contribute to any land, vegetation or water management activity, the activity must be technically sound, produce outcomes consistent with identified priorities and benefits must justify costs. In considering costs and benefits, economic, social and environmental factors all need consideration.

Generally,

• All natural resource users and managers have a duty of care to not damage the natural resource base. Users should be responsible for any damages from their actions.

• Where polluters or impactors can be identified, the full cost of impact prevention and control attributable to them, including costs of required activities, should be borne by them (impactor-pays principle).

• No public money should be invested in a project dependent on continued subsidy or public payment, unless there is a clear responsibility for Government to address the issue.

**Groundwater Resource Management Roles**

**Role of Government**

Government has a primary role in groundwater management of managing resource access to optimise net social benefit. The primary tool is a legislative framework based on policies for development and management of the resource.

Government may also have a direct resource management role as the designated resource manager of public lands such as national parks.

Under the Australian Constitution, primary responsibility for land and resource management lies with State and Territory Governments. They have policy, program delivery, regulatory and statutory roles which support implementation of natural resource management policy. Through primary industry, resource management and environmental agencies, State and Territory Governments conduct research, deliver information and other support to users of Basin groundwater resources, allocate entitlements to groundwater, regulate its use and management, and monitor resource, environmental and social values related to the Basin.
Specifically, State and Territory Governments have a role in providing necessary regulatory power, planning and policy to provide the primary mechanism for implementing the Plan. Governments could initiate plans or policies or, where relevant, endorse the plans or policies of other bodies. State and Territory Governments have a clear role in Plan implementation and investment in partnership with the Commonwealth Government in the Plan’s public component.

Government may make strategic investments in resource management to promote specific objectives. In the early 1900s, resource and industry development was the primary objective, so Government invested in resource assessment and bore construction. The current objectives are water conservation and waste reduction. Government is investing in infrastructure renewal to reduce water waste and ensure pressure recovery.

The Commonwealth Government has a number of responsibilities and interests relevant to the Basin. These include providing leadership in consultation with the States to develop strategic national approaches and principles and ensuring that matters of national interest relating to environment and heritage, sustainable agriculture and natural resources management are addressed. Commonwealth investments are made according to clearly defined principles for shared investment in partnerships.

Role of Water Users

Water users are key stakeholders in water resource management.

Their primary roles are to achieve efficiencies and economies in water use and to make sure water extraction and distribution infrastructure is maintained in a serviceable condition and operated with respect for the needs of the environment, biodiversity, neighbours and the wider community. Enterprise management should be committed to ensure the value of priority environmental and heritage assets is maintained consistent with socioeconomic objectives of the enterprise.

Water users also have an important role providing informed feedback to Government through State Advisory Committees on practical application of water use management practices and implementation of key aspects of this Plan. Water users can provide local input to solutions and help bridge communication gaps between Government and some sections of the Basin community.
Appendix 4: Implementation Planning

Introduction
This section provides an implementation framework as a guide for the development of more specific implementation prescriptions in State or regional plans.

This Plan contains a set of interdependent objectives of equal importance. Implementation of this Plan depends upon active cooperation and involvement of water users, State and Commonwealth Government agencies, industry and interest groups. Those involved in Basin management and charged with making decisions about funding will decide when and how the plans, strategies and actions are implemented.

This section provides a framework to achieve the Basin’s vision.

Functions of Key Groups

Water Users
Water users have the major responsibility for sustainably managing the Basin. The key to success for this Plan and to achieve its vision is the active participation and willing compliance of water users in its implementation. Water users have a primary role to:

• use water efficiently and responsibly; and
• maintain water infrastructure in a serviceable condition.

Active participation of water users will ensure that management practices are practical, credible and lead to on-ground works to improve the condition and management of the Basin.

Other Interest Groups
The Basin supports nationally and regionally important values and benefits, so that the many people who do not directly use Basin water also have an interest in the Basin. During implementation, these interest groups could work collaboratively with water users and managers to:

• expand the scientific and technical knowledge base about water resources, environment and community in the Basin;
• become advocates for the Basin to influence decision makers and managers to protect community interests; and
• help ensure sufficient investment is available to maintain infrastructure and sustain management practices.

State Advisory Committees
State Advisory Committees are an important link between water users, State Governments and the Council. They have a key role in advising on implementation and helping facilitate cooperative arrangements between various partners. State Advisory Committees have a role in establishing partnerships with potential stakeholders. In particular, advisory committees can:
• collaborate with community and State Government agencies to develop State water management plans;
• advise on on-ground works to determine priorities, shared investments and partnerships;
• advise on selection criteria for regional and zonal priorities of works to be carried out with Basin-wide priorities;
• facilitate communication between Government and water users and other stakeholders involved in implementation;
• liaise with other State-based resource management groups to ensure an integrated approach;
• market implementation and encourage parties with a direct interest in the Basin to take part;
• provide advice to State Governments and Council on the effectiveness of shared investments and cooperative partnerships; and
• work cooperatively with other resource management groups to ensure an integrated approach.

**State Governments**

State and Territory Governments have a primary responsibility for water resource management, policy, legislation and operational delivery of programs. In particular, State and Territory Governments have a role in or are responsible for:

- development of State Basin groundwater management plans in collaboration with advisory committees and water users;
- development and coordination of Statewide and regional natural resource management and investment policy;
- identification and cooperation on resolution of cross-border policy matters;
- development of institutional arrangements;
- establishment of a regulatory framework to support implementation;
- provision of technical support;
- establishment of shared investments and partnerships;
- establishment of monitoring networks and systems to provide the information necessary to evaluate the impacts of implementation;
- maintaining momentum and commitment;
- ensuring water users comply with regulatory requirements; and
- undertaking on-ground works.

**Commonwealth Government**

The Commonwealth Government has a range of national and Basin-wide interests in implementation. It has policy and program functions to provide leadership and strategic investment sufficient to trigger investment by others in partnership. In particular, the Commonwealth function is to:

- provide leadership in developing Basin-wide natural resource management policy;
- make strategic investments and provide leadership in negotiation of shared investments;
- provide technical support;
• ensure national and international obligations are met; and
• maintain momentum and commitment.

Great Artesian Basin Consultative Council

The initial role of Council was to provide advice to Government on a strategic framework for sustainable use of the Basin. The results of this advice are contained in this Plan. In implementing the Plan, Council will have particular roles to:

• identify Basin-wide priorities for achieving each Plan;
• coordinate periodic Basin-wide reviews of implementation and outcomes and report to stakeholders;
• provide advice and assistance to Governments in developing the form and means of program delivery and evaluation;
• collaborate with investors to ensure Basin-wide priorities;
• collaborate with State jurisdictions to identify potential partners and facilitate partnerships that will improve implementation;
• identify knowledge gaps and promote coordinated research and assessment;
• liaise with other resource management groups to ensure an integrated approach;
• facilitate communication between Governments and water user groups in close cooperation with State advisory committees; and
• provide leadership in building support and actively engage the broader community.

A Technical Working Group has been established with a primary role of providing technical support to Council.

Timeframe

This Plan is intended to provide a consistent framework for various State and Territory programs over the next 15 years. A shorter period is not a practical timeframe to achieve the Plan’s objectives. Specification of a timeframe within which objectives are to be achieved will provide certainty for all stakeholders in the Plan. Within the 15-year life of various programs used to implement the Plan, a number of planning and funding stages will be established. Five years for the first stage is sufficient for programs to be initiated and achieve measurable progress. It is also appropriate for performance auditing and review.

Implementation Plans for each State and Territory will be developed to address each objective. In developing project timelines, State implementation planning will recognise interdependencies between objectives. Due to these interdependencies, programs designed to achieve some objectives will be dependent on other programs. Various activities to implement the Plan are expected to run for varying periods and may not exist for the Plan’s lifespan. Core infrastructure renewal programs are expected to exist for the Plan’s lifespan.

Timeframes for reporting and program review are identified in the section on Review and Reporting of this Appendix.

Resources

Resources Needed

Outcomes desired from implementation will be achieved through a set of interdependent activities. These activities can be grouped into:
• core infrastructure renewal; and
• activities involved with changing management practices, including institutional reform, community consultation and education, monitoring and research and development.

Interdependency among activities will mean some activities will have higher priority. Some of the non-infrastructure activities may need priority to ensure implementation of the core infrastructure renewal component can proceed in a timely manner.

The minimum cost of implementing the Plan is shown in Table 5.

### Table 5: Estimated Costs of Plan Implementation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore Rehabilitation(^{3}) (880 bores @ $45,000/bore)</td>
<td>$40 million</td>
</tr>
<tr>
<td>Bore drain replacement(^{4}) (43,000 km of pipe @ $4,000/km)</td>
<td>$172 million</td>
</tr>
<tr>
<td>Allowance for rehabilitation of reactivated artesian bores</td>
<td>$10 million</td>
</tr>
<tr>
<td><strong>Total Infrastructure Renewal Cost</strong></td>
<td><strong>$222 million</strong></td>
</tr>
<tr>
<td>Communication, social, Indigenous, environmental, heritage, and research objectives</td>
<td>$64 million</td>
</tr>
<tr>
<td><strong>TOTAL COST OF PLAN IMPLEMENTATION</strong></td>
<td><strong>$286 million</strong></td>
</tr>
</tbody>
</table>

**Infrastructure Renewal**

Bore rehabilitation and bore drain replacement with polyethylene piping and water troughs has commenced in the Basin. Some 480 bores (Table 3) have been rehabilitated or plugged and abandoned, and over 50 bore drain systems replaced with more than 2,500 km of pipes and troughs. The task is still only partly complete.

The total size of this task is difficult to quantify. There are approximately 880 bores known to need rehabilitation (that is, have obvious leaks or are completely uncontrollable) (Table 5), but there could be other controlled bores leaking below the surface, or with casing weaknesses, which will not be known until the bore is controlled to pipeline distribution.

It is reasonable to assume up to 50% of the 318 controlled bores of uncertain status that may need rehabilitation are in fairly good condition, as many are located in non-corrosive areas. Uncertainty of these numbers means bores needing rehabilitation may have been excluded from cost estimates. For purposes of this Plan it is assumed that there are 200 bores in this category. Cost estimates are therefore a minimum estimated cost. Further refinement of this figure will not be undertaken until additional data are available.

This Plan has been limited in its scope to address artesian bores or bores that have stopped flowing and may again flow. The Plan recognises there are subartesian bores in the Basin that may be contributing to leakage across aquifers. The extent to which these bores are contributing to problems is unknown. In this phase of Plan implementation, subartesian bores are not dealt with. An attempt to define the extent of the problem for subartesian bores will be made during a program review.

Rehabilitation of bores (880 estimated) and conversion of about 34,000 km of bore drains to piped systems is estimated to save more than 200,000 M L/year providing substantial improvement in Basin management. It would effectively eliminate most of the waste in the pastoral industry.

A cost estimate for completing bore rehabilitation for 880 bores and a bore drain conversion program can be

\(^{3}\) Costs include administration, planning, design and contract supervision.
made on the basis of average costs, although these will vary with location and condition of bores and bore drains. It is assumed 43,000 km of pipe will be needed to replace 34,000 km of drains, since replacement systems need adequate watering points to reduce land degradation. A provisional estimate of rehabilitation costs of currently non-flowing bores to become artesian from expected pressure gains will be some $10 M. Table 5 presents costs of infrastructure renewal of 880 bores and replacement of 34,000 km of bore drain. These activities specifically address Objective 2 of the Plan.

Fifteen years is an appropriate timeframe for a rehabilitation and piping program. A shorter program will lead to practical delivery and technical problems, as well as policy and social problems, given the time required to recruit bore owners into the scheme and finance the works and to plan and undertake the work. The timeframe will allow for operational reform in the pastoral industry and reform in Government policy to keep pace with obligations and opportunities created by improved water management. A 15-year program will cost approximately $14.5 million per year.

Remaining Strategies
It is recognised the achievement of the Plan's objectives 1, 3-6 (that is, those objectives other than the objective directly related to infrastructure renewal) will require additional funds. Implementation costs for the remaining strategies are estimated at $64 million over 15 years with the cost for the first 2 years as $6 million per year and $4 million in each of the remaining years. This is an initial estimate only and includes the cost of implementing these activities, including administration, marketing and program management.

Each objective will require a specific implementation plan to be formulated by the jurisdiction identified as best suited to implementing the strategies and refinement of the scope as cost estimates become more clearly defined. Implementation should be considered as part of the plans to be developed by the States.

Targets
An intermediate target for implementation is to achieve savings in uncontrolled discharge of bores and bore drains of 100,000 ML by the end of the fifth year of the Plan and a significant improvement in artesian pressures. Investing in strategic areas will make water savings. Stabilisation and improvement of aquifer pressure should occur in the targeted areas. The amount of water to be saved to improve pressures is complex to calculate and the recently completed computer simulation model of the Basin will be used to assist.

An intermediate target is to convert 11,000 km of open bore drains to piping by the end of the first 5 years of the Plan. This target needs to be met if water savings are to be achieved. Additional targets will be established for non-infrastructure components such as research projects to address aspects of bore corrosion, recharge estimation, stock water demand, guidelines for recharge area management, polyethylene piping technology, human and animal health, a range of biodiversity issues and the economics of Basin water use.

Current research programs on casing corrosion rates, recharge zones and measurement of recharge will be completed. Education and extension programs targeting key areas of water use efficiency, public education and property management of water will be implemented. Existing institutional reforms will be continued under the current timeframe and any new reforms implemented where appropriate. The current bore monitoring network will be reviewed and appropriately modified.

Targets for research, education and extension are poorly defined at this stage and require considerable development during planning for the Plan's implementation.
Resourcing Strategy
Basin water users such as pastoralists, mining companies, tourist ventures and communities are beneficiaries of groundwater and have primary responsibility for on-ground management and maintenance of water extraction and delivery systems. The pattern of investment available to maintain water supplies and manage resources is driven by market forces and the level of investment. Investment is normally determined by relative costs and benefits to business and communities of maintaining infrastructure and the costs of compliance with regulations to maintain the resource.

Governments increasingly rely on market-driven measures to sustain appropriate resource management practices. They have accepted a role to intervene in the operation of investment markets where there is clear failure in market-driven investments or regulatory frameworks and where current investments are inadequate to generate best outcomes for the community. Shared investments involving Governments, users or other interest groups are necessary because of the need to accelerate change to sustainable management practices producing both public and private benefits.

Where the achievement of public and private benefits is inextricably linked, a shared investment approach offers the greatest opportunity for their realisation. Investment by Government in the Basin to date has been concentrated on infrastructure renewal programs to cap bores and replace bore drain systems. Investment in infrastructure renewal alone will not achieve desired outcomes. Future Government action may take the form of further capital investments (subsidies on works), clarification of water entitlements, research and development programs and extension and awareness raising campaigns.

The Standing Committee on Agriculture and Natural Resource Management (SCARM) (Appendix 3) has agreed to guidelines for public investments in natural resource management and mitigation of environmental degradation. This document provides a coherent and agreed basis for public investments in natural resource management applicable to the Basin.

Dependencies and Processes
This Plan has identified six objectives for achieving the vision for the Basin. The objectives are closely interrelated and implementation will need to recognise these interdependencies. For example, a reduction in land degradation associated with bore drains can only be achieved by controlling bore discharge and piping water. Improvements in environmental outcomes associated with use of artesian water can be achieved through improved management of the extraction, distribution and use of Basin groundwater. Achieving the level of water use efficiency desired in the Basin can only be achieved if attitudes change. Implementation needs to recognise some objectives will be an outcome of the way the Plan is implemented. This means many desired outcomes cannot be separated from actions taken to achieve other outcomes. For example, a program to replace all bore drains will help reduce erosion and weed pests and allow greater control over animal pests. Control of discharge will be a necessity if options for new uses are to be achieved and water is to be made available for the environment.

Planning for implementation means activities should be structured into various programs to meet the range of objectives outlined in this Plan.

Monitoring, Review and Reporting
Monitoring
Various strategies developed in this Plan identify a broad approach for achieving the six objectives. Effective implementation will depend on a clear and practical range of programs and on monitoring the

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effectiveness of their implementation to provide information necessary for evaluating progress towards achievement of objectives.

Practical and measurable targets should be clearly identified at the strategic level. Table 1 provides indicative targets for expected outcomes.

Each objective identifies a strategy for monitoring progress towards achieving that particular objective. Outcomes expected of each strategy are also identified. This monitoring would occur for the duration of the Plan.

All functional groups with roles and responsibilities for implementation will have a role in the acquisition of monitoring data. Primary responsibility for gathering data on resources, management programs and data evaluation will rest with State and Territory agencies responsible for program implementation. Monitoring of progress towards objectives will be a primary responsibility for Council. Council and State Advisory Committees have responsibility to monitor progress towards targets and to identify shortcomings in knowledge, standards, practices and program coordination at their respective levels. Landholders have an important role in monitoring the impact of various management practices and policies for practicality and to communicate relevant issues to State agencies and Advisory Committees.

Review and Reporting

There are many issues, known and unknown, with the potential to impact on the Plan’s success. Ongoing review of information from monitoring data will be an integral part of managing implementation. This process will incorporate the necessary mechanisms to permit changes to the Plan where necessary. Incorporation of a change mechanism will provide flexibility to make sure programs remain relevant and effective and that targets are achieved. Segmentation of the 15-year timeframe for the Plan into stages and incorporation of an audit process will facilitate change at a strategic level.

Those with an interest in the Basin will be kept informed of progress through release of regular information reports. Those with committed investment in the partnership need to be kept informed of progress. Reporting to landholders, State, Territory and Commonwealth Governments and any other investor in a partnership is essential. Provision of annual reports to landholders, Governments and other investors is needed for accountability and also as a means of informing partners of Plan changes.

A review of progress by reviewing and auditing the Plan will occur at the completion of each planning stage. States and the Territory have responsibility to evaluate monitoring data and report on progress of programs, expenditure and issues annually.

Reporting will take place at a number of levels and through a number of mechanisms. Data needed to support reviewing and reporting will be provided at Basin-wide, Statewide, management zone and landholder levels. These would comprise:

- reports to respective funders of progress, issues and expenditure annually;
- reports to Government, Ministers and landholders annually. Council would also have a role in coordination of reporting by jurisdictions, State Advisory Committees and landholders;
- progress and information bulletins to the wider community as needed;
- reports to Government and Ministers on the outcomes of major program reviews and audits. These reports are the responsibility of the Commonwealth, State and Territory Government agencies; and
- reports as needed by landholders to State and Territory Advisory Committees and Governments.
State Implementation Plans
States and the Territory, in consultation with Advisory Committees, will develop implementation plans consistent with this Plan. State and Territory plans will consider all objectives, establish priorities and incorporate monitoring arrangements. The formulation of State implementation plans will recognise interdependencies among the various objectives. Each State implementation plan should be developed for different timeframes, possibly on a rolling cycle, linked to funding cycles of relevant agencies. A staged approach combined with regular review and audit allows for certainty and actual outcomes to be aligned with desired outcomes. While the various State plans are likely to be different in their content and approach, there are broad areas where plans should adopt a consistent approach. These include:

- monitoring data and methods
  - monitoring network guidelines to specify parameters, frequency of measurement and methodologies;
  - data formats for data likely to be transferred between Governments; and
  - monitoring and reporting frameworks for progress towards objectives.
- cross-border issues
  - resource management targets in State border areas.
- standards
  - bore construction standards (with adaptations for regional conditions); and
  - codes of practice for use and management of Basin groundwater (with due consideration of regional differences in water quality, land use systems and production systems).

Figure 8 shows Basin management zones which will form an initial basis for resource management and implementation of activities. The development of management zones, each with appropriate codes of practice and zone-specific management objectives consistent with global management objectives, will be a key strategy for developing appropriate management practices for the productive and sustainable use of Basin water. Monitoring will be needed to make sure objectives for each zone are achieved and not degraded in the future.
Figure 8: Basin Management Zones

- Gulf Zone
- Flinders Zone
- Eastern Recharge Zone A
- Barcaldine Zone
- Eastern Recharge Zone B
- Mimosa Zone
- Eastern Recharge Zone C
- Western Zone
- North West Zone
- Central Zone
- Warrego Zone
- Surat Zone
- Southern Recharge Zone
- Western Recharge Zone
- Southwest Springs Zone

0 600 KILOMETRES
### Appendix 5: Summary of Objectives and Strategies

**Key Outcome:** Sustainable use of the Great Artesian Basin groundwater resources, with management aimed at achieving optimum economic, environmental and social benefits.

<table>
<thead>
<tr>
<th>Objective 1</th>
<th>Communicating and changing attitudes</th>
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<tbody>
<tr>
<td>Strategy 1.1:</td>
<td>Develop communication and education activities on environmental, social and economic values and limitations to increase understanding and recognition of the need for improved Basin management.</td>
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<tr>
<td>Strategy 1.2:</td>
<td>Implement targeted extension and education activities to increase understanding and recognition of need for improved management; increase water user investment in water management and infrastructure maintenance.</td>
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<tr>
<td>Strategy 1.3:</td>
<td>Promote understanding of Indigenous values and knowledge relating to Basin groundwater resources.</td>
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<tr>
<td>Strategy 1.4:</td>
<td>Assist opinion leaders and key decision makers to clearly understand the Basin’s importance and the support needed to properly manage it.</td>
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<tr>
<td>Strategy 1.5:</td>
<td>Monitor and evaluate effectiveness of communication, education and attitudinal change strategies.</td>
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<tr>
<th>Objective 2</th>
<th>Managing pressure and reducing waste</th>
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| Strategy 2.1: | Control all artificial outflows by:  
  • renewal, rehabilitation and maintenance of bore casing and headworks, and plugging unwanted bores; and  
  • replacing bore drains with piped water distribution systems. |
| Strategy 2.2: | Develop and implement a monitoring and maintenance schedule for bore casing, headworks and water reticulation systems by ensuring that all water infrastructure complies with regulatory requirements. |
| Strategy 2.3: | Develop and implement a bore and piped water reticulation maintenance training program for bore owners and operators. |
| Strategy 2.4: | Develop a groundwater protection strategy for Basin recharge zones. |
| Strategy 2.5: | Develop and implement a monitoring schedule for water levels and quality in recharge zones. |
| Strategy 2.6: | Establish appropriate codes of practice for the judicious use of Basin groundwater and for the design, construction and operation of bores and distribution systems. |
| Strategy 2.7: | Monitor and evaluate:  
  • pressure, quality, quantity and values of Basin bore discharge and natural surface discharge; and  
  • extent of access for new uses. |

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<tr>
<th>Objective 3</th>
<th>Water Reforms</th>
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<tr>
<td>Strategy 3.1:</td>
<td>Develop institutional arrangements to establish security of access and entitlement for users.</td>
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<tr>
<td>Strategy 3.2:</td>
<td>Establish groundwater management zones and objectives to indicate pressure targets for the Basin.</td>
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<tr>
<td>Strategy 3.3:</td>
<td>Establish groundwater management plans that involve a whole-of-systems approach and integrate consideration of Indigenous, cultural, land, water and vegetation values.</td>
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<td>Strategy 3.4:</td>
<td>Develop and implement compatible systems of water allocation, as appropriate, in line with national policy frameworks for groundwater management.</td>
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<tr>
<td>Strategy 3.5:</td>
<td>Build on existing financial instruments to foster water use efficiency and to create clear incentives for sustainable use of Basin groundwater resources.</td>
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<tr>
<td>Strategy 3.6:</td>
<td>Integrate Indigenous values and knowledge into groundwater management plans.</td>
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<tr>
<td>Strategy 3.7:</td>
<td>Monitor and evaluate institutional arrangements including resource legislation, administration structures, taxation and incentives.</td>
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<th>Objective 4</th>
<th>Environment and Heritage</th>
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<tr>
<td>Strategy 4.1:</td>
<td>Promote understanding of Basin environmental and cultural heritage values to increase their recognition and protection.</td>
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<td>Strategy 4.2:</td>
<td>Ensure that environmental and cultural heritage values are key factors in the management of Basin groundwater.</td>
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| Strategy 4.3: | Work collaboratively with other resource management groups to:  
  • actively manage and maintain groundwater-dependent environmental and cultural heritage values; and  
  • ensure that the extraction, distribution and use of Basin water do not lead to unacceptable environmental and cultural heritage impacts. |
| Strategy 4.4: | Ensure that changes in use and management practice do not result in unacceptable impacts on Indigenous or non-Indigenous cultural values. |
| Strategy 4.5: | Monitor and evaluate impact on environmental and cultural heritage values affected by use of Basin groundwater. |

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<th>Objective 5</th>
<th>Social and Economic</th>
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<tr>
<td>Strategy 5.1:</td>
<td>Promote an understanding of the integral relationship between Basin groundwater and socioeconomic values of the Basin dependent on the groundwater resource.</td>
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<tr>
<td>Strategy 5.2:</td>
<td>Work collaboratively with resource users and managers to improve socioeconomic outcomes through better Basin groundwater management practices.</td>
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<tr>
<td>Strategy 5.3:</td>
<td>Monitor and evaluate impact of changing groundwater management practices on socioeconomic values in regions of the Basin.</td>
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<th>Objective 6</th>
<th>Information and New Technology</th>
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<tr>
<td>Strategy 6.1:</td>
<td>Foster collaborative relationships that encourage the integration of scientific, technical and local information to make continual improvements in management practice desirable and feasible.</td>
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<tr>
<td>Strategy 6.2:</td>
<td>Provide an information-rich environment for Basin users and managers to encourage implementation of more appropriate management practices.</td>
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<tr>
<td>Strategy 6.3:</td>
<td>Coordinate and manage research and development to identify and fill strategically important knowledge gaps relating to Basin groundwater resource management.</td>
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<tr>
<td>Strategy 6.4:</td>
<td>Develop an information base on the relationship between the use and management of Basin groundwater and the value of the social and economic capital and infrastructure in the Basin.</td>
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<tr>
<td>Strategy 6.5:</td>
<td>Work collaboratively with Indigenous groups to identify Indigenous knowledge and values in the Basin.</td>
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<tr>
<td>Strategy 6.6:</td>
<td>Work collaboratively with industry groups to encourage research and development of technology to contribute to the management of Basin groundwater resources.</td>
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<tr>
<td>Strategy 6.7:</td>
<td>Work collaboratively with other resource management groups to ensure the best natural resource outcomes from Basin resources and its use.</td>
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<tr>
<td>Strategy 6.8:</td>
<td>Coordinate development and management of strategically important information systems to support management of Basin groundwater resources.</td>
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<tr>
<td>Strategy 6.9:</td>
<td>Monitor and evaluate decision-making processes and management practices to identify inefficiencies and barriers caused by insufficient information or inadequate technology.</td>
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