Avon River Basin 2050

Four regional scenarios for the next half-century

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for the ARB 2050 Working Group partners:
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>$A$</td>
<td>Australian dollars</td>
</tr>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ACC</td>
<td>Avon Catchment Council</td>
</tr>
<tr>
<td>AGO</td>
<td>Australian Greenhouse Office</td>
</tr>
<tr>
<td>ARB</td>
<td>Avon River Basin</td>
</tr>
<tr>
<td>ARB2050</td>
<td>Avon River Basin 2050 Scenario Planning Project</td>
</tr>
<tr>
<td>ATSI</td>
<td>Aboriginal and Torres Strait Islander</td>
</tr>
<tr>
<td>Basin</td>
<td>Avon River Basin</td>
</tr>
<tr>
<td>CDMA</td>
<td>Code Division Multiple Access (telephony)</td>
</tr>
<tr>
<td>CRC</td>
<td>Co-operative Research Centre</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Science and Industrial Research Organisation</td>
</tr>
<tr>
<td>CSO</td>
<td>Community Service Obligation</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental Management System</td>
</tr>
<tr>
<td>GAWS</td>
<td>Goldfields and Agricultural Water Supply (scheme)</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GMO</td>
<td>Genetically modified organism</td>
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<tr>
<td>ILC</td>
<td>Indigenous Land Corporation</td>
</tr>
<tr>
<td>IWP</td>
<td>Integrated Wood Processing</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>LCDC</td>
<td>Land Conservation District Committee</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
</tr>
<tr>
<td>M</td>
<td>million</td>
</tr>
<tr>
<td>MI</td>
<td>megalitre</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>NEWROC</td>
<td>North-east Wheatbelt Region of Councils</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-government organisation</td>
</tr>
<tr>
<td>no.</td>
<td>number</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resource Management</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>PII</td>
<td>Proposed Investment Initiative</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SD</td>
<td>Scenario Driver</td>
</tr>
<tr>
<td>SRG</td>
<td>Stakeholder Reference Group</td>
</tr>
<tr>
<td>t</td>
<td>tonnes</td>
</tr>
<tr>
<td>TAFE</td>
<td>Technical and Further Education (colleges)</td>
</tr>
<tr>
<td>TBL</td>
<td>Triple bottom line (society, environment and economy)</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>WA</td>
<td>Western Australia</td>
</tr>
<tr>
<td>WACC</td>
<td>Wheatbelt Area Consultative Committee</td>
</tr>
<tr>
<td>WALGA</td>
<td>Western Australian Local Government Association</td>
</tr>
<tr>
<td>WDC</td>
<td>Wheatbelt Development Commission</td>
</tr>
<tr>
<td>yr</td>
<td>year</td>
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Preface

The aim of the Avon River Basin 2050 project was to complete a scenario planning exercise in the Avon River Basin in order to consider the robustness of current regional strategies, identify key drivers, avoid relying on business-as-usual as the default strategy, identify opportunities and challenges not apparent now, and build a ‘future-aware’ culture in the region.

Looking back half a century to 1950, there were a number of issues that we didn’t recognize as important at the time. As a land holder and resident of the Avon River Basin I have seen many achievements of our communities and individuals. Agriculture was still expanding although much of the region had been cleared of nature vegetation. Early signs of secondary salinity were appearing in the broad valley floors. Long fallows and multiple cultivations were unsustainable but continued for 30 plus years, leading to erosion by wind and water. Wool was the key animal industry. In society there was a lack of awareness of the causes of long-term health problems – smoking, farm chemicals, diet, alcohol and driving. However health services were well distributed. Babies were still being delivered in local areas. The Government was a major employer. The region was served by many small schools, with only a few people sending kids away for secondary and tertiary education.

Some of the issues emerging in the 1950s still pose a major concern today. Overclearing of the landscape has led to a major expansion of dryland salinity, and a loss of species richness, as well as the emergence of Landcare groups. Agriculture has become high input, high risk, yet remains profitable and productive. It is a market-focussed industry for food and fibre production. Major changes to agricultural equipment provide flexibility. Agriculture holds a declining share (4%) of the national economy, while in the Basin mining is cyclical and small business diverse. Socially, there is a shift from local to external focus (shopping, education, investment). Contraction of health services is occurring alongside increased awareness of personal health risks. The region has far fewer schools, and many seek secondary and tertiary education outside region. Our indigenous population is rising. Did any of this seem plausible back in 1950? Our core business is still based around agriculture, but today’s daily lives and tools have changed. We are now beginning to think about the future more strategically because of resource limitations.

To ensure our adaptability and capacity to change is maintained and to increase our prospects for a more vibrant future we need to make choices today, choices that will influence what happens in the Avon River Basin tomorrow. These choices must be based on systematically assessing our future prospects.

This report outlines four plausible scenarios to 2050. Although these may seem familiar and comfortable to many, the challenge now is to stretch our thinking. Compare the scenarios to how you see our way forward in a rapidly changing world. These are the first steps on the journey to developing possible and preferable futures.

For groups in the Avon River Basin, this project has also generated some very important futures resources. In particular, data about the Basin and past, its social, economic and environmental trends, and details of 22 drivers of current and future change. They will be very useful when developing scenarios tailored to your own situation.

Mike McFarlane
Convenor, ARB 2050
Executive Summary

Aims

Avon River Basin 2050 is a futures-based research project for a major part of the Western Australian wheatbelt. Economic, social and environmental strategic thinkers from the Avon River Basin (ARB) looked towards the year 2050. The aim of the project was to identify critical issues and drivers of change that would affect efforts by present and future generations in the Basin to improve regional prospects.

The Region

The Wheatbelt of Western Australia is under pressure to respond to environmental, economic and social challenges. Many of these challenges have emerged in the past 50 years, and will have a significant impact on our future. By envisioning the future we can prepare for and manage these forces in the best way possible. The ARB is the central region of the Wheatbelt, and was selected as the geographic focus for this research for its economic significance and location.

The Project

The project was initiated by CSIRO’s Water for a Healthy Country flagship project and developed and operated through a partnership with the Avon Catchment Council, Wheatbelt Development Commission, Department of Agriculture Western Australia and the community. The community was represented by Mr Mike McFarlane, a Doodlakine landholder who took on the role of Project Convenor. Dr Don MacRae of APT Business Services facilitated the workshop series and the development of 10 investment initiatives. Fifty residents and strategic thinkers participated through a series of workshops. These stakeholders were divided into four groups to develop scenarios.

Outcomes

1. Providing a social, environmental and economic context for Water for a Healthy Country flagship projects in southwest Western Australia (further details of these projects are available at http://www.healthycountry.com.au/SWWesternAus/index.htm)

   - **Rural Town Water Management**
     Optimising management of water resources in Wheatbelt rural towns.

   - **Wheatbelt Drainage Evaluation**
     Evaluating the impact of regional land use and river drainage systems.

   - **Farm Water Futures**
     Adding value to water by helping people to manage water flows on farms and the broader landscape.


3. Twenty two critical drivers of change were identified. The most uncertain and important were:

   (1) **Access to new markets**, and

   (2) **Environmental change**.

These two clusters were used to define four plausible scenarios for the Basin:

<table>
<thead>
<tr>
<th>1. SALINE GROWTH</th>
<th>3. HARMONY WITH PROSPERITY</th>
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<tbody>
<tr>
<td>2. GRAIN AND DRAIN</td>
<td>4. LANDCARE BOUNTY</td>
</tr>
</tbody>
</table>
4. Past and future trends were estimated for three key triple-bottom line indicators:

![Population Chart]

5. The prospects for ten Proposed Investment Initiatives were assessed. Establishing a CRC for Grainbelt Futures was selected as the most promising for initial development.

### Outputs

The results of ARB2050 have been communicated in the following publications:

- 20-page full-colour Brochure
- Final Report (this document)
- Future Broadacre Agricultural Landscapes Conference paper to be published by RIRDC.
- Website pages on the [Water for a Healthy Country](http://www.arb2050.com) website (see [www.arb2050.com](http://www.arb2050.com))
1 Introduction

Avon River Basin 2050 (ARB2050 for short) is a joint initiative to explore critical issues and drivers likely to shape the region's future. The partners are CSIRO Water for a Healthy flagship project, Avon Catchment Council, Wheatbelt Development Commission, Department of Agriculture WA.

1.1 Participants

1.1.1 Working Group

Representatives from each of the project partner organizations formed the ARB working group to manage the project. The working group was led and convened by Mr Mike McFarlane, landholder from Doodlakine in the central wheatbelt, and formally met for the first time on 26 June 2003.

1.1.2 Stakeholders

Across the triple-bottom line we sought a group of stakeholders, the Basin’s key strategic thinkers and investors, to interact creatively in assessing possible and preferred futures for the Avon River Basin. The invited stakeholders represented the following themes and activities within the Basin:

- Agricultural and economic consultants, aquaculture
- Banking
- Climate adaptation, conservation, current and former State government members
- Energy supply, environment
- Farm forestry, federal regional funding body
- Grain export
- Health
- Indigenous land use
- Landholders, local government
- Renewable energy, research and development, rural support and social enterprises
- Secondary education students and teachers, State government departments
- Telecommunications, tertiary education, tourism, transport, and
- Water supply.

A complete list of stakeholders is contained in Appendix 5.

1.2 Guiding Question

Scenario planning is only effective when applied to a question of interest. The Avon River Basin 2050 project was guided by this question:

What critical issues and attendant drivers of change are relevant to community efforts to improve the regional prospects for present and future generations of the Avon River Basin to 2050?

1.3 Regional prospects defined

Improving regional prospects is defined as any regional configuration that that improves the triple-bottom line, although it may not necessarily represent optimal or maximal settings of economy, society and environment. It is also seen to be any change that maintains, develops or increases the present amount, quality, accessibility, use or distribution of regional assets, including people, biodiversity, services, regional identity, and equitable return on contributions to the national economy.

Improved regional prospects could be achieved by a combination of:

- Improved income,
- Investment,
- Rearrangement of assets into arrangements that improve benefits, efficiencies and outputs,
1. Introduction

Avon River Basin 2050

- Increased independence of the population to control some aspects of life, while understanding there are inherent links between other regions, nations and the global economy, and
- Reduction in inputs and/or increase in outputs.

Improvement in regional prospects may or may not develop a regional identity.

1.4 Scenario planning method

The initiative was based around the established technique of scenario planning, a set of methods for understanding what will drive future choices: the choices of those who make social, environmental and economic investments in the region, the choices of those who live and work there (Schwartz 1996; O’Brien 1999).

During the project activation phase, the invited stakeholders were provided with a short summary, as an introduction to scenario planning. The messages in that document were grouped into the following four key themes:

1. Scenario planning is a tool that Regions can use to:
   - Think systematically about the future, leading to better decisions about choices that need to be made in the short term.
   - Test opportunities for development over the long term.

2. Scenario planning is a learning process, in which a region can gain an understanding of:
   - Current qualities and conditions (a stocktake).
   - How past driving forces shaped the present.
   - Drivers that may operate in the near and distant future.
   - Certainty or uncertainty of future drivers.
   - Processes operating within and beyond the region.

3. Scenario planning works best when:
   - Regional stakeholders drive the process and, therefore, own the outcomes.
   - Economic, social and environmental forces acting in the future are considered.
   - Science, technology and emerging industries are an integral part of the process.

4. Scenario planning is none of the following:
   - Prediction of the future.
   - A single vision of the future.
   - Prescription for what to do in the future.
   - Means of justifying business-as-usual

1.5 Project events

The scenario planning method requires knowing the region, the local and world forces or drivers shaping it, and how these drivers might possibly combine into scenarios. Throughout the project past and possible future trends were explored and, where possible, documented. We also tested the robustness of current and emerging strategies, public and private, against the set of scenarios that strategic thinkers, investors and residents developed.

The project was conducted as a series of three workshops at the Muresk Hall (at Curtin University of Technology’s Muresk Institute near Northam), each on a different stage of scenario planning. Don MacRae from APT Business Services facilitated the workshop series and guided the scenario planning process.
1.5.1 Critical Issues Workshop

17 October 2003

In this half-day workshop the stakeholders discussed existing and identified emerging issues and related data and analytical tools that were critically important to improving regional prospects for present and future generations. Related issues were debated and grouped into 'drivers' that were used to create the scenarios.

1.5.2 Scenarios Creation Workshop

20 February 2004

At this one day session stakeholders used data about, and analytical profiles of, 'drivers' to create scenarios describing plausible futures for the Avon River Basin.

1.5.3 Strategies Response Workshop

26 March 2004

Stakeholders considered the relevance of working group members' strategies to each of the scenarios created. This was followed up with analysis of the strengths and weaknesses of these strategies, and how this technique could be applied to other strategy documents.

Working group meetings were conducted at Department of Agriculture, Northam, on 26 June 2003, 28 July 2003, 7 October 2003, at CSIRO, Floreat, on 6 February 2004 and again at Department of Agriculture, Northam, on 4 June 2004. Between meetings drafts of project documents and outputs were shared by email.

1.6 Other project activities

The scenario planning method requires knowing the region, the local and world forces or drivers shaping it, and how these drivers might possibly combine into scenarios. Throughout the project past and possible future trends were explored and, where possible, documented. We also tested the robustness of current and emerging strategies, public and private, against the set of scenarios that strategic thinkers, investors and residents developed.

In parallel with the workshops, a subgroup of the stakeholders and working group canvassed ideas for investment initiatives. These ideas were developed into brief proposals suitable for further development (see Proposed Investment Initiatives on page 41 and Appendix 4 on page 111).

1.7 Beyond ARB2050

ARB2050 Stakeholders saw the project as a starting point for developing a future-focussed culture in the region. Creating Our Future on page 84 lists a range of activities that individuals and organisations could undertake to extend the project results.

In addition, there is a need to extend the stocktake element of the project, investigating and documenting historic trends (see A triple-bottom line summary on page 8). A number of economic and social trends are not well understood, or are only documented for no more than the past decade. For example, employment levels and employment sectors data are patchy, while data on sport participation are patchy and trends since 1950 are anecdotal. New research in these areas could be contributed to the ARB2050 website www.arb2050.com).

1.8 Acknowledgements

ARB2050 was completed with contributions from many people.

- The project was managed by a Working Group chaired by Mike McFarlane, project Convenor. Members included Ted Lefroy, Michael O’Connor and Mick Poole (CSIRO), Damien Martin and
Zanda Cameron, and subsequently Mark South and Pip Shields (Wheatbelt Development Commission), Barbara Morrell and Wayne Clarke (Avon Catchment Council), Cec McConnell and James Fisher (Department of Agriculture, WA) Murray McGregor, Muresk Institute, and Don MacRae, APT Business Services.

- The development of the ARB statistical database and analysis of past trends was conducted by Michael O’Connor. Subsets of statistical data were provided by Department of Planning and Infrastructure (population) and Department of Agriculture, WA (agricultural production). Other data sources are acknowledged in the related map or figure.

- Mick Poole, CSIRO, and Hendy Cowan, WACC, managed the Proposed Investment Initiative process, while Hendy provided a decisive analysis of the best approach to choosing an initiative most likely to attract investment funds.

- Don Harrison of Western Power provided a diagrammatic integration of a staged development of the proposed investment initiatives.

- Amy Harrison and Gemma Hutchinson of Altier Business+Marketing designed and generated the brochure.

- Michael O’Connor compiled the Final Report drawing on project materials where possible, researched and wrote sections 1-3 and 7, and created the maps and tables from the sources indicated.

- Text from the workbooks produced for the Workshop series is courtesy of APT Business Services, Canberra.

- Stakeholders gave up considerable time to be present on the workshop days, to develop the drivers, issues and scenarios, and to respond to survey requests for assessments of outputs and future opportunities. A number of stakeholders with expertise in particular fields took on extra work to oversee the revision of assigned drivers and issues.

- Karen Mobbs produced the ARB2050 webpages following the Communication Plan developed by APT Business Services.
2 Taking stock of the past 50 years

2.1 Historical sampling

Preparation for the 50-year scenarios began with a retrospective look at the past 50 years in the Avon River Basin. The focus was on key trends across the triple bottom line that had emerged within the region since the early 1950s. The historical trends were investigated at whole-of-region scale, and expressed in map or graph form, wherever possible. The data gathering and analysis task provided stakeholders with a snapshot of the region, so that they were:

- Familiar with the geography of the Basin and their relationship to it, and
- Understood key trends within the Basin over the past 50 years, as their knowledge may not have stretched back far enough.

It was also hoped that this resource might limit the opportunity for disagreements on historical trends to hinder progress on the scenarios.

Historical trends investigated for use in Workshop One were based on the initial list of drivers and issues researched by the project working group. Additional historical trends were researched in response to new drivers contributed by stakeholders in Workshop Two, with subsequent additions aimed at building a more comprehensive data resource for use in understanding the ARB2050 scenarios and in future scenario planning activities.

2.2 Assembling the historical data

Taking a Basin-scale view of the past was a necessary first step in ARB2050. However the only readily-available data at that scale was environmental (salinity, vegetation change, soils). A triple bottom line perspective required the addition of historical social and economic data. This led to the development of a method for resampling Local Government Area statistical data to the Avon River Basin boundary. The possibility of using published statistical sub-region aggregated totals was investigated, but found unsuitable. Shires were aggregated into Statistical Districts until 1973, at which time the present arrangement of Statistical Divisions was decreed (ABS pers. comm.). At all times four sub-regions overlapped the Basin, but the extent and degree of overlap varied, making aggregation to the Basin boundary difficult (Figure 1). Added complications were that LGA boundaries and names had altered since 1950, and that most statistical data published before 1985 was not available electronically.

Forty-three shires were partly or completely within the ARB boundary in the year 2000, but this had not always been the case. The effects of boundary changes were investigated by compiling a list of LGAs overlapping or within the ARB (Table Figure 1.

![Figure 1. Changes in statistical collection areas, Avon River Basin, 1952 – present.](image)
Details of significant changes were obtained from LGA maps in the introductory notes to the LGA summary tables in the Statistical Registers of WA (see Statistical sources on page 7).

WA Shire/LGA based statistical summaries were published annually by the ABS under the series title Statistical Registers up until 1960, and then under a variety of titles until the early 1990s. Over 100 statistical subjects were included in each publication, although the labelling changed over time and subjects were deleted and added. Units of measurement changed with the introduction of the metric system in Australia in the early 1970s.

Copies of the statistical summaries for 1951 to 1991 for LGAs (in five-yearly intervals to limit the quantity of data) and for Western Australia (for every year) were scanned and converted to columns of text and numbers using optical character recognition software. These were imported into an Access database table. Each statistic was associated with a record in a table of LGAs. For LGAs with changed boundaries post-1950 separate LGA identifiers were used. For example pre-1965 York Town was ‘York 1’ and York Shire was ‘York 2’, while their merged entity post-1965 was labelled ‘York 3’. Revisions in statistical labels over time were accommodated by creating a set of standard statistical labels, then associating them with the actual labels used in each statistical summary publication. For example, in the 1951-2 Statistical Register the statistic ‘Area Under Crop’ is equivalent to the statistic ‘Land used for crops’ from 1956-7 onwards, along with a data collection date that was used to sort in date order. While most of the available statistical data was published under a double half-year date heading (eg. 1971/72) some statistics for larger regions (eg. state of Western Australia) are published under a whole year date (eg. 1972).

Further investigation was able to identify the likely collection date for data originally published under whole year headings eg. WA agricultural data published as 1958 actually relates to the season 1958/9 and was collected on 31-March-1959. Additional statistical data were provided by Department of Planning and Infrastructure (population) and Department of Agriculture, WA (agricultural production). The final data table contained over 50 000 statistics.

For LGAs that were only partly within the ARB a method was established for extracting the part of their statistical data that was attributable to the ARB. Statistical subjects were assigned a ratio type, either area-based, town-based or area+town based (Table 2). The area of each LGA was extracted from a Geographic Information System and checked against published area data. The area+town ratio type was mostly relevant to population data. A check of applicable population data for 1961-2 established that the approximate ratio of on-farm to off-farm residents in ARB LGAs was 1:1.

Conversion tables standardised ARB-scale calculations in metric measurements in simple consistent units eg. kg/ha. The latter conversions were necessary because metric units became standard in the 1970s but statistics continued to be published at various levels of precision (eg. tonnes v. ‘000 tonnes).

Table 1. Major changes to LGAs within the ARB, 1952-1985 (Department of Local Government and Regional Development (2003)).

<table>
<thead>
<tr>
<th>Local Government Area</th>
<th>Date of Change</th>
<th>Effect on portion within ARB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dalwallinu resized</td>
<td>1 Jul 1962</td>
<td>16% → 8%</td>
</tr>
<tr>
<td>Gnowangerup resized</td>
<td>1 Jul 1982</td>
<td>3% → 8%</td>
</tr>
<tr>
<td>Kondinin resized</td>
<td>18 May 1962</td>
<td>Minimal</td>
</tr>
<tr>
<td>Phillips River renamed Ravensthorpe</td>
<td>1 Jul 1961</td>
<td>-</td>
</tr>
<tr>
<td>Kent renamed Nyabing-Pingrup</td>
<td>28 Mar 1958</td>
<td>50% → 55%</td>
</tr>
<tr>
<td>Nyabing-Pingrup renamed Kent</td>
<td>2 Dec 1972</td>
<td>55% → 64%</td>
</tr>
<tr>
<td>Kununoppin-Trayning renamed Trayning-Kununoppin-Yelbeni</td>
<td>01-Jul-1961</td>
<td>-</td>
</tr>
<tr>
<td>Trayning-Kununoppin-Yelbeni renamed Trayning</td>
<td>10-Sep-1965</td>
<td>-</td>
</tr>
<tr>
<td>York Town and York Shire merged into York</td>
<td>15 Mar 1965</td>
<td>70% → 75%</td>
</tr>
</tbody>
</table>
ARB-scale data for 1950-2000 was calculated with an Access database crosstab query, correlating statistical subject to year and summing relevant values into an Excel spreadsheet. A number of derived statistics were then calculated from the ARB-scale data eg. wheat yield. WA summary data were extracted from the database for the same year range. A summary of all the values is contained in Appendix 2.

The Excel spreadsheet data was the basis for the range of historical trend graphs in the following three sub-sections – Environment, Economy and Society. The five-year time steps of the ARB-scale data occasionally produced an unusual spike or drop in these graphs (eg. the number of pigs in the Basin in the early 1970s). This was compared to the annual WA state data to check whether these unusual ARB values were representative of state trends or a result of possible data errors.

2.3 Statistical sources

The basis of the triple-bottom line summary in the next section was retabulated statistical data from the following Australian Bureau of Statistics sources and publications (also included in the References).


Table 2. Conversion formulae for sampling LGA statistics.

<table>
<thead>
<tr>
<th>Ratio Type</th>
<th>Meaning and Formulae applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>Proportion of statistic attributable to the ARB corresponds to percentage area of shire with ARB eg. Land used for crops.</td>
</tr>
<tr>
<td></td>
<td>[[\text{MetricConversion}]<em>[\text{Value}]</em>[%\text{LGA area in ARB}]/100]</td>
</tr>
<tr>
<td>Town</td>
<td>Proportion of statistic attributable to the ARB corresponds to percentage of the LGAs towns within ARB eg. Number of Manufacturing sites.</td>
</tr>
<tr>
<td></td>
<td>[[\text{MetricConversion}]<em>[\text{Value}]</em>[%\text{Towns in Basin}]/100]</td>
</tr>
<tr>
<td>Area+town</td>
<td>Proportion of statistic attributable to the ARB corresponds to the sum of percentage area of shire with ARB and percentage of LGA towns within the ARB eg. Aged 25-44 last birthday.</td>
</tr>
<tr>
<td></td>
<td>[[\text{MetricConversion}]<em>[\text{Value}]</em>[%\text{LGA area in ARB}]/100 + \text{[MetricConversion]}/[\text{Value}]*[%\text{Towns in Basin}]/100]</td>
</tr>
</tbody>
</table>
3 A triple-bottom line summary

3.1 Location

Nearly twice the size of Tasmania, the Avon River Basin (ARB) is east of Perth, the state capital of Western Australia. The Great Eastern Highway through Northam, Merredin and Southern Cross links Perth with the Eastern States (Figure 2). The Goldfields water supply pipeline and rail lines follow this route also.

3.2 Why the Avon River Basin?

The Wheatbelt in south-western Australia was selected as the general geographic focus of ARB2050. However the term ‘Wheatbelt’ is one that is open to confusion. To others the Wheatbelt is one of the State Government’s development regions, taking in shires from Yilgarn to Lake Grace through to Dandaragan and Gingin on the coast (Figure 3). More generally ‘wheatbelt’ it implies the cleared lands, the entire broad-acre grain farming areas within the region bounded by
the coastline and a line approximately from Geraldton to Esperance (Figure 4).

The histories of these two competing visions of the 'wheatbelt' are not easy to analyse across the triple bottom line, a necessary part of any scenario planning exercise. The Avon River Basin was selected as the project boundary, being the Avon River's surface water catchment boundary. It is an area of increasing interest as management of water and salinity becomes critical to the region's future and that of the Swan River estuary downstream. As a representative sample of the WA wheatbelt lessons, learned in ARB2050 would also be applicable more widely.

Figure 3. Overlap of the State Government Wheatbelt Development region (light shaded shaded, whole LGAs) and the Avon River Basin (whole and part LGAs).

Figure 4. Overlap of the 'wheatbelt' broadacre farming zone of south-western Australia (light shading) to the Avon River Basin (dark line) and Local Government Areas.
3.3 Local Government Areas

There are 150 communities across the region, within 43 Local Governments Areas (LGAs) that are partly or entirely within the Avon River Basin (Figure 5). Of these LGAs, or shires, 16 are completely within the Basin and another 7 have at least 80% overlap, while a further 7 have less than 10% overlap. The LGAs were typically the smallest level of analysis of Environmental, Economic and Social trends in the following subsections. Typically this is the level at which statistical data was published annually. The emergence of the current boundaries is described in Taking stock of the past 50 years on page 5, and illustrated in Figure 36, but has mostly remained unchanged since the early 1950s.

![Figure 5. Local Government Areas (LGAs) that overlap the Avon River Basin.](image)
Table 3. Local Government Areas within the Avon River Basin, extent of overlap with the Basin and the name and gazettal dates of some towns and townsites within each Basin LGA.

<table>
<thead>
<tr>
<th>LGA</th>
<th>Total Area (km²)</th>
<th>Overlap with Basin (km²)</th>
<th>Overlap with Basin (%)</th>
<th>LGA Name</th>
<th>Towns and townsites within Basin (Gazettal Date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beverley</td>
<td>2369</td>
<td>1901</td>
<td>80</td>
<td>Beverley</td>
<td>Beverley (1830)</td>
</tr>
<tr>
<td>Brookton</td>
<td>1599</td>
<td>1599</td>
<td>100</td>
<td>Brookton</td>
<td>Brookton (1899)</td>
</tr>
<tr>
<td>Bruce Rock</td>
<td>2724</td>
<td>2724</td>
<td>100</td>
<td>Bruce Rock</td>
<td>Bruce Rock (1913), Shackleton (1951)</td>
</tr>
<tr>
<td>Coolgardie</td>
<td>30174</td>
<td>9391</td>
<td>31</td>
<td>Coolgardie</td>
<td>Corrigin (1913)</td>
</tr>
<tr>
<td>Corrigin</td>
<td>2680</td>
<td>2680</td>
<td>100</td>
<td>Corrigin</td>
<td>Cunderdin (1906)</td>
</tr>
<tr>
<td>Cuballing</td>
<td>1194</td>
<td>45</td>
<td>4</td>
<td>Cuballing</td>
<td></td>
</tr>
<tr>
<td>Cunderdin</td>
<td>1861</td>
<td>1861</td>
<td>100</td>
<td>Cunderdin</td>
<td></td>
</tr>
<tr>
<td>Dalwallinu</td>
<td>7222</td>
<td>1184</td>
<td>16</td>
<td>Dalwallinu</td>
<td>Dalwallinu (1914), Pithara (1914)</td>
</tr>
<tr>
<td>Dowerin</td>
<td>1862</td>
<td>1862</td>
<td>100</td>
<td>Dowerin</td>
<td>Dowerin (1907)</td>
</tr>
<tr>
<td>Dumbleyung</td>
<td>2538</td>
<td>418</td>
<td>16</td>
<td>Dumbleyung</td>
<td></td>
</tr>
<tr>
<td>Dundas</td>
<td>94275</td>
<td>1467</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Gnowangerup</td>
<td>4265</td>
<td>349</td>
<td>8</td>
<td>Gnowangerup</td>
<td></td>
</tr>
<tr>
<td>Goomalling</td>
<td>1834</td>
<td>1834</td>
<td>100</td>
<td>Goomalling</td>
<td>Goomalling (1903)</td>
</tr>
<tr>
<td>Jerramungup</td>
<td>6509</td>
<td>12</td>
<td>0</td>
<td>Jerramungup</td>
<td></td>
</tr>
<tr>
<td>Kellerberrin</td>
<td>1914</td>
<td>1914</td>
<td>100</td>
<td>Kellerberrin</td>
<td>Kellerberrin (1901)</td>
</tr>
<tr>
<td>Kent</td>
<td>5630</td>
<td>3606</td>
<td>64</td>
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<td>Pingrup (1924)</td>
</tr>
<tr>
<td>Koorda</td>
<td>7370</td>
<td>7362</td>
<td>100</td>
<td>Koorda</td>
<td>Hyden (1932), Karlgarin (1931), Kondinin (1915)</td>
</tr>
<tr>
<td>Koorda</td>
<td>2831</td>
<td>1441</td>
<td>51</td>
<td>Koorda</td>
<td>Koorda (1917)</td>
</tr>
<tr>
<td>Kulin</td>
<td>4709</td>
<td>4516</td>
<td>96</td>
<td>Kulin</td>
<td>Dudinin (1915), Kulin (1914)</td>
</tr>
<tr>
<td>Lake Grace</td>
<td>10381</td>
<td>10005</td>
<td>96</td>
<td>Lake Grace</td>
<td>Lake Grace (1916), Lake King (1936), Newdegate (1925)</td>
</tr>
<tr>
<td>Menzies</td>
<td>126040</td>
<td>161</td>
<td>0</td>
<td>Menzies</td>
<td></td>
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<tr>
<td>Merredin</td>
<td>3296</td>
<td>3296</td>
<td>100</td>
<td>Merredin</td>
<td>Burracoppin (1891), Merredin (1906), Muntadgin (1925)</td>
</tr>
<tr>
<td>Moora</td>
<td>3760</td>
<td>296</td>
<td>8</td>
<td>Moora</td>
<td>Bindi Bindi (1947)</td>
</tr>
<tr>
<td>Marshall</td>
<td>10173</td>
<td>3282</td>
<td>32</td>
<td>Marshall</td>
<td>Beacon (1931), Bencubbin (1917)</td>
</tr>
<tr>
<td>Mount</td>
<td>3432</td>
<td>3150</td>
<td>92</td>
<td>Mount</td>
<td>Bonnie Rock (1932), Mukinbudin (1922)</td>
</tr>
<tr>
<td>Narembeen</td>
<td>3829</td>
<td>3829</td>
<td>100</td>
<td>Narembeen</td>
<td>Narembeen (1968)</td>
</tr>
<tr>
<td>Northam</td>
<td>1403</td>
<td>1102</td>
<td>78</td>
<td>Northam</td>
<td>Northam (1836)</td>
</tr>
<tr>
<td>Northam</td>
<td>26</td>
<td>26</td>
<td>100</td>
<td>Northam</td>
<td>Northam (Town)</td>
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<tr>
<td>Nungarin</td>
<td>1161</td>
<td>1161</td>
<td>100</td>
<td>Nungarin</td>
<td>Nungarin (1912)</td>
</tr>
<tr>
<td>Pingelly</td>
<td>1293</td>
<td>945</td>
<td>73</td>
<td>Pingelly</td>
<td>Pingelly (1898)</td>
</tr>
<tr>
<td>Quairading</td>
<td>2015</td>
<td>2015</td>
<td>100</td>
<td>Quairading</td>
<td>Quairading (1907), Yoting (1914)</td>
</tr>
<tr>
<td>Ravensthorpe</td>
<td>13572</td>
<td>583</td>
<td>4</td>
<td>Ravensthorpe</td>
<td></td>
</tr>
<tr>
<td>Tammin</td>
<td>1101</td>
<td>1101</td>
<td>100</td>
<td>Tammin</td>
<td>Tammin (1899)</td>
</tr>
<tr>
<td>Toodyay</td>
<td>1691</td>
<td>745</td>
<td>44</td>
<td>Toodyay</td>
<td>Toodyay (1860)</td>
</tr>
<tr>
<td>Trayning</td>
<td>1649</td>
<td>1649</td>
<td>100</td>
<td>Trayning</td>
<td>Trayning (1912)</td>
</tr>
<tr>
<td>Victoria Plains</td>
<td>2549</td>
<td>679</td>
<td>27</td>
<td>Victoria Plains</td>
<td>Bolgart (1909)</td>
</tr>
<tr>
<td>Wandering</td>
<td>1898</td>
<td>263</td>
<td>14</td>
<td>Wandering</td>
<td></td>
</tr>
<tr>
<td>Westonia</td>
<td>3303</td>
<td>3286</td>
<td>99</td>
<td>Westonia</td>
<td>Westonia (1926)</td>
</tr>
<tr>
<td>Wickepin</td>
<td>2039</td>
<td>1113</td>
<td>55</td>
<td>Wickepin</td>
<td>Wickepin (1908), Yealering (1912)</td>
</tr>
<tr>
<td>Wongan-Ballidu</td>
<td>3363</td>
<td>3016</td>
<td>90</td>
<td>Wongan-Ballidu</td>
<td>Ballidu (1914), Cadoux (1929), Wongan Hills (1911)</td>
</tr>
<tr>
<td>Wyalkatchem</td>
<td>1593</td>
<td>1593</td>
<td>100</td>
<td>Wyalkatchem</td>
<td>Wyalkatchem (1911)</td>
</tr>
<tr>
<td>Yilgarn</td>
<td>30182</td>
<td>26640</td>
<td>88</td>
<td>Yilgarn</td>
<td>Bodallin (1918), Bullfinch (1910), Koolyanobbing (1965), Marvel Loch (1911), Moorine Rock (1925), Southern Cross (1890), Yellowdine (1935)</td>
</tr>
<tr>
<td>York</td>
<td>2269</td>
<td>1603</td>
<td>71</td>
<td>York</td>
<td>York (1836)</td>
</tr>
</tbody>
</table>
3.4 Environment

3.4.1 Water

The Avon River Basin is about 120 000 km² in area. It comprises three water catchments, the Avon on the western margin, the Yilgarn in the north-east and the Lockhart in the central-southern area (Figure 6). The region also contains two drainage zones caused by the land west of the Meckering line being uplifted about two million years ago (Avon Catchment Council 2004). From west to east, rainfall reduces from 750 to 200 mm per year. Through the upper part of the catchment, which remains extensively vegetated, chains of salt lakes connect up in extremely wet years (Viney & Sivapalan 2001).

The majority of annual river flow is generated in the Avon catchment (Pen 1999). Major floods occurred in 1955, 1958, 1963, 1964, 1983 and 2000 (Hatton and Ruprecht 2002). The Water and Rivers Commission has established river monitoring sites at various locations across the Basin, at which records of flow rate and water quality indicators (eg. sedimentation, pH, nitrogen) began in the 1960s (Figure 7).

The lower Avon exports 360 gigalitres of salty water into the Swan River annually (Viney and Sivapalan 2001), influencing the health of Perth’s estuary. Long sections of the lower Avon were retrained in the 1950s (Water and Rivers Commission and Avon River Management Authority 1999). Since 2000, the Avon Catchment Council has had the task of coordinating landscape management in the Basin. The Council has recently published a draft regional plan under the National Action Plan on Salinity and Water Quality (Avon Catchment Council 2004).
WA water assets (streams, catchments, lakes, swamps) have been assessed and ranked for the State Salinity Investment Framework Interim Report 1 (Department of Environment 2003). ARB regional assets (Figure 8) were ranked at Tier 2 (Medium to High Value and Threat combinations) and Tier 3 (Medium to Low Value and Threat combinations).

Figure 8. Water assets ranked in the State Salinity Investment Framework Interim Report 1.
3.4.2 Soil and landscapes

A system of soil-landscape combinations for the agricultural zone of the Avon River Basin was recently published by Galloway (2004). The intent of the system is to improve land use planning by identifying areas with common biophysical attributes and resource degradation issues. Nine areas were identified, with six major soil types - deep and shallow sandy duplexes, shallow loamy duplexes, sandy and loamy earths, and ironstone gravels (Figure 9). These soil types cover 82% of the Basin, with the remaining area mapped to 8 other soil types (Figure 10). Understanding of the nature, optimal uses and limitations of the region’s soils has progressed significantly since 1950. Estimates of soil-related land degradation are continually being revised (Table 4).

Figure 9. Agricultural sub-regions of the ARB.

Figure 10. Percentage area of the ARB covered by various soil types.
3.4.3 Vegetation

The vegetation of the region in pre-European times included five major formations – heathland, samphire shrubland, tall mallee shrubland, tall open shrubland and extensive areas of woodland (Figure 11).

Following the establishment of Perth in 1829, agro-pastoral activity commenced in the Avon Valley, the western margin of the Basin, in the early 1830s. Although agriculture was relatively stagnant during the 19th century, pastoral leasing expanded throughout the region. Changes in government policy in the early 20th century lead to a series of initiatives aimed at increasing agricultural production. While the take-up of farmland essentially progressed eastward in waves, the actual pattern varied from area to area (Figure 12). Most of the initial alienation occurred within the Basin prior to 1950.
Since 1900, some 80 000 km² of native vegetation has been cleared for agriculture in the lower reaches (Avon Catchment Council 2004). The remnant vegetation of the region is highly fragmented, as measured by the CSIRO and Department of Agriculture WA Landmonitor project (Figure 13).

The south-west of WA, including the Basin, has been identified as one of 25 global biodiversity hotspots due to the exceptional level of endemism under an exceptional degree of threat, particularly reptiles and plants (Myers et al. 2001). Much of the remnant vegetation is on privately-owned land. A large number of small Crown reserves have been gazetted across the region, although the largest are on the margins (Figure 14).

Figure 13. Remnant vegetation distribution in 2001.

Figure 14. Location, relative size and number of Crown reserves in the Avon River Basin, June 2003.
Public and private understanding of land degradation has evolved since the 1950s. A range of challenges has been identified and documented, initially by census, field measurement and more recently by remote sensing.

Secondary salinity was first noticed about 1897 (Wood 1924), but remediation was limited until the early 1980s. The area within LGAs affected by salinity has been surveyed a number of times since 1974 (Figure 15). The 2002 Land Management and Salinity Survey (Australian Bureau of Statistics 2004) estimated the extent in 21 priority regions of the National Action Plan for Salinity and Water Quality. The Avon River Basin was found to be the NAP region having the most extensive challenge - 450 000 ha on 2279 farms affected by salinity. Over 63% of the salinised land is estimated to be unproductive at present.

<table>
<thead>
<tr>
<th>Threat</th>
<th>Areal extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity</td>
<td>&lt; 6%</td>
</tr>
<tr>
<td>Sub-surface soil acidity</td>
<td>32% at high risk</td>
</tr>
<tr>
<td>Sub-surface compaction</td>
<td>42%</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>23%</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Eastern areas especially (estimated average 6.6 – 9.8 t/ha/yr)</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>&lt; 20%</td>
</tr>
</tbody>
</table>

Figure 15. Relative areas of saline farmland per Local Government Area, 1979-1984 (Reid, 1988).
The risk of salinisation within the cropping zone of the Avon River Basin over the next fifty years was estimated by Short and McConnell (2000). For a number of areas there was insufficient data available to estimate future risk, while much of the agricultural area of the Avon River Basin has areas of high and medium risk. **Figure 16** shows the estimated extent for the year 2020. By 2050 it is predicated that 30% of agricultural land will be affected by salinity and two-thirds will require some treatment for soil acidity (Avon Catchment Council 2004).

Within south-western WA 38 towns have joined the Rural Towns Program of the Department of Agriculture WA, aimed at counteracting threats from salinity. Risk for each town was calculated by dividing population by the number of years to impact, from which priority for action and investment was assigned. There are 21 Avon River Basin towns in the Program, of which 9 have high priority, 6 are medium and 6 are low (**Figure 17**).

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**Figure 16.** Estimated risk of landscape salinisation at 2020.

**Figure 17.** Towns registered in the Department of Agriculture Rural Towns Program, risk from salinity effects and prioritisation for action.
3.4.4 Biodiversity

The Avon River Basin overlaps five designated regions of the Interim Biogeographical Regions of Australia. It is a region of high endemic natural biodiversity (species only found within the region). Only one bird species is known to have become extinct in the region (the Thick-billed Grass Wren), but local extinctions of bird, mammal and reptile populations, species and communities continue. An estimated 340-400 plant species are at risk of extinction due to salinity (Keighery et al. 2002).

The south-west of WA (including the whole of the ARB) is one of 25 global biodiversity hotspots based on exceptional endemism undergoing exceptional threat (Myers et al. 2001). Forty hotspots have been identified within the Basin based on exceptional species richness (Hopper and Gioia pers. comm.). Fourteen of the 43 mammal species believed to have existed in the Basin in the early 1800’s are now extinct, almost all of these extinctions occurring many decades before agricultural expansion (Figure 19).

Table 5. Estimates of numbers of species of various types in the ARB and their current status (Avon Catchment Council 2004).

<table>
<thead>
<tr>
<th>Natural Taxa</th>
<th>Original Species (1829)</th>
<th>Endemic Species</th>
<th>Threatened Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td>4850+ +</td>
<td>60-80%</td>
<td>343</td>
</tr>
<tr>
<td>Mammals</td>
<td>62</td>
<td>59</td>
<td>23</td>
</tr>
<tr>
<td>Birds</td>
<td>203</td>
<td>94</td>
<td>14</td>
</tr>
<tr>
<td>Fish</td>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Frogs</td>
<td>16</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Reptiles</td>
<td>110</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>Unknown</td>
<td></td>
<td>17</td>
</tr>
</tbody>
</table>

Figure 19. IBRA regions (version 5.1) overlapping the ARB.

Figure 18. Decline in mammal species across the Wheatbelt since 1829, and probable causes (from Short 1999).
3.4.5 Climate

Recent changes in rainfall have been a source of uncertainty for Avon River Basin landholders and residents. There is an apparent decline in average May-October rainfall from 1925-1975 to 1976-2000 (Figure 20). The change for the Avon River Basin is not as severe for areas to the south-west, and ranges from -5% to +10% (IOCI 2002).

The variation in decline in average winter rainfall after 1975 can also be appreciated by a comparison of data for three towns—Northam, Lake Grace and Merredin (Figure 22). The range of average daily maximum and minimum temperatures for the same three towns show very similar patterns (Figure 21). This may be due to variations in length of record for Northam compared to the other two towns.

Figure 20. Percentage change in winter (May-Oct) rainfall, 1975-2002/1913-1975.

Figure 21. Change in winter rainfall for three towns of the Avon River Basin, 1913-2002.

Figure 22. Long term daily average temperatures for three towns of the Avon River Basin.
3.5 Economy

The Avon River Basin mean annual economic growth rate between 1996 and 2001 is estimated to have been 4.4% (URS Australia 2003).

3.5.1 Plant and Animal Production

Agricultural production, the dominant income earner of the Avon River Basin, was valued at $1.4 billion in 2000. Over 70% was exported.

Production is dominated by rain-fed crops, such as wheat and barley, together with wool and meat production from sheep and cattle. The area sown to wheat has expanded since the late 1970s, as has the importance of lupins in cropping systems. Canola production has risen in significance since the mid-1990s, while volumes of barley and oats have remained relatively constant for several decades (Figure 23, Figure 24).

The Basin produces nearly 20% of Australia’s wheat. In line with trends in Australian grain growing regions, the ARB has experienced a rise in wheat yield since 1952 (Figure 25). GMO crops are not sanctioned in the ARB at present (Gallop 2004).
Rain-fed pasture cover a greater area in the Basin than cropping land, with fluctuations in the crop-area:pasture-area ratio dependent on climate and prevailing market prices. Further work is needed on pre-1982 trends, but comparison of ARB and WA sheep, pig and cattle numbers suggest that their trends are similar (Figure 26, Figure 27).

Value-adding diversification is increasing in the form of tree crops (such as oil mallees for biomass harvest, olive oil, and sandalwood), aquaculture and flour milling. Non-agricultural sectors include eco- and indigenous tourism, air sports and air training. Statistical data on trends in factories, retail establishments and earnings was available for the mid-1950s to mid-1980s (Figure 28).

Figure 26. Sheep in the ARB (red bars) and WA (blue lines), 1952-2002.

Figure 27. ARB pig and cattle herds (points) compared to WA herds (lines) 1952-2002.

Figure 28. Trends in ARB retail establishments, retail sales and number of factories, 1952-2000.
3.5.2 Mining

Mining of gold, nickel and iron ore earned $303 million in 2000/01. Other mineral products include industrial pegmatite, rare earths, tin-tantalum-lithium, dimension stone, alunite, clays, dolomite, gypsum, salt, and silica (Figure 29). At present the number of historical sites far exceeds the number of active sites; future developments could make reworking these deposits active (Figure 30). Much of Western Australia’s eastern goldfields lie just outside the Avon River Basin.

Agriculture and mining have remained the largest components of earnings in the period since 1952. The income generated by agriculture was significantly higher than that of mining enterprises in the Avon River Basin for the years 1999/2000 and 2000/2001. Mining earns between 17% and 27% of the income generated by agriculture (Department of Local Government & Regional Development 2002). There would be value in researching the long-term fluctuations in ARB income from mining relative to agriculture since the 1950s or earlier.

Figure 29. Mining site types and stages in the Avon River Basin, June 2002.

Figure 30. Mining sites in or near the Avon River Basin (Department of Industry and Resources 2002).
3.5.3 Infrastructure

Infrastructure trends were mapped for water consumption, road systems, and electricity distribution. Coverage of mobile telephony systems (eg. CDMA and MobileNet) are not yet complete for the Avon River Basin.

Household water in the Avon River Basin is primarily supplied by the Goldfields and Agricultural Water Supply Scheme, developed from the CY O’Connor’s 1903 pipeline (Figure 31). The main distribution lines extensively cover the agricultural areas of the Basin. Some on-farm storage supplements this network.

Electricity is distributed across the agricultural zone of the Avon River Basin by Western Power along a network of 66, 132 and 220 kV lines (Figure 32). Some remote mining centres have onsite power generation using gas turbines.

Tonts (1996) traced changes since the 1970s in public and private services in wheatbelt towns (primarily in the Avon River Basin). Two distinct phases were identified, extensive decline to the mid-1980s, followed by a more stable period that reversed some losses.

Figure 31. Goldfields and Agricultural Water Supply Scheme.

Figure 32. Major electricity distribution lines (Office of Energy 2004).
Available data on the length of roads in the Basin reflects trends in infrastructure investment and increases in farm sizes leading to closure of road reserves (Figure 34).

The number of grain receival points operated by Co-operative Bulk Handling has declined by over 40% since 1964, although new sites have been added (Figure 33). The capacity at receival points that have been retained has increased significantly to accommodate the rise in production over the past 40 years. These changes may reflect increases in average farm size and expansion of road-based transport to deliver grain into receival points.
3.6 Society

3.6.1 Governance

There are 150 communities across the Basin, within 43 Local Governments Areas that are partly or entirely within the ARB (Figure 35). Most LGA boundaries have remained essentially unchanged since 1950, excepting the extension of Kondinin to incorporate the southern section of Yilgarn shire, the merger of York Town into York Shire, and the movement of a small part of Lake Grace to Ravensthorpe. Several names have changed: Kent became Nyabing-Pingrup in 1958 and reverted to Kent in 1972, in 1961 Phillips River became Ravensthorpe, and Kununoppin-Trayning renamed Trayning-Kununoppin-Yelbeni before being simplified to Trayning.

Figure 35. Major arrangements of Local Government Areas of the Avon River Basin, 1962 and 1985, based on data in Department of Local Government and Regional Development (2003).
The Avon River Basin overlaps a number of state and federal electoral areas. At the state level the number of WA Legislative Assembly (lower house) seats that overlap the Basin has declined from 10 in 1979 to 6 since 1994 (Figure 36). In the 1996 and 2001 elections the Basin returned National Party members in all seats except Moore (Liberal) and Eyre (Labour).

In 1979 Basin electors voted in five Legislative Council (upper house) seats – Upper West, Central, South-East, Lower Central and South. By 1994 this had been reduced to two upper house seats – Agricultural and Mining & Pastoral. A new redistribution of seats will be used at the 2005 election.

For the lower house of the Australian federal level the Basin is covered by parts of the Commonwealth Electoral Divisions of Pearce, O’Connor and Kalgoorlie (Figure 37). Upper house federal seats are organised on a whole-of-state basis.

The Avon River Basin primarily overlaps the state development region of Wheatbelt. (see Figure 3), with smaller areas within the Goldfields-Esperance and Great Southern regions.

**Table 6.** Parties elected in WA 1950-2000 (Government of Western Australia 1964-1998; WA Electoral Commission 2004).

<table>
<thead>
<tr>
<th>Elected Party</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coalition</td>
<td>1950-53</td>
</tr>
<tr>
<td>Labour</td>
<td>1953-59</td>
</tr>
<tr>
<td>Coalition</td>
<td>1959-71</td>
</tr>
<tr>
<td>Labour</td>
<td>1971-74</td>
</tr>
<tr>
<td>Coalition</td>
<td>1974-83</td>
</tr>
<tr>
<td>Labour</td>
<td>1983-94</td>
</tr>
<tr>
<td>Coalition</td>
<td>1994-2001</td>
</tr>
<tr>
<td>Labour</td>
<td>2001-</td>
</tr>
</tbody>
</table>

**Figure 36.** Changes in WA Legislative Assembly districts within the Avon River Basin, 1979 and 1994.

**Figure 37.** House of Representatives (Federal) seats within the Avon River Basin, 2000.
3.6.2 Demographics

Many social indicators have declined since 1950, driven by farm amalgamation and drift to coastal cities (Avon Catchment Council 2004). Over the past two decades population has decreased 8% to 43,000 (Figure 38). Some 40% of the population reside in only four towns - Northam, York, Toodyay and Merredin.

The declining population has also aged in relative terms, with the biggest falls occurring in residents aged 14 years or younger (Figure 40).

Aboriginal people are a growing proportion of the Basin's population, rising to nearly 5% in 2001 (Australian Bureau of Statistics 1996, 2001), and have a significantly larger proportion of people aged 14 years or younger, and a relatively low proportion that are aged 55 years or more (Figure 39).
The distribution of changes in ARB population after 1950 was mapped at LGA-level in three periods – 1962-1985, 1985-2001 and 1962-2001 (Figure 41). This confirmed that growth had occurred primarily along the western margin of the region.

The rate of population decline appears to have slowed after 1985, which confirms the total population trends (see Figure 40). The slowing of population decline in many LGAs after 1985 is also reflected in changes in rural towns services in the Wheatbelt at the same period (Tont 1996).

Figure 41. Distribution of population change in ARB population by LGA, 1962-2001.
3.6.3 Avon Arc and NEWROC

The peri-urban rural shires along the northern and eastern borders of Perth have become known as the Avon Arc (Figure 43). Over 60% of the Arc is within the Avon River Basin. This area is undergoing extensive change in population, land use and environment. A recent State Government study predicts a rise in Basin population by 2031, primarily driven by the expansion of Perth into fringing rural shires (such as the Avon Arc), encouraged by better connections to Perth (Government of Western Australia 2002). Major regional planning initiatives have been commenced within the Avon Arc.

The North-east Wheatbelt Region of Councils (NEWROC) was formed in the early 1990s to share resources. Nearly 70% of the NEWROC shires’ areas are within the Avon River Basin.
3.6.4 Education

The number of schools within the Basin has not reduced at the same rate as the population, based on available data for 1977 to 1987. In this period the loss of primary and secondary students was between 20% and 24%, indicating that the number of students per school fell below the state average (Figure 46). The State Government’s Midlands School District has the greatest overlap with the ARB, and the subregion containing the majority of schools. At present there are 56 schools within the Basin, of which only 4 are private schools operated by the Catholic Church (Figure 45).

In the last three Census counts, the number of ARB residents with post-secondary qualifications has risen by nearly 30% (Figure 44). The relative mix of existing and new residents with these education levels is not clear.
3.6.5 Water for households

The Goldfields and Agricultural Water Supply system has increased both the number of services and volume (megalitres) supplied since the early 1960s (Figure 47). The relationship between this trend and population changes could be explored further.

3.6.6 Indigenous groups

The Basin primarily covers the traditional lands of the Ballardong, Galimaia and Nyaginyagi groups, plus small areas of five others (Figure 48). Over the past 150 years Aboriginal people from other parts of Western Australia have worked in the region, particularly during the pastoral era of the mid- to late-19th century. The non-freehold land of the Avon River Basin is the subject of a number of native title claims before the Federal Court.
3.6.7 *Multilingual speakers*

Total number of multilingual speakers in the region is about 700, or 1.5% of Basin residents (*Figure 49*). Languages spoken included Italian (256 speakers), German (143), Polish (81), Netherlandic (60), Chinese (51) and Australian Indigenous Languages (43) and French (29). Smaller numbers of speakers were recorded for Arabic, Croatian, Greek, Indonesian, Japanese, Portuguese, Serbian, Spanish, Russian, and Tagalog.

3.6.8 *Calendar of Events*

Community events in the Avon River Basin mix economic, environment and social activities. A wide range of three types of events were planned for 2003 (*Figure 50*), including:

- Agricultural Shows and Field days,
- Festivals (which have expanded in number since the 1980s), and
- Community Events (sports, cultural and other events).

The number and type of events continues to evolve.
4 Drivers and issues

The retrospective summaries of economic, environmental and social changes in the Avon River Basin provided a starting point for the next phase of the scenario planning, the identification and documentation of drivers and issues. The main criterion for selection of drivers was relevance to future regional prospects.


<table>
<thead>
<tr>
<th>Event</th>
<th>Pre-Workshop #1 Analysis</th>
<th>Workshop #1</th>
<th>Removal of duplicates</th>
<th>Stakeholder comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17 October</td>
<td>22 October</td>
<td>23 October</td>
<td>21 December</td>
</tr>
<tr>
<td>Drivers</td>
<td>12</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Issues</td>
<td>54</td>
<td>548</td>
<td>137</td>
<td>114</td>
</tr>
<tr>
<td>Prospects</td>
<td>15</td>
<td>127</td>
<td>90</td>
<td>113</td>
</tr>
</tbody>
</table>

Table 8. Origin and names of ARB2050 Drivers.

<table>
<thead>
<tr>
<th>Initial Drivers</th>
<th>Drivers Added in Workshop 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Policy+Governance</td>
</tr>
<tr>
<td>Water</td>
<td>Perth - metro-centricity</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Emerging industries</td>
</tr>
<tr>
<td>Climate</td>
<td>Tourism</td>
</tr>
<tr>
<td>Demographics</td>
<td>New large-scale industry</td>
</tr>
<tr>
<td>Plant production</td>
<td>Marketing the ARB</td>
</tr>
<tr>
<td>Animal production</td>
<td>Education</td>
</tr>
<tr>
<td>Manufactures and other industries</td>
<td>Nature of work</td>
</tr>
<tr>
<td>Minerals and energy</td>
<td>Alternate fuels</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Capacity Building</td>
</tr>
<tr>
<td>Service industries</td>
<td></td>
</tr>
<tr>
<td>Society and culture</td>
<td></td>
</tr>
</tbody>
</table>

Prior to Workshop No. 1, the ARB Working Group developed an initial set of 12 drivers relevant to future regional prospects, to kick-start the project (Table 7, Table 8). This driver set was derived from reviews of a range of published scenarios, with particular reference to regional projects. The stakeholders were informed during the workshop that there was no requirement to retain any or all of these initial drivers, but they were eventually all retained. The stakeholders identified ten additional drivers at Workshop No. 1 (Table 8), and then expanded each driver by adding, deleting and modifying further new issues and future prospects. Along with drivers and issues the stakeholders also defined future prospects.

The stakeholder inputs were collated after Workshop 1, then analysed for duplicates by the Working Group. The revised driver/issues set was sent to the stakeholders for comments, leading to a reduction in the number of issues and an increase in the number of prospects. The counts of drivers, issues and prospects during this crucial stage of the project are listed in Table 7. On the pages to follow the twenty two drivers are defined, past and future trends are summarised, and the names of associated issues are listed. The initial twelve drivers are marked with an asterisk. Complete details of each issue and its prospects are contained in Appendix 1: Drivers and issue.

On the following pages the initial 12 drivers are marked with an * after their title.
4.1 Alternate fuels (SD1)

**Defined as** alternative energy sources for transport and other economic essentials.

**In Retrospect..** economic activities have been mostly dependent on fossil fuel energy.

**In Prospect..** available stocks of fossil fuels are predicted to decline by 2050 and therefore become uneconomic in their current use, especially for transport.

**Critical Issues**

1-1 Biodiesel
1-2 Ethanol

4.2 Animal industries* (SD2)

**Defined as** production of meat from sheep, cattle, pigs and goats, as well as milk and wool. Aquaculture is a niche enterprise in the Basin.

**In Retrospect..** pastoral land use has been extensive over the Basin since the 19th century, reduced by agricultural expansion, but remaining a vital part of diversified farm production.

**In Prospect..** sheep products likely to dominate animal production, with an increasing emphasis on meat over wool.

**Critical Issues**

2-1 Biodiesel
2-2 International context
2-3 Single-product reliance
2-4 Value-adding
2-5 Disease-free status
2-6 Benefits of 'clean and green'
2-7 New industries
2-8 Risk management
2-9 GMOs

4.3 Biodiversity* (SD3)

**Defined as** the variety of natural life within the Basin, whether it be individual species, populations or communities.

**In Retrospect..** the long-term clearing of the landscape over a century has led to the loss of plant and animal species as well as threatened communities.

**In Prospect..** the significance of the south-west as a biodiversity hotspot is focusing attention and resources on the region.

**Critical Issues**

3-1 Extinction
3-2 Loss of ecosystem function
3-3 Decline in vegetation quality
3-4 Hotspot status
3-5 Economic drivers for biodiversity protection
3-6 Perception and management
3-7 Introduced species

4.4 Capacity building (SD4)

**Defined as** the attraction, development and retention of individuals, organizations and resources necessary to develop opportunities that enhance the Basin.

**In Retrospect..** programs funded through state and Commonwealth agencies have contributed to capacity building in the region.

**In Prospect..** individuals and organizations have greater reach via internet connections to seek resources that lead to capacity building.

**Critical Issues**

4-1 Capacity building
4-2 Planning for the future
4.5 Climate* (SD5)  
**Defined as** the general trend towards drier, warmer conditions in the second half of the 20th century seems set to continue. The relative contribution of natural variability and human-induced climate change to this process is uncertain.  
**In Retrospect...** extension of agriculture across the Basin proceeded prior to long-term data sets and was followed by retreats from marginal areas. Phase shift in weather since c.1975.  
**In Prospect...** a wide range of global and national forecasting tools are available to unravel causes and mechanisms, and assess possible impacts.

**Critical Issues**

- 5-1 Warming and drying
- 5-2 Variability and extremes
- 5-3 Uncertainty and informed response
- 5-4 Climate sensitivities and thresholds
- 5-5 Greenhouse emissions

4.6 Demographics* (SD6)  
**Defined as** population size, a measure of our hold on land-use and habitation within the Basin. The size of the human resource limits the scope for driving change.  
**In Retrospect...** the Basin population has been in flux since the 1940s, leading to decrease in overall numbers and increase in age.  
**In Prospect...** recently the Avon Arc has seen a rise in population, but this is unlikely to stem the drain from eastern parts of the Basin.

**Critical Issues**

- 6-1 Population
- 6-2 Aging
- 6-3 Indigenous population
- 6-4 Social and cultural diversity
- 6-5 Voices of youth
- 6-6 Community survival

4.7 Education (SD7)  
**Defined as** the ability of the Basin to provide education from primary to tertiary level to its residents, and to receive education funding that is equitable with more populous areas of Western Australia.  
**In Retrospect...** the schools in the Basin are among the most poorly funded in Australia.  
**In Prospect...** education funding is tied to population levels and distribution. Growth of Avon Arc may begin to redress some of the present imbalances.

**Critical Issues**

- 7-2 Investment

4.8 Emerging industries (SD8)  
**Defined as** new or revitalised economic activities that have the potential for significant contributions to its economy in the future.  
**In Retrospect...** no major industry has emerged in the wheatbelt beyond grain, meat and wool other than specialisation within those sectors eg. noodle wheats.  
**In Prospect...** there is a common view the scope for emerging industries is enormous, and will provide the Basin with a more robust economy and society.

**Critical Issues**

- 8-1 Education
- 8-2 Aged care
- 8-4 Value-adding
- 8-5 Lack of capital
- 8-6 Enabling change
4.9 Infrastructure* (SD9)
**Defined as..** the physical form of our presence within the Basin, the resources that support the range of activities in which we engage. In some activities the size and distribution of these resources limit the opportunity for further growth.

**In Retrospect..** infrastructure investment has lagged behind that of urban centres, and typically been largest in relation to agricultural productions.

**In Prospect..** minimum level of service to be defined and improved, critical mass communities, infrastructure maintained and enhanced as the basis for sustainable development.

**Critical Issues**

9-1 Infrastructure development
9-2 Computing, phone and Internet access
9-3 Transport
9-4 Reticulated water
9-5 Alternative sources of power supply
9-6 Governance structures
9-7 Standards, relevance and quality
9-8 Urban and community resources

4.10 Land* (SD10)

**Defined as** a fundamental resource with links to many of the other drivers being considered. How people use and value land varies widely across the Basin, and must continue to evolve in response to current and future trends.

**In Retrospect..** rapid clearing of the Basin in three pulses, 1910s, 1920s and 1950s has exposed the landscape to a range of degrading processes. Landcare groups were a response to this.

**In Prospect..** increasing salinity, soil erosion and acidity but also increasing production and land use changes, with implications for other drivers such as biodiversity.

4.11 Manufactures and other industries* (SD11)

**Defined as** rural-based manufactures include non-agricultural activities such as flour milling, engineering works, cabinet and furniture making, brick works, and abattoirs.

**In Retrospect..** peaks in many manufacturing and other industries corresponded to the population rises up to the 1960s. Declines since then may reflect efficiencies of scale as well as population change.

**In Prospect..** retaining and developing these industries is necessary to support economic and community development.

**Critical Issues**

11-1 Diversification
11-2 Constraints
4.12 Marketing the Avon River Basin (SD12)

Defined as activities and symbols that promote an identity for the entire Avon River Basin.

In Retrospect.. the Basin has had few brands in the past and major products have been marketed in pools that were branded as Australian rather than Avon River Basin (eg. wheat single desk).

In Prospect.. the opportunity exists for marketing the ARB in a range of creative ways that may access and capture new markets and add value to the region’s products.

Critical Issues

12-1 Regional and product branding
12-2 ARB Image
12-3 Perception of decline

4.13 Minerals and energy* (SD13)

Defined as... those minerals extracted for local use (eg. gypsum) or export (eg. salt, gold), and local renewable energy sources and imports of fossil fuel energy as gases, liquids or electricity.

In Retrospect.. diesel fuels, wind power and grid electricity have been the key sources of energy since the 1950s. Mining, currently low, has had several boom cycles within the Basin.

In Prospect.. diesel fuels, solar power, wind power, grid electricity and co-generation are the likely energy sources into the near future.

Critical Issues

13-1 Infrastructure aging
13-2 Renewable energy
13-3 Energy access and development
13-4 Greenhouse emissions
13-5 Mineral production
13-6 Biomass energy

4.14 New large-scale industry (SD14)

Defined as the development of industry extensive across much of the Basin, and internationally competitive or unique.

In Retrospect.. the Basin has experienced two introductions of large-scale industry in the twentieth century; pastoralism and the development of the wheatbelt.

In Prospect.. there may be potential for the development of industry for creating large international market products.

Critical Issues

14-1 Industrial crops

4.15 Perth – metro-centricity (SD15)

Defined as the bias in focus, services and funding towards the population of Perth, the Western Australian capital.

In Retrospect.. this trend has accelerated over the past fifty years in line with the Basin’s declining population relative to Perth.

In Prospect.. the development of the Avon Arc will increase the Basin’s population, and bring increased connections with Perth residents.

Critical Issues

15-1 Urban-rural overlap
15-2 Fly-in fly-out
15-3 Reverse Perth-ARB telecommute
4.16 Plant industries* (SD16) Defined as production that includes grains such as wheat, barley and oats, legumes and oilseeds, as well as hay production. Horticultural enterprises are included here.

In Retrospect... wheat has remained the major plant product and export of the Basin since the early 20th century. Expansion of crops such as canola occurred in the 1960s.

In Prospect... wheat export will remain the primary income-generating activity in the Basin for some time to come. Basin-specific brands could leverage access to markets and sales. Landscape issues exert pressure and uncertainty on the sustainability of current production.

Critical Issues
16-1 International context
16-2 Productivity and sustainability
16-3 Research and Development
16-4 Farm forestry
16-5 Value-adding
16-6 Investments
16-7 Single-product reliance
16-8 Niche-products
16-9 GMOs
16-10 Disease-free status

4.17 Policy and Governance (SD17) Defined as (a) the impact of policies by local, state, federal and international bodies on the Basin, and (b) the local governance structures, particularly of local government areas.

In Retrospect... establishment of the wheatbelt was driven by government policy in the 19th and 20th centuries. Residents have maintained a continuous engagement with decision makers to push for policy beneficial to the Basin’s interests. Local government boundaries have been in flux since first established in the 1870s.

In Prospect... must maintain a focus on national and international policy that impacts the Basin. Some rationalisation of local government is likely in the future.

Critical Issues
17-1 Subsidies
17-2 Regional governance
17-3 State Sustainability policy

4.18 Service industries (SD18) Defined as... seeking to define and improve the minimum level of service, development of critical mass communities, and infrastructure maintained and enhanced.

In Retrospect... in the past 50 years the range of service-based industries have diversified.

In Prospect... trends of declining service provision may occur.

Critical Issues
18-1 Availability and distribution
18-2 Tourism
18-3 Health and Aged Care
18-4 Education
18-5 Microbusiness
18-6 Family support services
18-7 Professional services

4: Drivers and issues
4.19 Society and culture* (SD19)

**Defined as** an ongoing driver that impacts many other major drivers. It includes trends in the makeup of the Basin’s society, its common activities and engagement with the communities and organisations in WA, Australia and internationally.

**In Retrospect...** despite immigration and population decline the Basin has remained relatively consistent culturally. Notable exception has been the rise in Indigenous population by 15% over the last fifteen years.

**In Prospect...** further engagement with people, communities and regions outside the Basin is likely to influence the Basin’s development.

**Critical Issues**

19-1 Partnerships
19-2 External influence
19-3 East/west divide
19-4 Community infrastructure
19-5 Indigenous development
19-6 Cultural diversity and awareness
19-7 Amplification of Aboriginal place and meaning
19-8 Social/cultural identity
19-9 Mobility
19-10 Electoral reform

4.20 Telecommuting and work (SD20)

**Defined as** the potential for the Basin to be promoted as an excellent place to relocate their lives and work through telecommuting.

**In Retrospect...** there may have been small numbers of individual telecommuters in the past.

**In Prospect...** growth of the Avon Arc infrastructure and population could lead to increased numbers of telecommuters.

**Critical Issues**

20-1 Nature of work

4.21 Tourism (SD21)

**Defined as** the development of events and sites that bring short- and long-term visitors to the region.

**In Retrospect...** the number of visitors to the region has been growing over the past ten years.

**In Prospect...** there are many sites and events with the potential for development, and a growing source of visitors in Perth.

**Critical Issues**

21-1 Eco-cultural tourism
21-2 Events and sites

4.22 Water* (SD22)

**Defined as** the characterising element of the Basin. Human settlement is dependant on water piped in from coastal regions, while the landscape is widely affected by saline groundwater. The Basin has three separate sub-regions with different flow regimes.

**In Retrospect...** rapid clearing of the Basin in the 1910s, 1920s and 1950s exposed the landscape to a range of degrading processes. Many stream attributes have been changed.

**In Prospect...** a growing resource of salinised groundwater encourages thinking of opportunities for new development.

**Critical Issues**

22-1 Salinity
22-2 Global issues
22-3 Drainage
22-4 Quality
22-5 Channel and floodplain changes
22-6 Bank condition
22-7 Scheme water
22-8 Equity issues
22-9 Making a virtue out of necessity
22-10 Water storage/harvesting
22-11 Economics and management
5 Proposed Investment Initiatives

At the initial workshop the suggestion was made that the ARB would most benefit from scenario planning if the exercise also led to new and substantial investment. The investment initiatives activity proceeded in parallel to the scenario planning, through the leadership of stakeholders Hendy Cowan, former Deputy Premier, and Mick Poole, CSIRO Plant Industries.

Investment initiatives were defined to be major in scale, private or public, imaginative, and characterised by any of the following:

- Expansion of existing successful industries and enterprises operating in the ARB region
- New industries or enterprises, including those operating in other parts of regional Australia or in regional settings overseas
- Expansion of existing services leading to significant exports from the ARB region
- Expansion of existing services, particularly if this will reduce significant gaps between the ARB and the average for regional Australia
- New services, particularly if this could lead to significant exports from ARB

Fourteen brief descriptions of potential investment initiatives (PIIs) were submitted by the stakeholders, from which a top-ten was selected for further definition.

The fourteen initial suggestions were:

1. Aquaculture*
2. Large-scale value-added crops*
3. Bioenergy-based energy hub*
4. Biodiesel*
5. Fuel ethanol research centre
6. Wind farm
7. CRC for Grainbelt Futures*
8. Value-adding to grains*

9. Large scale exporting of rural development education*
10. Using saline water*
11. Power from thermal ponds
12. Water harvesting*
13. Adaptive change
14. Rural enterprise investment*

Those marked with an asterisk were developed into one-page briefs (see below and also Appendix 3).

5.1 Large-scale value-added crops (PII 1)

Every ARB farmer has the choice of two or three woody crops that sell profitably into large-scale industrial markets. All these crops require local processing to add value for export of products from the region. Markets are large enough not to be over-supplied by large-scale adoption of the crop by ARB farmers.

5.2 Using saline water (PII 2)

Capitalise on current deep drainage efforts and desalination technology to halt the escalation of dryland salinity. Diversify local industry by capitalising on market demand for desalination by-products. Reverse current negative trends in agricultural production, infrastructure life expectancy and native flora and fauna populations.

5.3 Water harvesting (PII 3)

Harvesting surface water from catchments in the order of 50 000 -200 000 ha into community dams/aquifers for water security and development of local niche industries such as aquaculture and horticulture.

5.4 Bioenergy-based energy (PII 4)

As a model, facilitate construction of a bioenergy plant in the region where grid support is required,
where bulk biomass is available (refer PII-2) and where compatible industries are likely to benefit. This provides (a) a bulk outlet for 100,000’s tonnes/annum of long-term biomass contracts to support bioenergy tree crop planting, and (b) a decentralised energy supply and grid support equivalent to say 10-20 MW of grid enhancement (facilitates other industry growth). Potential association with other industries requiring process heat, steam waste products. Could provide a research base for value-adding bio-product such as charcoal, oils, chemicals etc.

5.5 Aquaculture (PII 5)

Diversified farm income. Reduced population drain. Making productive use of an otherwise useless product (salty water and salt land).

5.6 Biodiesel (PII 6)

Facilitate construction of a biofuel processing plant based on either or both of the following:

- An esterifying plant making biodiesel from oil crops and/or tallow from abattoirs
- An ethanol from cellulose plant using waste agricultural products and/or plantation short-rotation timber.

The first is established technology but the oil sources are not developed. The biodiesel is fully substitutable with ordinary diesel. The second is less developed technically but the fuel sources are/will be available. The ethanol requires blending to a maximum of 20% with petrol. Key to the project would be the commitment of the region to utilise the fuel in the region (USA midwest support for soy-based biodiesel in farm machinery is a model). The project would deliver regional development while removing some insecurity over the availability and price of imported oil in the near future.

5.7 Value-adding to grains (PII 7)

Grain is the major industry of the Avon River Basin and will continue to be so for many years to come. 3500 farmers crop 3,168,762 ha to wheat, barley, canola, lupins, oats and other minor crops. The five year average of grain delivered from the ARB is over 4.4 million tonnes. Grain and its by-products (straw etc) have the opportunity to give better returns to the Region and counter higher production costs.

5.8 Large scale exporting of rural development education (PII 8)

Australia is unique among OECD countries in successfully developing “first world” regional, rural and remote communities in the full range of physical environments that challenge developing countries. This offers unprecedented opportunities to deliver education and training in situ and online from bases in regional Australia to developing country students. Of particular relevance to the ARB is the mass-scale delivery of education to achieve advances in sustainable dryland agriculture in developed and developing countries alike. One scenario envisages more than doubling the population of ARB by 2025 from this enterprise alone.

5.9 CRC for Grainbelt Futures (PII 9)

To catalyse development of (a) new industries and (b) new products from existing industries in wheatbelt regions (using the Avon Region as a test bed), by bringing together technologies, expertise, resources, infrastructure and investment in new ways. This initiative was originally named the CRC for Wheatbelt Futures.

5.10 Rural enterprise investment (PII 10)

Opportunities and vehicles for investment in rural enterprise:

- Investigation of financial and social vehicles that provide urban dwellers with opportunity to invest and participate in rural life.
- Could explicitly address issues of valuing and marketing the economic, environmental and social aspects of rural enterprise as a pathway to change.
Following a contribution from the Wheatbelt Development Commission in December 2003, each of these outlines was developed into a one-page brief by Don MacRae. Each brief covered possible proponents, key partners, likely impact on all other PIIs, opportunities, outcomes, threats, potential benefits, relevance and ARB capacity to implement. The complete briefs are presented in Appendix 3.

5.11 Identifying synergies

The eventual nomination of the CRC for Grainbelt Futures as the initiative of choice flowed from the insights of stakeholder Hendy Cowan. In a statement to the Third Workshop, he noted that "Many of the investment initiatives have common threads" with "merit in looking at the synergies of some of the investment initiatives and putting a comprehensive funding package in front of governments for their consideration.". The proposition is reproduced in Figure 51.

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At least seven of the ten investment initiatives have their origins in the workshop participants wanting to deliver sustainable agriculture. If they are not that specific about the main economic driver of the Avon region, agriculture, then certainly it is to ensure that the society in which they live has a viable future.

I am conscious of the effort that has gone into ARB 2050 and you may think this is a flippant response to that effort, but I am of the view that public funding will only be accessed by combining the majority of the initiatives into one comprehensive package. We have all witnessed what happens when decisions are made to strike out alone. Narrogin has its biomass energy plant; Merredin has its desalinator; Narooma has its drains; Northam has Muresk. Individually they are not entirely successful. The task is to produce a package that will combine them, or at least the principles they embody.

In other words, it should not be overly difficult for those people who have put these investment priorities together to find a way of condensing them into one project.

I would begin with the CRC for Wheatbelt Futures. Locate it at Muresk as a joint venture with interested universitites, government agencies and private sector groups. Charge this body with the responsibility of implementing those other initiatives that will guarantee sustainable economic, social and environmental outcomes.

Each of the other investment initiatives may be located at various sites in the ARB, but the important difference is that they will all be coordinated by a single group.

Hendy Cowan
Narembeen, 19 Feb 2004

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Figure 51. Suggestion for a means of consolidating Proposed Investment Initiatives

Figure 52. Synergistic and staged approach to development new investment initiatives in the Avon River Basin. Source: Don Harrison, Western Power.
This rationale was expanded further. The scope to proceed one stage at a time from the highest priority to the lowest (or at least the more long term) is reflected in a systems diagram by Don Harrison, Western Power (Figure 52). ‘You need energy to attract industry, and you need wood to develop the energy supply. But you can work your way down one at a time from the top and not lose economically. As the development cone widens of course, the amount of research and development required expands dramatically, and you could see the node becoming a major research centre as well.’

5.12 From ideas to actions: rating the PIIs

The stakeholders then rated the PIIs from strongest to weakest, in terms of likelihood of improving regional prospects (Table 9). A count of stakeholder ratings indicated that the CRC for Grainbelt Futures was considered as the investment initiative most worthy of pursuit.

The CRC for Grainbelt Futures initiative has already developed momentum. A working group under the leadership of Professor Murray McGregor, Muresk Institute (Curtin University of Technology) has been formed to take this forward. It could be headquartered at Muresk as a national joint venture with interested universities, government agencies and private sector groups, and could be charged with the responsibility of implementing those other initiatives that will guarantee sustainable economic, social and environmental outcomes.

- More resilient, sustainable and outward focused Grainbelt businesses and communities.
- Improved quality of life for Grainbelt people.

The research group developed for the proposed Grainbelt Futures CRC would involve the following broad groupings:

- Business.
- Research and development corporations.
- Universities.
- CSIRO.
- State Government.

### Table 9. Cumulative stakeholder ratings of whether Proposed Investment Initiatives were likely to improve regional prospects. Ratings given were from 1 (weak) to 10 (strong). Ratings conducted during Workshop Three, Muresk, 26 March 2004. Total number of participants = 29.

<table>
<thead>
<tr>
<th>Prelim. Investment Initiative</th>
<th>Weak</th>
<th>Stakeholder Ratings</th>
<th>Summary</th>
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<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td>Large-scale value-added crops</td>
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<td>2</td>
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<td>Using Saline Water</td>
<td>4</td>
<td>3</td>
<td>8</td>
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<td>Water Harvesting</td>
<td>5</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Bioenergy-based energy</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Aquaculture</td>
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<tr>
<td>Biodiesel</td>
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<tr>
<td>Value-adding to grains</td>
<td>2</td>
<td>2</td>
<td>9</td>
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<tr>
<td>Large-scale export of rural</td>
<td>5</td>
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<td>development education</td>
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<td>CRC for Grainbelt Futures</td>
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<tr>
<td>Rural enterprise investment</td>
<td>9</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

McGregor, Muresk Institute (Curtin University of...
6 Identifying the scenarios

6.1 Importance and uncertainty

Each stakeholder was asked to score the future importance and uncertainty of each driver relative to the future prospects of the Avon River Basin to 2050. The scoring system range was from 1 for least uncertain and least important through to 10 for most uncertain and most important. The average scores for the importance and uncertainty of each driver were graphed, to identify the critical scenario drivers – those drivers or clusters of drivers perceived to be both most uncertain and most important, and therefore those with the potential to have significant influence on the Basin’s future (Figure 53).

6.2 Choosing the critical scenario drivers

There would be few surprises if future scenarios were developed around drivers that were judged to be both important and relatively certain, such as those that underpin the dominant activities in the Basin today (Plant industries, Animal Industries, Land and Infrastructure). Such scenarios would read like variants of business-as-usual, for which many ARB enterprises already have robust strategies.

Of more value to the region would be plausible scenarios shaped by the more uncertain and important drivers. They offer an opportunity to test the robustness of current strategies against

Figure 53. Final ARB 2050 Uncertainty v. Importance graph of average driver scores, as judged by participants at Workshop Two, Muresk, 20 February 2004. The two clusters of critical scenario drivers are indicated by the solid outlines (New Industries and Markets; Environmental Change). The dashed line surrounds the six drivers that were determined as Shared/Core for all scenarios.
future uncertainties. Relative to how they are today, each of the two clusters of drivers in the high uncertainty/high importance quadrant (top half of Figure 53) could develop towards the high/positive/open or low/negative/protectionist ends of their range in the future. These two clusters of drivers were arranged along two axes to form four quadrants - the four ARB 2050 scenarios.

6.3 Critical driver clusters

Two scenario-shaping critical driver clusters emerged from the importance-uncertainty graph. The combinations of critical drivers in each quadrant were further scoped to aid the scenario writing, and to improve consistency across scenarios sharing the same end of an axis.

6.3.1 Environmental change

- Climate
- Policy & Governance
- Water, and
- Biodiversity

This combination of drivers was defined in terms of two future extremes:

1. Environment improving: Climate change is no longer accelerating, and rainfall patterns appear to be returning to long-term averages of the 1970s. Changes are at the minimum of the range suggested by modelling reports of the early 21st century. The predicted impact of dryland salinity is revised downwards as understanding of hydrologic processes improves, consequently one of the major threats to biodiversity declines. Soil acidity, soil structural decline and wind erosion are increasingly viewed as manageable through improvements in agronomic practices such as liming and tillage. Biodiversity protection and enhancement have reduced the rate of loss of endangered plant and animal species. Implementation of policy and governance at local, state and federal levels contribute to this improvement.

2. Environment declining: Climate change has lead to much drier and warmer conditions across the basin. While salinity initially continued to increase to levels predicted in the 1990s – some 30% of the ARB including many of the valley floors – by 2050 the rate of spread was essentially zero, aided by declining rainfall. Extreme weather events have become more frequent and unpredictable. Loss of species, populations and communities accelerated as a result of climate change. Some highly acidic soils have become unsuitable for agriculture. Changes to policy and governance at local, state and federal levels have little or no effect or work against any improvement.

6.3.2 New Industry and Markets

- New Large-Scale Industries
- Manufactures and Other Industries
- Policy & Governance
- Emerging Industries, and
- Biodiversity

This combination of drivers was defined in terms of two future extremes:

1. New markets expanding: International and national policy, together with emerging market opportunities, favour the ARB’s investors in efforts to develop new large-scale industries and a bigger range of diverse enterprises, such as industrial tree crops, biofuels and value-adding to agricultural production. The value of the region’s biodiversity has a role in driving this change. Changes to policy and governance at local, state, national and federal levels benefit this expansion.

2. New markets not relevant to ARB: International and national policy works against ARB efforts to develop new opportunities in industries outside the
traditional areas of agriculture and pastoralism. For example, the national telecommunications infrastructure investment in regional Australia is insufficient to arrest or reverse trends in rural migration. The threat of declining access to liquid fossil fuels leads to expansion in the development of alternatives but these do not extend to biofuels from tree crops in low rainfall areas. Biodiversity either does not have a significant role in driving this change, or any gains by planting trees for alley farming (but not for commercial farm forestry applications) are offset by losses of local biota. Changes to policy and governance at local, state, national and federal levels either don’t materialise or are ineffective and hinder this expansion.

6.3.3 Shared Driver Cluster

The stakeholders identified a third cluster – the important+certain drivers. Regardless of how the uncertain driver clusters proceed between now and 2050, the following drivers are likely to be key elements in the ARB’s future, and would be present in all four scenarios:

- Plant industries
- Infrastructure
- Land
- Alternate Fuels
- Education
- Demographics

6.4 Naming the scenarios

The stakeholder group selected a naming theme of Grainy Futures, based on an acknowledgement that whatever the future holds for the ARB it will most likely have a major agricultural component. Within this theme a suitable name was devised for each scenario, and a colour assigned:

Scenario 1: Saline Growth
Scenario 2: Grain and Drain
Scenario 3: Landcare Bounty
Scenario 4: Harmony with Prosperity

The association between the scenarios and the critical drivers is illustrated in Figure 54.

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1 The scenario colours are Scenario 1 [RGB=232,136,28], Scenario 2 [RGB=245,225,0] Scenario 3 [RGB=108,157,159], Scenario 4 [RGB=63,75,37]
6.5 Driver-impact matrix

The scenarios are based on the maps of causal relationships between the 22 scenario drivers within the parameters of each scenario. The causal relationships were mapped at the workshop as feedback loops or influence diagrams (included at the end of each scenario). A driver impact matrix was developed by the driver overseers, stakeholders with high-level knowledge and experience relevant to a particular driver. Each overseer recorded their judgement of the impact of their driver on the other 21 drivers. The scenario groups used the accumulated score to test their causal relationship maps (Table 10).

Each column of the matrix contains a driver overseer’s judgements of the impact of their driver on the other 21 drivers, while the rows represent how impacted each driver is by other drivers. The scores range from 1 (very low impact) to 5 (very high). The most impacted drivers were found to be Water (SD22), Infrastructure (SD10) and Marketing the ARB (SD12). The least impacted but still fairly interrelated were judged to be Animal industries (SD2), Education (SD7), Emerging Industries (SD7), Minerals and Energy (SD13) and Policy/Governance (SD17).

Table 10. Driver-Impact Matrix of scores by overseers of the impact of their assigned driver on other drivers, and impact of other drivers on their assigned driver.

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<th>Impacts on other drivers</th>
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<td>Education SD7</td>
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<td>Manufactures and other industries SD11</td>
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</table>
7 Building the four scenarios

7.1 The guiding question

The guiding question that gave rise to ARB2050 was:

What critical issues and attendant drivers of change are relevant to community efforts to improve the regional prospects for present and future generations of the Avon River Basin to 2050?

The stakeholders were divided into four syndicates (see Appendix 5) containing a broad mix of skills across the range of critical 22 drivers to flesh out the scenarios. The challenge for the four scenario writing teams was to keep in mind two related questions:

How long should the Basin’s investors wait before the market opportunities are confirmed, and climate, biodiversity and salinity patterns become clear enough to convince them that its time to make critical investment decisions that enhance regional prospects out to 2050? What do they do as the trends become clear?

Within each scenario quadrant, the syndicates developed logic for their scenario, and then imagined how their scenario might develop. The ARB2050 scenarios are therefore built upon thematic forecasts, predictions, other scenario plans and the imaginative plausible extrapolations of the stakeholders (Figure 55).

The forecasts generally look five to ten years ahead, and many super-regional scenario planning projects have 25 to 50 year outlooks. Between these two periods is a 15 to 20 year window often called a time of flux, during which it is probable that today’s uncertainties become better understood or resolved. The uncertainty of this period allows degrees of freedom to extrapolate a forecast in any plausible direction consistent with a particular scenario. The ARB 2050 scenarios all contain elements in which about twenty years from now some key uncertainties are resolved.

7.2 Polyoptimists not Polly-Annas

An initial assumption for any scenario creation activity is that present conditions lead to the outcomes described in each scenario (Schwartz 1996). Stakeholders at the initial Critical Issues Workshop were presented with a summary of past trends and current conditions for many aspects of the Basin. This highlighted some of the many challenges facing the ARB, as well as the assets being carried forward to meet current and future challenges. Since the 1950s the economic viability of the region’s main industry, agriculture, has been maintained at the expense of the environment and society.

Despite these challenges, it is obvious that the four scenarios were built by optimistic syndicates using one of the most common scenario plots - challenge and response (Schwartz 1996). All four scenario syndicates took the current ARB conditions as a challenge and described an adaptive response to the plausible future trends of their quadrant.

When the ARBeings of 2050 look back to 2004 today’s ARB2050 participants are hopeful that this project will be seen as the beginning of broader ways of thinking about the road ahead.
7.3 Scenario assumptions

Assumptions are necessary scene-setters for any scenario planning activity. They limit the outputs to a plausible and manageable set of scenarios, by eliminating a myriad of possible but less relevant futures. The stakeholders were clearly interested in futures in which human society is still present in the ARB, so scenarios focussed on war, famine, pandemic or catastrophic asteroid strikes are not considered. In those circumstances the question of regional prospects to 2050 might not be as relevant as considerations of survival. Therefore the scene-setting assumption is a future for the ARB occurring within certain state, national and global trends that will occur or continue between now and the mid-21st century. Some trends to 2050 seem inevitable or highly likely because of their inherent momentum, absence of any evidence of change, physical constraints, or the unavoidable lag between human action and effect.

Below are some of the relevant global, Australian, Western Australian, and Avon River Basin trends we have used as our basic assumptions about the world in which the ARB scenarios could unfold.

7.3.1 Global

The four scenarios are assumed as having unfolded in a future of developed nations continuing the push for globalisation, even though there are great uncertainties in the final endpoint. Will it be a global society, a series of trading blocks or chaotic (Schwartz 1996)? In this context Australia, and thus the ARB, operate on the margins as a participant rather than a controller. The ARB can still seize opportunities to develop and supply world-class products, or to evolve a social culture and lifestyle the envy of others, but global forces set prices and make the rules (Australian Business Foundation 2000). As reflected in the environmental scenario axis, the global push for environmental sustainability has uncertain outcomes but is assumed to be firmly linked to economic drivers.

It seems likely that world population will continue to rise throughout the period to 2050 to about 9 billion (Cocks 2003), and that ARB population will represent a declining share of that total. A majority of these people will live in developing nations in which a middle-class will probably spend much of the next fifty years pursuing development (Cocks 2003:99). Global population rise provides the possibility for increased migration from crowded neighbouring regions to less populated places such as the ARB. Inequity between rich and poor will remain static or grow, and while this stress could also remain true within the ARB, the region will travel to 2050 as a member of a developed nation. Thus within the timeframe in question, it is assumed that there will always be a market for ARB agricultural products.

Despite efforts to decarbonise and dematerialise the global economy, total energy and material consumption is predicted to rise until at least 2050 when global population may peak (Harper 2000). Current reserves of fossil fuel supply are seen as likely to be insufficient leading to a push for alternative fuels well before 2050. The global biosphere impact most relevant to the ARB futures is greenhouse gas emissions due to continued rise in resource use by developing countries. This is likely to lead to a rise in carbon trading markets and instruments, or at least ongoing attempts to establish them. Global CO₂ levels are predicted to continue rising through to 2050 and probably to 2100, the rate being tied to the impact of carbon trading markets and elements of the natural global carbon sinks that are not clearly understood.

7.3.2 Australia

In line with assumed global trends, Australia’s population throughout the period to 2050, will steadily increase to between 21 to 28 billion (Foran and Poldy 2002). Final level will mostly determined by immigration, either sanctioned or unsanctioned. Already the internal growth rate is below replacement level, and is thought unlikely to respond to policy initiatives for the foreseeable future.
The Australia of ARB2050 remains a nation with a competitive streak, yet ready to engage with the world to varying degrees. It remains active in development or support of international conventions and the rule of law. Australia continues to develop national standards and systems. Regardless of whether it is a Commonwealth or Republic in 2050, it remains one nation on its own continent. The ARB’s voluntary/involuntary participation in, and compliance with, national programs and international conventions will continue to be driven by both direct and indirect funding.

7.3.3 Western Australia

The ARB scenarios are based on the assumption that it remains within the state of Western Australia (WA). WA will participate in attempts to diversify Australia from resource-based dependency towards a knowledge-and-services economy that will be the mark of developed nations in 2050 (Western Australian Technology and Industry Advisory Council 2000). The state will most likely remain the arbiter of inter-regional issues, and continue to administer funding on regional infrastructure and social programs. The evolution of Perth into a coastal stretch-city seems almost certain by 2030, with ongoing positive and negative effects on the ARB through to 2050.

7.3.4 Avon River Basin

In Critical Driver Clusters on page 46, six ‘important and certain’ drivers were identified: Plant industries, Infrastructure, Land, Alternate Fuels, Education, and Demographics. These drivers form the ARB-specific assumptions of this scenario planning exercise. However these drivers and unknowns play out at state, national and global levels through the 21st century, the stakeholders have made it clear about what will remain important to the ARB. Right through to 2050 they will contain to be an integral part of the ARB and its prospects.

Other parts of state and national economies may make the transition to knowledge and service-based economies, but the ARB will remain an agro-pastoral region for the foreseeable future. This looks likely despite the ongoing long-term decline in terms of trade (at about 4% per annum) and reduction in the available area of land due to salinity. Productivity of farms is improved by a continuation of the trend in farm amalgamation, while between amalgamations landholders will be likely to invest in addressing the trade decline via new technology and farming practices. Amalgamation will mean that on-farm residential population is likely to decline by 50%, from nearly 15 000 to 7 000 over 50 years. Conversely, larger farms should partly offset this loss with growing seasonal employment in farm contracting and consulting. A long-term interest in climate will continue. Transport fuels will remain a necessary part of the life of a population distributed over a wide area, and dependent on the sale of high volume low cost products such as wheat.

The obvious strong positive correlation between demographics and levels of regional resources and services should continue. They will increase or decrease in line with the economic fortunes of the region, as reflected broadly in the number of residents. Equity of resource allocation compared to more populous coastal areas of the state and nation is less certain.

The Avon Arc will figure in all the ARB scenarios to some degree. The rate of population increase in western ARB shires, the mix, wealth, skills and diversity of people that move there, and the effect on traditional production systems of the area will be an element of all four ARB2050 scenarios. The development of the Avon Arc population will enhance links with Perth, both in the daily interaction with workers commuting from the ARB, and the generation of Perth residents who now have relatives and friends in the Avon Arc.
7.4 Future trends

Creating scenarios is often proceeded by an examination of future prospects for each driver, particularly those in the two critical clusters. The possibilities within each scenario are constrained by the future values or states of each driver. Future prospects contributed by stakeholders during the workshops are summarised in the preceding Drivers and Issues section. There remained several ARB-specific uncertainties. These were resolved by extrapolating historical trends for the following three drivers/issues using the extrapolation methods described below.

7.4.1 Population

Population trends for each scenario were estimated by dividing the ARB into four regions of different growth potential (Figure 56). The four classes are Avon Arc, Corridor (the towns and main east-west transport route, the Great Eastern Highway), Broadacre Farms (equivalent to the number of landholders), and the Broadacre Towns (smaller towns situated within the broadacre farming areas, but not on the Great Eastern Highway).

Each scenario has an ARC growth rate selected on a range of forecast Avon Arc growth rates (Government of Western Australia 2001): 1.2% (Scenario 3), 1.6% (Scenarios 1 and 4), 1.9% (Scenario 2). These rates are based on ranges in the Avon Arc study that correspond with the probable attractiveness for city residents to move to the sub-region in the next 30 years, and it was assumed that these rates continued to 2050.

Population on Broadacre Farms is assumed to decline by the same amount in all scenarios, in line with trends that have been occurring for the past 50 years. This was estimated by continuation of the future trend in number of broadacre farms: 2850 (in 2001), 2550 (in 2010), 2250 (in 2025) and 1350 (in 2050) (Figure 57).

Established trends in decline of the population of Broadacre Towns were extrapolated in line with decline in Broadacre Farm population, but modified by the likely impact of developments in each scenario.

The estimates of population change for each zone in each scenario at 2010, 2025 and 2050 are shown in Figure 59.

![Figure 56. Four-zone model of population change in the Avon River Basin, 2000-2050. Each zone has a rate of change consistent with its scenario.](image)

![Figure 57. Actual and extrapolated change in farm numbers in the Avon River Basin, 1952 to 2050.](image)
7.4.2 Salinity extent

Future trends in salinity extent were graphed from the predictions incorporated into each scenario. The final extent in 2050 in each scenario was within the range of plausible values in the literature. These were 15% (Scenario 2 and 4) and 30% (Scenario 1 and 3).

![Image of salinity extent graph]

**Figure 59.** Estimated population changes for each ARB2050 scenario, at 2010, 2025 and 2050, based on the four-zone population model of the region.

7.4.3 Wheat production

In the period of current cropping technologies, the average annual wheat yield in the ARB ranges between 1.57 t/ha (1987-2000 average) and 1.79 t/ha (1996-2000 average). Historical rates of yield increase have been the 20 kg/yr (1900 to 1980) and 50 kg/yr (1980 to 2000). Current area sown to wheat is 2.5 M ha of which 6% is unproductive due to salinity. In the four ARB scenarios an additional 9% to 24% of this area could be lost to wheat cropping by 2050. The historical production figures (1950-2000) indicate that in any single year of production there is the possibility of a 20% increase or decrease relative to the long-term average; this variation was not included in the extrapolation.

The range of values for ARB wheat production in 2050 was extrapolated for highest and lowest combinations of yield, annual yield increase and available cropped area (Figure 59). Initial calculations gave a range of wheat production in 2050 of 6.4 to 10.7 M tonnes. Consideration of productive area lost due to salinity reduced these totals to 4.9 to 9.7 M tonnes per annum in 2050, which translated to a yield of 2.6 to 4.3 t/ha. Assigning a sequence of future wheat production totals to each scenario was not possible. It would require extensive modelling of a variety of factors, some of which are being explored in other Water for a Healthy Country projects in south-western Australia.

![Image of wheat yield graph]

**Figure 58.** Approach for extrapolating ARB historical wheat yields to 2050.
7.4.4 Summary: Trend ranges

In summary, the range of possible future triple-bottom line values for ARB2050 scenarios can be illustrated by three key indicators (Figure 60). As previously noted, the extrapolation of future wheat harvests provides a zone of possibilities that need further research.

Figure 60. Avon River Basin 2050 ranges for key triple bottom line indicators.
7.5 Scenario Snapshots

Each scenario is described by one-line summaries of its social, economic and environmental dimensions (Figure 61). In the four sections that follow the details and triple bottom line possibilities of each scenario are described in detail.

Figure 61. ARB2050 Scenario Snapshots (Graphic by Amy Harrison, Altier Marketing+Business Solutions, Yallingup, WA).
8 Saline Growth

Social and economic diversity from environmental adversity

Saline Growth is a future reminiscent of the goldfield’s pipeline – finding opportunity in adversity that brings new industries and new people to the wheatbelt. While the world argued over climate change right through the 20s, ARB enterprises took a risk-averse approach, and diversified into industry with natural resource management benefits. By 2050 the economy, infrastructure and social capital of the Avon River Basin are showing signs of ongoing development. The Basin is now a mix of vibrant diversified and sustainable zones around major centres, value-adding and specialist enterprise sites, surrounded by a broad expanse of depopulated broadacre farming. We make a steady income from grains in a warmer, drier world. The region has diversified its economic base: agricultural industries incorporating more perennial plants also drive value-added industries. There are expanding inland fisheries, indigenous eco-tourism enterprises, a world-class resort hotel, a university focussing on disciplines associated with the industries, culture and environment of the region.

The remarkable turn-around in the Basin, from experiencing constant population decline and the threatened closure of many smaller towns in 2004, to one in which the population is steadily rising. But the triple-bottom line has remained out of our grasp, a failure of the global community to act on key issues and the inherent lag between global climate change and remedial action.

Avon River Basin Triple Bottom Line in 2050

Economy (New industries): New integrated tree processing industries from native woody perennial plantings over 10% of the Basin, grain value-adding and intensive animal production. New exportable products include activated carbon, eucalyptus oils, biofuels and grid-fed electrical energy. Alternate fuel are supplied by bioenergy plants running on the same principle. Farming remains profitable due to greater economies of scale despite climate change: farm amalgamation, plant breeding, growth in saline pastures and new market opportunities for traditional commodities. Alternate fuels are a necessary part of making a living and the ARB supplies its own. Tree plantings are improving biodiversity, but are offset by losses due to environmental degradation.

Environment (Losses and gains): Climate has declined by the maximum of its predicted future ranges. The annual average daily maximum temperature has increased by 3° to 6°C across the Basin. Basin-wide biodiversity is at 75% of levels predicted in 2004. This is caused in part by the spread of salinity to 30% of the Basin’s area, a lack of support and investment in the 2004 National Action Plan on Salinity and Water Quality and a failure of state/national/global initiatives to address some of the major problems. Native species plantings for new industry feedstock continue to assist survival of some Basin species at risk, matching in area but not diversity the losses of remnant vegetation and indigenous flora and fauna. It was left to an external philanthropist to build a biodiversity ark in the ARC, to store remaining plant diversity for generations to come.

Society (New and Different People): Population has increased to about 56 000 in 2050, despite a decline in farm and small town population of 7 000, nearly 2 500 additional rural residents distributed across the Basin in towns near new industry sites, and a rise in the population of the Avon Arc of 17 000. The rate of increase within the ARC was high after 2025, prompted by the effects of sea-level rise. Through to 2050 the increasing proportion of indigenous people with improved access to education continues to result increased employment opportunities. Some smaller towns were lost, but infrastructure in several larger towns is ensuring their survival to service new tree processing complexes.
Impending decline?

Water table rise and rainfall patterns in southern WA became clearly delineated through the first decade of the new century, in line with trends described in the late 20th and early 21st centuries. The successful completion of the Narrogin Integrated Wood Processing (IWP) pilot plant led to an inflow of new investment for full-scale sites. After a promising start with its regional National Action Plan for Water and Salinity Quality signed off in 2004, the ACC found that investment to develop and protect prime NRM assets slowly began to decline in ongoing State/Federal funding issues. Other Australian regions such as the Murray-Darling Basin received relatively more support.

Schematic

In 2010 the ARB was similar to 2004 – a few farmers lost by amalgamation, a little growth in the Avon Arc, and most towns still viable.

Trends

2004 The Avon Catchment Council (ACC) released its National Action Plan for natural resource management. The plan suggested that the future would be one of salinity and water management. Would we accept the realities of living with salt?

2005 The IWP plant at Narrogin was opened. Rural voters protested loss of seats.

2006 CRC for Grainbelt Futures focusing on the development of Australia’s temperate grainbelt received support under the Commonwealth Cooperative Research Centre programme, and opened the following year. The CRC was one of the most complex collaborations of its kind, involving Universities, Industry research funders, CSIRO, Departments of Agriculture, Regional Development Commissions and the private sector.

2007 Diesel prices above $2 per litre. Oil prices continued to rise, driven by the developing shortfall in supply relative to demand and the fear of continuing Middle East conflict. Interest in alternative fuels was increasing. Merredin experienced wettest December on record.

2008 Industrial and farm diversification continued as more farmers develop systems based on annual cash crops and perennial native plants stimulated value-added industries and energy crops. Narrogin Bioenergy saved from receivership by Avon co-operative. Proposal to legislate for 90% energy self-sufficiency for all buildings and dwellings rejected by parliament.

2009 “Downshifting” a major trend in WA. There is an increasing population drift to the Avon Arc rural areas driven by continued global socio-political unrest and the quest for lifestyle over high pressure, high income jobs.

2010 Area ‘lost’ to salinity reached 14% of arable land in the ARB but town-site salinity appeared to be being controlled by methods introduced at the beginning of the century as part of the Rural Towns Programme. Population of ARB appears to be stabilising and the indigenous population continues to increase as a proportion of the overall population. China leads moves to end Middle East war as world continues to decrease its oil dependence. Narrogin Bioenergy, now Avon Bioenergy, unveils plans for power network throughout the wheatbelt.
Energy renewed

ARB enterprises and communities added their voices to a ground swell of discontent, the by-product of decades of failure by the existing three-tier government system to deal with important regional development, environmental and social issues. The referendum on the establishment of regional governments headed by a Federal executive was a fait accompli. However without protection from the now mostly ceremonial state government, more powerful regions elsewhere in Australia lobbied for a bigger share of federal funding and policy direction. The ARB regional government was unable to fund all elements of regional salinity management plans. New modelling suggested climate change was real and ongoing, but the warming rate remained at a manageable increase throughout the period. An economic diversification push arose as grain varieties and risk management tools from the Grainbelt Futures CRC improved farm productivity.

Schematic

The spread of salinity was being turned to advantage through new saltland grazing systems. Nearer to Merredin three IWP plants were supporting ongoing cropping among alley plantings of woody perennials. Farm prices continued to rise, as former Avon Valley and eastern wheatbelt farmers competed for land.

Trends

2012 Diesel price reached $3 per litre. The two-year drought ended with a mega-storm and extensive infrastructure damage.

2014 Increasing numbers of international tourists were coming to the ARB seeking indigenous cultural experiences. Exports to China of seaweed grown on salt lakes reached 200,000 tonnes. Referendum on establishment of regional governments passed by all states.

2016 Avon Bioenergy expanded its network to three towns in the ARB. Aquaculture Upon Avon recorded its first 10-species 500 tonne export year.


2019 State Government completed a $35M infrastructure investment in towns of the ‘glowbelt’, the 100 km-wide eastern margin of the Avon Arc’s bright lights.

2020 Regional governments took office throughout Australia. Rural service industry sector was now majority-owned by indigenous corporations. The ARB indigenous Back-On-Country initiative purchased three recently abandoned small towns to reconnect elders and develop ecotourism.

2021 Inaugural Northam fishing contest attracted big crowds. Atmospheric CO$_2$ rises delivered a record average wheat yield of 2.95 t/ha. Salinity covered 23.5% of Basin. The regional government mandated energy-efficient storm-proof buildings.

2023 The Avon Energy Corporation was spun-off from Avon Bioenergy. Power from the station interconnected into the grid for the whole south-west.

2024 International backers saved Lake Baladjie resort plans. March mega-storms left no major damage thanks to new regional building codes but brought forward the Long-course Avon Descent by four weeks.

2025 Avon energy resources the envy of the State. Bush food industry begins export – salted varieties were at no extra cost. Regional salinity management plans were 10 years behind schedule. Two bird species were declared extinct after their habitats were lost to salinity.
### 8: Saline Growth (Scenario 1)

**Basin-wide opportunity**

After 2025 approaches to natural resource management and associated economic development were more in line with the environmental realities of the region. A wide range of value-adding and specialist enterprises emerged, surrounded by broad expanse of more sparsely populated broadacre farming with a steady income from grains. Climate change accelerated after 2030, to nearly the worst-case scenario predicted in 2004. The effect on ARB crop yields was minimised by recent advances in risk management and plant breeding. After a period of adjustments, reassessments and false starts the new industries proposed in 2004 were well established during the late 20s and 30s and stabilised during the 40s. The breakdown of global carbon trading frameworks limited further expansion. Consistent increases in rainfall in the eastern areas of the Basin led to some here-to-fore undreamed of opportunities in the form of inland fisheries and a proposal for an audacious resort on the banks of Lake Baladjie which had become a permanent wetland. Perth was suffering as sea-level rises inundated low-lying suburbs along the river margins, and the Avon delivered larger flood events into the Swan Estuary. Perth’s regional government committed large funds to flood remediation throughout the Basin. Infrastructure rollouts only proceeded where beneficial to new markets or agriculture.

**Schematic**

Population increases were focussed in the Avon Arc and the corridor. Farm holdings continued to decline in number, but some broadacre towns persisted and grew to service the new industries.

**Trends**

- **2026** President to open Lake Baladjie resort. World government sought an end to ongoing international unrest.
- **2028** Merredin University stalled for lack of private backers to match regional government funds. Area of salt-affected land unlikely to change as hydrological balance is reached at 15%. Hydrogeobotanists mapped seven new permanent saltwater pools in the Avon.
- **2030** President opened the Eastern Avon University at Merredin. The university commenced with courses relating to the industries of the region, focussing on eco-tourism, salt-land management and development, perennial production systems and energy production. The Avon Energy Corporation supplied the growing energy needs of the south-west with its mix of nuclear, bioenergy, wind and solar power stations.
- **2035** ARB indigenous communities continued to prosper despite the declining climate.
- **2038** Doodlakine hosted the 25th annual Taste of Avon food and lifestyle festival.
- **2039** Patenting of energy converters developed by scientists and engineers based at Eastern Avon University. These cells harness energy from miniaturised nuclear reactors and are deployed as safe, life-long fuel for motor vehicles.
- **2042** New eco-tourism resort opened in the Avon. Eastern Avon University opened a satellite campus at Lake Grace. Summer storms and rising sea levels led to inundation of many coastal and low-lying areas.
8.2 Scenario 1 progress and logic

8.2.1 Indicators

During the three scenario time periods particular attributes of the ARB the following attributes may be relevant in indicating progress towards realisation of this scenario:

2010
Crop production, animal production, development of other ‘agricultural’ industries, price of diesel and other oil-based fuels, area of salt-affected land, annual rainfall relative to historical record, rainfall distribution, summer flow in Avon, population in the ARB, international unrest

2025
Increasing local energy production, increasing summer rainfall, more permanent salt lakes, increasing agricultural production, fossil-fuel prices, rainfall, experimental aquaculture, bush foods industry, trend towards “downshifting”.

2050
Net value of production from ARB increasing, environmental indicators stable or ‘improving’, population and infrastructure increasing, ‘wellness’ indicators of population improving, increased global political and social stability, flooding on Swan Coastal Plain.

8.2.2 Influence diagram

The causal relationships relevant to Saline Growth were mapped to provide a framework for the inherent flow of the scenario story. In the diagram below the bubbles represent either one of the 22 drivers or a particular issue or expression of the driver.

Figure 62. Scenario 1 causal relationships diagram.
8.3 Scenarios to strategies

At Workshop Three the *Saline Growth* syndicate analysed their scenario with a strategic mindset, looking for elements that might impact to social, environmental and economic success within that plausible future. The analysis was conducted for three themes – opportunities, threats and critical success factors. Common responses across all four scenarios were compiled in plenary (see page 80).

8.3.1 Opportunities

- Local energy production (produce own, self reliance).
- Free & Fair Trade Agreement – Japan etc.
- Investment attraction.
- People power – capacity and commitment to community development.
- Improved access and participation in education – maintain and enhance; community linked.
- No limit to cheap land for ‘big’ industry development.
- Improved control of service delivery to region.
- Increased consumer demand for our products/services/lifestyles (safe, green, not Perth!!!).
- International tourists love our safe, green different adventure experiences.
- Population increase – increased demand for our lifestyle and work opportunities.
- Our biosecurity competitive advantage.
- Diverse/robust economy.
- Youth – opportunities to work and contribute.
- Technology – salt tolerant crop; improving efficiency.
- Increase in prominence/effectiveness of regional government.
- “Green” government policy.
- Greater social integration – “we are one”, utilising diversity; shared vision.

8.3.2 Threats

- No response to energy/fuel prices; Others “solve” transport fuel problem, we’ve missed opportunity for bio-energy.
- Competition from other regions. Mass migration to north of state.
- Environmental decline eg biodiversity – “cures” lost.
- Government policies metrocentric.
- New industries threaten/increase environmental damage.
- Globalization – threat to biosecurity.
- Cost of infrastructure, lack of PPPs.
- Lack of investment because of our poor ‘health’ – poor perceptions of our competitive advantage.
- Development of essential services doesn’t match rate/type of growth. Government withdraws services (continues 5 year global trend).
- Environmental impact – negative & not to our advantage – further inappropriate resources/commitment to reverse trends.
- Lack of capacity for local management of large entities – therefore “off site” headquarters.
- International factors limit our external earnings.
- Attitude/perception of government, consumers, potential residents and worked.

8.3.3 Critical Success Factors

- Adequately resourced, grass roots, people power.
- Shared vision for the region beyond current trends
- Best marketing strategy in the state.
- Development of appropriate technology/+infrastructure.
- Whole of region approach.
- Confidence that we do have resources already in the region.
- Funding models beyond 1 year.
- Realistic assessment of threats and trends.
- Investment attraction.
- Good education base.
- Positive international image.
- TBL Government decision making (true).
- Capacity to implement “intellectual, mental, willingness.
- Culture that fosters and supports risk taking.
- Monitoring environmental, economic and social change.
9 Grain and Drain (Scenario 2)

Draining a way of life while markedly increasing grain tonnage

*Grain and Drain* is a future that feels like an old couch – hard at times but comfortingly familiar, growing while eroding. The region has held onto its agricultural industries in spite of the challenges of nearly five decades of declining environment. A valid way to go when faced with the many triple-bottom line uncertainties of a globalized 21st century in constant disagreement about most issues. Diversification outside agriculture came and went but never really stayed. The region still makes an important contribution to the WA and Australia economies, but is somewhat poorer socially. As the average temperature climbed slowly, the rainfall declined and the people left. They were going anyway as phases of farm amalgamation made some smaller rural towns unviable. New Industries and Markets (such as industrial tree crops and payments for ecosystem services) were identified in the 1990’s as potential drivers of major change in land use and the economy of the region with flow on effects for the environment and society. The physical markets failed to eventuate, while markets for ecosystem services (such as provision of fresh water and amenity) were not seen as relevant to the basin as. As a result, traditional agricultural industries remained the dominant activity. The Environment cluster (Climate, Water and Biodiversity) were also negative with the drying trend of the 1980’s and 1990’s continuing, falling water quality due to salinity and increasing drainage, and both of these adding to the threats to biodiversity. Attempts to rationalize governance structures are defeated in referenda.

Avon River Basin Triple Bottom Line in 2050

**Economy** *(More of the same):* Agriculture has retained its dominance due to greater economies of scale through farm amalgamation, improved productivity, and new market opportunities for traditional commodities. New markets and technologies for plant-based energy and industrials failed to emerge. In 2050 the total cereal harvest has doubled to 8.1 million tones per annum. Annual infrastructure repair costs for salinity damage are reduced by the unplanned drainage system but still costs $500 million per annum.

**Environment** *(Continuing decline):* Climate change reached the hottest and driest of the ranges predicted for 2050: the annual average daily maximum temperature increased by 3 to 6°C across the Basin. Salinity has eventually spread to 30% of the Basin. The world recognized the region as a global biodiversity hotspot (based on the large number of plant and reptile species found nowhere else) but did not act and losses were extensive. Environmental degradation compounded by a lack of support and investment in the National Action Plan on Salinity and Water Quality and subsequent programs, and a failure of state/national/global initiatives to tackle major problems.

**Society** *(Declining & fragmented communities):* Farm amalgamation and fly-in-fly-out farming reduced the number of farm businesses by half causing many small towns to die. Population has risen slightly, to 46 000 by 2050, comprised of a decline in farm population by 8 000, and a rise of 11 000 in the population of the Avon Arc. The latter increase was slower than predicted to 2025 as it was merely warmer and drier but by 2050 the impacts of climate change and sea-level rise saw some migration from the coastal megacity. Indigenous people continue to be a growing cohort of the Basin’s population, and reduce the ageing effect of the non-indigenous community. Inequities in income and services between cities and inland towns have continued to widen.

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*Grain and Drain* is a future that feels like an old couch – hard at times but comfortingly familiar, growing while eroding. The region has held onto its agricultural industries in spite of the challenges of nearly five decades of declining environment. A valid way to go when faced with the many triple-bottom line uncertainties of a globalized 21st century in constant disagreement about most issues. Diversification outside agriculture came and went but never really stayed. The region still makes an important contribution to the WA and Australia economies, but is somewhat poorer socially. As the average temperature climbed slowly, the rainfall declined and the people left. They were going anyway as phases of farm amalgamation made some smaller rural towns unviable. New Industries and Markets (such as industrial tree crops and payments for ecosystem services) were identified in the 1990’s as potential drivers of major change in land use and the economy of the region with flow on effects for the environment and society. The physical markets failed to eventuate, while markets for ecosystem services (such as provision of fresh water and amenity) were not seen as relevant to the basin as. As a result, traditional agricultural industries remained the dominant activity. The Environment cluster (Climate, Water and Biodiversity) were also negative with the drying trend of the 1980’s and 1990’s continuing, falling water quality due to salinity and increasing drainage, and both of these adding to the threats to biodiversity. Attempts to rationalize governance structures are defeated in referenda.
Anti-drains and anti-GMOs

The decline in annual rainfall first noticed over the last two decades of the 20th century continued into the first half of the 21st century. Despite this, the impacts of salinity continued to increase at rates predicted in the 1990’s, accounting for 12% of cleared land by 2010. Drainage proved to be the only effective treatment for salt affected land, and the thousands of kilometres of artificial drains constructed by landowners placed additional pressure on waterways and native vegetation already under pressure from climate change. Engineering also became the only reliable method of protecting high value built assets such as hospitals, schools, phone boxes, grain silos, roads and railways.

Grain production increased 6% per annum from 2005, with 5.1 million tons produced by 3000 farm businesses in 2010.

Schematic

By 2010 the ARB was similar to its state in the year 2000: a few farmers lost by amalgamation, a little growth in the Avon Arc, and most towns still viable.

Trends

2008 The WA government moratorium for GMO-free agriculture, established in 2004, created access to green markets in Europe and Japan. Growing meat consumption in SE Asia drove exports of feed grain, beef and pork that initiated the first major shift in the basin’s livestock industries since the wool price crash of 1990.

2006 A major breakthrough in reverse osmosis desalination technology offered hope that wheatbelt towns would be able to wean themselves from the Goldfields water supply scheme that was coming under increasing pressure with declining rainfall.

2007 An ongoing stalemate with the Avon River Basin integrated drainage plan was signed off by the state government. It aimed to co-ordinate a deep drainage network across the basin for salinity abatement and ensured it conformed to the new Environment Protection Act. By the time the plan was approved, illegal drainage was estimated to exceed 10,000 km. The plan involved sacrificing some of the basin’s larger lake systems as evaporation ponds.

2008 The Conservation Council, the Australian Conservation Foundation and the Worldwide Fund for Nature lobbied the Federal government and the United Nations Environment program to use commonwealth powers through international treaties to stop the drainage plan and limit collateral damage to the environment. A leading Resource Economist launched a scathing attack on the government over the hugely negative benefit cost ratio of the government’s publicly funded engineering program for salinity control.

2009 CSIRO Water for a Healthy Country project released its Wheatbelt natural and engineered drainage model.

2010 Australia’s Prime Minister signed a 10 year/10 million ton wheat deal with the Middle East in July. In the same year, new disease scares in northern hemisphere beef herds brought European supermarket buyers and investors to the Basin looking for opportunities for vertical integration and guaranteed supply of safe meat.

2010 A major breakthrough in hydrogen technology caused fledgling local energy initiatives such as the oil mallee industry to fall over.
Hotter and saltier

Free trade in agriculture by 2020 opened up more competitive markets for basin produce. The worst case IPCC scenarios emerged by 2020. While the world’s population growth rate declined, the total number of people continued to rise throughout the period. Access to fresh water remained the most critical issue, a flashpoint for growing national and international disputes. During this period the Education Department closed 10 schools in the eastern two-thirds of the Basin and opened six in or near the Avon Arc. Livestock industries received a boost early in the 21st century from growth in Asian markets on top of continued health scares in northern hemisphere livestock industries. Cattle and pigs took over from sheep as the traditional livestock industry in the Basin, with this growth made possible by forced improvements in surface water harvesting.

Schematic

Between 2010 and 2025 slow population rise offset losses elsewhere in the ARB. This led to the loss of several small towns. The downward trend in farm holdings continued unchanged.

Trends

2011 Despite a decade of state government lobbying the Federal Government formed a trade bloc with US to work against Greenhouse Gas abatement targets, citing the national interest. Carbon trading remained bloc-based.

2013 End of GMO-free multinational supply contracts signed prior to 2005.

2016 National census showed a continuing population drain out of the basin despite an influx into the Avon Arc from the coastal plain.

2017 In line with population decline, the WA Electoral Commission successfully proposed a reduction in the number of lower house seats in State parliament that left the Basin represented by one sitting member.

2020 Pannell Royal Commission on the Management of Dryland Salinity recommended that salinity be regarded as inevitable, and that funds be redirected into improving productivity in conventional agricultural industries and rural re-adjustment schemes.

2020 WA reached the largest exporter of chicken and pig meat into SE Asia and the largest exporter of lentils and chickpeas to the Indian subcontinent, fuelled by rapidly growing economies and rising standards of living. WA grain fed beef declared the healthiest in the world at the Brussels Agricultural Expo in 2020. In the same year, 10 towns in the ARB disconnected from the Goldfields water scheme in favour of local water supplies. Meanwhile the stalemate persisted with the integrated drainage scheme resulting in a free for all of illegal drainage with serious consequences for the environment.

2023 A national audit measured hypersalinity in over 70% of the regions wetlands, with associated loses in diversity of plants and aquatic invertebrates.

2025 Avon River Basin wheat crop topped 6 million tons for the first time, while the number of farm businesses in the basin reached an all time low of 2000.
**Farming to the fore**

In the past quarter century a warming world of growing populations, customers for Australia’s agricultural products, have become interested in something to eat than the grain’s lineage. GMOs were eventually seen as a necessary tool in the fight to maintain production. Very quickly, advances in gene technology resulted in 30% yield improvement in new wheat varieties. Productivity gains in the grains industry came from genetics, improved rotations with new break crops and precision agriculture technologies such as yield mapping, zone management of fertilisers and ‘tramlining’. World population is set to peak at over 9.5 billion. Despite energy supply shocks, particularly in transport and heating fuels in the USA and Europe, governments proved reluctant to use policy instruments to encourage renewables; they only made up 5% of global production in 2050 and carbon trading, which has a troubled roll-out, has no measurable impact on greenhouse gas emissions. The ARB still makes an important contribution to the WA and Australian economics, but in contrast to the year 2000 is somewhat poorer socially.

**Schematic**

The result in 2050 is an ARB with 15% more people than in 2000, due to the contribution of Avon Arc growth. The corridor towns have mostly held ground, but the broadacre areas – both towns and farms – are far less populated.

**Trends**

2030 Maintenance of strict quarantine protects Australian livestock industries in the face of outbreaks of mad cow disease in Asia, followed by foot and mouth in Europe and north Africa in 2032, further strengthened the reputation of the ARB’s animal industries as reliable suppliers.

2033 Demand for clean green produce from Europe and increasingly North Asia resulted in the *Countryperson* newspaper reporting that 20% of ARB’s grain exports were now certified organic while free range beef and sheep meats finished on rehabilitated saltland pastures found gourmet markets in European and North America.

2037 In the crossover from fossil- to bio-fuels a price spike severely dented agricultural profitability. It was over five years before fuel prices returned to long-term averages.

2038 Merredin Agricultural Company was formed. It would come to dominate grain production in the central ARB within 10 years, taking the record as Australia’s biggest grain grower.

2040 The Hatton Commission found that illegal drainage over the past 40 years has resulted in considerably more environmental damage than the ill-fated government scheme blocked by the Federal government after lobbying from environment groups.

2044 Remote diagnosis systems installed on over 85% of regional farm machinery.

2050 The World Watch Institute listed the ARB as third in a list of human-induced environmental disasters after the Amazon Basin and the Ural Sea.

2050 ARB exports more than 8 million tones of wheat, but this year the number of farms in the ARB falls below 1400 for the first time.
9.1 Scenario 2 progress and logic

9.1.1 Indicators

During the three scenario time periods the following attributes may be relevant in indicating progress towards this scenario:

2010  Tons of wheat exported; tons of beef, pork and sheep meat exported; basin population; number of farm businesses; number of kilometers of drains; number of hectares of remnant vegetation affected by saline drainage water; number of towns independent of the Goldfields water supply scheme; annual rainfall; number of threatened and endangered species and ecological communities.

2025  same as for 2010

2050  same as for 2010

9.1.2 Influence Diagram

The causal relationships relevant to Grain and Drain were mapped to provide a framework for the inherent flow of the scenario story. In the diagram below the bubbles represent either one of the 22 drivers or a particular issue or expression of the driver.

![Influence Diagram](image-url)

Figure 63. Scenario 2 causal relationships diagram.
9.2 Scenarios to strategies

At Workshop Three the Grain and Drain syndicate analysed their scenario with a strategic mindset, looking for elements that might impact to social, environmental and economic success within that plausible future. The analysis was conducted for three themes – opportunities, threats and critical success factors. Common responses across all four scenarios were compiled in plenary (see page 80).

9.2.1 Opportunities

- Intensive animal industries.
- GMOs.
- Healthy food – Quality Assurance.
- World demand for grain increases 40%.
- Immigration (overseas).
- Drawing on Global Research and Development.
- Carbon trading.
- NRM technology.
- Better use of technology.
- Technical capacity from which to build.
- Strengthening Corporate Agribusiness Sector (Australian Wheat Board etc.).

9.2.2 Threats

- Declining labour base for agriculture.
- Farming systems increase pressure on environment.
- Dependence on grains.
- GMOs.
- Saline myopia – it’s water stupid!!
- Declining services & infrastructure.
- Climate Change.
- Loss of competitive advantage.

9.2.3 Critical Success Factors

- Market access, especially Middle East.
- Labour.
- International relations.
- Research and Development, especially biotech.
- Biosecurity – crop and disease.
- Infrastructure – rail, bulk handling, electricity.
Sustainable livelihoods while caring for the environment

Landcare Bounty is striving for sustainable living by harmonising land use and landcare expertise. Those that say the solution was just staring us in the face forget that fifty years ago the challenges for the ARB didn’t seem entirely obvious, with a range of environmental, social and economic challenges trying to stare us down. The regional implications of global climate models talked of 1°C to 5°C temperature rises by 2050 and rainfall declines of up to 60%, but actually never went much beyond the lower end of the predicted range. As systems knowledge improved, so did the forecasting, and concerted action to reduce the human contribution to global climate change. Our risk management systems got fancier, our commitment to those hard-won ‘green’ sustainable credentials strengthened, and we could still grow crops and herd animals to market and do so at a profit. All through the first half of the 21st century we were driven by the same slogans that infected national and global action - “Think global, act local” and “Partner or Perish”. Our planning and commitment to the Basin paid off in developing sustainable agriculture, and it helped to retain and even grow, our population. We remained in step with national and global trends through the partnerships we made and kept. The challenge in this scenario is the uncertainty of acting before fuller knowledge of climate change/variability are understood and while there are ongoing national and international tensions in developing concerted environmental action.

Avon River Basin Triple Bottom Line in 2050

Economy (Green industry): New markets for traditional products from environmentally accredited production systems. Agriculture remained the dominant Basin industry due to greater economies of scale achieved by farm amalgamation, improved productivity, and new market opportunities for traditional commodities. Despite non-emergence of new markets for plant-based energy and industrial products, plantings of woody perennials across 10% of the arable area in the ARB improved the sustainability of farming and the environment.

Environment (Slower decline): An impressive concert of state/national/global initiatives evolved to address some of the major environmental problems including salinity, biodiversity loss, climate change/variability and greenhouse gas emissions. Climate change only reached the minimum of predicted future ranges – increased temperatures of 1°C to 2°C across the Basin to 2050. Pressure on native vegetation and rivers stabilized, and the decline in surface water quality was not significant. Biodiversity losses occur across the ARB at less than the level predicted in 2004.

Society (Community optimism): Population is up 24% to 52,000 by 2050. Indigenous people remain a growing cohort, resulting in a net decrease in the historical ageing trend. Fifty years of farm amalgamation and a trend towards fly-in-fly-out farming reduced the number of farm businesses by half. The solid rise in Avon Arc population brought new links to Perth, through workers commuting from the ARB, and many Perth-ites with relatives and friends in the ARC. Development in the ARC triggered a new echo of development in adjacent areas to the east, cementing the population rise for the long term. Small towns were lost from broadacre areas, but not as many as predicted. Inequities in income and services between cities and inland towns widened. The gradient between Perth and ARB populations remains.
Tentative steps

In the period to 2010, the outlook took a ride on the hope and despair roller coaster, propelled by the ups and downs of each new quarterly climate prognosis. Who to believe – the old timers or the scientists? As many later admitted they weren’t sure themselves. Talk of climate doom intensified with every passing month of a drought that did not substantially break in the mid- and eastern Basin until April 2006. One-in-a-hundred drought, followed by a record early spring flood, hit the eastern areas of the Basin hard. These conditions resulted in reduced grain and livestock production leading to a population decline in these areas.

Schematic

In 2010 the ARB was similar to today – a few farmers lost by amalgamation, a little growth in the Avon Arc, and most towns were still viable.

Trends

2004 The National Action Plan signed off in mid 2004 was the foundation of key natural resource management partnerships – with the Federal and state governments.

2006 The Australian Census revealed the slow progress of recent ARB demographic trends – an ageing population with fewer farmers, and a healthy jump in the number of indigenous people in the Basin. Between then and 2010 indigenous groups concluded a number of joint-use agreements with the Federal and WA State governments on national and state park management. The first Aboriginal Retirement Village north-east of Northam placed elders in close unhindered residence to country and to the young people. New opportunities lay ahead.

2007 Indian Ocean Climate Initiative Stage 2 completed. New climate risk management tools were released onto the market and decade-long forecasting became important farming tools.

2008 Scientists were busy working at their climate models. A breakthrough in mid-2008 suggested the variability was as much natural as human-induced but showed conclusively that the road ahead would be grim by 2050 without concerted global action. The WA greenhouse gas inventory was completed for the first time.

2009 Department of Agriculture began their evaluation of the decade-long program of investigation of options for rural towns threatened by rising salty ground water. Feasible combinations of desalination and evaporation ponds saved at least one big town in the Basin, and we learned enough to design a suitable system for most combinations of town, catchment and soil. Chosing towns to save wasn’t easy, but in the decades ahead the choice was made for us by demographic changes.

2010 The government also announced that subsidised water to rural areas would be phased out over the next 15 years, as Perth’s water resources came under increasing stress. Scientists predicted a drier, warmer climate for the second half of the century. The Basin’s future was looking bleak unless the local communities worked together to improve their local environment.
Stable salinity

The outlook for the Basin remained bleak immediately after 2010, but at least risks and rates of change were much better understood. Somewhere between the emergence of low-cost activated carbon supplies in Asia and protracted negotiations on a global carbon trading scheme, the opportunity to diversify economically was essentially put on the back burner. With water subsidies stopping, businesses and household in the Basin began to look for alternative water sources. Due to overcrowding in Perth the state government offered to subsidise farmers who increased the number of employees as a way to encourage people out of the city. The few who ventured east with government money were soon turned away as farm businesses find they hindered productivity gains. Adoption of Twice Yield from Half the Area (Factor-4) systems improved business productivity and rural town amenity.

Schematic

By 2025 the ARB had significantly fewer farmers due to amalgamation, moderate growth in the Avon Arc, and very few towns were lost in the broadacre regions.

Trends

2015 Research into alternative water sources was put into practice. Trials were setup around the basin to determine the best options for the basin in the future. Some local councils, with the help of Federal Government funding, built desalination plants to supply fresh water to households and small businesses within the shire. Large businesses were encouraged to install their own desalination plants and upgrade to machinery that could use saline water.

2018 ARB farmers spent increasing sums on climate risk management tools from former Australian companies now based in India.

2020 Local governments were working together to share resources and ideas. Desalination plants could be found throughout the region, and there was less reliance on the Goldfields Pipeline. The Basin’s outlook was improving. With the increased use of saline water there was a reduction in the spread of saline affected land. The effect of government legislation in 2010 and combined local community efforts to protect reserves led to a slight drop in the number of threatened and endangered species.

2021 Indigenous groups in the ARB achieved Native Title finality, but found the greatest advantage from agreement and concord for access and use.

2022 Land use tensions in Avon Arc receded as new horticultural enterprises raised land values and generate profits and local employment.

2023 A decade of implementing recommendations of CSIRO’s Farm Water Futures project gave farmers confidence to run more cattle and pigs, returning to the long-term crop:animal ratios of the late 20th century.

2024 Scientists announced a stabilisation point in the spread of salinity, now at 20% of the Basin’s area. Climate forecasts suggested global warming will be at the manageable end of the range. Farmer-owned New McDonald climate risk management system loses market share and is quietly sold to foreign investors.

2025 Compared to 2000 there aren’t many more people in the Basin. Every time a farm family left the Basin another family moved from Perth into the Avon Arc.
Green and clean

In 2050 the Avon River Basin is starting to look and feel like the plans and dreams of the early Landcare movement. Reductions in the area of salinity plaguing the Basin has been noticed over the past few years, delivering long hoped for benefits to the whole community. Improved earnings from farm enterprises are reducing costs for maintenance on degrading infrastructure. The Avon River Basin is voted onto the United Nations 21C Honour Roll for leading the way with regional sustainable water and land use. Tourism in the Basin has increased. The well managed biodiversity in the area is attracting tourists to the region, especially during the wildflower season. Guided tours of nature reserves during the day and night have proved very popular. Visitors from all over the world are booking “Agri Tours” to see best practise first hand. Many people are moving from the city to the Basin for the more relaxed lifestyle resulting in an increase in infrastructure for the region. International/national policy is successfully decarbonising and dematerialising the global economy. Incentives to reduce agricultural greenhouse gas emissions allow the ARB to play its part. Climate is still more adverse relative to 2004, but prospects for better trends in the late 21st century have reduced uncertainties. The Basin is moving forward to an even better future.

Schematic

The ARB population has risen by 21% relative to 2000 – substantial in the Avon Arc and moderate along the corridor. Rural towns and farm holdings have continued to decline in number.

Trends

2026 Trials for salt tolerant crops proved favourable and seed was released for the 2026 season. The use of salt tolerant crops meant an increase of usable land. Animal production for the basin achieved record earnings and scientists were predicting higher than ever plant and animal productivity.

2030 Indigenous people remain a growing sector of the Basin’s population, but health and education disadvantage is not eliminated until almost 2030. Indigenous youth have increased employment opportunities as the average age of the non-indigenous population continues to rise.

2038 Conservation investments from national and international agencies and NGOs contribute to significant decreases in threats to biodiversity and water quality.

2041 ARB farmers spend increasing sums on post-2050 climate risk management tools from former Australian companies now in India.

2045 Through support and investment directed via the National Action Plan on Salinity Quality (2004), and state/national/global initiatives to address some of the major problems, salinity is reduced to 15% of the Basin’s area.

2048 The 1500th microbusiness is registered, but their total earnings are less than 3% of ARB GDP.

2050 Local news reports of a decline in the prospects for salt-affected building repair. Only two barely viable companies remain in the Basin, down from 12 in 2015.
10.1 Scenario 3 progress and logic

10.1.1 Indicators

During the three scenario time periods the following attributes may be relevant in indicating progress towards the realisation of this scenario.

**2010** Amount of grain and livestock exported, Amount of arable land, Annual rainfall, Numbers of threatened and endangered species, Amount of land affected by salinity, Number of farm businesses, and population of the basin.

**2025** Same for 2010

**2050** Same for 2010

10.1.2 Influence Diagram

The causal relationships relevant to Landcare Bounty were mapped to provide a framework for the inherent flow of the scenario story. In the diagram below the bubbles represent either one of the 22 drivers, or a particular issue or expression of the driver.

![Scenario 3 causal relationships diagram](image-url)

**Figure 64.** Scenario 3 causal relationships diagram.
10.2 Scenarios to strategies

At Workshop Three the Landcare Bounty syndicate analysed their scenario with a strategic mindset, looking for elements that might impact to social, environmental and economic success within that plausible future. The analysis was conducted for three themes – opportunities, threats and critical success factors. Common responses across all four scenarios were compiled in plenary (see page 80).

10.2.1 Opportunities

- To build on fledgling industries already there.
- Change in demographics eg overseas flying schools.
- Build onto service industries.
- Overseas investors in best practice in dryland management.
- Retain assets and population.
- Encouraging people to the basin.

10.2.2 Threats

- State policy doesn’t encourage full exploration of desalination.
- Illegal drainage system.
- Narrow view of government.
- People not accepting change.
- Local government policy needs to reflect/embrace regional not local issues.
- Changing weather conditions.

10.2.3 Critical Success Factors

- Social and political will to manage/embrace change – education and training; resources to support change; Research and Development, finance, markets, demand.
- Government policies to allow sustainability.
- Create an environment that encourages change and innovation in existing industries.
Harmony with Prosperity delivers to the Basin lifestyle vibrancy fuelling innovation in developing industries, servicing “green markets” in harmony with regional environments. Over 50 years the Avon River Basin transforms from a prosperous agricultural region with a declining resource base to a diverse sustainable region. This is helped by the relatively slow rate of rainfall decline and temperature rises and a concerted effort through policy and governance to achieve a more sustainable triple bottom line. Markets for the ARB’s diverse range of products are found in the sophisticated trading blocks of the 20s and their successors, the decarbonated, dematerialised open global economy of 2050. Similar to Saline Growth some towns are lost as a result of farm amalgamation over time, though a number are saved and even enhanced by the new industries dotted across the landscape. Although indigenous people are the growing sector of the Basin’s population, health and education disadvantage is not eliminated until almost 2030. Ownership, access to and use of land and enterprises in the ARB promotes indigenous culture and socio-economic development such as ecotourism. In a post-fossil fuel global economy alternate fuels are a necessary element and the ARB manufactures, consumes and exports its own.

**Avon River Basin Triple Bottom Line in 2050**

**Economy** *(Diverse & integrated)*: Agriculture is enhanced by the slower-than-expected rate of climate change. Rising atmospheric CO₂ captured by adding new industries based on extensive native woody perennial plantings across up to 10% of ARB. This leads to a range of products including activated carbon, eucalyptus oils and grid-fed electrical energy. Alternate fuel supplied by bioenergy plants running on the same principle. Farming remains profitable due to greater economies of scale through farm amalgamation, improved productivity, plant breeding, and new market opportunities for traditional commodities.

**Environment** *(Biodiversity valued)*: Environmental conditions in 2050 improve the quality of flows from the Avon to the Swan Estuary, with no increase in the size of flood events. The National Action Plan for Salinity and Water Quality and subsequent programs successfully implemented over several decades, through local and external support and investment. Combined with state, national and international policy shifts, climate change is kept to the minimum of ranges predicted in 2000 - only 1°C increase. Far fewer biodiversity losses occur than predicted in 2004, an outcome of stabilising salinity to 15% of the Basin by 2050. Widespread replanting of suitable native species addressed several environmental problems including biodiversity retention, and supplied feedstock to new large-scale industry.

**Society** *(Diverse communities)*: Population increases from current 43 000 to nearly 66 000 in 2050. Despite losses of 7 000 due to farm amalgamation, rises came from 3 000 additional rural residents employed in the new industries and 26 000 more in the Avon Arc and nearby areas. Widespread investment in saving rural towns is based on a strategy to save the larger centres, but there are public funds support new places of employment close to tree planting and harvesting zones near small towns. Perth takes no greater interest in the ARB. Increased proportion of indigenous people increasing value from cultural, social, environmental and economical perspectives.
Planting for plants

During the first decade of the new century all the conscientious landcare effort of the preceding two decades finally began to deliver. Unlike the infamous UK Iraq War dossier, the “Greenhouse Gas and WA” report was not sexed up. Realising this, the state government quickly enacted legislation to control greenhouse gas emissions. Emissions control enhanced the economic viability of tree crops, while the risk of trade penalties for continuing the environmental damage inflicted by agriculture provoked serious investment nation wide to develop the perennial plant base for sustainable agricultural systems. New large scale industries like mallee had invested more than $1 billion in WA alone and were as attractive economically as any other wheatbelt enterprise. Scientific research showed conclusively that the solid perennial base for agriculture increased plant water use, decreased recharge to groundwater and, through greatly reduced groundwater discharge volumes, made it feasible to safely dispose drainage water. Tourism businesses were profitable and expanding.

Schematic

In 2010 the ARB was similar to today – a few farmers lost by amalgamation, a little growth in the Avon Arc, and most towns were still viable.

Trends

2005  The WA State Government decided to emulate the NSW greenhouse gas emissions control legislation.

2006  Environmental certification emerged in international negotiations as a condition in agricultural free-trade agreements.

2007  Woody-perennial processing prototype completed three years of profitable operation. First full-scale plants were nearing completion in the central and north-western regions of the Basin.

2008  Sophistication and range of ARB-based manufacturing develops to support the new large-scale industry.

2009  Salinity spread still rising; estimated to have reached 14.2% of the wheatbelt.

2009  The Wheatbelt Development Commission continued to support air sport tourism through the “Avon Air” marketing campaign for ballooning, flying, gliding and parachuting businesses in the region.

2009  Climate modelling revealed lower-than-expected decline in rainfall and temperature.

2010  The central region Integrated Wood Processing Plant came on line, and by year-end produced 1 MW of power for the grid.
I’ll have energy with that

By 2025 woody crop production was comparable in scale to wheat and wool but supported much larger regional industry particularly, wood processing and bioenergy, as well enhanced infrastructure, service industries and populations. Regional scale reversal of salinisation was now clearly evident with recovery of biodiversity and water resources at a number of locations. With steeply contracting supplies of cheap petroleum and huge global energy demand diverting natural gas to export, major domestic energy industries emerged in the wheatbelt using the cereal and woody crop biomass residues for electricity and ethanol production. The predicted population of the ARB in 2025 was not reached as it was warmer and drier. Expected migration from megaPerth never materialised as conditions were still bearable and not affected by sea-level rises. Implementation of the regional salinity management plans were funded by ongoing public and private investment, encouraged by consistent work on maintaining key partnerships.

Schematic

By 2025 in Scenario 2 the only element of the ARB in population decline is farm holdings. New industries and environmental conditions contribute to population rises in all other sectors.

Trends

2017 The entire eastern Basin Nickel output for the next decade was sold to China’s two largest stainless steel makers. Prices had declined a little since 2004, but the reliable income stream benefited further exploration and rural town investment confidence.

2018 Australian Grains Industry completed the implementation of production triple bottom line as the key plank of its Single Vision framework.

2019 Scientists revealed that salinisation was being significantly slowed within catchments running ITP plants.

2020 Microbusiness spinoffs from new industry brought rising incomes in ARB towns.

2021 Recent Australian Greenhouse Gas inventory showed the predicted rise above the Kyoto targets. This provided impetus for woody perennial-based industry and lowering inputs to agriculture.

2022 Commissioning of third and four IWP plants boosted the annual electricity cogeneration level to 12 MW, and also increased earnings.

2023 An ARB-based manufacturing corporation signed $75 million of design and supply contracts with customers in south-East Asia.

2024 The third ITP (integrated tree processing plant) was opened by the State Minister for Energy and other Cool Industries. The Minister was driven back to Perth using two litres of ARBgas, the new clean and locally-produced car fuel.

2025 The 9th Taste of Avon food and lifestyle festival showcases 84 different locally-produced foods.

2025 Regional government replaced Local Government Areas.
Approaching a ‘golden age’?

The ARB has made a remarkable transformation to triple bottom line sustainability, at least at what is considered to world’s best practice. It is now a region of primary production linked to resource management, a net exporter of energy, a growing population. The native plant-based industry is making a major contribution to Australia’s rural economy. Worlds’ best practice in infrastructure, education and health service delivery match because of investment and development in virtual services. The provincial towns - Northam, York, Kellerberrin and Merredin - create vibrant society and culture in their surrounding areas. The Avon Arc population belatedly reaches the most optimistic of 2004 forecasts due to overcrowding in Perth. Ongoing work on partnerships, and demonstrated progress on sustainability have delivered a seat at the table in state and national policy forums. The confidence of wheatbelt society is in good shape for the challenges of the next fifty years.

Schematic

The outcome of Harmony with Prosperity is fifty percent more people in the ARB compared to 2000. Fewer towns are lost in the broadacre area; in fact the corridor has extended from its East-West origins to connect new IWP centres. The environmental conditions and growth throughout WA lead to a large increase in Avon Arc population.

Trends

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2026</td>
<td>Global carbon trading system comes online following Bonne Agreement.</td>
</tr>
<tr>
<td>2031</td>
<td>Carbon offset prices hit a ceiling as climate change predictions show warming and drying has not accelerated since 2025.</td>
</tr>
<tr>
<td>2035</td>
<td>Salinity has receded to only 15.1% of the Basin, down from a peak of 19.5% in 2026.</td>
</tr>
<tr>
<td>2038</td>
<td>State Education department opens two new schools east of Northam, the first in over 50 years.</td>
</tr>
<tr>
<td>2040</td>
<td>Avon BioProc Inc. fails to secure investment for an Activated Carbon Processing Plant. Abatement of salinity and climate issues are blamed.</td>
</tr>
<tr>
<td>2042</td>
<td>Farmers increasingly adopt land leasing to capture short-term market opportunities, bringing diverse employment opportunities to the ARB’s rising population.</td>
</tr>
<tr>
<td>2043</td>
<td>Department of Natural Resource Management’s latest BioCatch report receives UN tick for the good condition of global biodiversity hotspots in the Basin.</td>
</tr>
<tr>
<td>2044</td>
<td>Industrial multiskilling is the most popular regionally-taught TAFE course.</td>
</tr>
<tr>
<td>2047</td>
<td>Annual electricity cogeneration reaches 30 MW. Biofuels production at record level.</td>
</tr>
<tr>
<td>2050</td>
<td>ARB society blossoming. The ARB has made a remarkable transformation based on regional, state, national and international partnerships.</td>
</tr>
</tbody>
</table>
11.1 Scenario 4 progress and logic

11.1.1 Indicators

During the three scenario time periods the following attributes may be relevant in indicating progress towards this scenario:


2025 Several IWP plants running. Rate of salinisation slowing. ARB manufacturers gain contracts in South-East Asia. ARB food festival well established. Local biofuels on sale.

2050 Global carbon trading system. Salinity slowly receding. Electricity cogeneration a prominent energy source. Land leasing to improve farm enterprise flexibility.

11.1.2 Influence diagram

The causal relationships relevant to Harmony with Prosperity were mapped to provide a framework for the inherent flow of the scenario story. In the diagram below the bubbles represent either one of the 22 drivers, or a particular issue or expression of the driver.

![Scenario 4 Influence Diagram](image)

**Figure 65.** Scenario 4 causal relationships diagram.
11.2 Scenarios to strategies

At Workshop Three the Harmony with Prosperity syndicate analysed their scenario with a strategic mindset, looking for elements that might impact to social, environmental and economic success within that plausible future. The analysis was conducted for three themes – opportunities, threats and critical success factors. Common responses across all four scenarios were compiled in plenary (see page 80).

11.2.1 Opportunities

- Major disruption of oil supply.
- Service industry that hangs off ‘green’ industry.
- Self sufficient in energy.
- Market/regulation mechanism changes environmental approach.
- Increasing mobility address service issues.
- Terrorism – lifestyle change.
- Forest – loss of access to land in traditional forest land.
- Creating farming futures – more animals.
- Isolation.
- Local processing to support development – independence, value adding, people.

11.2.2 Threats

- Disease – plant/animal.
- Infrastructure status – power.
- Major of land managers with grain focus.
- Perception of future (suicide rates high).
- Economic drivers don’t support independent development.
- Low levels R & D into new opportunities.
- Isolation from external market.

11.2.3 Critical Success Factors

- Good analysis/R&D/planning that underpins development.
- Economic drivers i.e. must be $ viable.
- Industry must be inter-generational.
- Other major markets (additional to energy) for products (bioenergy, active carbon, etc).
- Long term public investment / support for new industries.
- Rate of environmental decline is reduced.
- Legislation (global, federal, state) that supports environmentally-driven industry.
12 Beyond ARB2050

12.1 Applying scenarios to strategies

The future that unfolds in the Avon River Basin between now and 2050 will most likely be a mix of elements from all four of the scenarios above. As mentioned in the introductory section, the purpose of developing the scenarios was not to attempt to predict the future – this is clearly impossible. Instead, the scenarios become a starting point from which the people, enterprises and organizations of the ARB can begin a dialogue about the future. The question to be answered by the dialogue, whether informal or formal, is ‘How robust is our strategy if each scenario did occur?’

12.2 Common strategic elements

The strategic elements generated by each scenario were distilled into common elements of opportunity, threat and critical success factors that would apply to all scenarios.

12.2.1 Opportunities

Common opportunities arising from all or most scenarios that would contribute to improving regional prospects:

- Inwards migration
- Natural Resource Management technologies
- Service industry spin offs
- Clean-green
- Trading on positive safe lifestyle
- Animal-based farming

12.2.2 Threats

- Common threats arising from all or most scenarios that would be critical to meet in improving regional prospects:
  - Infrastructure decline
  - Diseases and biosecurity
  - Dependence on grain
  - Un-inspirational government policy
  - Lack of political influence
  - Lack of regional effectiveness of government (all levels)
  - Losing out to other regions
  - Releasing investment capital for change – distribution of farmer wealth
  - Lack of human capacity to change

12.2.3 Critical success factors

Common factors arising from all or most scenarios that would be critical for improving regional prospects:

- Quality of governance
- Research and development targeted and sustained
- Infrastructure (resource for implementation of change)
- Capacity to change (education and training)
- International choices favourable
12.3 Capacities
Stakeholder responses indicated that the ARB is strongest in relation to the critical success factor of Favourable international choices and weakest in relation to Infrastructure resources to implement change. Notwithstanding, some considered the ARB weakest in Favourable international choices.

The next step in the process involved asking stakeholders to identify **Strengths** in existing capabilities and **Weaknesses** in terms of capabilities lacking in the ARB. In the light of identified strengths and weaknesses, several types of capabilities were identified for priority development. A selection of the most commonly raised follows…

12.3.1 Strengths

**People**

- Proven ability to get things done with or without government.
- Examples of collaborative approaches to development Innovation/entrepreneurship - have a go mentality.
- Strong commitment to community.
- High levels of hidden talent particularly skilled retirees.

**Realisation of great agricultural potential**

- Reliable climate relative to elsewhere.
- Large resource base - comparative advantages and innovative, skilled farmers and land managers.
- Well developed agricultural and R&D infrastructure.
- International reputation for production, and agricultural machinery and infrastructure development.

**Physical Infrastructure**

- On the main route East-West for all road and rail transport - good road/retail infrastructure.
- Close to ports - short supply and delivery lines.

12.3.2 Weaknesses

**People**

- Fewer, older people managing businesses.
- Ability to pull possibilities together to build new integrated sustainable business systems.
- Low business and corporate management skills.
- Ability to hold young people - proximity to Perth.
- Difficult living conditions, especially for families.

**Governance**

- 43 local governments – average age of councillors 50+
- Cohesiveness - lack of regional focus

**Others**

- Long term strategic and business planning.
- Poor image projected by media.
- Agriculture dominance - agriculture mindsets?

12.3.3 Capacities

**To be developed**

- Integrated land and water planning - across agencies and the regional Natural Resource Management group.
- A framework to bring science and innovation together to work on real things.
- Management of wheatbelt valleys for biodiversity, ecotourism and water management.
- Widen the ARB2050 net to identify and specify more investment prospects.
- More to come…
12.4 Rating existing strategies

12.4.1 Stakeholder responses

Prior to Workshop Three the key strategies of three working group organizations, the Wheatbelt Development Commission (Weigall 1996), Avon Catchment Council (2004) and CSIRO (2004), were extracted from publicly available documents and grouped according to their relevance to one of three driver groups – environmental cluster, new markets cluster, other driver (Table 11). Note that these strategies have been revised and developed since the time of the Workshop Three.

During the workshop each scenario syndicate rated the relevance of each strategy to their scenario, using the scale of 1 (very low significance) to 5 (very high significance). All 39 strategies rated above an average of 2.5, 30 above 3.5, and 16 above 4.0.

These results highlighted that:

- Sustainable agricultural industry development with an average of 4.7 was somewhat higher than the next two highest rated strategies find ways to develop and maintain infrastructure and service levels that promote economic growth and Water use and allocation both on 4.4.

- At the other end of the scale, Tourism development rated 3.0 and Support emerging hay processing industry by investigating transportation rated 2.7.

These data and other findings of this project could be applied by ARB enterprises and organizations in future reviews of their own strategies, and in targeting sources of future investment in the region.

12.4.2 Other Regional Strategy Documents

Over the past 10 years a wide variety of regional strategy documents have been published by organisations, departments and enterprises that have strategic investments and service obligations in the Western Australian wheatbelt and rural areas. Typically these strategy documents are restricted to a single sector, although a number of key state-wide strategies are also relevant (eg. State Sustainability Strategy). A number of them are listed below for further reading.


- BSD Consultants. (1998). Aviation training strategy for Western Australia: final report / prepared for Department of Transport by BSD Consultants P/L in conjunction with Midland College of TAFE, Airport Planning P/L. Midland College of TAFE, Midland, WA.


Table 11. Cumulative stakeholder ratings of relevance of example regional strategies to the ARB2050 scenarios *= relevant driver number within each group of drivers.

<table>
<thead>
<tr>
<th>Strategy Org.</th>
<th>Environment*</th>
<th>New Markets*</th>
<th>Other*</th>
<th>Theme</th>
<th>Key Strategy</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDC</td>
<td>1, 8</td>
<td>Resources</td>
<td></td>
<td></td>
<td>Cleaner production encouraged</td>
<td>3.9</td>
</tr>
<tr>
<td>WDC</td>
<td>8, 14</td>
<td></td>
<td></td>
<td></td>
<td>New industries based on comparative advantages, downstream process, diversification</td>
<td>3.8</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td>Tourism development</td>
<td>3.0</td>
</tr>
<tr>
<td>WDC</td>
<td>17, 18</td>
<td>Infrastructure &amp; Services</td>
<td></td>
<td></td>
<td>Political commitment to better servicing. Redefine minimum service level.</td>
<td>3.9</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td>Find ways to develop and maintain infrastructure and service levels that promote economic growth</td>
<td>4.4</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>Regional profile</td>
<td>4.1</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Educate and inform political representatives. Get increased government priority by selling region’s economic export efficiencies.</td>
<td>4.2</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>Facilitate regional change</td>
<td>3.6</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Build partnerships with leaders for new industries</td>
<td>3.7</td>
</tr>
<tr>
<td>WDC</td>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td>Address sectors of disadvantage</td>
<td>3.3</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>Integrated Water &amp; Waterways Managements</td>
<td>4.2</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>River and tributaries restoration</td>
<td>3.3</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Valley floor management</td>
<td>4.0</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>Wetlands and lakes restoration</td>
<td>3.5</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>Water use and allocation</td>
<td>4.4</td>
</tr>
<tr>
<td>ACC</td>
<td>14</td>
<td>Sustainable Industry Development</td>
<td></td>
<td></td>
<td>Sustainable agricultural industry development</td>
<td>4.7</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>Public infrastructure corridor</td>
<td>3.5</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rural towns program</td>
<td>3.3</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Natural Landscape Diversity</td>
<td>4.0</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Demonstration landscapes</td>
<td>3.2</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Regional Capacity Building</td>
<td>4.1</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Community capacity</td>
<td>4.1</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>8, 11</td>
<td>Sustainable industry extension</td>
<td>4.1</td>
</tr>
<tr>
<td>ACC</td>
<td>17</td>
<td>Local government partnership</td>
<td></td>
<td></td>
<td></td>
<td>4.1</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td>Institutional, Planning, Legislative and Policy Support</td>
<td></td>
<td></td>
<td>Partnerships</td>
<td>3.9</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Legislative framework and policy development</td>
<td>3.9</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Regional and local planning framework</td>
<td>4.2</td>
</tr>
<tr>
<td>ACC</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Institutional and governance framework</td>
<td>4.2</td>
</tr>
<tr>
<td>CSIRO</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Water Futures in Southwest WA</td>
<td>4.1</td>
</tr>
<tr>
<td>CSIRO</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>Development of plausible ARB scenarios to 2050</td>
<td>4.1</td>
</tr>
<tr>
<td>CSIRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protection of $100 M of infrastructure assets and $50 M/yr. recovered production threatened by salinity.</td>
<td>3.8</td>
</tr>
<tr>
<td>CSIRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>An increase in the populations and social amenity of rural towns.</td>
<td>3.9</td>
</tr>
<tr>
<td>CSIRO</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>80% increase in protection of the remnant biodiversity threatened by salinity.</td>
<td>3.5</td>
</tr>
</tbody>
</table>
13 Creating Our Future

How do we confront our future and go beyond the plausible scenarios in this brochure to create preferred scenarios for the Avon River Basin? The next steps to involve residents, communities and organisations in creating our future are:

1. Continue investigation to establish a national Cooperative Research Centre for Grainbelt Futures with headquarters at the Muresk Institute

2. Support investigation of the Proposed Investment Initiatives

3. Seek responses to ARB2050 project results from organisations represented by members of the Stakeholders Reference Group

4. Distribute this brochure to:
   - High schools
   - Local governments
   - Businesses
   - Landcare and other interest groups
   - Media contacts with list of available spokespersons

5. Set-up ARB2050 website at [www.arb2050.com](http://www.arb2050.com) to provide access to the following:
   - This brochure and media releases
   - Final report and other publications of the ARB2050 project
   - Responses of organisations represented by members of the Stakeholders Reference Group

6. Questionnaire seeking responses to the ARB2050 scenarios and ideas and insights for preferred scenarios from Avon River Basin residents and groups

7. Support adoption of project results and the foregoing responses by Local governments

Avon River Basin 2050: What’s your next step?
Appendices

Appendix 1: Drivers and issue details

**Alternate fuels (SD1)**

**Defined as** alternative energy sources for transport and other economic essentials. **In Retrospect...** economic activities have been mostly dependent on fossil fuel energy. **In Prospect...** available stocks of fossil fuels are predicted to decline by 2050 and therefore become uneconomic in their current use, especially for transport.

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd1-ci1 Biodiesel</td>
<td>Fuels for transport are essential to the region, in which the major economic products are high volume and low value distributed over vast areas. Fuel prices will rise as world supply declines after 2050.</td>
<td>As fossil fuel become too expensive then biodiesel from canola and other oil crops may become alternative fuels. This will require investment in technology some 10 years in advance. Economies of scale required by multi-nationals may dictate that local cooperatives drive this transition.</td>
</tr>
<tr>
<td>sd1-ci2 Ethanol</td>
<td>Driver same as for biodiesel, but the alternative system requires significant change in land-use and production.</td>
<td>Ethanol could use crop residues or woody plants as feedstock.</td>
</tr>
</tbody>
</table>

**Animal industries* (SD2)**

**Defined as** production of meat from sheep, cattle, pigs and goats, as well as milk and wool. Aquaculture is a niche enterprise in the Basin. **In Retrospect...** pastoral land use has been extensive over the Basin since the 19th century, reduced by agricultural expansion, but remaining a vital part of diversified farm production. **In Prospect...** sheep products likely to dominate animal production, with an increasing emphasis on meat over wool.

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd1-ci1 Biodiesel</td>
<td>Inclusion of animals in production systems has been historically an important aspect of managing climate and market variability. Efficient animal production is profitable and less risky than high-input cropping. The best use of livestock in farming systems still being defined. More room for improvement in livestock systems than cropping systems, based on past productivity performance. Feral animals and weeds remain management issues.</td>
<td>Trends towards value-adding, diversification and intensification likely to continue. Increased feed utilisation will increase production. By 2050 animal management systems may be better linked to key environmental issues eg. feedlots using desalinated water. Potential to find plants and animals to suit modified environment eg. saline grazing.</td>
</tr>
<tr>
<td>sd2-ci2 International context</td>
<td>Production exports and imports are linked to international forces such as regional economic prosperity (especially south-east Asia), exchange rates and perceptions of environmental quality. Animal exports related to competition and cost of production.</td>
<td>Create international marketplace through brands and segregation. New products will be market driven. Major export markets in south-east Asia should continue to expand in line with their population growth and increased affluence.</td>
</tr>
<tr>
<td>sd2-ci3 Single-product reliance</td>
<td>Sheep products have been a major animal industry over the past 50 years.</td>
<td>Must carefully consider the alternatives in future of this major industry. Projected growth in demand for beef in south-east Asia. Likely to be limited by availability of water.</td>
</tr>
</tbody>
</table>
### Appendix 1: Drivers and issue details

#### Critical Issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sd2-ci4 Value-adding</strong></td>
<td>Intensive animal industries are increasing.</td>
<td>Can we process materials in the region instead of shipping elsewhere? Ability to value-add agricultural products. Available professional support may limit mix of agricultural enterprises. Food technology investment required. Economics of current examples. Opportunity for value-adding, and for small business to contribute.</td>
</tr>
<tr>
<td><strong>sd2-ci5 Disease-free status</strong></td>
<td>Disease-free status comprised by Ovine Johanne Disease.</td>
<td>Make better use the absence of foot and mouth, CJD, (viruses common elsewhere). Potential increase in biosecurity risks.</td>
</tr>
<tr>
<td><strong>sd2-ci6 Benefits of 'clean and green'</strong></td>
<td>Animal production in the Basin is largely extensive and not from intensive systems such as feedlots. This is a selling point in its own right. Environmental degradation may comprise 'clean and green' image, but no evidence of this to date.</td>
<td>Growth in the organic market is in the order of 20% per annum in Europe. This trend is likely to reach Australia in the next 50 years.</td>
</tr>
<tr>
<td><strong>sd2-ci7 New industries</strong></td>
<td>Alternative animal industries and products (goats, dairy sheep, ostriches etc.) presently limited to small-scale intensive production in the Avon Arc. New investment in niche plant and animal products currently limited to the western Basin (Weigall 1996).</td>
<td>Indigenous animals for productive use eg. emu, kangaroo yet to be explored. Potential for capital wealth in ARB to be directed towards intensification, value-adding (eg. feedlots). New research and development investment required to support emerging products/industries.</td>
</tr>
<tr>
<td><strong>sd2-ci8 Risk management</strong></td>
<td>Low tolerance to risk taking prevents growth.</td>
<td>The energy balance of agriculture may become important if fuel prices rise. Potential shifts in suitable pastoral areas and patterns of profitable seasons.</td>
</tr>
<tr>
<td><strong>sd2-ci9 GMOs</strong></td>
<td>No trials in south-western Australia to date (Gallop 2004).</td>
<td></td>
</tr>
</tbody>
</table>

#### Biodiversity* (SD3)

**Defined as** the variety of natural life within the Basin, whether it be individual species, populations or communities. **In Retrospect...** the long-term clearing of the landscape over a century has led to the loss of plant and animal species as well as threatened diverse communities. **In Prospect...** the significance of the south-west as a biodiversity hotspot is focusing attention and resources on the region.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sd3-ci1 Extinction</strong></td>
<td>Fourteen of the 43 mammal species believed to have existed in the Basin in the early 1800’s are now extinct, almost all of these extinctions occurring many decades before agricultural expansion (Short 1999). An estimated 400 plant species are at risk of extinction due to salinity (Keighery et al. 2001 and CALM Biological Survey of the Wheatbelt). Only one bird species is known to have become extinct in the region (the Thick-billed Grass Wren), but local extinctions of bird, mammal and reptile populations, species and communities continue.</td>
<td>Extinction debt: loss will continue even if we could halt salinity, clearing overnight. Keeping what we’ve got requires significant reconstruction: with &gt;80% cleared, 2050 extinction prospects are high. Biodiversity loss in salinising valleys may become an issue bigger than the regional community and affect land and water use decisions. Prospects could rise if: (a) buffered by supportive land use, (b) knowledge of biodiversity exists in Avon area (how to deliver ownership), (c) adoption via mix of economics (market drivers)/social processes/incentives/policy/legislation. Prevent extinctions: community ownership and knowledge of problem and solution - regional decisions (landscapes) + economic drivers (built on urban desires for bush, plus other uses such as biodiversity and tourism).</td>
</tr>
</tbody>
</table>
### Critical Issues

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sd3-ci2 Loss of ecosystem function</strong></td>
<td>Altered nutrient cycling, hydrology, fire regimes, pollination, weeds, stock grazing etc. have resulted in reduced opportunities for reproduction, dispersal and recruitment which affect the persistence of species and communities. Loss of function has occurred at micro scale and macro scales.</td>
<td>Restoration of ecosystem function may be impacted by climate change as native vegetation is more vulnerable to climate change than agricultural species which can be adapted more rapidly through human agency (breeding and selection).</td>
</tr>
<tr>
<td><strong>sd3-ci3 Decline in vegetation quality</strong></td>
<td>The most obvious and continuing consequence of the loss of ecosystem function is decline in the quality of remaining native vegetation. About 20% of the Basin total area but only 7% of the Basin’s agricultural zone retains natural vegetation cover. Landmonitor data shows ongoing decline in area and quality due to salinity, weeds, grazing, insects, disease, clearing (still occurring but at a very low rate, about 1000 ha per year (Commissioner of Soil and Land Conservation 2002).</td>
<td>Economic drivers for biodiversity protection. Revegetation - carbon credits.</td>
</tr>
<tr>
<td><strong>sd3-ci4 Hotspot status</strong></td>
<td>The south-west of WA (including the whole of the ARB) is one of 25 global biodiversity hotspots based on exceptional endemism undergoing exceptional threat (Myers et al. 2001). Forty hotspots have been identified within the Basin based on exceptional species richness (Hopper and Gioia pers. comm.).</td>
<td>Hotspot listing could be used to increase local awareness and pride and to promote the area on the world stage.</td>
</tr>
<tr>
<td><strong>sd3-ci5 Economic drivers for biodiversity protection</strong></td>
<td>Economic drivers for biodiversity protection not well defined. Integrate management of landscape+public investment. Protection of intellectual property in natural assets (native animals and plants).</td>
<td>Economic drivers that provide opportunities for biodiversity protection, such as utilisation of native flora in the management of threats (eg. Oil mallees and sandalwood for water management), harvesting native wildlife, bio-prospecting for food and pharmaceuticals including indigenous rights eg. Plants for People Project, Curtin University.</td>
</tr>
<tr>
<td><strong>sd3-ci6 Perception and management</strong></td>
<td>Decision making and activity is fragmented, with little incentive for owners to retain bush and manage it well. Community awareness through better communication of the unique biodiversity values of the region may lead to better appreciation and management.</td>
<td>The analytical tools are needed to predict the impacts of intervention on the viability of vulnerable populations, species and communities. More incentives for intervention through economic drivers for biodiversity protection such as biodiversity and carbon credits</td>
</tr>
<tr>
<td><strong>sd3-ci7 Introduced species</strong></td>
<td>Competition and predation by introduced flora and fauna, including non-WA native species. Increasing incidence of pests and diseases that contribute to loss of biodiversity - eg. Wandoo crown decline.</td>
<td>Increasing biosecurity risks through exotic plants, animals, disease and possibly GMO’s. Introduced species management essential to future of some activities. Eradication unlikely in most instances.</td>
</tr>
</tbody>
</table>

### Capacity building (SD4)

**Defined as** the attraction, development and retention of individuals, organizations and resources necessary to develop opportunities that enhance the Basin. **In Retrospect:** programs funded through state and Commonwealth agencies have contributed to capacity building in the region. **In Prospect:** individuals and organizations have greater reach via internet connections to seek resources that lead to capacity building.

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sd4-ci1 Capacity building</strong></td>
<td>Lack of big picture strategic thinking beyond traditional shire boundaries has limited the Basin’s capacity for development and self-reliance (Regional Development Council 1999).</td>
<td>Increased community capacity could lead to more locally-generated 'big-picture' initiatives. Hindered while local government does not look beyond its boundaries - local government will need to be rationalised first.</td>
</tr>
</tbody>
</table>
Appendix 1: Drivers and issue details

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>sd4-ci2 Planning for the future</td>
<td>Identification of areas in need of capacity building difficult due to lack of an atlas of the region, an integrated set of Basin data. Data are generally available but widely scattered. Many organisations have duplicated sets of similar data.</td>
<td>Development of a whole-of-Basin set of maps and data about past trends and current state could address this problem and promote identify with the basin.</td>
</tr>
</tbody>
</table>

**Climate** (SD5)

**Defined as** the general trend towards drier, warmer conditions in the second half of the 20th century seems set to continue. The relative contribution of natural variability and human-induced climate change to this process is uncertain. **In Retrospect...** extension of agriculture across the Basin proceeded prior to long-term data sets and was followed by retreats from marginal areas. Phase shift in weather since c.1975. **In Prospect...** a wide range of global and national forecasting tools are available to unravel causes and mechanisms, and assess possible impacts.

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<tr>
<td>sd5-ci1 Warming and drying</td>
<td>Predictions of long-term large decrease in winter/spring rainfall in South-western Australia. Predictions of 2-5°C Celsius day and night rises. Regardless of the predictive uncertainty some change is occurring NOW which may be resulting from both natural and human induced processes. Technology and practices have kept up with climate change in agriculture - crop types/vegetation types and new crop varieties are managing drought tolerance. Absence of wet years in recent decades, consequent reduction of flooding/water-logging, and productive influence of winter warming and increased atmospheric CO2 may have been beneficial to agriculture. Water resources have been significantly diminished and some natural ecosystems may be adjusting to altered water stress. Incidence of fire may alter.</td>
<td>Modfied crops that can survive on less water, adsorbs water from the environment differently. Water resources (catchment runoff, river flow, groundwater recharge) are expected to be diminished severely by drying because of magnifying effects of the non-linear relationship with rainfall. This will require adaptive response in public and private water systems. Impacts of drying on salinity, waterlogging and flooding will tend to be beneficial. Successions and climaxes may adjust in regional ecosystems requiring adaptive alterations to management plans. Adaptation in various sectors will involve judgements under evolving climate and science. Judgements will always have an element of uncertainty and responses will depend on risk structure of the sector.</td>
</tr>
<tr>
<td>sd5-ci2 Variability and extremes</td>
<td>Causal factors of sustained drought/rain or event intensity in the region are not yet well understood and climatic projections, whether inter-seasonal or long term, are difficult. Greater skill exists in relation to temperature. Change in variability of seasons is a key to understanding and planning i.e. are we going to see a higher incidence of drier seasons. Inter-seasonal expectations and longer term expectations now need to be weighted by observed trends of the last two decades. Some myths persist in local perceptions of model projections of variability and extremes for this region.</td>
<td>Climate impacts and climate adaptation are particularly affected by climate variability and the stresses and issues in managing under more extreme conditions. Skills in forecasting inter-seasonal climate prospects can potentially help in operational responses. For long the term prospectivity of sectors or ecosystems relative changes to the nature, frequency and intensity of extremes will be a shaping influence on ecosystems and climate affected sectors of economy.</td>
</tr>
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</table>
## Critical Issues

<table>
<thead>
<tr>
<th>sd5-ci3 Uncertainty and informed response</th>
<th>sd5-ci4 Climate sensitivities and thresholds</th>
<th>sd5-ci5 Greenhouse emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of resolution of uncertainty may be inhibiting investments. Could be of wider community impact than salinity. Need for increased knowledge and understanding. Likely that climate change will affect productivity, land use and industry in the region. Uncertainty will be a continuing problem for climate adaptation. Both the issue and the scientific knowledge are continuously developing. Access to useful up-to-date information integrated for managers. Accuracy of prediction - WA needs to do more. Increased access to information (a) interpreted for use by managers (b) including averages, extremes (ranges).</td>
<td>Climate sensitivities differ significantly between sectors and under circumstances of change not all will be affected simultaneously or equally. Agriculture may have benefited from change of the last two decades but if trends continue a threshold could be crossed where impacts from moisture stress exceed benefits from warming. Water production has already crossed an adverse threshold. Link between climate change, water supply, farming methods needs further consideration. May not be under our control but need to be aware of what's happening as it could have a big effect on this region in the future. What is our capacity to change?</td>
<td>Sources, extent and trends in Basin emissions unknown. For this region, focus on Greenhouse emissions is a potential distraction and needs to be kept in proportion for how relevant it is in the national and State context. It is driven by energy production and use and, to a lesser extent, transportation. Greenhouse emissions need to be measured in the Avon Basin eg. Green globe.</td>
</tr>
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Appendix 1: Drivers and issue details

**Demographics** *(SD6)*

**Defined as** population size, a measure of our hold on land-use and habitation within the Basin. The size of the human resource limits the scope for driving change. **In Retrospect**.. the Basin population has been in flux since the 1940s, leading to decrease in overall numbers and increase in age. **In Prospect**.. recently the Avon Arc has seen a rise in population, but this is unlikely to stem the drain from eastern parts of the Basin.

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<td>sd6-ci1 Population</td>
<td>Since 1957 a loss of 15% of basin population, but decline has slowed since the mid-1980s and levelled out with recent growth of Avon Arc population (see Figure 40; Department of Commerce and Trade and the Wheatbelt Development Commission (1996). Comparison with other WA regions unknown. Need market research to see why people have left eg. are farms more efficient?</td>
<td>Fast-growing region incorporating western Basin, rising by drift from eastern Basin and expansion of Perth. By 2026, Avon Arc population could increase above 1996 levels by 43% – 147%. Likely to ensure rise in total ARB population to 2050. Must consider the infrastructure required to meet needs of growing population. Creating opportunities through education, social &amp; industrial investment to encourage young people to stay/return to ARB. 2050 population will be a result of how well we manage all our other critical issues and opportunities.</td>
</tr>
<tr>
<td>sd6-ci2 Aging</td>
<td>Those remaining in basin are aging, accelerated by drift of young people to cities. Average age of farmers increasing. Aging population impacts health care and services and leaves insufficient people resources to maintain infrastructure and sustain services (Australian Bureau of Statistics 1996, 2001).</td>
<td>Aging of farm population and evacuation within 2050 time horizon. Issue of who will buy the farm land and for what usage? Western fringe composed of many smaller land holdings, less suitable for broad acre farming due to creeks, rock, hills etc.</td>
</tr>
<tr>
<td>sd6-ci3 Indigenous population</td>
<td>Absolute rise of 14.9 % since 1991 - same as rate of whole population decline over past 45 years. Share of Basin population up from 4.0 % to 4.8 % since 2001. Conflict between different Aboriginal groups forced together in larger regional centres.</td>
<td>Conflict may deter outside investment in these towns.</td>
</tr>
<tr>
<td>sd6-ci4 Social and cultural diversity</td>
<td>Population capital driven by decentralisation, immigration. Other demographic factors of importance: education level, employment categories, skills, culture. Skilled labour needs of large farm business - availability issues/sustainability etc. Must be addressed; create opportunities for knowledge and understanding. Recognition of cultural and societal diversity and strength and capitalise on it.</td>
<td>Is this a key driver rather than a critical issue? 2050 population will be a result of how well we manage all our other critical issues and opportunities. Potential to enhance the growth and development of Aboriginal social capital.</td>
</tr>
<tr>
<td>sd6-ci5 Voices of youth</td>
<td>{further research required}</td>
<td>{further research required}</td>
</tr>
<tr>
<td>sd6-ci6 Community survival</td>
<td>Key driver for survival of communities. Communities become self driving and more diversified. Identification of the requirements for community and societal connectedness and sustainability and provision of the right mix of the right services. We need to sell our strengths - community, safety, lifestyle, sense of community.</td>
<td>Will current communities persist to 2050? Identify and address our limitations in order to improve our attractiveness as a place to live. Present 44+ communities is not sustainable, and need to back survivors, otherwise all will go down and none will survive</td>
</tr>
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</table>
Appendix 1: Drivers and issue details

Education (SD7)

**Defined as** the ability of the Basin to provide education from primary to tertiary level to its residents, and to receive education funding that is equitable with more populous areas of Western Australia. **In Retrospect..** the schools in the Basin are among the most poorly funded in Australia. **In Prospect..** education funding is tied to population levels and distribution. Growth of Avon Arc may begin to redress some of the present imbalances.

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<td>sd7-ci2 Investment</td>
<td>Numbers of schools and students has fallen since 1950, in line with population loss (see Figure 40). Preference for secondary &amp; tertiary education outside Basin. This might be bringing new skills and ideas back to the ARB, as the total number and percentage of population with post-secondary qualifications are rising (see Figure 44). Investment in Basin schools amongst the lowest in regional Australia.</td>
<td>The trend towards increasing number of international students in Australia could lead to growth in the Basin’s tertiary institutions (Curtin University campus at Muresk, Merredin Flying School). Universities have massive resources and wide range of skills. Staff &amp; students must be involved in groups like ARB 2050. Majority of professionals working in ARB are locally educated. Vast pool of good will to tap into. Opportunity to utilise these resources and skills in the ARB. Joint initiatives with educational a likely first step.</td>
</tr>
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Emerging industries (SD8)

**Defined as** new or revitalised economic activities that have the potential for significant contributions to its economy in the future. **In Retrospect..** no major industry has emerged in the wheatbelt beyond grain, meat and wool other than specialisation within those sectors eg. noodle wheats. **In Prospect..** there is a common view the scope for emerging industries is enormous, and will provide the Basin with a more robust economy and society.

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<tr>
<td>sd8-ci1 Education</td>
<td>Currently 100 000 international students education in Australia each year. Few have been educated in regional centres.</td>
<td>Growth in the overseas students in Australia expected to reach 1 000 000 by 2050 presents an opportunity for regional tertiary institutions.</td>
</tr>
<tr>
<td>sd8-ci2 Aged care</td>
<td>Population in adjacent metropolitan area is aging, with this trend likely to increase over the long term.</td>
<td>Provide aged-care services directed to people not currently resident in the Basin could represent an emerging industry.</td>
</tr>
<tr>
<td>sd8-ci3 Value-adding</td>
<td>Agriculture and mining currently export essentially raw commodities which may have potential for further processing.</td>
<td>This would require feasibility studies in food and mineral processing. The value added to the region would depend on the proportion of local ownership.</td>
</tr>
<tr>
<td>sd8-ci4 Lack of capital</td>
<td>Inability to attract capital to the region has been a major inhibitor to the growth of emerging industries.</td>
<td>A coordinated approach by three tiers of government could produce smarter ways to bring capital into the region in a targetted and focussed way.</td>
</tr>
<tr>
<td>sd8-ci5 Enabling change</td>
<td>Lack of regional focus, strategy, current governance arrangements and parochial views inhibit the ability to focus new investment.</td>
<td>Regional focus is difficult with the current governance arrangements.</td>
</tr>
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</table>
**Infrastructure* (SD9)**

**Defined as...** the physical form of our presence within the Basin, the resources that support the range of activities in which we engage. In some activities the size and distribution of these resources limit the opportunity for further growth. **In Retrospect...** infrastructure investment has lagged behind that of urban centres, and typically been largest in relation to agricultural productions. **In Prospect...** minimum level of service to be defined and improved, critical mass communities, infrastructure maintained and enhanced as the basis for sustainable development.

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<td>sd9-ci1 Infrastructure development</td>
<td>Infrastructure is running down. Lack of regional strategy to address declining investment.</td>
<td>Use of technology to produce ‘virtual offices’ would encourage people to live and work in the Basin (mainly in the AvonARC), and get around the problem of “I’d love to live there but the work is in the city.”</td>
</tr>
<tr>
<td>sd9-ci2 Computing, phone and Internet access</td>
<td>The share of Basin population accessing the Internet was 30%, while 38% used a computer (Australian Bureau of Statistics 2001). Satellite mechanisms preferred for Internet, rather than ground lines. Extensions to coverage hampered by land infrastructure restrictions. Communications need improvement eg. wireless data speed. High adoption rates since roll out of CDMA, but satellite phone ownership is low.</td>
<td>Geographic coverage likely to remain a limiting factor, and investment to extend coverage unlikely to keep pace with capital cities.</td>
</tr>
<tr>
<td>sd9-ci3 Transport</td>
<td>The length of sealed roads remained constant during the 1970s and 80s. Fewer public roads are unformed and the length of gravel roads increasing.</td>
<td>Transport costs set to double in next decade. Possibility of the end of petroleum-based fuels by 2050. Demand to rise for power, water, telecommunication infrastructure to rise with growth of industry - challenge for government to provide this infrastructure to truly drive the development of the region. Roads will be relatively more expensive in the future. Ethanol and biodiesel are practical replacements for petrol.</td>
</tr>
<tr>
<td>sd9-ci4 Reticulated water</td>
<td>Supplied primarily from Goldfields Agricultural Water Scheme since the 1940s (Broun 1974). Changes in demand since the 1950s not quantified.</td>
<td>Uniform tariff currently limits development of alternatives such as desalinated ground water.</td>
</tr>
<tr>
<td>sd9-ci5 Alternative sources of power supply</td>
<td>Electricity supply currently inadequate to grow infrastructure.</td>
<td>As long as subsidised power is available, things will not change, more expensive to use alternative power.</td>
</tr>
<tr>
<td>sd9-ci6 Governance structures</td>
<td>The current system of 43 shire councils is unsustainable.</td>
<td>Amalgamation of LGAs and move towards regional councils would improve efficiency and focus. The cost of amalgamation likely to be the loss of smaller towns.</td>
</tr>
<tr>
<td>sd9-ci7 Standards, relevance and quality</td>
<td>Minimum standards have become the benchmark where the standard sits/ rests. Old infrastructure not reflecting community needs and is resource dominant.</td>
<td>Quality infrastructure needed to attract quality support staff to the area. Do not set minimum standards. Multi-purpose facilities seen as means of addressing needs of distributed population. Cannot expect to have high standard of service delivery at 43 shires in ARB.</td>
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<td>sd9-ci8 <strong>Urban and community resources</strong></td>
<td>How do we aggregate resources and ensure that adequate levels of service are available to communities? Salinity-related damage to buildings etc. Ability to maintain resources may be reduced in line with population decline and demographic changes. Loss of key services such as banking. Community infrastructure sports/arts/schools unassessed.</td>
<td>Linked to the number of people, as numbers decline, so will resources</td>
</tr>
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**Land** (SD10)

**Defined as** a fundamental resource with links to many of the other drivers being considered. How people use and value land varies widely across the Basin, and must continue to evolve in response to current and future trends. **In Retrospect**… rapid clearing of the Basin in three pulses, 1910s, 1920s and 1950s has exposed the landscape to a range of degrading processes. Landcare groups were a response to this. **In Prospect**… increasing salinity, soil erosion and acidity but also increasing production and land use changes, with implications for other drivers such as biodiversity.

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<td>sd10-ci1 <strong>Secondary Salinity</strong></td>
<td>Significant increase in recharge after farm clearing has resulted in 10% of the Basin farmland being salinised today. Salinity cultural change occurring (Hatton 2002).</td>
<td>Up to 30% of Basin predicted to be salinised by 2050. Salinity not likely to be solved quickly. Coordinated approach needed. Broader thinking around use of saline water eg. Desal, rebuilding soil structure, surface water use, crops. Shift in value, from lost/unproductive to highly valuable with use of saline groundwater. Salinity won’t be the major issue and that other elements will be more critical. Number of different approaches to salinity problem being trialled – catchment demonstrations, agroforestry field trials etc. Salinity denial gone by 2050 with a more realistic view of what we see happening and how.</td>
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<tr>
<td>sd10-ci2 <strong>Land use</strong></td>
<td>Since 1900 has changed from government and pastoral to private and agricultural. While most of the land alienation was pre-1955, clearing continued into the 1980s. Related air quality issues impacting on life. Native title and indigenous land purchases may return access, use and rights to Aboriginal people.</td>
<td>Need broader thinking around land use - broad acre v. the expansion of urban areas and uses in and around the ARC. Greater diversity in land-use in future (agriculture, energy production, tourism, eco-tourism). Links between urbanisation and population growth. Education on land uses, particularly alternatives, must increase. Paradigm shift that links land use to community viability. Globally: the loss of biodiversity in salinising valleys may become an issue bigger than the regional community and affect land and water use decisions. Retention of agricultural areas in western part of Basin. Could we see single houses with cropped areas surrounding them in the western part.</td>
</tr>
<tr>
<td>sd10-ci3 <strong>Productivity</strong></td>
<td>Productivity increase in WA grain industry averaged 5% over the last 10 years. What is limiting potential yield - rainfall, nutrients, soil physical properties?</td>
<td>Will increased productivity offset the amount of saline land? Proposed regulation of high-value agricultural land in conflict with population expansion in the Avon Arc.</td>
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<tr>
<td>sd10-ci4 Soil Changes</td>
<td>Water repellence affects 6.6% of agricultural soils in the Basin, 65% require treatment for soil acidity. Sub-surface structure compaction reduces yields. Fertility import/export of nutrients. Biological activity and chemical aspects of soils have been changed. Economics driving soil pH management.</td>
<td>Improved water harvesting and perennial crops are two possible avenues for reducing current trends in soil degradation. If pH not addressed then crop production may be compromised. Ongoing requirement to manage flux in Aluminium etc. as a consequence of decreasing pH.</td>
</tr>
<tr>
<td>sd10-ci5 Erosion</td>
<td>Water erosion reducing soil fertility. Lighter soils subject to wind losses.</td>
<td>Predicted increase in incidence of summer rainfall and runoff as soil profiles become saturated, balanced against general drying trend in rainfall.</td>
</tr>
<tr>
<td>sd10-ci6 Decision making</td>
<td>The emergence of the Avon Catchment Council means there is now a body concerned with Basin decision making and planning. There are data available on most aspects, but much of it is aggregated to regions that don’t correspond well with the Basin entirely.</td>
<td>Need and opportunity for analytical tools to examine options for specific locations, and to assess impacts of options on land, water and biodiversity.</td>
</tr>
<tr>
<td>sd10-ci7 Integrated landscape management</td>
<td>Conservation and production areas. Community must debate and reach agreement about who will fund the work. Need to ensure we don’t convince the community that land degradation is irreversible or their commitment to solve problem is reduced. Impact of climate change/variability. Does the rate of research match change in landscape? Surrendering of rights on freehold - water allocation/pricing.</td>
<td>Should it be centralised. Identify regional specific opportunities across the ARB. Take a more holistic view. Recognise diversity of landscapes/connectedness. 2050 EMS integral and provides a marketing basis. By 2050 must be dealing with issues. Monitoring+regulations to respond to market demand. Research capability is to keep up with change. Need to do reality check. Change in pastoral line - move inland.</td>
</tr>
<tr>
<td>sd10-ci8 Diversification, value-adding, intensified land use</td>
<td>Currently restricted to small scale enterprises concentrated in the Avon Arc.</td>
<td>Growth most likely to continue in the western half of the Basin in particular.</td>
</tr>
<tr>
<td>sd10-ci9 Indigenous access</td>
<td>Three major claims for native title encompass the entire Basin. Indigenous people need to have more say in land tenure</td>
<td>Native title - determination of native title unlikely to bring much, but native title connects with other issues eg. Transferability of land management responsibility (cultural issue).</td>
</tr>
</tbody>
</table>
**Manufactures and other industries** *(SD11)*

**Defined as** rural-based manufactures include non-agricultural activities such as flour milling, engineering works, cabinet and furniture making, brick works, and abattoirs. In Retrospect.. peaks in many manufacturing and other industries corresponded to the population rises up to the 1960s. Declines since then may reflect efficiencies of scale as well as population change. In Prospect.. retaining and developing these industries is necessary to support economic and community development.

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<td>sd11-ci1 Diversification</td>
<td>Since the 1990s a wide range of attempts to diversify income from agricultural and agriculture-support into other economic prospects. However, the potential for radical new woody crops producing industrial products appears promising but has not been explored until very recently. Diversification in mix of industries esp. small and medium manufacturing. Retail sales and rural manufacturing establishments have declined in number since 1952, although the value of retail sales has continued to rise in gross terms.</td>
<td>New industry - diversity of region, opportunity, adoption of new technology. Value adding of produce likely to be important in maintaining the place of primary industries and generate local employment and economy. Desalination and associated technology could be a valuable co-product in the wheatbelt.</td>
</tr>
<tr>
<td>sd11-ci2 Constraints</td>
<td>Constraints that have been identified as limiting development include market proximity, infrastructure, water, suitable sites and native title. Marketing region’s comparative advantage not worked up yet. Terms of trade decreasing 4% per annum. Industrial growth linked to product growth. Infrastructure lacking for big industries. Difficult to get consensus and sharp focus on the best targets for diversification (Wheatbelt Area Consultative Committee [2001]).</td>
<td>Potential for small enterprises esp. based around tourism in western areas. Development of infrastructure nodes would support new industries establishment eg. power and water.</td>
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**Marketing the Avon River Basin (SD12)**

**Defined as** activities and symbols that promote an identity for the entire Avon River Basin.  **In Retrospect..** the Basin has had few brands in the past and major products have been marketed in pools that were branded as Australian rather than Avon River Basin (eg. wheat single desk).  **In Prospect..** the opportunity exists for marketing the ARB in a range of creative ways that may access and capture new markets and add value to the region’s products.

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<td>sd12-ci1 Regional and product branding</td>
<td>Lack of regional identity and branding strategy has limited the opportunities for further promotion of products. Large-scale and niche products lack Basin-specific brands and identity.</td>
<td>Branding could assist the region in promoting itself as a positive, go-ahead place of investment, lifestyle, tourism.</td>
</tr>
<tr>
<td>sd12-ci2 ARB Image</td>
<td>ARB does not exist in the minds of most metropolitan people and customers of Basin products. ARB products, when marketed as Australian products, are positively viewed and accepted.</td>
<td>Potential for image to be consistently and aggressively promoted.</td>
</tr>
<tr>
<td>sd12-ci3 Perception of decline</td>
<td>Some Basin residents and enterprises are concerned that there is a wider community perception of the ARB as being in decline.</td>
<td>ARB marketing and regional development could form the basis of an ongoing campaign to promote the strengths and vision of the region.</td>
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**Minerals and energy* (SD13)**

**Defined as**... those minerals extracted for local use (e.g. gypsum) or export (e.g. salt, gold), and local renewable energy sources and imports of fossil fuel energy as gases, liquids or electricity.  **In Retrospect..** diesel fuels, wind power and grid electricity have been the key sources of energy since the 1950s. Mining, currently low, has had several boom cycles within the Basin.  **In Prospect..** diesel fuels, solar power, wind power, grid electricity and co-generation are the likely energy sources into the near future.

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<td>sd13-ci1 Infrastructure aging</td>
<td>The power delivery system in the Basin may be in need of new investment; supply interruptions common. In 2003 Energy Safety Directorate identified $48 million of remedial works required to address electricity supply problems.</td>
<td>Attract funding to implement the upgrade/replace of aging infrastructure. Deregulation of WA energy market pending. Disaggregation of Western Power planned.</td>
</tr>
<tr>
<td>sd13-ci2 Renewable energy</td>
<td>Wind power on farms common, solar point sources have increased in past 15 years. No large-scale plants in Basin. Possible co-generation for oil mallee plant. Renewable energy research and development threatened by break-up of Western Power (eg. the IWP program)? Renewable energy research needed. The energy balance of agriculture may become important if fuel prices rise. (Western Power 2002)</td>
<td>Green Globe benchmarking could be beneficial. Bioenergy - agricultural product, from tree crops. Saline solar ponds; support industry; can we be the biomass producer for renewable energy needs.</td>
</tr>
<tr>
<td>sd13-ci3 Energy access and development</td>
<td>Access to and production of both critical to the region. Reliance on fossil fuels - lack of alternative energy supply. Energy grid may limit local generation, limited sites. New technology and investment needed. Encouragement of co-generation, distributed generation required.</td>
<td>Great potential for energy production esp. local energy production for local use. Biodiesel, solar, co-generation are future alternatives. Biodiesel more feasible than hydrogen and ethanol (from grain). Could be a possibility to export energy out of the region - biomass and ethanol from lignocellulosic residues. New technology advances will add value to the region.</td>
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### Avon River Basin 2050

#### Critical Issues

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<td>sd13-ci4 <strong>Greenhouse emissions</strong></td>
<td>Unmeasured for the Basin specifically. Conflict between federal policy and possible Kyoto protocols and other agreements.</td>
<td>Signing of the Kyoto protocol will see greenhouse-labile entities (particularly Japanese utilities) invest heavily in mallee-type plantations which in turn could spur new industries based on agricultural-scale tree farming, power generation etc.</td>
</tr>
<tr>
<td>sd13-ci5 <strong>Mineral production</strong></td>
<td>Boom-bust cycles over past 50 years. Small sites predominate and major projects currently in decline. Minerals extensive in eastern basin.</td>
<td>Minerals will remain very important in next 50 years. Prospects for new nickel and gold projects, and continued demand for nickel and iron ore in China and South-east Asia.</td>
</tr>
<tr>
<td>sd13-ci6 <strong>Biomass energy</strong></td>
<td></td>
<td>Biomass energy is a prospective co-product, i.e. a use for woody biomass residues (and agricultural residues). Because it is only likely to be developed as a co-product it may be best dealt with in the new large-scale industry section.</td>
</tr>
</tbody>
</table>

**New large-scale industry (SD14)**

**Defined as** the development of industry extensive across much of the Basin, and internationally competitive or unique. **In Retrospect...** the Basin has experienced two introductions of large-scale industry in the twentieth century; pastoralism and the development of the wheatbelt. **In Prospect...** there may be potential for the development of industry for creating large international market products.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd14-ci1 <strong>Industrial crops</strong></td>
<td>Develop large-scale industry—industrial crops. Harness the comparative advantage of ARB farmers by providing new woody perennial crop options that require local processing and have large markets.</td>
<td>There may be too many other places with cheaper infrastructure. This option puts the workhorse of wheatbelt economic life (farmers) to work on serious prospects for new large-scale industry. The mallee industry model gives some credibility to this option. The Search and Florasearch projects indicate good potential for other large international market products like panels and paper. There is also potential for large volume co-products like bioenergy and plant chemicals.</td>
</tr>
</tbody>
</table>

**Perth – metro-centricity (SD15)**

**Defined as** the bias in focus, services and funding towards the population of Perth, the Western Australian capital. **In Retrospect...** this trend has accelerated over the past fifty years in line with the Basin’s declining population relative to Perth. **In Prospect...** the development of the Avon Arc will increase the Basin’s population, and bring increased connections with Perth residents.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Detail</th>
<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd15-ci1 <strong>Urban-rural overlap</strong></td>
<td>Opportunities for urban-rural concurrence, as reflected in the development of the Avon Arc, required communication, power, politics.</td>
<td>The overlap will continue to grow and bring improved services to the western part of the Basin. Perth will become increasingly important as a market and a gateway for ARB goods and services.</td>
</tr>
<tr>
<td>sd15-ci2 <strong>Fly-in fly-out</strong></td>
<td>Fly-in fly-out is a preferred means of supplying skilled labour to mining operations. A limited mode of work in agriculture that has helped to retain family farms when families move to Perth for education needs.</td>
<td>Likely to increase if region loses critical mass in some centres. Fly-in fly-out is a solution not a problem.</td>
</tr>
</tbody>
</table>
### Critical Issues

<table>
<thead>
<tr>
<th>SD16-ci1</th>
<th>International context</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detail</strong></td>
<td>Production exports and imports are linked to international forces such as regional economic prosperity, exchange rates and perceptions of environmental quality. Marketing by measures such as single-desk has persisted for some time. Mix of crops dictated by International trade. We are a big player in a small market. Competition from emerging countries. Benefits of 'clean and green'. Increase in biosecurity risks.</td>
</tr>
<tr>
<td><strong>Prospects</strong></td>
<td>Likely to determine whether wheat remains dominant as at present. Create international marketplace through brands and segregation. Opportunities for export must be competitive - China. Effect of the predicted 40% population increase by 2050 will be ongoing demand. Exploit disease free status (not just clean+green) of plants and animal industries (eg. Foot and mouth, CJD, viruses common elsewhere). Major export markets in south-east Asia should continue to expand in line with their population growth and increased affluence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SD16-ci2</th>
<th>Productivity and sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detail</strong></td>
<td>A critical issue - linked to climate, water, land. Exploitation for production (food/bioenergy) is at cost of environmental conditions and ultimately leads to reduction in productivity ie. need for more sustainable production. Require integrated understanding of the things that drive primary productivity. Whole package to maximise outputs through smaller total inputs - integrate soils, climates, practice, energy, transport, markets etc. Pressures of production from other land uses eg. housing. Control of feral animals and weeds must be addressed. The energy balance of agriculture may become important if fuel prices rise. Low tolerance to risk taking prevents growth.</td>
</tr>
<tr>
<td><strong>Prospects</strong></td>
<td>Increases on saline systems possible with technology and breeding improvements. Plant production must keep up with growing population &amp; climate change eg. different varieties. If productivity decreases long-term, how much more can we produce if we design, resource issues, market issues. Crop yield will rise with systems improvement. Utilise water resource (shallow, artesian, ex-saline) for production. Sale of technology to overseas who have similar problems &amp; issues.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SD16-ci3</th>
<th>Research and Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detail</strong></td>
<td>Productivity increase in WA grain industry averaged 5% last 10 years. Shift in research and development since the early 20th century from production to productivity to product quality tailored to specified markets to environmental sustainability.</td>
</tr>
<tr>
<td><strong>Prospects</strong></td>
<td>Continuing emphasis on improved productivity and environmental sustainability. If the drying trend persists there will be a need to modify crops to suit the environment. Research and development investment in emerging products/industries. Identification of opportunities (eg biofuels, perennials, alternative animals); production systems; potential in landscape;other impacts;plants/animals to suit modified environment.</td>
</tr>
</tbody>
</table>

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**Plant industries** (SD16)

**Defined as** production that includes grains such as wheat, barley and oats, legumes and oilseeds, as well as hay production. Horticultural enterprises are included here. **In Retrospect**. wheat has remained the major plant product and export of the Basin since the early 20th century. Expansion of crops such as canola occurred in the 1960s. **In Prospect**. wheat export will remain the primary income-generating activity in the Basin for some time to come. Basin-specific brands could leverage access to markets and sales. Landscape issues exert pressure and uncertainty on the sustainability of current production.
Appendix 1: Drivers and issue details

### Critical Issues

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<thead>
<tr>
<th>Critical Issues</th>
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<tbody>
<tr>
<td><strong>sd16-ci4 Farm forestry</strong></td>
<td>Oil mallees and maritime pines being grown to diversify income-source and deal with land degradation such as salinity. Impacts and implications must be acknowledged.</td>
<td>Many potential new woody crops especially short cycle ones that are likely to be the most economically competitive. The Search project confirms that the native flora has species with good product potential. Needs major investment in research and development that is larger than any one Regional catchment group, but ARB could take the lead.</td>
</tr>
<tr>
<td><strong>sd16-ci5 Value-adding</strong></td>
<td>Very little processing of crops at present. Production limited to crops and pastures. The case for been made for alternative uses of plant production - fuel, lubricants, plastics, pharmaceuticals – but no viable alternatives have yet been demonstrated.</td>
<td>Can we process materials in the region instead of shipping elsewhere - needs careful consideration. Potential shifts in suitable growing areas and patterns of profitable seasons. Illustrate economics of current examples.</td>
</tr>
<tr>
<td><strong>sd16-ci6 Investments</strong></td>
<td>Phenomenal capital wealth in ARB; willingness to invest locally; current estimate of off-farm investments; intensification of animals (feedlots).</td>
<td>In large scale industries. Farmers have capital to invest if they believe the investment is a sound money-making venture.</td>
</tr>
<tr>
<td><strong>sd16-ci7 Single-product reliance</strong></td>
<td>Wheat production has been the major economic activity and land use for the past 50 years. Yields continue to rise. Single-commodity emphasis is risky for ARB - could be an Achilles heel.</td>
<td>Wheat may not be main produce in future.</td>
</tr>
<tr>
<td><strong>sd16-ci8 Niche-products</strong></td>
<td>Value-added and new products are typically small and may not shift the overall regional mix. Without value-adding, diversification, intensification it’s all just more of the same. Investment in / development of niche plant and animal products eg. small scale profitable examples - horticulture, aquaculture, specialist animals especially in western area but not limited to it.</td>
<td>Diversity of products is increasing rapidly. Development of new plant species will create benefits i.e. modified plants to suit the environment - use less water, salt tolerant.</td>
</tr>
<tr>
<td><strong>sd16-ci9 GMOs</strong></td>
<td>Trials limited in south-western Australia to date.</td>
<td>GMO will have an impact on the Basin, and will either be extensive or non-existent (the jury is still out).</td>
</tr>
<tr>
<td><strong>sd16-ci10 Disease-free status</strong></td>
<td>Disease free status at present. Is it truth or myth?</td>
<td>Exploit disease free status (not just clean+green) of plants and animal industries (eg. Foot and mouth, CJD, viruses common elsewhere).</td>
</tr>
</tbody>
</table>

### Policy and Governance (SD17)

**Defined as** (a) the impact of policies by local, state, federal and international bodies on the Basin, and (b) the local governance structures, particularly of local government areas. In Retrospect... establishment of the wheatbelt was driven by government policy in the 19th and 20th centuries. Residents have maintained a continuous engagement with decision makers to push for policy beneficial to the Basin’s interests. Local government boundaries have been in flux since first established in the 1870s. In Prospect... must maintain a focus on national and international policy that impacts the Basin. Some rationalisation of local government is likely in the future.
### Appendix 1: Drivers and issue details

#### Critical Issues

<table>
<thead>
<tr>
<th>SD</th>
<th>Name</th>
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<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd17-ci2</td>
<td>Regional governance</td>
<td>The unsustainability of the current number of shire councils has been recognised for over 20 years.</td>
<td>There is potential for improved efficiencies and delivery of service through rationalisation of governance structures. Is there a need for all the tiers of government in the future - perhaps there is little need for state government? However rationalisation may produce a rapid decline in the number of small towns.</td>
</tr>
<tr>
<td>sd17-ci3</td>
<td>State Sustainability policy</td>
<td>Impacts on salinity, renewable energy</td>
<td>Final policy “Hope for the Future” has been released. Implementation details still being developed.</td>
</tr>
</tbody>
</table>

#### Service industries (SD18)

**Defined as..** seeking to define and improve the minimum level of service, development of critical mass communities, and infrastructure maintained and enhanced. **In Retrospect..** in the past 50 years the range of service-based industries have diversified. **In Prospect..** trends of declining service provision may occur.

<table>
<thead>
<tr>
<th>SD</th>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>sd18-ci1</td>
<td>Availability and distribution</td>
<td>Trend has been withdrawal of services. Major concerns are quality, access, timeliness and proximity.</td>
<td>Increased service access via remote methods eg. telebanking. Further integration of service types into fewer sites eg. banking and post office, social services and health care.</td>
</tr>
<tr>
<td>sd18-ci2</td>
<td>Tourism</td>
<td>Tourism associations have arisen in order to develop the industry within the Basin, which lies within the Heartlands tourism region.</td>
<td>Tourism likely to increase in region and provide local benefits by increasing demand for services.</td>
</tr>
<tr>
<td>sd18-ci3</td>
<td>Health and Aged Care</td>
<td>Decline in and lack of rural health services eg. no obstetrics at Merredin hospital (even though the hospital has the facilities) - have to go to Northam or Perth. Concentrated in major centres, with very small facilities across region, often resulting in extra accommodation and travel costs. Ongoing investment by state and federal governments. Staff availability remains problematic. Lack of sustainable integrated health care.</td>
<td>Community driven changes to health care delivery. Linked to the number of people who can pay. Health profile of the Basin population required to plan appropriate health services.</td>
</tr>
<tr>
<td>sd18-ci4</td>
<td>Education</td>
<td>Numbers of schools and students has fallen since 1950, in line with population loss. Preference for secondary &amp; tertiary outside Basin. This might be bringing new skills and ideas back to the ARB, as the total number and percentage of population post-secondary qualifications is rising. Investment in Basin schools amongst the lowest in regional Australia.</td>
<td>The trend towards increasing number of international students in Australia could lead to growth in the Basin’s tertiary institutions (Curtin University campus at Muresk, Merredin Flying School).</td>
</tr>
<tr>
<td>sd18-ci5</td>
<td>Microbusiness</td>
<td>Not strongly supported eg. marketing support mechanisms.</td>
<td>Likely to continue growing, especially in the Avon Arc.</td>
</tr>
<tr>
<td>sd18-ci6</td>
<td>Family support services</td>
<td>Few opportunities for/recognition of women’s contribution. Services such as child care and respite care are insufficient for current demand.</td>
<td>Further investment in family services more likely with local government amalgamation.</td>
</tr>
<tr>
<td>sd11-ci7</td>
<td>Professional services</td>
<td>Linked to community development.</td>
<td>Development linked to the number of people who can pay. Likely to increase in the Avon Arc and decline elsewhere.</td>
</tr>
</tbody>
</table>
**Society and culture* (SD19)**

**Defined as** an ongoing driver that impacts many other major drivers. It includes trends in the makeup of the Basin’s society, its common activities and engagement with the communities and organisations in WA, Australia and internationally. **In Retrospect..** despite immigration and population decline the Basin has remained relatively consistent culturally. Notable exception has been the rise in Indigenous population by 15% over the last fifteen years. **In Prospect..** further engagement with people, communities and regions outside the Basin is likely to influence the Basin’s development.

<table>
<thead>
<tr>
<th>Critical Issues</th>
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<th>Prospects</th>
</tr>
</thead>
<tbody>
<tr>
<td>sd19-ci1 Partnerships</td>
<td>Basin communities are increasingly forming partnerships with state and federal entities, and attracting funding for a diverse range of environmental, economic and social projects (Wheatbelt Area Consultative Committee 2004).</td>
<td>Likely to continue in the short-term, such as National Action Plan for Salinity Quality and the federal assistance available through the Wheatbelt Area Consultative Committee and Indigenous Land Corporation.</td>
</tr>
<tr>
<td>sd19-ci2 External influence</td>
<td>Decisions made by governments outside the Basin continue to have a dominant impact of social and cultural development.</td>
<td>Likely to continue given the Basin’s population trends.</td>
</tr>
<tr>
<td>sd19-ci3 East/west divide</td>
<td>A recent phenomenon has been a shift in social and economic indicators in the Western edge of the Basin (the Avon Arc) and the Eastern and parts of the Basin.</td>
<td>Strong population growth in the Avon Arc will likely continue this difference in the future.</td>
</tr>
<tr>
<td>sd19-ci4 Community infrastructure</td>
<td>Unsustainable levels of community service.</td>
<td>Prospects linked to reform of local government structures.</td>
</tr>
<tr>
<td>sd19-ci5 Indigenous development</td>
<td>Since the 1950s Aboriginal groups in the Basin, from being excluded in census counts, are now developing an economic resource base (Australian Bureau of Statistics 2001). How to unearth, discover, amplify the fact of traditional ownership and interpretation of landscape, ownership of Intellectual Property Rights in plants &amp; animals, and representations of culture through art, etc.</td>
<td>Indigenous land access, ownership and right-to-negotiate likely to increase, more through joint agreements rather than court-based determinations. Partnerships with governments and corporations concerning land access and bioprospecting likely to increase eg. MOU between South West Aboriginal Land and Sea Corp and about 140 LGAs). Social issues within indigenous communities may continue to limit these developments.</td>
</tr>
<tr>
<td>sd19-ci6 Cultural diversity and awareness</td>
<td>Basin has remained relatively consistent culturally for the past 50 years (Mickle 1994). Notable exception has been an absolute rise in Indigenous population by 15% over the last fifteen years, and an increase in the share of the Basin’s population from 4 to 4.8% (Australian Bureau of Statistics 1996, 2001).</td>
<td>Immigration may change the mix of cultural backgrounds in the Basin to its economic and social advantage. However these benefits will be dependent on greater cultural awareness and understanding.</td>
</tr>
<tr>
<td>sd19-ci7 Amplification of Aboriginal place and meaning</td>
<td>A lack of recognition, understanding, and engagement with Aboriginal people has characterised the Basin’s history to date.</td>
<td>Since the Native Title Act was passed there are growing signs that this lack of recognition is being addressed. These issues will become more significant as the Aboriginal proportion of the Basin’s population increases.</td>
</tr>
<tr>
<td>sd19-ci8 Social/cultural identity</td>
<td>What does it mean to be an ARB inhabitant? Lack of an identifiable profile for living in the Basin limits promotion of unique lifestyle (Patterson Market Research et al. 1999).</td>
<td>Devolution of responsibility for management of social, economic and environmental issues to the ARB by state and federal governments may strengthen social and cultural identity.</td>
</tr>
<tr>
<td>sd19-ci9 Mobility</td>
<td>Increasing mobility of the population has reduced the loyalty of Basin residents to local businesses.</td>
<td>Trend is likely to have negative implications for most of the Basin, except the Avon Arc where critical mass may see the establishment of new local businesses.</td>
</tr>
</tbody>
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Appendix 1: Drivers and issue details
## Appendix 1: Drivers and issue details

### Electoral reform

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<thead>
<tr>
<th>Critical Issues</th>
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<th>Prospects</th>
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</thead>
<tbody>
<tr>
<td>sd19-ci10 Electoral</td>
<td>Redistribution by boundary change a constant activity since 1952. Possibility of one-vote, one-value. Long-serving state and federal members suggests constancy of political views (see <a href="http://www.waec.wa.gov.au/">http://www.waec.wa.gov.au/</a>).</td>
<td>'One-vote, one value' reform would reduce the number of political representatives and may result in reduced state government services.</td>
</tr>
</tbody>
</table>

**Telecommuting and work (SD20)**

**Defined as** the potential for the Basin to be promoted as an excellent place to relocate their lives and work through telecommuting. **In Retrospect...** there may have been small numbers of individual telecommuters in the past. **In Prospect...** growth of the Avon Arc infrastructure and population could lead to increased numbers of telecommuters.

<table>
<thead>
<tr>
<th>Critical Issues</th>
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<th>Prospects</th>
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</thead>
<tbody>
<tr>
<td>sd20-ci1 Nature of</td>
<td>Recent developments in telecommunications and computing are providing the opportunity to vary work activities between office and home.</td>
<td>Accessibility and quality of telecommunications likely to continue to improve and further enhance these opportunities.</td>
</tr>
<tr>
<td>work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sd20-ci2 Information</td>
<td>To date the availability and reliability of information technology in the Basin has been poor.</td>
<td>Improvements in technology could drive improvements to service industries in the Basin.</td>
</tr>
<tr>
<td>Technology services</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tourism (SD21)**

**Defined as** the development of events and sites that bring short- and long-term visitors to the region. **In Retrospect...** the number of visitors to the region has been growing over the past ten years. **In Prospect...** there are many sites and events with the potential for development, and a growing source of visitors in Perth.

<table>
<thead>
<tr>
<th>Critical Issues</th>
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<tbody>
<tr>
<td>sd21-ci1 Eco-cultural</td>
<td>Ecotourism has been growing in the region, but limited by available infrastructure. Many tourist enterprises are home-based micro-businesses.</td>
<td>Strong link between indigenous culture and eco-tourism has yet to be made as it has elsewhere in Australia eg. Uluru and Kimberley. This has the potential to drive regional development and employment but the proposition for growth in the region has yet to be clearly demonstrated.</td>
</tr>
<tr>
<td>tourism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sd21-ci2 Events and</td>
<td>Tourism currently site-centred and therefore seasonal eg. Wave Rock. Little else of wide appeal in region (Western Australian Tourism Commission 2003).</td>
<td>Events could attract tourists and visitors eg. bush races, Avon Descent.</td>
</tr>
<tr>
<td>sites</td>
<td></td>
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</tbody>
</table>
**Water** *(SD22)*

**Defined as** the characterising element of the Basin. Human settlement is dependant on water piped in from coastal regions, while the landscape is widely affected by saline groundwater. The Basin has three separate sub-regions with different flow regimes. **In Retrospect..** rapid clearing of the Basin in the 1910s, 1920s and 1950s exposed the landscape to a range of degrading processes. Many stream attributes have been changed. **In Prospect..** a growing resource of salinised groundwater encourages thinking of opportunities for new development.

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<tbody>
<tr>
<td>sd22-ci1 Salinity</td>
<td>Stream-flow and groundwater affecting waterways, lakes, wetlands, infrastructure and productive land. A range of solutions have been attempted, including tree planting, agronomic changes and artificial drainage.</td>
<td>Salt water will be a valuable resource in 2050. Investigate salt-tolerant species. Groundwater salinisation rate slower in warmer/drier conditions.</td>
</tr>
<tr>
<td>sd22-ci2 Global issues</td>
<td></td>
<td>The loss of biodiversity in salinising valleys may become an issue bigger than the regional community and affect land and water use decisions. The energy balance of agriculture may become important if fuel prices rise.</td>
</tr>
<tr>
<td>sd22-ci3 Drainage</td>
<td>Since the 1980s drainage of salinised land via natural and artificial channels has been ad-hoc and not always in compliance with legislation. Impacts on adjoining private and public lands unassessed. Aquatic values/Wetescapes.</td>
<td>Drainage a solution for some and a problem and others; impactor pays?; Improvements - not pristine anymore; attract higher participation.</td>
</tr>
<tr>
<td>sd22-ci4 Quality</td>
<td>Decline and eutrophication of river and tributaries by point- and diffuse sources.</td>
<td>Possible increased salt, acidity, sediment and summer flows from deep drainage scheme installed in upper valleys may impact on downstream ecosystems and infrastructure.</td>
</tr>
<tr>
<td>sd22-ci5 Channel and floodplain changes</td>
<td>Loss of pools, and increased flow, erosion and sedimentation following 1950s river training. Decline in flood areas and increased in flood levels. Development pressures encroaching on floodplains, particularly in Avon Arc area. Flooding of towns remains an issue.</td>
<td>100 year flood level &gt;50 cm above current predictions. Avon region maybe in the future increase to &gt;1 m - effect on towns needs to be communicated. Relationship between Avon &amp; Swan and connection of Avon River with Perth likely to become stronger. Increase in flood peaks and 100 year flood levels following salinisation will impact on built infrastructure.</td>
</tr>
<tr>
<td>sd22-ci6 Bank condition</td>
<td>Riparian habitat loss, rubbish dumping and weed invasion altering in-stream ecology. Water temperatures higher than before due to lack of shading; salinisation makes banks unstable. Aquatic values/biodiversity have been impacted by current and past land uses.</td>
<td></td>
</tr>
<tr>
<td>sd22-ci7 Scheme water</td>
<td>Human habitation dependent on heavily subsidised water from Darling Ranges (and more recently the coastal plain) for 100 years. Major expansion of the scheme in the 1930s-1960s (Broun 1974). Remains conduit for goldfields water supply. Areas outside Goldfields Agricultural Water Supply receive Farm Water Grants but this is less of a subsidy than reticulated water. Water distribution a bigger issue than supply. Goldfields region’s water supply options being reviewed (Department of Minerals and Petroleum Resources 2002).</td>
<td>GAWS unlikely to be changed in the next 5 –10 years as a result of a goldfields water supply study just completed. Will become more necessary as hobby farmers increase in number. Predicted increase in population in more arid regions means this issue needs to be addressed.</td>
</tr>
</tbody>
</table>
## Critical Issues

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<tr>
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<tbody>
<tr>
<td>sd22-ci8 Equity issues</td>
<td>Urban water users subsidise rural and regional water services (water, sewerage and drainage) – possible National Competition Council issue; increasingly scheme water will come from coastal plain sources (northern dams producing less runoff); rural water plan subsidy doesn’t compensate for lack of access to GAWS water; downstream impacts of arterial drainage waters caused by losses from channels and poor water in rivers and crossings. Govt policy and water ‘ownership’ - pricing (efficiency, equity mechanisms) and trading (rights and allocation). Remove impediments to re-use.</td>
<td>Will impact hugely on our future. Build a desalination plant to produce potable water using biomass energy systems based on straw as the feedstock. Use the potable water for domestic consumption or to establish new industries in the district. User pays - potable water (provide/deliver), aquatic values (impactor pays; impact analysis before), groundwater, potential loss or reduction of Community Service Obligations (CSOs), use of wastewater. Future loss of potable water subsidies /CSOs may provide an opportunity for new water developments to re-use.</td>
</tr>
<tr>
<td>sd22-ci9 Making a virtue out of necessity</td>
<td>Salinised groundwater could become a resource if able to be treated or used for serial concentration. However variability in water quality, lack of demand for water and power have to be overcome. Saline water needs to be seen to become a valuable resource - mineral harvesting, available potable water, salt tolerant plants, intensive plant production, dependent manufacturing. Needs to be marketed. Use water from the Basin in the basin, not drain away. Need analytical tools to assess impacts of options on land, water and biodiversity. Industry needs reason to come - chicken&amp;egg - water before industry?</td>
<td>New industries may solve some of these problems but require R&amp;D, capital and a skilled workforce. Investigate GMO crops that will survive on salt water. Invest in desalination technology. Basin might be a net water producer, not importer. Get plant water use up by 10% not easy - will need the time.</td>
</tr>
<tr>
<td>sd22-ci11 Economics and management</td>
<td></td>
<td>Decision making needs to be regional based.</td>
</tr>
</tbody>
</table>
Appendix 2: Statistical summary

The three tables that follow summarise historical statistical trends for a wide range of subjects in the Avon River Basin and for agriculture in Western Australia, at 5-yearly intervals between 1952 and the present. The Basin data were obtained by extracting Local Government Area (LGA) summary data in proportion to their overlap with the Avon River Basin. Pre-metric and pre-decimal currency data were converted to metric and decimal currency. Table 12 includes the statistical subjects as published, many of which have coverage of only a small part of the period. Table 13 regroups some of the key triple bottom line statistics under standard subject names. For example, the age cohort statistics ‘0-4 last birthday’ and ‘5-14 last birthday’ were published for the period prior to 1991, which can be added together to form a complete series with 1991 onwards statistics that were published under the heading ‘0-14 last birthday’.

A number of statistics available in published summaries were not collated for the Avon River Basin, but may be of use in future scenario planning. These include:

- New houses and other dwellings under construction [$A]
- New houses and other dwellings under construction [no.]
- New houses completed [no.]
- New other dwellings completed [no.]
- Non-house (unit) residential buildings commenced [no.]
- Non-residential buildings commenced [$A]
- Non-residential buildings completed [$A]
- Orchards [ha]
- Other cleared land [ha]
- Rapeseed area [ha]
- Rapeseed production [kg]
- Sheep, average weight per fleece [kg]
- Stone fruit [kg]
- Tractors on rural holdings [no.]
- Uncleared area [ha]
- Unformed public roads [km]
- Utilities, vans, trucks, omnibuses [no.]
- Value of output [$A]
- Vegetables area [ha]
- Vineyards area [ha]
- Whole milk [l]

The following tables are not completed for each statistic-year combination. Missing data was not published, not collected or was only available for one or more intervening years and is omitted from the table. For each statistic there is typically only one datum for each five year period, excepting some 1990s agricultural data for which annual data was made available by the Department of Agriculture, WA. This data for intervening years is included in an Excel spreadsheet that will be available from the Avon River Basin 2050 website (www.arb2050.com) and from the ARB2050 pages on CSIRO’s Water for a Healthy Country website (www.healthycountry.com.au).
Table 12. Avon River Basin statistics, 1952 – 2001, for every fifth year. Statistical subjects as recorded in Local Government Area summaries published by the Australian Bureau of Statistics and its predecessors. Units converted to metric and decimal currency where applicable. Many subjects were collated for short periods, and as such were not applied to the Triple Bottom Line summary of the region’s past trends (see page 5).

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**AVON RIVER BASIN 2050**

**Appendix 2: Statistical Summary**

107
### ARB Statistics (Published Labels)

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Table 13. Avon River Basin statistics, 1952 – 2001 for standardised subjects (groups of similar statistics collected under different labels in different years).

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<td>Retail sales ($ M)</td>
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<td></td>
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<td>Unproductive land</td>
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<td>21777</td>
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<td>21204</td>
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<td>30435</td>
<td>24355</td>
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<tr>
<td>Wheat area in mixed crop yrs</td>
<td>km2</td>
<td>7339</td>
<td>6426</td>
<td></td>
<td>21678</td>
<td>20147</td>
<td>20961</td>
<td>22562</td>
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<tr>
<td>Wheat yield</td>
<td>kg/ ha</td>
<td>857</td>
<td>756</td>
<td></td>
<td>989</td>
<td>1438</td>
<td>1787</td>
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Appendix 2: Statistical Summary

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<td>Barley area</td>
<td>000 ha</td>
<td>23</td>
<td>139</td>
<td>219</td>
<td>167</td>
<td>632</td>
<td>419</td>
<td>535</td>
<td>826</td>
<td>498</td>
<td>744</td>
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<td>Barley production</td>
<td>t</td>
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<td>769000</td>
<td>505000</td>
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<td>Cattle, total</td>
<td>000s</td>
<td>846</td>
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<td>1218</td>
<td>1357</td>
<td>1975</td>
<td>2464</td>
<td>1942</td>
<td>1660</td>
<td>1649</td>
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<td>Cropping</td>
<td>ha</td>
<td>18243</td>
<td>20797</td>
<td>27340</td>
<td>34190</td>
<td>38310</td>
<td>42070</td>
<td>55470</td>
<td>59700</td>
<td>53540</td>
<td>65080</td>
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<td>Hay, all types area</td>
<td>km²</td>
<td>115000</td>
<td>118000</td>
<td>190000</td>
<td>163000</td>
<td>240000</td>
<td>201000</td>
<td>219000</td>
<td>245000</td>
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<td>Hay, all types production</td>
<td>t</td>
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<td>421000</td>
<td>613000</td>
<td>536000</td>
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<td>633000</td>
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<td>km²</td>
<td>2657</td>
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<td>5200</td>
<td>3200</td>
<td>3820</td>
<td>2880</td>
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<td>Oats production</td>
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<td>189447</td>
<td>960000</td>
<td>422000</td>
<td>520000</td>
<td>386000</td>
<td>384000</td>
<td>338000</td>
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<td>Pigs</td>
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<td>Sheep</td>
<td>000s</td>
<td>12475</td>
<td>15724</td>
<td>18314</td>
<td>273704</td>
<td>344054</td>
<td>31158</td>
<td>30268</td>
<td>33463</td>
<td>34060</td>
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<tr>
<td>Wheat area</td>
<td>km²</td>
<td>12523</td>
<td>11187</td>
<td>16270</td>
<td>24890</td>
<td>23610</td>
<td>31710</td>
<td>43330</td>
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<td>2957000</td>
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<td>Wool</td>
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<td>52681</td>
<td>67301</td>
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<td>108231</td>
<td>151900</td>
<td>175049</td>
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<td>Wheat yield</td>
<td>kg/ha</td>
<td>869</td>
<td>780</td>
<td>1068</td>
<td>1116</td>
<td>1252</td>
<td>1300</td>
<td>765</td>
<td>1052</td>
<td>1500</td>
<td>1754</td>
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Appendix 3: Income from agriculture vs. mining

The first six columns list whole LGA income for agriculture and mining, and the estimated proportions that are attributable to the part of each LGA’s overlap with the ARB. The final four columns list the estimated income from whole and part LGAs within the ARB. The subtotal line demonstrates that mining earns about 17.5% of the income generated by agriculture (Department of Local Government & Regional Development 2002).


<table>
<thead>
<tr>
<th>LGA Name</th>
<th>Whole LGA Data</th>
<th>Estimated data for ARB boundary</th>
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<tbody>
<tr>
<td></td>
<td>Agricultural Production ($)</td>
<td>Minerals &amp; Petroleum ($)</td>
</tr>
<tr>
<td>Beverley</td>
<td>24.4</td>
<td>39.2</td>
</tr>
<tr>
<td>Brookton</td>
<td>23.6</td>
<td>23.3</td>
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<tr>
<td>Bruce Rock</td>
<td>55.9</td>
<td>55.2</td>
</tr>
<tr>
<td>Coolgardie</td>
<td>0.6</td>
<td>21.0</td>
</tr>
<tr>
<td>Corrigin</td>
<td>35.9</td>
<td>51.3</td>
</tr>
<tr>
<td>Cuballing</td>
<td>17.3</td>
<td>23.9</td>
</tr>
<tr>
<td>Cunderdin</td>
<td>40.2</td>
<td>70.4</td>
</tr>
<tr>
<td>Dalwallinu</td>
<td>121.7</td>
<td>136.9</td>
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<tr>
<td>Dowerin</td>
<td>42.6</td>
<td>36.1</td>
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<td>Dumbleyung</td>
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<td>66.6</td>
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<td>Dundas</td>
<td>18.0</td>
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<td>Gnowangerup</td>
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<td>Jerramungup</td>
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<td>Kent</td>
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<td>Kondinin</td>
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<td>65.2</td>
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<td>Koorda</td>
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<td>34.1</td>
</tr>
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<td>Kulin</td>
<td>53.7</td>
<td>79.9</td>
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<tr>
<td>Lake Grace</td>
<td>128.7</td>
<td>182.2</td>
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<td>Merredin</td>
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<td>41.5</td>
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<tr>
<td>Moora</td>
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<td>52.6</td>
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<td>Mount Marshall</td>
<td>70.8</td>
<td>66.9</td>
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<tr>
<td>Muckinbudin</td>
<td>60.5</td>
<td>60.5</td>
</tr>
<tr>
<td>Narembeen</td>
<td>45.1</td>
<td>57.1</td>
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<td>Northam</td>
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<td>10.6</td>
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<td>Northam (Town)</td>
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<td>7.7</td>
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<td>Nungarin</td>
<td>13.9</td>
<td>16.8</td>
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<tr>
<td>Pinjelly</td>
<td>25.1</td>
<td>29.8</td>
</tr>
<tr>
<td>Quairading</td>
<td>25.3</td>
<td>66.5</td>
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<td>87.8</td>
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<td>York</td>
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<td>SUBTOTALS</td>
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Appendix 4: Proposed Investment Initiatives

From the original list of proposed investment initiatives a top-10 was selected by the stakeholders (Table 17). These 10 were then developed into one-page brief outlines that are presented in this appendix.

Table 16. Titles and proponents of the top-10 proposed investment initiatives.

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<th>No.</th>
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<th>Title</th>
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<td>1</td>
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<td>pii-10</td>
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<td>Brendon Grylls, MLA Merriden</td>
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<td>Doug Abrecht, Agriculture WA</td>
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<td>pii-3</td>
<td>Bioenergy-based energy</td>
<td>Don Harrison, Western Power</td>
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<td>Peter Armanasco, Water Corp</td>
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<td>Biodiesel</td>
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<tr>
<td>7</td>
<td>pii-8</td>
<td>Value-adding to grains</td>
<td>Mike McFarlane, Convenor ARB 2050</td>
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<tr>
<td>8</td>
<td>pii-9</td>
<td>Large scale exporting of rural development</td>
<td>Don MacRae, Consultant to ARB 2050</td>
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<td>9</td>
<td>pii-7</td>
<td>CRC for Grainbelt Futures*</td>
<td>Mick Poole, CSIRO</td>
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<td>10</td>
<td>pii-14</td>
<td>Rural enterprise investment**</td>
<td>Doug Abrecht, Agriculture WA</td>
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</table>

* PII 9 was originally titled ‘CRC for Wheatbelt Futures’.
** PII 3 and 10 were not supplied by time of printing this report.

It was originally proposed that these PIIIs be rated for impact upon the successful development of the other PIIIs, but this was not completed. The following table has been provided for you to record your own ratings:

<table>
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<th>Rate each initiative against</th>
<th>PII-1</th>
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<td>CRC for Grainbelt Futures*</td>
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Impact rating range 1 = very low, 5 = very high
### Appendix 4: Proposed Investment Initiatives

#### Avon River Basin 2050

**PII 1. Develop new large-scale regional industries based on woody crops**

**Possible Proponent(s):**
A state wide ‘industry association’ formed from growers from all NRM Regions. ARB to nominate a nucleus of farmers to represent the region’s interests to achieve orderly new industry development across the state. ARB could take a position of leadership in new industry development. The industry association will link with a major industry development R&D project within the CRC for plant-based management of dryland salinity and CALM.

**Summary:**
- Every ARB farmer has the choice of 2 or 3 woody crops that sell profitably into large-scale industrial markets.
- All these crops require local processing to add value for export of products from the region.
- Markets are large enough not to be over-supplied by large-scale adoption of the crop by ARB farmers.

**Key Partners:**
All other NRM Regions, CRC for Plant-based Management of Dryland Salinity, CALM.

**Outcomes:**
- A choice of 2 or 3 attractive woody crop options for every farmer.
- Commercial potential and market size large enough for profitable woody crop adoption on the scale necessary to control salinity.
- Salinity control achieved without resort to ‘environmental credits’ instruments.

**Opportunities:**
- Utilise latent industrial product production competitiveness of farmers.
- Locks in local processing because bulk woody biomass is too low in value to export without processing.
- Provides motivation for across region collaboration.

**Threats:**
- Too difficult to win consensus and collaboration between NRM regions.
- No competitive new woody crop types can be developed.
- Too little R&D investment available to create the new woody crops.

**Potential Benefits:**
- Extra water use capability available at a profit within large-scale industry means regional-scale salinity control is achievable. Potential scale in wood panels, paper, bioenergy and chemical industries is large enough to achieve whatever proportion of woody perennial cover is required (Olsen et al. 2003).
- New local industry stimulates regional development, each full-scale mallee processing plant would cost $25m, require 10 000 ha of mallee and create 40 permanent jobs (Enecon 2001).
- Wheatbelt communities develop pride and confidence underwritten by commercially viable industries and environmentally sustainable agriculture.

**Ability to Capture (Potential Benefits):**
- The advantage of the globally competitive primary production capability of wheatbelt farmers applied to production of industrial commodities.
- Wheatbelt economies based on the superior terms of trade of industrial products compared to food products.
- More soundly based government programs – success in commercial development will stimulate R&D support from governments.

**Relevance:**
- There is no alternative to new industry development that has anywhere near the potential to deliver extensive NRM benefit as well as revitalisation of wheatbelt communities.
- Using the mallee development as an indicator, the concept of new tree crops/industries is enthusiastically supported by farmers.
- More than 20% of farmers have planted mallee and local government bodies are tuned to pursue the opportunity of mallee industry development in their patch.
- ARB could become the national leader in facilitation of mallee and other new industry development.

**Capacity of ARB:**
- Collaboration across NRM regions is imperative if new large-scale commodity export or local bioenergy industries are to be created.
- ARB should take the lead role in winning across region collaboration.
- Especially important to link into industry development R&D through the CRC for Plant-Based Management of Dryland Salinity.
- ARB could be the lowest cost industrial feedstock production province in the world.
### PII 2. Using Saline Water

**Possible Proponent(s):**
Local farming community, Avon Catchment Council, local LCDCs, Department of Agriculture (WA)

**Summary:**
- Capitalise on current deep drainage efforts and desalination technology to halt the escalation of dryland salinity.
- Diversify local industry by capitalising on market demand for desalination by-products.
- Reverse current negative trends in agricultural production, infrastructure life expectancy and native flora and fauna populations.

**Key Partners:**
Government (project finance), CSIRO (research knowledge and expertise), Avon Catchment Council (drainage and regional NRM knowledge), local community (on-ground project co-ordination, management and support).

**Opportunities:**
- Makes profitable use of an otherwise unproductive resource.
- Development of new local industries through the marketing of desalination by-products and application of desalinated water.
- Provides a model for an alternative water source having world-wide applicability.

**Outcomes:**
- Current deep drainage efforts fully realised through the provision of an appropriate water disposal site (i.e. a desalination plant).
- Salt encroachment halted, preserving remaining arable land, infrastructure and native ecosystems.
- Reliable water source provided for alternative industries.
- Diversification of local industry (eg. minerals and rare earths).
- New jobs created in desalination, mineral extraction, research and education.

**Threats:**
- Defeatist attitude of key stakeholders towards practicability of desalination.
- Application of current desalination technologies may be impossible or futile in the context of a large-scale saline water source.
- Reluctance of the Water Corporation to purchase desalinated water.

**Potential Benefits:**
- The establishment of a desalination plant serving as an appropriate disposal site for groundwater will allow the total ARB average daily groundwater flow to increase to 100,000 megalitres per day (based on the Narembeen drainage model), providing vast quantities of water from which minerals can be extracted and potable water created for a myriad of uses.
- Future of the agricultural industry in the ARB secured through the preservation of salt-threatened land.
- Alternative industries will insulate the ARB from volatility in agricultural commodity markets.
- Agricultural waste products may be used to power the desalination plant.

**Ability to Capture (Potential Benefits):**
- Lucrative market exists for the sale of desalination by-products.
- Expansion of the deep drainage system throughout the ARB easily facilitated through knowledge sharing between existing Landcare and NRM groups.
- Costs of desalination offset by proceeds of sale of by-products.
- Considerable incentive exists for farmers particularly to participate in drainage and desalination.

**Relevance:**
- Complements existing efforts to combat salinity.
- Strong community interest (despite scepticism) and commitment to alleviating effects of salinity.
- Numerous opportunities exist for the application of desalinated water.
- The rate at which salinity is spreading throughout the ARB renders any desalination strategy necessary and urgent.

**Capacity of ARB:**
- Desalination technology is already being researched, applied and refined (eg. at Merredin and through Geo Processors).
- Abundance of saline water available.
- Suitable location for a desalination plant available at minimal cost.
- Necessary frameworks for the implementation of a desalination strategy already in place throughout the ARB (eg. the Landcare network with its supporting resources).
### PII 4. Facilitation of a bioenergy based energy/industry node

**Possible Proponent(s):** ARB Farmer’s Association (refer PII-2), WDC as Government liaison? Requires a feasibility study.

**Summary:**
- As a model, facilitate construction of a bioenergy plant in the region where grid support is required, where bulk biomass is available (refer PII-2) and where compatible industries are likely to benefit.
- Provides a bulk outlet for 100,000’s tonnes/annum of long-term biomass contracts to support bioenergy tree crop planting.
- Provides a decentralised energy supply and grid support equivalent to say 10-20 MW of grid enhancement (facilitates other industry growth).
- Can associate other industries requiring process heat, steam waste products.
- Can provide a research base for value-adding bio-product such as charcoal, oils, chemicals etc.

**Key Partners:**

**Opportunities:**
- Provides a cost-effective long-term solution to dry-land salinity.
- Provides a beneficial alternative to network augmentation.
- Core for energy/wood related industrial development/R&D.
- 50:50 funding from AGO may be available if the project offers end-of-grid support.

**Outcomes:**
- A bioenergy plant of, say 10MW, consuming 200,000 t/yr of biomass under long-term contracts with farmers.
- The resulting 10MW energy node providing surplus energy for more industry development.
- Electricity take price reflecting the true cost of electricity supply to the region plus renewable energy certificates.

**Threats:**
- Grid augmentation seen as more reliable long-term energy solution.
- Uniform tariff and uniform networks charges hide the true value of the energy produced (forced to sell electricity at city wholesale price).
- All the external benefits may need to be realised (real money) for an economic outcome.
- The capital cost may be too high (say $30M for 10MW).
- The end-of-grid solution may be too technically difficult and the plant would need to come back to a more regional centre, losing the AGO funding.

**Potential Benefits:**
- Farmers will have a new commercial crop to harvest that would return at least the per acre income from wheat/sheep but with salinity abatement and carbon sequestration as well. Returns to farmers from a 10MW plant could equate to $3M/yr.
- The community benefits from extra energy availability for new industries, employment, diversity etc. A 10MW plant could provide energy for say 10 new 1 MW industries.
- It would assist Australia in meeting its international commitments in greenhouse abatement and agricultural sustainability.
- It may relieve the need for regulatory pressure on land-use, or international pressure (import tariffs etc.) due to unsustainable agriculture and species extinction.

**Ability to Capture (Potential Benefits):**
- Ability to finance the project – or provide the incentive for other private capital.
- Availability of feedstock at acceptable price – stubble, mallees, energy crops etc.
- Ability to gain cooperation of energy entities to realise the real value of the energy.

**Relevance:**
- Electricity supply and reliability are major concerns of all the agencies and this project provides a model to solve the issue internally, rather than relying on investment in unprofitable rural networks.
- Industry development is a key in providing community stability.
- A large bulk consumer is required for deep-rooted perennial crops to help arrest the spread of salinity and species extinction. Bioenergy is a large consumer and not as quality-constrained as most other wood-based industries.

**Capacity of ARB:**
- ARB farmers can produce and deliver bulk biomass more efficiently than European or American farmers.
- The enthusiasm and broad-based ARB support of a plant located in one chosen town is yet to be tested.
- Ownership of down-stream processing facilities has never been a priority of farmers and this may limit regional investment in the plant.
**PII 5. Aquaculture industry – triple bottom line potential**

**Possible Proponent(s):** TAFE is already a big player in fish farming in the ARB. This industry could be built off the back of the work they have already initiated. The Department Of Agriculture and the Fisheries Department would also be proponents. There are also a few emerging aquaculture industries in the region that could be expanded with some support and advice.

**Summary:**
Diversified farm income. Reduced population drain. Making productive use of an otherwise useless product (salty water and salt land).

**Key Partners:**
Government (through Research and Development and demonstration sites). The farming community. Private enterprise for larger ventures.

**Opportunities:**
- Development of a new industry in the inland agricultural area (i.e. medium/large scale fish farming).
- Making use of a product (salty groundwater) that would otherwise be wasted/not used.
- Development of associated industries:
  - On farm fish food supply (made from locally produced grain),
  - On farm tourism.
  - Fish processing.
  - Development of a Centre of Excellence/Education in inland fish farming.

**Outcomes:**
- Diversification of and an increase in farm income.
- New markets for farm produce.
- Making otherwise non productive land and water useful.
- Reduce the labour drain from the ARB.
- Improved job prospects.

**Threats:**
- Ongoing research is required – government may cut funding.
- May be more efficient to do closer to the ocean (i.e. pump seawater inland).
- Cost benefit – cost of developing on farm infrastructure may exceed potential return.
- No established market.
- False starts (i.e. farmers making a start too soon and failing with subsequent negative publicity).

**Potential Benefits:**
- There are an estimated 200 farmers in WA “playing around” with aquaculture. This could easily grow tenfold. With an average income of $25,000 per farm this could become a $50 M per annum industry in Western Australia, of which half could come from the ARB.
- Ancillary industries would reduce the population drain and create other opportunities.
- Increased employment opportunities associated with fish farming and ancillary industries such as fish processing and fish food (say 1000).

**Ability to Capture (Potential Benefits):**
- The abundance of salty water in the region will make this an attractive source of alternative income for farmers (i.e. make more productive use of the land and use an otherwise useless resource).
- Resources such as low cost land and salty water are readily available (already a sunk cost on most farms).
- The demand for fish products continues to grow, while fish caught from the wild has remained relatively static since the early 90s. The difference is being made up by farmed fish – and this market will continue to grow.

**Relevance:**
- Compliments existing farming (land and water available and farm products can be turned into fish food).
- Strong community interest and acceptance.
- TAFE and private interests are already heavily involved in the developmental phase of this industry.

**Capacity of ARB:**
- Cheap land and water available.
- Up to 200 farmers already involved in one way or another.
- Increasing demand for fish products.
- TAFE and private interests are already heavily involved in the developmental phase of this industry.
### PII 6. Biofuel processing plant

**Possible Proponent(s):** Department of Agriculture WA, Farmer-based cooperative

**Summary:**
- Facilitate construction of a biofuel processing plant based on either or both of the following:
  - An esterifying plant making biodiesel from oil crops and/or tallow from abattoirs,
  - An ethanol from cellulose plant using waste agricultural products and/or plantation short-rotation timber.
- The first is established technology but the oil sources are not developed. The biodiesel is fully substitutable with ordinary diesel.
- The second is less developed technically but the fuel sources are/will be available. The ethanol requires blending to a maximum of 20% with petrol.
- Key to the project would be the commitment of the region to utilise the fuel in the region (USA midwest support for soy-based biodiesel in farm machinery is a model).
- The project would deliver regional development while removing some insecurity over the availability and price of imported oil in the near future.

**Key Partners:**
- AgWest Northam (eg. Paul Carmody - biodiesel research),
- CALM, CRC for Plant-Based Management of Dryland Salinity, WDC, possible financial backing from CVC REEF, AGO etc.

**Opportunities:**
- Remove threat of oil price and supply volatility by developing sources internally.
- Become a major centre for R&D and renewable fuels promotion.
- Expand the use of agricultural waste and alternative crops.
- The Federal Government has a biofuels program which can be tapped into.

**Threats:**
- The ARB relies on cheap transport for its livelihood and oil availability is predicted to be almost depleted by 2050, with severe price rises certain in the near future.
- There may be other large-scale producers set up outside the ARB using imported tallow, palm-oil etc that would get the early market.
- The Federal Biofuels program may expire before the plant is established.

**Potential Benefits:**
- The first plant could produce sufficient blended fuel for ARB use, say 40 Ml (on-farm, transport for biodiesel, off-farm passenger) to firmly establish an industry.
- Other plants in other towns, or expansion of the original plant could then begin to take over from fossil fuel as prices rise.
- Overall greenhouse gases are reduced, helping to meet international targets and improving the sustainability rating of ARB.
- New uses for agricultural wastes and/or woody crops will be established, assisting in regional development and salinity abatement.

**Outcomes:**
- The ARB will be at least partially self-sufficient in fuel, removing some volatility from the oil price.
- A world-class manufacturing facility of say 40 Ml at competitive price.
- A world-class research facility bringing research funding and staff into the region.

**Ability to Capture (Potential Benefits):**
- Need to tap into the Federal Governments biofuels program fairly quickly before the benefits expire.
- Support for the product needs to be embraced by the ARB community so that forward sales can be confirmed.
- Warrantees on farm machinery needs to be confirmed with alternative fuels (generally accepted in Europe for example)

**Relevance:**
- The ARB’s reliance on transport fuels makes it particularly vulnerable to oil price rises and availability.
- This is a sustainable solution to a potentially devastating threat to the region.
## PI 7. Value-adding of grains

### Possible Proponent(s)

### Summary:
- Grain is the major industry of the Avon River Basin and will continue to be so for many years to come. 3500 farmers crop 3,168,762 ha to wheat, barley, canola, lupins, oats and other minor crops. The five year average of grain delivered from the ARB is over 4.4 million tonnes.
- Grain and its by-products (straw etc) have the opportunity to give better returns to the Region and counter higher production costs.

### Key Partners:
Australian Wheat Board, CBH Group, Grain Traders, Hay Exporters, National and International Millers, Livestock Exporters, Farmer Groups.

### Opportunities:
- ‘Get closer to the Market’ Avon River Basin varieties directly marked to individual oversees millers.
- Processing in the Avon River Basin with Regional Branding and a focus on the health market.
- Attract major international miller ie. Nippon Flour has set up mills in Canada.
- Produce niche livestock feeds from straw, chaff and low value grains and sell to local and international markets.

### Threats:
- International competition.
- Climate change.
- Soil degradation – salinity/structure.

### Outcomes:
- Financially stronger agricultural enterprises and creation of jobs making communities more sustainable.
- Avon River Basin produce recognised for quality and health benefits.

### Potential Benefits:
- Use of large amounts of grain by-products - straw, chaff and low value grain - would deliver better outcomes through increased profit, employment as well as support other industries like animal value adding and energy.
- Land would become more valuable leading to better conservation outcomes.
- Securing markets through partnerships with overseas business and attracting investment into our regions.

### Relevance:
- Increasing the value of the Basin’s major industry is critical to its long-term future.
- This is a sustainable solution to a potentially devastating threat to the region.

### Ability to Capture (Potential Benefits):
- Milling of grains is very competitive in overseas markets. So partnerships would be vital as it is in other exporting industries.

### Capacity of ARB:
- The capacity is dependant on external investment.
### PII 8. Large-scale exporting of education in sustainable rural development

#### Possible Proponent(s):

AusAID, ODA-Japan, other ODA sources and United Nations University (UNU) to establish the UNU Institute for Sustainable Rural Development throughout regional Australia with Muresk Institute as the lead Australian partner.

#### Summary:

Australia is unique among OECD countries in successfully developing “first world” regional, rural and remote communities in the full range of physical environments that challenge developing countries. This offers unprecedented opportunities to deliver education and training in situ and online from bases in regional Australia to developing country students. Of particular relevance to education and training in situ and online from bases in regional Australia is unique among OECD countries in successfully delivering online learning courses, supporting sustainable rural development, to hundreds of millions of primary, secondary and tertiary students in developing countries.

#### Opportunities:

- Match 1 million foreign students from urban centres and financially able families - projected to be studying in metro Australia by 2025 – with places in regional Australia for 1 million poor students from developing countries.
- Create one million jobs in regional Australia developing and delivering online learning courses, supporting sustainable rural development, to hundreds of millions of primary, secondary and tertiary students in developing countries.
- Delivery of tertiary education for foreign students throughout regional Australia will lead to major opportunities for regional youth and residents to obtain a tertiary education locally.

#### Threats:

- Australian universities will misconstrue initiative as a threat.
- Xenophobes...

#### Potential Benefits:

- **Urban Australia**: One million foreign students from urban centres and financially able families are projected to be studying in metropolitan Australia by 2025.
- **Regional Australia**: Proposed matching of 1 000 000 foreign students from rural areas in developing countries – studying in 100 campuses in regional Australia by 2025. Each campus would grow to 10 000 foreign students, 2 500 regional Australians and about 2,500 professional and support jobs. Major growth in regional employment of wide range of professional skills required to create and deliver online learning materials.
- **Avon River Basin**: Three campuses each with 10 000 foreign students, 2 500 ARB and Australian and students and 2,500 employees. Up to further 30 000 jobs in ARB creating and exporting online learning materials. It could more than doubling of the population of the region.

#### Key Partners:

Australian universities and research providers. Interactive multimedia enterprises, education content providers, and myriad other kinds of professionals required to create and deliver online learning to rural areas in developing countries.

#### Outcomes:

- Major contribution to improving education of regional poor in developing countries and with it global security.
- Effective transfer of the inherent know how of regional Australian and ARB communities to developing countries.
- Very widespread participation of regional Australia’s and ARB’s youth and residents in myriad projects to transfer capacities in sustainable rural development to developing countries in collaboration with foreign student colleagues.
- Creation of > 1 million new (predominately professional) jobs in regional Australia by 2025 – over 30 000 in ARB.
- Continuous improvement in the quality of primary, secondary and tertiary education and training available to regional Australia and ARB residents - significantly beyond current projected improvements.

#### Ability to Capture (the Potential Benefits):

- Australia is unique among OECD countries in successfully developing “first world” regional, rural and remote communities in the full range of physical environments that challenge developing nations – particularly in the management of dryland areas.
- A few thousand of the world’s most competitive farmers provides the ARB with significant comparative advantage.
- Major innovative projects with the potential to give the ARB comparative advantage in delivering major advances in enhancing the sustainability of dryland agriculture.
- The Avon Catchment Council is working towards a best practice strategy in natural resources management.
- World-class integration of existing abilities of the ARB and regional Australia and the foregoing initiatives into education and training programs in SRD.

#### Relevance:

- The educational development needs of developing countries striving to achieve sustainable livelihoods has never been greater and is likely to multiple in next 25 years.
- Major innovative projects in progress could advance the state of the art in increasing the sustainability of not only dryland agriculture but in the delivery of a wide range of sustainable livelihoods in dryland areas.
- Earlier proposal for Avon International Multiversity to deliver post-graduate education to students on-campus and around the world using online technology was well accepted.

#### Capacity of ARB:

- China Southern Airlines has a 20-year program to train 3,000 pilots at its Merriden and Jandakot airport facilities.
- Existence of major innovative projects to develop capacities: (a) large-scale value-added crops providing, among other things, feedstock for bio-energy plants and ARB energy self-sufficiency and (b) to use saline water eg. for development of a significant aquaculture industry.
- Potential for major Japanese investments in large-scale value-added crops to facilitate trading in carbon credits in ARB and regional Australia.
**PII 9. CRC for Grainbelt Futures**

**Possible Proponent(s):**
A case could be made for basing this Cooperative Research Centre in the Avon River Basin with various partners operating from laboratories and field stations in or near other towns throughout the Australian wheatbelt. Of over 60 existing CRCs, only the Desert Knowledge CRC (DK-CRC) is not headquartered in a capital city or metropolitan centre. Curtin University’s Muresk Institute of Agriculture is a partner in the DK-CRC.

**Summary:**
To catalyse development of (a) new industries and (b) new products from existing industries in wheatbelt regions (using the Avon Region as a test bed), by bringing together technologies, expertise, resources, infrastructure and investment in new ways.

**Key Partners:**
Key collaborators and the main focus of collaboration: Commonwealth Government CRC Programme; State Governments; State agencies; Universities and CSIRO; TAFE; Development Offices; Rural R&D Corporations; Private sector from farmers to multinationals; NGOs….

**Opportunities:**
- We should be looking at an initiative with a core investment of the order of $15 to $25 million over seven years. The core investment would leverage other investments and interest to allow significant new work on business opportunities for the region.
- The core investment could come from the Commonwealth CRC Program, in which case it would need an Australia wide focus, or be a State Govt initiative for the 15 million hectare wheatbelt region using the ARB as a test bed.

**Outcomes:**
- New profitable and sustainable industries for the wheatbelt.
- Whole of chain value building for cereals.
- New woody and herbaceous perennial crops for the wheatbelt.
- New animal systems for the wheatbelt.
- Integrated systems development for new industries.
- Smart infrastructure for the wheatbelt.
- Education, training and tourism for the wheatbelt.

**Potential Benefits:**
- Significant benefits of global, national and regional significance would flow from the progressive realisation of the foregoing outcomes.
- An early task in preparing the case for this CRC would be to estimate the benefits and costs of delivering these outcomes subject to the current objective of the Commonwealth’s CRC Programme:
  - “to enhance Australia’s industrial, commercial and economic growth through the development of sustained, user-driven, cooperative public-private research centres that achieve high levels of outcomes in adoption and commercialisation”.
- Also relevant is the CRC Programme guideline to account also for the educational, environmental and social implications of work of CRCs as very important, providing an excellent opportunity to bring together researchers from many disciplines.

**Ability to Capture (Potential Benefits):**
- The business model for a CRC for Wheatbelt Futures would be similar to the Commonwealth’s CRCs, where most of the governance and structural issues have been worked through.
- Probably would be an unincorporated joint venture with incorporated spin-off companies…

**Relevance:**
- The thrust of the other proposed investment initiatives is mainly towards developing sustainable industries, including sustainable agricultural industries, within the ARB.
- The development of these initiatives through the concept, business planning and investment attraction phases could provide the focus of the first seven-year term for a CRC for Wheatbelt Futures.

**Capacity of ARB:**
- The ARB is already delivering useful outcomes pertaining to a number of the proposed investment initiatives. This includes achieving in some cases economic and ecological synergies between existing and emerging industries. This in turn augurs well for using the ARB as a test bed for this CRC.
Appendix 5: Workshop attendees

Table 17. Representatives of organisations their scenario syndicates, and attendance at Workshops No. 1-3.

<table>
<thead>
<tr>
<th>Organisation(s)</th>
<th>Representative</th>
<th>Syndicate</th>
<th>No. 1 17-10-03</th>
<th>No. 2 20-02-04</th>
<th>No. 3 26-03-04</th>
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<td>Australian Association of Agricultural Consultants</td>
<td>John Duff</td>
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<td>Agriculture WA</td>
<td>Cec McConnell</td>
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<td>APT Business Services</td>
<td>Don MacRae</td>
<td>Facilitator</td>
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<td>Australian Wheat Board</td>
<td>Tony Matchett</td>
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<td>Avon Catchment Council</td>
<td>Wayne Clarke</td>
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<td>Avon Catchment Council</td>
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<td>Bird-Cameron</td>
<td>Paul Hanson</td>
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<td>C.Y. O’Connor TAFEWA</td>
<td>Gavin Sarre</td>
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<td>CALM Farm Forestry Unit</td>
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<td>Challenger TAFE</td>
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<td>Country Womens Association</td>
<td>Yvonne Lawrence</td>
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<td>CSIRO Land &amp; Water</td>
<td>Tom Hatton</td>
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<td>Ted Lefroy</td>
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<td>Department for Planning and Infrastructure</td>
<td>Andrew Montgomery</td>
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<tr>
<td>Department of Agriculture</td>
<td>James Fisher</td>
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<td>Richard George</td>
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<td>Don McFarlane</td>
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<td>Department of Health (Wheatbelt Health Region)</td>
<td>Lisa McGinnis</td>
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<td>Department Conservation and Land Management</td>
<td>Greg Keighery</td>
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<td>Drylands Research Institute, Dept. of Agriculture</td>
<td>Doug Abrecht</td>
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<td>Rikki Foss</td>
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<td>Heartland Regional Tourism Association</td>
<td>Margaret Wilson</td>
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<td>Heartlands Regional Branding Group</td>
<td>Wendy Newman</td>
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<td>Indian Ocean Climate Initiative</td>
<td>Brian Sadler</td>
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<td>Landholder, former Deputy Premier of WA, WACC</td>
<td>Hendy Cowan</td>
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<td>Delegate for Hendy Cowan</td>
<td>Nadine Maisey</td>
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<td>MLA, Member for Merredin</td>
<td>Brendan Grylls</td>
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<td>Delegate for Brendon Grylls, MLA</td>
<td>Stephen Fry</td>
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<td>Merredin Senior High School (Year 11)</td>
<td>Donna Elsegood</td>
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Appendix 6: CRC for Grainbelt Futures proposal

Opportunities for the Australian Grainbelt

This document outlines a proposal to develop a Grainbelt Futures Cooperative Research Centre to contribute to the research and development needs of the existing and emerging industries for the Grainbelt of Australia.

The grain belt is economically important to the Australian economy as it contributes significantly to the GDP and export incomes of Australia through industries such as agriculture especially grain production, mining, tourism, manufacturing and service industries.

Businesses operating in the Grainbelt are facing a number of challenges including:

- Rapid globalisation and declining terms of trade in key industry areas;
- Greater risk and uncertainty associated with globalisation and agglomeration;
- Uncertainty over the impact and role of new technologies;
- Difficulty in attracting venture capital and suitable human capital;
- Highly variable climate;
- NRM problems impacting on the long-term sustainability of industry;
- Increasing susceptibility to bio-security breeches;
- Degradation of services;
- Changes in the size and density of population centres and a decrease in the number of farming businesses in particular; and
- Peri-urbanisation around major urban centres.

Despite these challenges the future for the grainbelt industries is solid with projected strong international and local demand for the products that are produced there. For example the recently published *Towards a Single Vision for the Australian Grains Industry* suggests that the demand for Australian grains could increase by up to 500 percent of current production by 2025.

Looked at it another way, the challenges provide the basis for the development of new business opportunities based on existing strengths factored together with emerging science and technologies such as green chemistry, biotechnology, ICT and nano-technology. There are also significant opportunities to develop innovative businesses through the value adding of existing products be they grains, minerals, NRM solutions and alternative means of service delivery to remote areas.

The challenge for the CRC will be to work with industry, communities, governments and researchers to identify and develop the opportunities, and turn the challenges into new sustainable businesses.

What are the benefits of this research?

- More resilient, sustainable and outward focused Grainbelt businesses and communities.
- Improved quality of life for Grainbelt people.

Research focus

The research focus of the CRC will be on sustainable business and community outcomes for the Australian Grainbelt.

The CRC will not - have a single industry (grain, beef, sheep, sugar etc), environmental, biotechnology or social science focus. A number of research structures are already in place dealing with these areas and links will be established to these to ensure no duplication of effort and partnerships developed where appropriate.

Because of the complex nature of the issues to be addressed it is expected that the majority of projects will be approached using a mix of scientific and systems research. All projects supported by the CRC will have at least one industry collaborator and a multidisciplinary research team drawn from a range of industry and CRC partners. Each funded project will have a steering committee assigned to it with a significant industry representation.
The following thematic research focal areas have been tentatively identified and these will be developed and focused further as the bid develops:

**Integrated Business Systems for the Grainbelt**

This thematic area will be the major focus of the CRC. The focus will be on **business-led and focused** research that will use new and emerging technologies such as green chemistry, nanotechnology, biotechnology and ICT to add value or create new industries.

A ‘**whole of chain**’ approach that develops integrated business systems for the Grainbelt will be encouraged in all projects to ensure that there is a demand pull through the value chain rather than a supply push approach. Projects will also be required to integrate into their analysis the social and environmental impacts of change. An example is the WA Oil Mallee project that takes oil mallee and turns it into an integrated industry that helps salinity management, provides multiple products – oil, chips, activated charcoal etc, energy to the grid, employment and carbon credits.

A further focus area will be on industry network development such that SMEs operating across the Grainbelt can work cooperatively in a distributed cluster to develop viable export markets while still competing locally.

Other potential areas for research include:

- Optimising logistics management for products.
- Post-production landscapes.
- Develop regional socio-economic and natural resource accounting models.

**Infrastructure**

The availability of high quality infrastructure (transport, ICT, energy, etc) is a fundamental requirement for efficient business operation. The provision of infrastructure in regional areas requires new and innovative solutions to bring the per unit costs of provision in-line with those charged in urban areas. Without low-cost infrastructure, regional areas will continue to struggle to be competitive with the coastal fringe in attracting inward capital investment or developing new industries.

Other potential areas for research include:

- Development if new innovative energy sources and ICT provision which are related to regional business needs;
- Design of optimum supporting industry infrastructure;
- Systemic understanding and optimisation of resource flows in regional areas;
- Understanding of product and workforce mobility;

**Regional/Community Adaptation**

Change is often difficult for individuals and communities to adapt to but if the nature and level of economic activity in a region is going to be increase there is a need to research and develop appropriate models of collective behaviour, capacity building and governance to ensure rapid adoption and the successful implementation of new business initiatives.

**Research partnership**

The research group developed for the proposed Grainbelt Futures CRC will involve the following broad groupings:

- Business – the business grouping will include major local and international agribusiness, mining, down-stream processing and marketing businesses. In addition, the CRC would be seeking to attract support from service industries such as banking, transport, accounting, etc as well as SMEs.
- Research and development corporations.
- Universities – at least one university from each of WA, SA, Victoria, NSW and Qld.
- CSIRO.
- State Government preferably at a whole-of-government level rather than at an individual departmental level but involving the following department types: agriculture; resource development; regional development and local government; and planning, infrastructure and service provision (education, health etc).

**Are you interested in being a partner or do you have research ideas? Then contact:**

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Tel: (08) 96901567 Fax: (08) 96225931
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### Bioenergy-based energy

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### Large scale export of rural development education

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### Large scale exporting of rural development education

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### Rural enterprise investment

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### Rural enterprise investment

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