

# Irrigation Futures

of the Goulburn Broken Catchment



Final Report 3 – Perspectives of future irrigation

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##### **Final Report – Summary**

Provides a brief introduction to the project and how the project objectives have been met.

##### **Final Report 1 – Scenarios of the Future: Irrigation in the Goulburn Broken Region**

Provides an overview of the region, drivers for change, scenarios, implications and strategies.

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Provides a manual of project methodology for next-users.

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Describes scenario implications for irrigation supply infrastructure.

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# **Irrigation Futures of the Goulburn Broken Catchment**

## **Final Report 3 – Perspectives of future irrigation**

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Cooperative Research Centre for Irrigation Futures

## **Perspectives of future irrigation**

This document was developed by the Irrigation Futures project team as a contribution to Goulburn-Murray Water's irrigation reconfiguration processes. It has been included as a chapter in the *Shepparton Regional Atlas* as a part of Goulburn-Murray Water's *Strategic View of Assets and Service Needs*. This document summarises the scenarios and their implications for irrigation infrastructure planning.



# Perspectives of Future Irrigation

Prepared by

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on behalf of

Goulburn Broken Irrigation Futures Project

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**action**  
Salinity & Water  
P U S R I L I A

Australian Governments and local communities working together to prevent, repair and manage rising salinity and declining water quality across Australia.



## Introduction

It is critical that irrigation infrastructure planning considers the needs of future irrigated agriculture. However, it is difficult to predict the future for irrigated agriculture as it will be influenced by many uncertain factors. Scenario planning is an approach to deal with the uncertainty by considering a plausible range of futures, so that the planned irrigation infrastructure will be able to service the needs of the future.

This section contains four scenarios, describing alternative plausible futures for irrigated agriculture in the Goulburn Broken catchment, and their implications for irrigation water supply. Although the scenarios have been developed for the Goulburn Broken catchment, they are also relevant to other irrigation regions in northern Victoria.

The four scenarios, Moving On, New Frontiers, Pendulum, and Drying Up, summarise the external driving forces, the region's response to those driving forces and the regional impacts that follow. The impacts focus on those factors relevant to irrigation infrastructure planning.

The four scenarios are not predictions of the future. They are intended to represent a range of possible opportunities and challenges that the Goulburn Broken catchment may face over the next 30 years. Many elements of the scenarios can be interpreted as metaphors or examples of possible events that may occur. For example, the outbreak of fire blight described in Scenario 2 has been used to depict a bio-security threat. Alternative bio-security threats such as foot and mouth disease or avian influenza could have been used. Similarly, government policies described in the scenarios should be considered as plausible, but should not be interpreted as a statement of future government policy or intent.

The four scenarios have been developed by the Goulburn Broken Irrigation Futures project. The project is a community initiative aiming to develop a shared vision for irrigated agriculture in the region. The project engaged the regional community and other key stakeholders through a series of 4 workshops held at 6 locations throughout the catchment. These workshops looked at the community's aspirations, the possible evolution of external driving forces in the future, and strategies to achieve the aspirations. The outputs of the workshops were developed further by a Technical Working Group to assess implications of the external driving forces and regional strategies.

Each scenario is presented in two forms: a summary and a more detailed description. The scenario summary provides a snapshot of the driving forces, regional impacts and implications for the distribution of water, along with illustrative graphs of land use, irrigated area, water use and farm gate gross value of production for the Shepparton Irrigation Region. The detailed scenario description contains additional information about the driving forces and impacts on different irrigation-dependent industry groups.

The scenarios are intended to stimulate discussions on strategic approaches to irrigation infrastructure planning including reconfiguration by considering what the future may hold and how the region can ensure it is robust under a range of possible futures. Further work looking at the implications of the scenarios for environmental management and the community will be reported in subsequent publications.

## Scenario Presentation

### Scenario Summary

#### Impacts

Describes a summary of regional scale consequences of the scenario including some economic, environmental and social impacts.

**Driving Forces**  
Describes a summary of the main factors influencing the region during the scenario.

**Implications**  
Describes the implications of the scenario for the distribution of irrigation water.

**Land Use**  
Illustrates the changes in land use within the industry for the Shepparton Irrigation Region over the period of the scenario.

**Farm Water Use**  
Illustrates the changes in farm water use by industry for the Shepparton Irrigation Region over the period of the scenario.

**Irrigated Area**  
Illustrates the changes in the area of land which is irrigated in a particular year by industry for the Shepparton Irrigation Region over the period of the scenario.

**Farm Gate Gross Value of Production**  
Illustrates the changes in the farm gate gross value of production for the Shepparton Irrigation Region by industry over the period of the scenario in 2005 dollars.

#### Summary of Scenario 1: Moving On

**DRIVING FORCES**

- **WATER RESOURCES**
  - Annual rainfall increases by 10% over the period 2007-2035.
  - Annual runoff increases by 10% over the period 2007-2035.
  - Annual evaporation decreases by 10% over the period 2007-2035.
  - Annual water use decreases by 10% over the period 2007-2035.
  - Annual water availability increases by 10% over the period 2007-2035.
- **LAND USE**
  - Annual cropland increases by 10% over the period 2007-2035.
  - Annual pasture increases by 10% over the period 2007-2035.
  - Annual woodland increases by 10% over the period 2007-2035.
  - Annual forest increases by 10% over the period 2007-2035.
  - Annual urban increases by 10% over the period 2007-2035.
  - Annual other increases by 10% over the period 2007-2035.
- **IRRIGATED AREA**
  - Annual irrigated area increases by 10% over the period 2007-2035.
  - Annual irrigated area per hectare increases by 10% over the period 2007-2035.
- **FARM WATER USE**
  - Annual farm water use decreases by 10% over the period 2007-2035.
  - Annual farm water use per hectare decreases by 10% over the period 2007-2035.
- **FARM GATE GROSS VALUE OF PRODUCTION**
  - Annual farm gate gross value of production increases by 10% over the period 2007-2035.
  - Annual farm gate gross value of production per hectare increases by 10% over the period 2007-2035.

**IMPLICATIONS**

- Annual water availability increases by 10% over the period 2007-2035.
- Annual water use decreases by 10% over the period 2007-2035.
- Annual water availability per hectare increases by 10% over the period 2007-2035.
- Annual water use per hectare decreases by 10% over the period 2007-2035.
- Annual water availability per hectare per hectare increases by 10% over the period 2007-2035.
- Annual water use per hectare per hectare decreases by 10% over the period 2007-2035.

**LAND USE**

Annual cropland increases by 10% over the period 2007-2035. Annual pasture increases by 10% over the period 2007-2035. Annual woodland increases by 10% over the period 2007-2035. Annual forest increases by 10% over the period 2007-2035. Annual urban increases by 10% over the period 2007-2035. Annual other increases by 10% over the period 2007-2035.

**IRRIGATED AREA**

Annual irrigated area increases by 10% over the period 2007-2035. Annual irrigated area per hectare increases by 10% over the period 2007-2035.

**FARM WATER USE**

Annual farm water use decreases by 10% over the period 2007-2035. Annual farm water use per hectare decreases by 10% over the period 2007-2035.

**FARM GATE GROSS VALUE OF PRODUCTION**

Annual farm gate gross value of production increases by 10% over the period 2007-2035. Annual farm gate gross value of production per hectare increases by 10% over the period 2007-2035.

### Scenario Description

#### Water Related Drivers

Describes the driving forces related to the availability of water, including forces related to government policy, climate and water trade.

#### Non-Water Related Drivers

Describes the non-water related driving forces and how they influence each of the major industries within the region. Price changes are real changes in price and do not include the effect of inflation.

**Regional Impacts**  
Describes some of the regional scale consequences of the scenario, in terms of some social, economic and environmental impacts. Specific impacts for irrigation infrastructure are also described.

**Industry Impacts**  
Describes the impacts of the combination of water and non-water related driving forces on the major industries within the region. Impacts are described for each industry as a whole and do not necessarily reflect the impact on individuals within each industry.



## Learning from the Scenarios

The four scenarios presented in this section describe alternative plausible futures for irrigated agriculture in the region and their implications on future irrigation water supply. Some of the drivers are common to all scenarios. For example, the emergence of new economic powers such as China and India providing both threats and opportunities for our industries. Other drivers diverge markedly, resulting in very different scenarios.

Scenario 1 "Moving on" depicts a steadily changing operating environment for the region. The industries in the region evolve successfully in response to international business conditions and moderate climate variability. In Scenario 2 "New Frontiers", agricultural production in the region declines over time because of a number of unfavourable conditions, most notably, the rise in synthetic food production. However, there is a sharp increase in the number of people who live in rural areas and work remotely, bringing a new and significant income stream to the region. Scenario 3 "Pendulum" describes how large shifts in water policy can dramatically change the face of the region. Scenario 4 "Drying up" highlights the vulnerability of the region to global economic recession and natural disasters such as drought.

The four scenarios represent four very different futures, as highlighted by the graphs below. Even though they are not predictions of the future, they provide useful test beds for examining the effectiveness of management strategies under a range of conditions. In the context of irrigation infrastructure planning, the four scenarios highlight a number of important issues.

### Flexibility of irrigation infrastructure

There is great uncertainty in the size of the irrigated area and the amount of water use in the future. There may be periods of rapid contraction and expansion of irrigation. Thus there is a need to build flexibility into irrigation infrastructure, so that it is adaptable to future demands. Flexibility may be achieved through innovative system configurations, flexible distribution technologies, a mix of infrastructure ownership, and improved management systems.

### Irrigation service level requirements

One of themes that emerged strongly from the scenarios is that the competitiveness of the agricultural industries in the region will depend on generating and marketing differentiated products. The industries are thus likely to demand greater levels of service in water supply than today. On the other hand, service requirements for water use on lifestyle properties are likely to be quite varied. Water supply to lifestyle properties may become more significant in the future as indicated by Scenario 2 "New Frontiers".

### Integration with land use and environmental planning

The scenarios describe significant changes in land use over the next 30 years, within and between agricultural, lifestyle and environmental uses. These land use changes can radically alter the viability and requirements of irrigation infrastructure. Irrigation infrastructure planning needs to be closely linked with land use and environmental planning. This calls for a collaborative approach to planning by agencies, industry groups and the community.

### Social and economic responsibility

The scenarios highlight the complexity of issues surrounding irrigation and the importance of involving stakeholders, including the community, in decision making. Changes to irrigation infrastructure and irrigation business viability can potentially have wide social consequences. Equity and social adjustment need to be carefully managed during periods of infrastructure change. Likewise, financial planning for infrastructure needs to make provision for industry down turns.

Large shifts in government policy on water can dramatically change the face of the region, as indicated by Scenario 3 "Pendulum". It is critical that the region actively influences all levels of government so that regional concerns and issues are addressed in policy development.

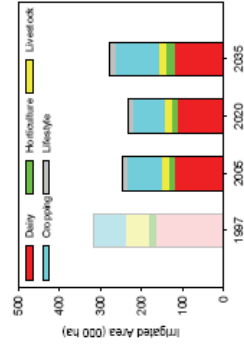
### Planning for changes

The scenarios also point to some of the potential weaknesses of the region. For example, the relatively small size of irrigated land parcels makes the region uncompetitive when the market demands large-scale production systems, as indicated in Scenario 2 "New Frontiers". Significant restructuring will be required to overcome some of these weaknesses, but it should be done under the right conditions so that changes can be made smoothly. The scenarios suggest that there are only a limited number of windows of opportunity for large-scale restructuring. In Scenario 3 "Pendulum" for example, government may be lobbied to assist in land amalgamation during periods of major water policy shifts. To seize these opportunities, there is a need for having plans and options prepared in anticipation of future conditions.

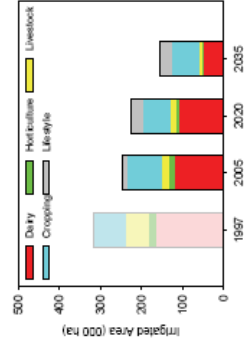
The issues highlighted above represent the learnings from the scenarios by the Goulburn Broken Irrigation Futures Project. The scenarios are intended to stimulate discussions on strategic approaches to irrigation infrastructure planning including reconfiguration. Therefore, readers are encouraged to use the scenarios to develop their own thoughts and ideas.

## Comparing the Scenarios - Irrigated Area

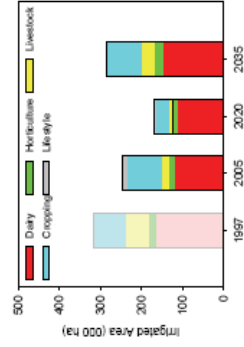
Scenario 1: Moving On



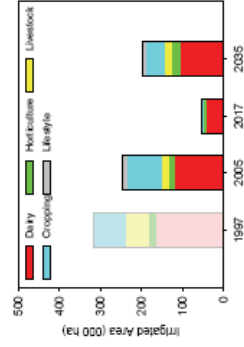
Scenario 2: New Frontiers



Scenario 3: Pendulum



Scenario 4: Drying Up



# Summary of Scenario 1: Moving On

## Driving Forces

2005-2020

- Free trade agreements signed with USA and ASEAN create demand for all agricultural products.
- Use of genetically modified organisms permitted for agriculture.
- Climate change results in a long period with no medium reliability water and hotter, wetter summers.
- 10% of irrigation water is traded to Sunraysia.
- Demand for lifestyle properties remains high.

2020-2035

- India and China become a significant market for agricultural products.
- Affluent consumers are becoming increasingly conscious of health and animal welfare issues.
- Climate remains relatively dry with only 25% of medium reliability water available.
- Water trade outside the region reduces.
- G-MW sold to Macquarie Infrastructure, prices increase and cross-subsidisation of infrastructure costs is reduced.
- Demand for lifestyle properties declines.

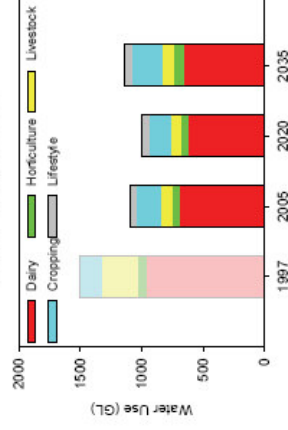
## Impacts

- Regional economy continues to prosper despite global competition.
- Agricultural businesses become larger, more intense and have a greater diversity of products. Larger farms employ people who live in towns. Few small farms remain. Some small towns decline.
- Intensification of agriculture increases the necessity for nutrient management.
- More water in the Goulburn River due to government policy and downstream trade.
- Irrigators move toward the river and the upper reaches of the irrigation system (cheaper water).
- In preparation for privatisation, infrastructure condition and operations are modified to maximise the sale price.

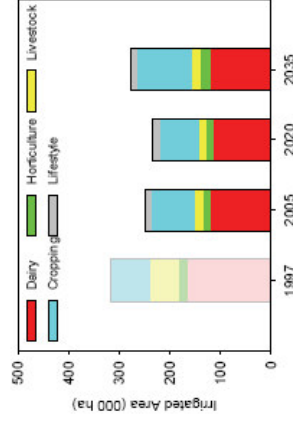
## Implications

- Water demand pattern changes as farming systems move toward more annual species.
- Area under irrigation decreases (10%) then increases (30%) as more water becomes available.
- Irrigation water use initially decreases (10%) due to trade and then increases as some (25%) medium reliability water becomes available.

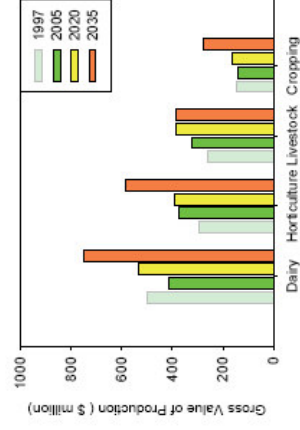
Farm Water Use



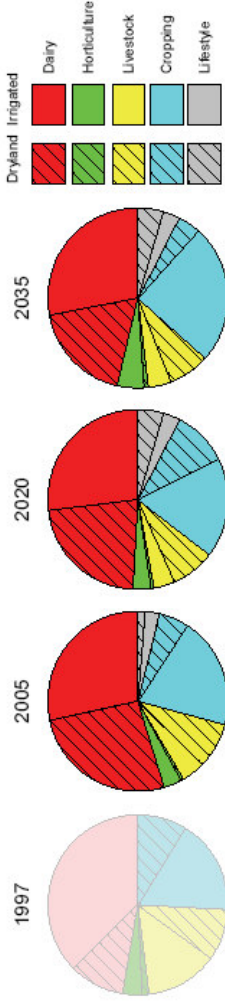
Irrigated Area



Farm Gate Gross Value of Production



Land Use



## Description of Scenario 1: Moving On

	WATER RELATED DRIVERS	NON-WATER RELATED DRIVERS	INDUSTRY IMPACTS	REGIONAL IMPACTS
<b>2005-2020</b>	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Water reform white paper is progressively implemented, involving unbundling of water rights, instituting a process for infrastructure reconfiguration, making 'sales' water into an independent entitlement and returning 20% of 'sales' water to the environment.</li> <li>Water tariffs increase at the inflation rate.</li> <li>Climate change increases, reduce the chill hours.</li> <li>Runoff decreases by 25%.</li> <li>High-reliability water not affected, but no medium-reliability water available.</li> <li>Temperature increases, reduce the chill hours.</li> </ul> <p><b>WATER TRADE</b></p> <ul style="list-style-type: none"> <li>10% of irrigation water is traded to Sunaysia.</li> <li>Trade water trade is introduced with little impact.</li> </ul> <p><b>OTHER</b></p> <ul style="list-style-type: none"> <li>No significant impact envisaged from forestry developments in the upper catchment.</li> <li>While Melbourne Water may acquire some water from the region, the volume will be relatively small and have no significant impact.</li> </ul>	<p><b>NON-WATER RELATED DRIVERS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Free trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.</li> <li>Genetically modified organisms introduced into agriculture.</li> </ul> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Demand from Asian markets grows.</li> <li>Decrease in competitiveness.</li> <li>No change in real price.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Free trade agreement allows cheap imports.</li> <li>Industry diversifies to different products.</li> <li>Decrease in competitiveness.</li> <li>Moderate increase in price.</li> <li>Genetic modification used throughout the world. No impact on markets.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Global demand for meat increases.</li> <li>No change in real price.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Growth linked to the dairy industry.</li> <li>Competitiveness due to genetic modification.</li> <li>No change in real price.</li> <li>Biotech demands for grain fulfilled by worldwide oversupply of grain. Little demand for grain from the region for biofuel production.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Demand up by 100%.</li> </ul>	<p><b>INDUSTRY IMPACTS</b></p> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Milk production increases 30%.</li> <li>Fewer farms.</li> <li>Area of dairy farm land decreases 10%, enabled by genetic modification, grain and fodder imports, and increased irrigation efficiency.</li> <li>Increased irrigation efficiency results in conflicts between agricultural production and lifestyle values.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Irrigation water use decreases 5%.</li> <li>Through diversification into new products.</li> <li>Growth of new industries with controlled environment systems are all.</li> <li>On farm round growth, but volumetric water requirements are all.</li> <li>Fruit production decreases 10%.</li> <li>No change in irrigated area.</li> <li>Irrigation water use decreases 5%.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Production increases 20%.</li> <li>Land area decreases 5% through increased use of feedlots and intensive systems.</li> <li>Irrigation water use decreases 10%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production increases 20%.</li> <li>No change in land area.</li> <li>Irrigated area decreases 10%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Irrigation water use decreases 10%.</li> <li>Land area up by 100%.</li> <li>Irrigation water use increases 20%.</li> </ul>	<p><b>REGIONAL IMPACTS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>The regional economy continues to prosper despite global competition. Import challenges are met through diversification into new products. Dairy, livestock and cropping will all absorb the regional water supply.</li> <li>Unleaded active irrigation in land-use planning results in conflicts between agricultural production and lifestyle values.</li> <li>This could be resolved by allowing market-based mechanisms to drive change. In parallel, the delivery of infrastructure systems which enhance production agriculture, requires close co-operation with Local Government planning across the region.</li> <li>Region on lowlands has low potential for new water supply. However, the remaining small farms have developed niche markets. Larger farms employ people who tend to live in large towns. Many small towns are declining.</li> <li>More water flows down the Goulburn River due to government water reform and downstream trade. Careful management of this water ensures environmental benefits are achieved.</li> <li>Nutrient management continues to be important due to the high value of water.</li> </ul> <p><b>IRRIGATION INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>Water demand pattern changes as farming systems move toward more annual pasture/crops.</li> <li>Irrigated area decreases 5%.</li> <li>Irrigation water use decreases 8%.</li> <li>Some timing changes associated with changes in farming systems. Highlights the general need for different water products.</li> </ul>
<b>2020-2035</b>	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>GAW sold to Macquarie Infrastructure.</li> <li>Cross-subsidisation of infrastructure costs decreases as a result of privatisation. Water tariffs increase to build in a commercial profit and through decreased cross-subsidisation.</li> </ul> <p><b>CLIMATE</b></p> <ul style="list-style-type: none"> <li>Climate remains drier than historical average. Summer rainfall more intense.</li> </ul> <p><b>WATER TRADE</b></p> <ul style="list-style-type: none"> <li>All high-reliability and 25% of medium-reliability water available.</li> <li>More internal trade and trade closer to main trunk channels.</li> <li>Trade outside the region reduces as limits to available land and water delivery capacity are reached.</li> </ul> <p><b>OTHER</b></p> <ul style="list-style-type: none"> <li>Demand for water from Melbourne continues to have little impact.</li> </ul>	<p><b>NON-WATER RELATED DRIVERS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>China and India grow as a market for agricultural produce.</li> <li>Consumers become increasingly affluent and health conscious.</li> </ul> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Demand from Asian markets continues.</li> <li>No change in competitiveness.</li> <li>Export growth to China and India.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>No change in competitiveness.</li> <li>No change in price.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Global demand for meat continues.</li> <li>Slight decrease in competitiveness.</li> <li>Change in price.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Growth linked to the dairy industry.</li> <li>No change in competitiveness.</li> <li>Moderate decrease in price fodder used locally.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Demand flattens.</li> </ul>	<p><b>INDUSTRY IMPACTS</b></p> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Milk production increases 30%. Increase in production of high-value nutraceuticals.</li> <li>Land area decreases, as farms become larger and more intense, and small farms exit.</li> <li>Irrigated area increases 5%.</li> <li>Irrigation water use increases 5%.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Production increases 50% due to GM and market opportunities.</li> <li>Land area increases 50%.</li> <li>Growth of controlled environment production continues.</li> <li>Irrigation water use increases 50%.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>No change in production.</li> <li>No change in land area. However grazing is important to increase in land area.</li> <li>Irrigated area increases 10%.</li> <li>Irrigation water use increases 10%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production increases 100% due to genetic modification and increases in land and water use.</li> <li>Irrigated area increases 40%.</li> <li>Irrigation water use increases 40%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>No change in land area.</li> <li>No change in irrigation water use.</li> </ul>	<p><b>REGIONAL IMPACTS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Water price increases do not hurt major industries because new owners need to maintain their customer base.</li> <li>Increases in water tariffs are greater at the 'bottom' of the system. Irrigators move toward the river and the upper reaches of the irrigation system where water tariffs are lower.</li> <li>Water users depend on water price to increase in water price, although impact reduced by increased technology, systems and management.</li> <li>Privatisation and take-up of local distribution networks by farmer groups provides greater grower flexibility to respond to market changes. However, it also requires the working together of those grower groups to be effective.</li> </ul> <p><b>IRRIGATION INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>As more water is available medium reliability water.</li> <li>Irrigation water use increases 15% due to the availability of medium reliability water.</li> <li>Irrigation water use increases in preparation for privatisation, infrastructure condition &amp; operations are managed to maximise the sale price.</li> </ul>

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# Summary of Scenario 2: New Frontiers

## Driving Forces

- 2005-2020**
- Free trade agreements signed with USA and ASEAN create demand for all agricultural products. Middle East trading partners lost due to our alliance with United States.
  - Large increase in lifestyle developments.
  - Genetically modified organisms prohibited.
  - Community concern for the environment increases.
  - Environmental flow entitlement increased through deal with medium reliability entitlement.
  - Climate change results in long period with high reliability allocation of less than 100%.
  - 15% of irrigation water is traded out of the region to Sunraysia and Northeast Victoria.

**2020-2035**

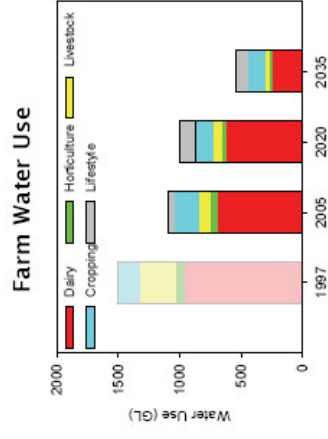
- International free trade is introduced.
- Fireblight and regulation cause a major decline in agricultural production across all industries.
- Synthetic food production significantly reduces the demand for naturally produced foods including dairy, horticultural and meat products, but substantially increases demand for grain.
- Demand for lifestyle properties plateaus.
- Genetically modified organisms allowed.

## Impacts

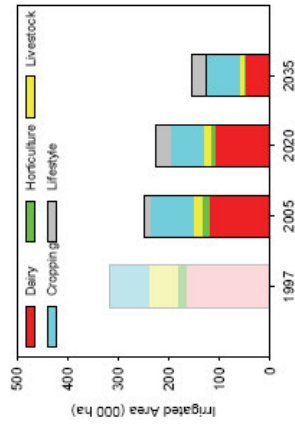
- Initially, a small decline in agricultural activity occurs due to the loss of markets. Followed by a substantial decline due to synthetic food production. Niche agricultural industries on some small properties cater for the health food market.
- Demand for grain causes increase in annual cropping. Large quantities of water trades to New South Wales where grain production is more efficient due to larger land parcel sizes. Water trade increases infrastructure costs for remaining irrigators.
- Regional economy is maintained by new lifestyle development. Lifestyle development is unplanned causing conflicts between agricultural production and lifestyle values.
- Land is reserved for environmental purposes.

## Implications

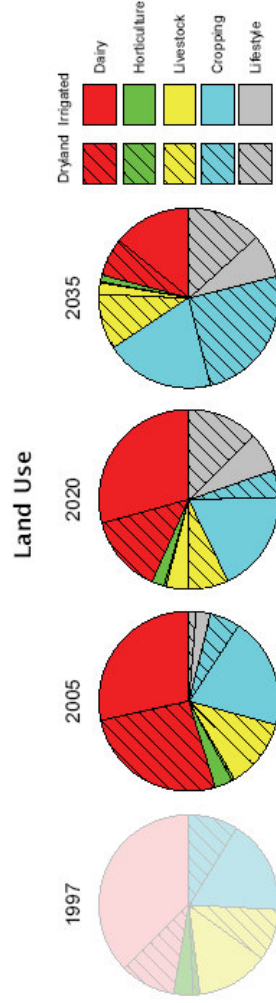
- Major contraction in most irrigated agricultural industries.
- Area under irrigation and irrigation water use decreases substantially (45%) due to water trade.
- Best areas for irrigation may change according to market demand for products and land availability.



## Irrigated Area



## Farm Gate Gross Value of Production



## Description of Scenario 2: New Frontiers

2005-2020	WATER RELATED DRIVERS	NON-WATER RELATED DRIVERS	INDUSTRY IMPACTS	REGIONAL IMPACTS
	<p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Barrages at mouth of Murray River removed giving large water savings - salt discharge entitlement increased by 100%</li> <li>Agricultural land purchased to produce wildlife and tourism corridors and wetlands across the region. Some prior stream areas retired.</li> <li>Climate dries further.</li> </ul> <p><b>WATER AVAILABILITY</b></p> <ul style="list-style-type: none"> <li>Irrigation constant due to water saved at barrages.</li> </ul> <p><b>WATER TRADE</b></p> <ul style="list-style-type: none"> <li>Large volume of water (55%) traded to grain growers in southern NSW as they have larger land parcels.</li> </ul>	<p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Trade agreements with USA and ASEAN create new export outlets for export, but also problems with cheap imports.</li> <li>Middle East trading partners lost through alliance with USA.</li> <li>Health and food safety important considerations in consumer purchases.</li> <li>Community concern for the environment increases.</li> <li>Increase in lifestyle developments and tourism.</li> <li>Cost of oil doubles causing a brief international recession.</li> </ul> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Use of genetic modification prohibited.</li> <li>Demand decreases.</li> <li>Small decrease in price.</li> <li>Small decrease in competitiveness.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Free trade agreement allows cheap imports.</li> <li>Freeflight outbreak cripples pome fruit industry.</li> <li>Large price decrease as import restrictions on pome fruit lifted.</li> <li>Export market increases through marketing of clean and green image.</li> <li>Small increase in price for other fruit and vegetables.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>International demand for meat reduces.</li> <li>No change in competitiveness.</li> <li>Small decrease in price.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Genetically modified organisms permitted to decrease food prices and increase exports.</li> <li>Oil substitution occurs (electricity, fuel cells etc). Small increase in energy cost.</li> <li>Substantial decrease in demand due to synthetic food production.</li> <li>Small niche for high price real milk.</li> <li>Small increase in price.</li> <li>Large increase in competitiveness.</li> </ul> <p><b>HORTICULTURE &amp; LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Similar to dairy although hit later.</li> <li>Small increase in price due to demand for real food.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>For grain increases greatly as raw feedstock for synthetic food production.</li> <li>Substantial increase in competitiveness.</li> <li>Large increase in price.</li> <li>Demand for land plateaus.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Demand for low cost rural housing up.</li> </ul>	<p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Milk production decreases 5%.</li> <li>Fewer farms and irrigated area decreases 10%.</li> <li>Water use decreases 10%.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Pome fruit production decreases 75%.</li> <li>Other fruit and vegetable production increases 20%.</li> <li>Irrigated area decreases 40%.</li> <li>Irrigation water use decreases 40%.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Production decreases 5%.</li> <li>Irrigated area decreases 20%.</li> <li>Irrigation water use decreases 25%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production decreases 5%.</li> <li>Irrigated area decreases 20%.</li> <li>Irrigation water use decreases 25%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Area increases 350%.</li> <li>Irrigation water use increases 150%.</li> </ul>	<p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Widespread development increasingly underpins the economic base of the region, creating increased demand for service industries.</li> <li>Unplanned lifestyle developments cause conflicts between agricultural production and lifestyle values.</li> </ul> <p><b>IRRIGATION INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>Contraction in most industries especially export focused industries with meeting cost of water.</li> <li>Pressure on water with meeting cost of water.</li> <li>Irrigated area decreases 10%.</li> <li>Irrigation water use decreases 10%.</li> </ul>
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2020-2035	WATER RELATED DRIVERS	NON-WATER RELATED DRIVERS	INDUSTRY IMPACTS	REGIONAL IMPACTS
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	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Barrages at mouth of Murray River removed giving large water savings - salt discharge entitlement increased by 100%</li> <li>Agricultural land purchased to produce wildlife and tourism corridors and wetlands across the region. Some prior stream areas retired.</li> <li>Climate dries further.</li> </ul> <p><b>WATER AVAILABILITY</b></p> <ul style="list-style-type: none"> <li>Irrigation constant due to water saved at barrages.</li> </ul> <p><b>WATER TRADE</b></p> <ul style="list-style-type: none"> <li>Large volume of water (55%) traded to grain growers in southern NSW as they have larger land parcels.</li> </ul>	<p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Trade agreements with USA and ASEAN create new export outlets for export, but also problems with cheap imports.</li> <li>Middle East trading partners lost through alliance with USA.</li> <li>Health and food safety important considerations in consumer purchases.</li> <li>Community concern for the environment increases.</li> <li>Increase in lifestyle developments and tourism.</li> <li>Cost of oil doubles causing a brief international recession.</li> </ul> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Use of genetic modification prohibited.</li> <li>Demand decreases.</li> <li>Small decrease in price.</li> <li>Small decrease in competitiveness.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Free trade agreement allows cheap imports.</li> <li>Freeflight outbreak cripples pome fruit industry.</li> <li>Large price decrease as import restrictions on pome fruit lifted.</li> <li>Export market increases through marketing of clean and green image.</li> <li>Small increase in price for other fruit and vegetables.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>International demand for meat reduces.</li> <li>No change in competitiveness.</li> <li>Small decrease in price.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Genetically modified organisms permitted to decrease food prices and increase exports.</li> <li>Oil substitution occurs (electricity, fuel cells etc). Small increase in energy cost.</li> <li>Substantial decrease in demand due to synthetic food production.</li> <li>Small niche for high price real milk.</li> <li>Small increase in price.</li> <li>Large increase in competitiveness.</li> </ul> <p><b>HORTICULTURE &amp; LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Similar to dairy although hit later.</li> <li>Small increase in price due to demand for real food.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>For grain increases greatly as raw feedstock for synthetic food production.</li> <li>Substantial increase in competitiveness.</li> <li>Large increase in price.</li> <li>Demand for land plateaus.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Demand for low cost rural housing up.</li> </ul>	<p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Milk production decreases 50%.</li> <li>Irrigated area decreases 55%.</li> <li>Fewer farms and irrigated area decreases 60%.</li> <li>Water use decreases 60%.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Pome fruit and vegetable decreases 50%.</li> <li>Other fruit and vegetable decreases 50%.</li> <li>Irrigated area decreases 50%.</li> <li>Irrigation water use decreases 50%.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Production decreases 50%.</li> <li>Irrigated area decreases 50%.</li> <li>Irrigation water use decreases 50%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production decreases 50%.</li> <li>Irrigated area decreases 50%.</li> <li>Irrigation water use decreases 50%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Area increases 350%.</li> <li>Irrigation water use decreases 20%.</li> </ul>	<p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Widespread development increasingly underpins the economic base of the region, creating increased demand for service industries.</li> <li>Unplanned lifestyle developments cause conflicts between agricultural production and lifestyle values.</li> </ul> <p><b>IRRIGATION INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>Contraction in most industries especially export focused industries with meeting cost of water.</li> <li>Pressure on water with meeting cost of water.</li> <li>Irrigated area decreases 10%.</li> <li>Irrigation water use decreases 10%.</li> </ul>

# Summary of Scenario 3: Pendulum

## Driving Forces

- 2005-2020**
- Free trade agreements signed with USA and ASEAN create demand for all agricultural products.
  - Multinationals take over food processing plants.
  - Genetically modified organisms prohibited.
  - High energy costs create demand for biofuels.
  - Government returns 3500 GL of environmental water to Murray River. Victoria contributes 1500 GL through buy back of all medium reliability and 30% of high reliability water, at premium prices. Some water trades into Goulburn Valley from NSW.
  - Water buy back coupled with government purchase, amalgamation and auction of land.

**2020-2035**

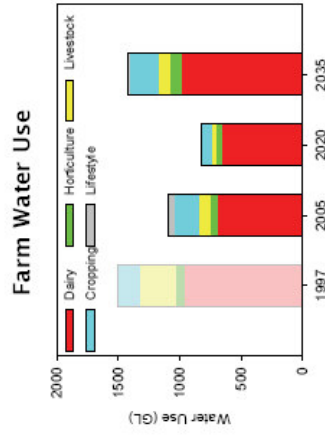
- Chinese Yuan floated and China grows as a market for agricultural products.
- Genetically modified free status becomes a marketing advantage.
- Government reverses policy and returns water to agriculture by auction. Proceeds of auction fund development of distribution infrastructure which is transferred to irrigator cooperatives.
- Wet climate sequence causes floods.

## Impacts

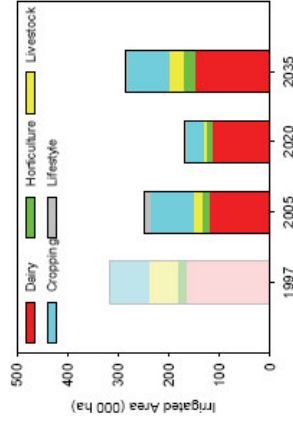
- Initially the regional economy declines as water is returned to the environment. Unemployment rises considerably as demand for service industries decreases.
- Perception of little additional benefit resulting from water being returned to the environment.
- Subsequently, the economy booms as international market conditions improve and policy reversal means more water is available for agriculture.
- Labour shortages occur.
- Planned adjustment of land and water resources allows infrastructure costs to be managed and leads to an improved match between land capability and use.
- Increased rainfall and floods lead to a re-emergence of water logging and salinity problems.

## Implications

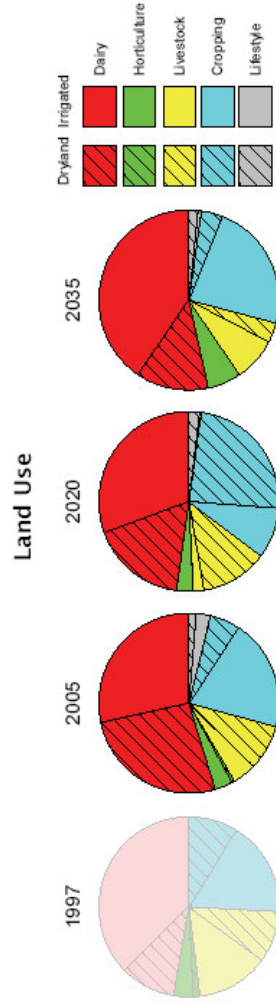
- Changes in government policy enable large changes in irrigated area and water use to be planned.



## Irrigated Area



## Farm Gate Gross Value of Production







# Summary of Scenario 4: Drying Up

## Driving Forces

2005-2020

- Financial crisis in the United States creates a global recession that reduces international trade considerably between 2009 and 2012.
- As global economy recovers, China begins to export high value horticultural products and import cheaper bulk commodities.
- Australian dollar strengthens making agricultural products expensive to overseas purchasers.
- Use of genetically modified organisms prohibited.
- Drought commences in 2012 lasting until 2020.
- High reliability irrigation water allocations between 2015 and 2020 are 80%, 50%, 30%, 90%, 100%.

2020-2035

- International export markets recover.
- International and domestic markets demand healthy food.
- Genetically modified free status becomes a marketing advantage.
- Government assists restructure and redevelopment of agriculture with focus on health food, environmental sustainability and animal welfare.
- Climate becomes wetter and enables medium reliability allocation of 25%.

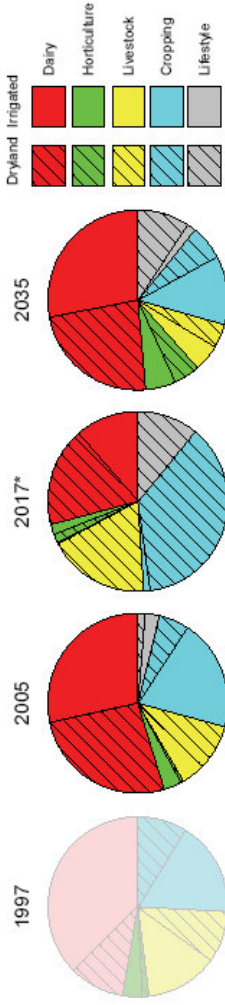
## Impacts

- Initially, all agricultural industries and the regional economy is decimated by international market collapse and prolonged drought. The population is stable because employment opportunities are poor elsewhere.
- Unemployment is very high.
- Irrigators unable to pay for costs of infrastructure maintenance.
- Subsequently, regional economy booms as international markets grow and water availability increases.
- Growth of agricultural industries is constrained by land parcel size.
- Drought increases the frequency of severe bushfires.

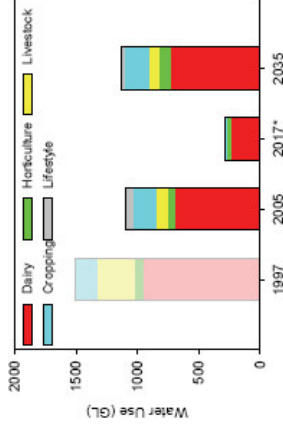
## Implications

- Initially, a large decrease in irrigation water use and area irrigated as drought decreases allocations, followed by a large increase in irrigated area and water use as the drought subsides.
- Water returns along existing irrigation infrastructure as no restructuring occurred during drought.
- Infrastructure declines during times of little maintenance.

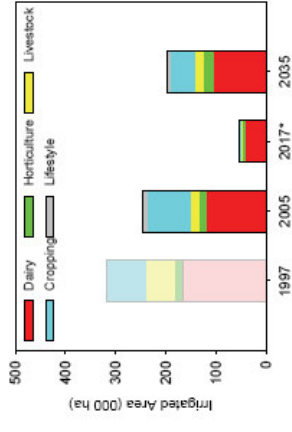
## Land Use



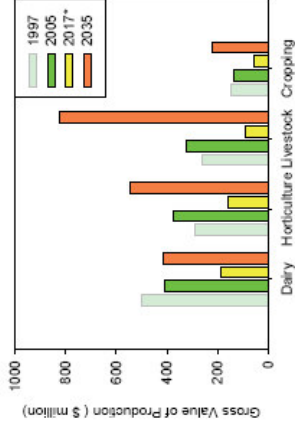
## Farm Water Use



## Irrigated Area



## Farm Gate Gross Value of Production



\* Graphics depict 2017 drought conditions with high reliability water allocation of 30%.

## Description of Scenario 4: Drying up

2005-2020	NON-WATER RELATED DRIVERS	WATER RELATED DRIVERS
	<p><b>NON-WATER RELATED DRIVERS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.</li> <li>Financial crisis in the USA causes a world recession between 2009 and 2012. The USA dries up as a market and capital is withdrawn from overseas.</li> <li>Australian dollar increases in value.</li> <li>International economy recovers around 2012.</li> <li>China exports high value horticultural products and imports cheap bulk commodities.</li> <li>USA dominates international market.</li> <li>Small decrease in price.</li> <li>Decrease in competitiveness.</li> <li>Focus on local market.</li> <li>Moderate price decrease.</li> <li>Small increase in competitiveness.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Global demand for meat holds but USA dominates market.</li> <li>Small price decrease.</li> <li>Decrease in competitiveness.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Decrease in demand.</li> <li>Large price increase at 2017 due to drought.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Competitiveness falls.</li> <li>Strong demand and migration from cities especially.</li> </ul>	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Governments assist rural communities and provide support to accelerate production growth.</li> <li>Restructuring and zoning used in the region based on soils and access to infrastructure.</li> <li>Water tariffs increase at the inflation rate.</li> <li>No additional water allocated to the environment.</li> </ul> <p><b>CLIMATE AND WATER AVAILABILITY</b></p> <ul style="list-style-type: none"> <li>Climate slightly wetter than normal.</li> <li>All high reliability and 25% of medium reliability available.</li> </ul>
	<p><b>INDUSTRY IMPACTS (2017)</b></p> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Milk production decreases 50% after 3 years of drought.</li> <li>Banks close many farms which exit dairies located.</li> <li>Processors restructure and one export processor centrally located.</li> <li>Irrigated area decreases 65%.</li> <li>Irrigation water use decreases 65%.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Production decreases 50% due to lack of competitiveness and processor scales back production but retains presence.</li> <li>Irrigated area decreases 50%.</li> <li>Irrigation water use decreases 50%.</li> </ul> <p><b>LIVESTOCK</b></p> <ul style="list-style-type: none"> <li>Production decreases 70%.</li> <li>Irrigated area decreases 95%.</li> <li>Irrigation water use decreases 95%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production decreases 70%.</li> <li>Irrigated area decreases 90%.</li> <li>Irrigation water use decreases 95%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Land area increases 1500%.</li> <li>Water use decreases 95%.</li> </ul>	<p><b>NON-WATER RELATED DRIVERS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Full recovery from drought and recession.</li> <li>Australia's ban on genetically modified organisms is a barrier to export.</li> <li>International and domestic consumers demand health food.</li> <li>Government assists restructure of agriculture with strong focus on health food, environmental sustainability and animal welfare in order to tap international demand.</li> </ul> <p><b>DAIRY</b></p> <ul style="list-style-type: none"> <li>Export to all international markets expands.</li> <li>Demand increases.</li> <li>Price increase.</li> <li>Water use increases 200%.</li> <li>Increase in competitiveness due to genetically modified free status.</li> </ul> <p><b>HORTICULTURE, LIVESTOCK, CROPPING</b></p> <ul style="list-style-type: none"> <li>Similar to dairy.</li> <li>Moderate price increase.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>No demand following previous large migration and regulations protecting right to farm.</li> </ul>
	<p><b>REGIONAL IMPACTS (2017)</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Regional market collapse coupled with prolonged drought declines all agricultural enterprise and the regional economy recession the population remains stable because employment prospects are no better elsewhere.</li> <li>This drought increases the frequency of bushfires in the region.</li> </ul> <p><b>IRRIGATION INFRASTRUCTURE</b></p> <ul style="list-style-type: none"> <li>Irrigated area decreases 80%.</li> <li>Irrigation water use decreases 70%.</li> <li>Major community discontent regarding payment of water fees during the drought.</li> <li>GMW loses major part of income and receives cash injection to continue.</li> </ul>	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Governments assist rural communities and provide support to accelerate production growth.</li> <li>Restructuring and zoning used in the region based on soils and access to infrastructure.</li> <li>Water tariffs increase at the inflation rate.</li> <li>No additional water allocated to the environment.</li> </ul> <p><b>CLIMATE AND WATER AVAILABILITY</b></p> <ul style="list-style-type: none"> <li>Climate slightly wetter than normal.</li> <li>All high reliability and 25% of medium reliability available.</li> </ul>

2020-2035	NON-WATER RELATED DRIVERS	WATER RELATED DRIVERS
	<p><b>NON-WATER RELATED DRIVERS</b></p> <p><b>GENERAL</b></p> <ul style="list-style-type: none"> <li>Slow and limited recovery.</li> <li>Milk production increases 30%.</li> <li>Export to all international markets expands.</li> <li>Irrigated area increases 150%.</li> <li>Irrigation water use increases 200%.</li> </ul> <p><b>HORTICULTURE</b></p> <ul style="list-style-type: none"> <li>Most new large investment will take place in the region on greenfield sites.</li> <li>Land around towns become lifestyle farms.</li> <li>Production increases 200%.</li> <li>Irrigated area increases 200%.</li> <li>Water use increases 200%.</li> </ul> <p><b>LIVESTOCK, CROPPING</b></p> <ul style="list-style-type: none"> <li>Production increases 700%.</li> <li>Irrigated area up and water use increases 1900%.</li> </ul> <p><b>CROPPING</b></p> <ul style="list-style-type: none"> <li>Production increases 240%.</li> <li>Irrigated area increases 1000%.</li> <li>Water use increases 1500%.</li> </ul> <p><b>LIFESTYLE</b></p> <ul style="list-style-type: none"> <li>Increase with conversion of most small horticulture to lifestyle farms.</li> <li>Irrigated area increases 1000%.</li> <li>Water use increases 1000%.</li> </ul>	<p><b>WATER RELATED DRIVERS</b></p> <p><b>GOVERNMENT POLICY</b></p> <ul style="list-style-type: none"> <li>Governments assist rural communities and provide support to accelerate production growth.</li> <li>Restructuring and zoning used in the region based on soils and access to infrastructure.</li> <li>Water tariffs increase at the inflation rate.</li> <li>No additional water allocated to the environment.</li> </ul> <p><b>CLIMATE AND WATER AVAILABILITY</b></p> <ul style="list-style-type: none"> <li>Climate slightly wetter than normal.</li> <li>All high reliability and 25% of medium reliability available.</li> </ul>
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