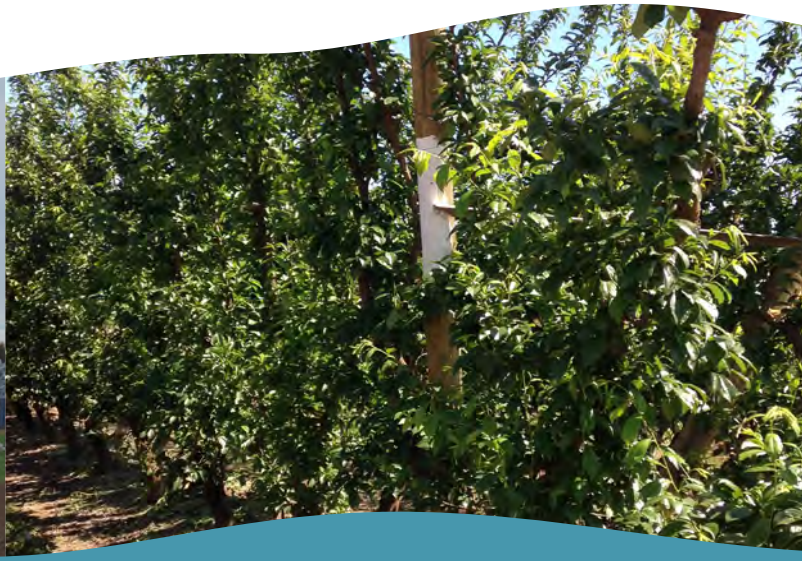
GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY



REGIONAL IRRIGATED LAND AND WATER USE MAPPING IN THE GOULBURN MURRAY IRRIGATION DISTRICT

EXECUTIVE SUMMARY

VICTORIA State Government | Environment, Land, Water and Planning

AGRICULTURE VICTORIA

NORTH CENTRAL Catchment Management Authority
Connecting Rivers, Landscapes, People

Murray DAIRY

Dairy Australia
Your Levy at Work

GOULBURN-MURRAY WATER

HMC PropertyGroup

This Executive Summary and a Technical Report can be found at www.gbcma.vic.gov.au

This project was co-funded by the following stakeholders:

- Goulburn Broken Catchment Management Authority (GB CMA)
- Department of Environment, Land, Water and Planning (DELWP)
- Department of Economic Development, Jobs, Transport and Resources (DEDJTR)
- Dairy Australia (DA) and Murray Dairy (MD)
- Goulburn-Murray Water (GMW)
- Goulburn-Murray Water (Connections)
- North Central Catchment Management Authority (NCCMA)

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Background

The Goulburn Broken Catchment Management Authority (Goulburn Broken CMA), and a steering committee of representatives from the North Central CMA (NCCMA), Goulburn-Murray Water (GMW), Dairy Australia, Murray Dairy, the Department of Environment, Land, Water and Planning (DELWP) and Agriculture Victoria collaborated and co-funded the Regional Irrigated Land and Water Use Mapping in the Goulburn Murray Irrigation District (GMID) project.

The GMID (Figure 1) is the largest irrigation system in Victoria, supporting a range of agricultural commodities produced from industry types such as dairy, cropping, horticulture, beef and sheep. The GMID covers 9,950 square kilometres or 995,000 hectares (ha) (GMW 2015), approximately 830,000ha of which are classified as irrigation properties. At the time of the 2015/16 project survey 258,117ha were identified as being actively irrigated. The properties classified as non-irrigation include land urban centres and conservation areas.

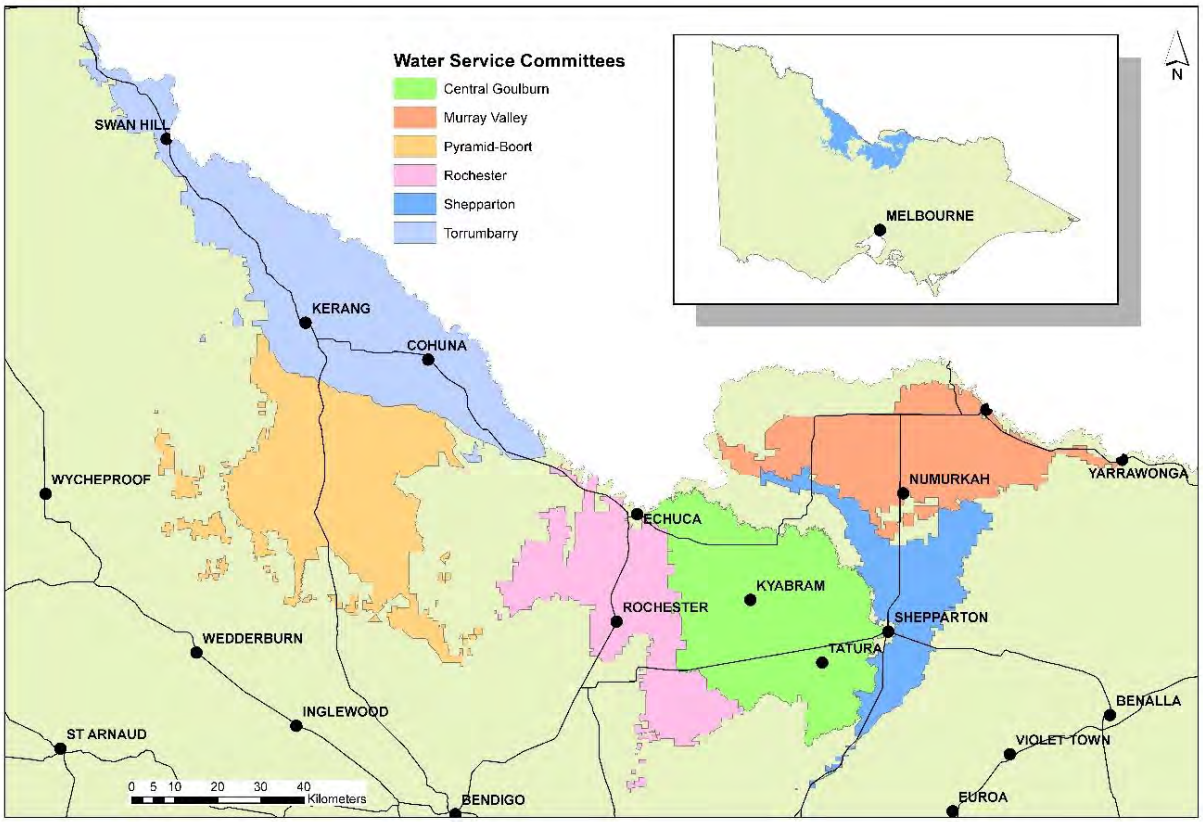


Figure 1: The project area, the Goulburn Murray Irrigation District (GMID)

Seasonal fluctuations (including the Millennium drought), climate change and commodity prices along with changes in water and planning policy (i.e. implementation of the Murray-Darling Basin Plan) have seen significant land and water use change in the GMID over the past decade. The Regional Irrigated Land and Water Use Mapping in the GMID project sought to investigate the dynamic nature of land use and industry change, to provide strategic direction for government and industry.

The project was also an opportunity to renew through on-farm surveying and spatial analysis, the land and water use data for all irrigated properties in the GMID (13,230), and interview a randomly selected subset of irrigators (384) to verify the land and water use information dataset. Specific objectives and outcomes are provided in the Technical Report, including a detailed methodology (GB CMA 2017).

This project builds upon a range of existing data that has been compiled over many decades, such as irrigators farm surveys, the last of which was undertaken in 2004/05 (GMW 2006), and land use mapping surveys, the last of which was undertaken in 2009/10 (HMC Property Group 2010). These datasets have been and will continue to be used to inform regional, state and national land and water use planning.

This project was undertaken in two stages during the 2015/16 irrigation season, including:

Stage 1 (Surveying): The collection of data describing the land use, irrigation methods, modernisation and production infrastructure for every irrigation classified property (13,230) in the GMID between January 2016 to May 2016. Note: Properties are defined as land parcels or titles. Many farm enterprises operate over two or more properties.

Stage 2 (Interviews): Detailed interviews with a representative sample of 384 irrigators in the GMID, stratified from each of the key land use activities in the region.

It is important to consider the methodology for data collection, including that the data was collected at a point in time (2015/16). Further information on this project including a technical report which details the methodology, can be found at www.gbcma.vic.gov.au

1. Key Findings

1.1 Land Use

1.1.1. Cropping

- In 2015/16 cropping was the most extensive land use across the GMID covering over 261,000ha and more than a quarter of the total land area of 829,382ha.
- Pyramid-Boort (97,258ha) and Central Goulburn (45,845ha) water service areas had the highest extent of cropping.
- Shepparton (19,792ha) and Murray Valley (21,607ha) water service areas had the least extent of cropping.
- Irrigated cropping accounted for approximately 75% of the total cropping at the time of survey.

Note: Refer to Appendix 1 for the land use map for the GMID; Appendix 2-7 for the land use maps for the six GMID water service areas; and Appendix 8 for the tabulated land use data.

Case Study: Decisions about land use

Bob* has owned his 250ha irrigated cropping farm near Undera for almost 40 years. He grows a wide range of fodder and grain crops and has a small area of orchard on the property, one of three he farms. The property is connected to the main channel system but due to the uncertainty around water availability and pricing, he has decided against further irrigation upgrades. Each year Bob makes decisions about what to grow depending on water and commodity prices. Depending on those decisions, Bob then uses a mixture of groundwater, HRWS and internal and trade allocations, to ensure he has the water he requires to meet his farm production needs.

**names have been changed*

1.1.2. Dairy

- In 2015/16 dairies and associated properties covered 180,665ha of the GMID, with another 54,000ha used for agistment/fodder.
- Central Goulburn (48,947ha) and Murray Valley had the highest extent of dairy land use.
- Shepparton (11,727ha) and Pyramid-Boort (15,762ha) had the least extent of dairy land use.
- There were 1,907 properties associated with functioning dairy sheds, with another 759 properties providing dairy cattle agistment/fodder.
- Dairy and associated properties are supported by other land uses such as dairy cattle agistment/fodder, mixed farming and cropping.

  Note: 'Properties' are land parcels or titles. Many farms operate over two or more properties.

1.1.3. Mixed farming

- In 2015/16 mixed farming covered over 118,116ha of the GMID and included 1,640 properties.
- Central Goulburn (35,451ha) and Torrumbarry (23,638ha) had the highest area (ha) of mixed farming.
- Murray Valley (4,856ha) and Pyramid-Boort (12,610ha) had the lowest area (ha) of mixed farming.

1.1.4. Grazing non-dairy

- There were 1,265 grazing non-dairy (e.g. beef and sheep) properties, covering 133,890ha of the GMID in 2015/16.
- Torrumbarry (48,197ha) and Murray Valley (40,540ha) had the highest area (ha) of grazing non-dairy.
- Rochester (3,955ha) and Shepparton (6,901ha) had the lowest area (ha) of grazing non-dairy.

1.1.5. Perennial horticulture

- There were 948 perennial horticulture properties (e.g. orchards), covering 29,129ha of the GMID in 2015/16.
- Perennial horticulture accounted for 3.5% of the total land area and was concentrated in areas of the GMID such as Shepparton, Bunbartha and Swan Hill, which are traditionally known to be horticultural areas.
- Torrumbarry (7,086ha) and Shepparton (6,482ha) had the highest area (ha) of perennial horticulture.
- Rochester (981ha) and Pyramid-Boort (4,448ha) had the least area (ha) of perennial horticulture.

1.1.6. Annual horticulture

- Annual horticulture (e.g. tomatoes) accounted for 1.2% of the total land area in 2015/16 and was randomly spread across the GMID, indicating that it is an opportunistic, transient land use.
- There were 115 annual horticulture properties, covering 10,040ha of the GMID.
- Rochester (3,501ha) and Central Goulburn (2,203ha) had the highest area (ha) of annual horticulture at the time of survey.
- Shepparton (283ha) and Murray Valley (794ha) had the least area (ha) of annual horticulture at the time of survey.

1.1.7. Intensive animal

- In 2015/16 there was 5,310ha of intensive animal land use, found predominantly in the west of the GMID in Torrumbarry (2,110ha) and Pyramid-Boort (1,936ha).
- The extent of the intensive animal land use was considerably higher in the western half of the GMID (4046ha) compared to the eastern half of the GMID (126ha).
- There was significantly less total area and number of intensive animal land use properties in the east of the GMID, in Murray Valley (52ha) and Shepparton (74ha).

1.1.8. Horses

- Horses accounted for 5,337ha, including 102 properties across the GMID in 2015/16.
- Horses were most extensive (area) in Shepparton (1,855ha) and Central Goulburn (1,821ha) and least extensive in Torrumbarry (8ha) and Rochester (245ha).
- Horse properties were commonly found within travelling distance of major regional centres.
- Eighty-three percent of horse properties were in the east of the GMID, close to regional centres such as Shepparton/Mooroopna, Echuca, Kyabram and Tatura.

1.1.9. Lifestyle

- Lifestyle (e.g. rural residential) had the highest number of total properties (4,112) of all land uses, covering 30,268ha of the GMID in 2015/16.
- Seventy-four percent of lifestyle properties were in the eastern half of the GMID, predominantly in Central Goulburn (11,014ha) and Shepparton (5,755ha).
- Lifestyle was least extensive in Pyramid-Boort (776ha) and Torrumbarry (2,835ha).

1.2. Land Use Change

- Almost one-third (34,000ha) of the 114,500ha of dairy properties reported in the 2009/10 land use survey had transitioned to other land uses such as mixed, grazing or cropping in 2015/16.
- Some of this transition is occurring close to major regional centres, such as Shepparton and Tatura, where properties that were traditionally able to carry smaller dairies became less profitable, but the small title sizes have lent themselves to lifestyle purchasers, and in some areas, horticultural development.
- Of the 114,500ha reported in 2009/10, 42,000ha (519 properties) are still directly linked to a dairy enterprise.
- There were 37,000ha (559 properties) former dairy properties that were not able to be directly linked to a property with a functioning shed in 2015/16, so they either still service the dairy industry (e.g. through agistment or fodder) or are in transition.

1.3. Land Cover

- Over half (131,000ha) of the irrigation classified land cover in the GMID in 2015/16 was winter grain or fodder crops such as wheat, barley, canola, faba beans and oats.
- Thirty-two percent of respondents were growing winter grain or fodder, which was primarily grown by mixed farmers (44.3%).
- Nearly three quarters (73.6%) of dairy respondents were growing annual pasture (for feed).

1.4. Farm Context

- GMID irrigators have farmed for more than 35 years on average. Most (96.5%) own their properties.
- More than 70% expect to operate the property for more than five years.
- More than 50% expect to pass the property on to a family member.
- More than 75% agreed that their properties would be irrigated in the next five years.

Case Study: Farming longevity

Sam and Ruth* have been farming their 310ha part-irrigated and part-dryland property near Echuca for almost 50 years. Their property is connected to the main channel system and they grow a mixture of pasture and fodder crops. A couple of years ago they sold 20ML of HRWS to allow them to complete some on-farm efficiency upgrades, but they have no plans to do any further upgrades. Their water needs are covered by their remaining HRWS, which fits with their desire to never be reliant on allocation trade to manage through the irrigation season. They plan to keep farming indefinitely.

**names have been changed.*

1.5. Irrigation Infrastructure

1.5.1. Irrigation systems

- The most common irrigation delivery method across the GMID in 2015/16 was gravity irrigation channel.
- Dairy (86%) and livestock producers (84.7%) were more commonly using gravity channel to irrigate their properties.
- Micro-drips (31.8%) and sub-surface irrigation systems (36.4%) were more commonly used to irrigate orchards.
- The majority of respondents (84%) use channel supply as the major source of water, significantly higher than groundwater (9.9%), drain and river diversion (3.9%) and treated waste-water (0.3%) use.

Case Study: Installing drip irrigation

Adam* owns a 20ha horticultural property near Shepparton and grows a mixture of apples, plums and pears for the fresh market. In recent years, Adam has sold some HRWS to allow him to upgrade his irrigation infrastructure and currently has drip irrigation throughout his orchard. Given the increasing number of hot years, Adam is also considering installing over-head sprinklers to reduce sunburn of his fruit by reducing the skin temperature. Adam now has 50% of his water in HRWS and can pay up to $300/ML if needed on the allocation trade market. Adam believes that he will be farming for a while although he feels that he will need to do something about securing more water.

**names have been changed*

1.5.2. Connection to the main channel system

- In 2015/16 68% of irrigators reported being connected to the main channel system.
- Cropping properties were most likely to be connected to the main channel system (73.2%) followed by dairy (69.4%) and mixed farming (68.5%).
- Orchardists were least likely to be connected to the main channel system (50%).
- Connections to the main channel system were lower in Gannawarra (47.5%) and Moira (59.6%) municipalities and highest in Loddon (80.4%) and Shepparton (79.1%) municipalities.
- Half of the irrigators have upgraded their infrastructure in the last five years, and 47.8% said they intended to upgrade infrastructure in the next five years.
- Of the respondents who were connected to the main channel system, less than half (39.5%) had modernised (upgraded) their on-farm irrigation infrastructure (see next page for more information).

Case Study: Connected to the main channel

Peter* has owned his 90ha irrigation farm in Northern Victoria for over 25 years. The property is connected to the main channel system, where he sources the majority of his irrigation water. He used to run a dairy herd but that became unviable for his business, so now he is focused on pasture and fodder crops to feed agistment dairy cattle. He sold about a quarter of his water entitlements, but still owns almost 50% of the water he uses in HRWS. Peter is unsure about his future in farming and although he upgraded his irrigation system about 10 years ago on 50% of his farm, he has put any further development on hold.

**names have been changed*

1.5.3. Modernisation of on-farm irrigation infrastructure

- In 2015/16, dairy respondents were most likely (52.6%) to have modernised their on-farm irrigation infrastructure following connection to the main channel system.
- Mixed farmers (18.8%) and orchardists (22.2%) were least likely to have modernised their on-farm irrigation infrastructure following connection to the main channel system.
- Half of all respondents indicated that they were intending to modernise their irrigation infrastructure in the next five years, including 52% of dairy respondents and 50% of mixed farmers (see next page for more information).

1.5.4. Barriers to modernising farm infrastructure

- The top three barriers for changing irrigation practices in 2015/16 were:
  - Uncertainty of water allocation (53.9%);
  - Lack of financial resources (52.6%); and,
  - Inadequate water availability (46.1%).
- Inadequate water availability increased as a barrier to practice change, from 19.3% in 2004/05 (GMW 2006) to 46.1% in 2015/16.
- Approximately one-third (36.1%) of all irrigators who had modernised their on-farm irrigation infrastructure (irrespective of connection to the main channel system) had received funding (government or private) to do so.
- Data suggests irrigators may be reluctant to invest further in farm upgrades and improved practices, due to uncertainty about accessing enough water at a price they can afford to operate the modernised systems and have a return on investment.

Case Study: Barriers to upgrading infrastructure

In the late 1990s when Allan* first purchased his farm near Nathalia, he developed a whole farm plan that he has now fully implemented. Allan and his family were keen to do what they could to manage the threat of salinity to their farm and the region. Their works include installing high flow irrigation structures, lasering irrigated land and matching that with the installation of re-use systems, to ensure all the runoff is captured and does not flow into the regional drainage system. Recently, the farm has been connected to the main channel, but given the work they have already done and the uncertainty around water allocations and availability, Allan doesn't see the value in investing in further irrigation system improvements.

**names have been changed*

1.6. Water Ownership and Use

- The distribution of water use change across the GMID has been impacted by many complex and interconnected factors such as water availability, the price of allocation (temporary) trade water and seasonal conditions (e.g. Millennium drought) (Figure 2).
- The percentage change of total water usage for 'pods' (a group of irrigation properties in a geographical area) showed most declining, but some increasing between 2014/15 and 2015/16 (Appendix 9).

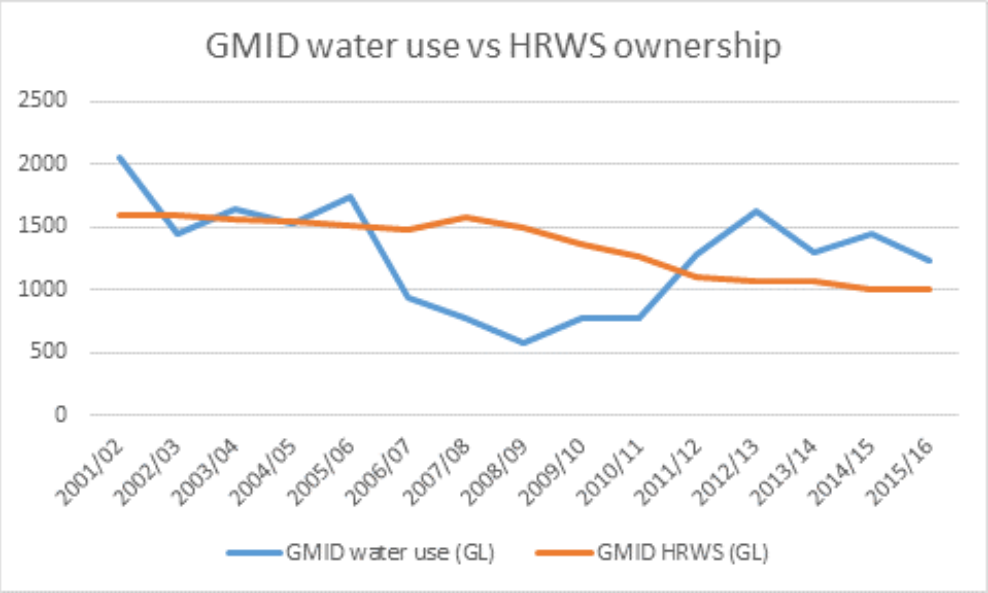


Figure 2: GMID water use versus HRWS ownership

- GMID irrigators collectively owned 1000GL in HRWS in 2015/16, compared with 1543GL in 2004/05 (refer to Appendix 8 for tabulated water use data).
- Almost half (49.4%) of individual irrigators owned less than 200ML HRWS, including 7.8% owning none.
- Sixty-four percent of respondents said that they did not own enough water entitlements to meet their irrigation needs. The figures were higher among dairy respondents (73.5%).
- GMID annual water use is highly variable, at 1622GL, 1295GL, 1456GL and 1230GL over the last four years. Pre-2006, GMID water use was fairly steady at around 1500-1600GL a year.
- GMID irrigators are using significantly less water now (2015/16) than a decade ago (Figure 2).
- Pre-2006, dairy farmers collectively used 30% more water than they owned in HRWS. Post-drought, dairy farmers use about 60% more water than they owned in HRWS (Appendix 10).
- There is a current gap between water ownership and water use, with water use higher than the volume of HRWS owned by irrigators in the GMID (Figure 2).
- Older or more established farm businesses were more likely to agree that they have the amount of HRWS they need (but not necessarily a higher amount), compared to younger farmers or new entrants (refer to Appendix 11 - statistical analysis).
- Those who have implemented on-farm irrigation upgrades have a longer term plan to use allocation trade (refer to Appendix 11 - statistical analysis).

1.7. Impact of Water Allocation Trade

- In 2015/16 nearly 37% of respondents said they rely heavily on allocation trade to meet their water needs; 21% said they have some reliance. This trend was highest for dairy farmers.
- There is a greater reliance on allocation trade across the GMID now than pre 2010/11.
- Almost 46% of irrigators said allocation trade forms a large part of their farm water use. This figure was higher for dairy respondents (54.2%).
- More than 50% of irrigators said it was part of their long-term plan business plan to use allocation trade to manage through the irrigation season. This was substantially higher for dairy respondents (61.3%).

Case Study: Allocation Trade

Les* has been farming in Northern Victoria all his life and has owned his 2500ha mixed cropping farm for over 20 years. Les irrigates approximately 170ha each year with 20ha of tomatoes and the rest in winter grains and fodder crops, which he supplies to the dairy industry. Les sold all of his HRWS to reduce farm debt and as long as the price is below $230/ML, he buys between 1000-1500ML on the allocation trade market each year. Although Les acknowledges that he doesn't have adequate water entitlements, he is not in a financial position to buy back any HRWS.

**names have been changed*

- Forty-seven percent of irrigators said allocation trade was affecting their ability to make a profit (dairy 67% versus 15.1% in 2004/05).
- Nearly half (46.6%) of all irrigators said allocation trade was affecting their ability to plan and implement a water budget (dairy 65.1% versus 14.4% in 2004/05).
- Nearly half (46.4%) said allocation trade was negatively impacting on their ease of operation (dairy 64.2% versus 11.2% in 2004/05).
- Forty-two percent said their business plan would be largely influenced by water policy.
- Those who have a long-term plan to use allocation trade pay a higher price for allocation water (refer to Appendix 11 – statistical analysis).

1.8. Water Price

- The majority (71.4%) of irrigators said that the price of water affected their buying and selling decisions. This was highest for dairy farmers (75.3%).
- One -third (33.7%) of irrigators said water prices over $150/ML were not viable for their business.
- The majority (76.6%) of irrigators indicated water prices over $200/ML were not viable for their business.
- Five percent of irrigators indicated water prices over $250/ML were not viable for their business.
- Orchardists' had the highest median price above which water became unviable ($250/ML) compared to the total mean for all irrigators ($150/ML).
- The majority (71.4%) of irrigators said prices in 2015/16 affected buying and selling decisions.

Note: the average weighted price in 2015/16 was $220/ML, peaking at $300/ML in November 2015 and $250/ML in May 2016 (Victorian Water Trade data 2016; Aither 2017).

1.9. Farm Management Practices (Environmental)

- In 2015/16 the majority (87.2%) of irrigators surveyed had a high willingness to manage salinity issues on farm.
- The majority (71.8%) of irrigators had a high willingness to manage and protect environmental features on farm.
- Over 73% of all irrigators have a professionally prepared Whole Farm Plan (WFP).
- WFPs were popular with dairy farmers with 89% having one for their property.
- The majority of respondents have implemented more than 75% of their WFP.
- Dairy properties were most likely to have implemented a reuse system.
- Orchardists were more likely to have implemented automatic irrigation systems and irrigation scheduling equipment.

Case Study: Valuing Natural Resource Management

Matthew* has been farming his 120ha irrigated (70ha) and dryland (50ha) property near Mooroopna for over 10 years. He has a mixture of perennial pasture, annual pasture, irrigated lucerne and winter grains with 90ML of HRWS. Matthew has almost no reliance on allocation trade to manage through the irrigation season. He has a Whole Farm Plan that is 6-10 years old and has been fully implemented, including installation of a reuse system. Matthew has a high willingness to manage his property for environmental and salinity values. Over the past five years this has included planting 2500 indigenous plants, fencing 3ha of remnant vegetation and fencing of additional low lying areas.

**names have been changed*

1.10. Dairy Analysis

- The GMID dairy industry currently (2015/16) uses about 25% less water in an average season than it did pre 2010/11.
- The 25% reduction in water use correlates with a 26% reduction in annual average milk production in the GMID, falling from 2345ML average in 2002/03 – 2005/06, down to 1740ML average over the last five years (Dairy Australia & Murray Dairy 2017).
- In 2015/16 GMID dairy used 59% more water (~740GL) than it owned in HRWS (465GL).
- In 2015/16 more than 30% of dairy farmers owned less than 200ML of HRWS, including 4.2% owning none at all.
- In 2015/16 73.5% of dairy farmers interviewed said they did not own enough HRWS water entitlement to meet their irrigation needs.
- While many dairy farmers have upgraded their irrigation infrastructure to use water more efficiently, milk production remains closely linked to the water available for the industry to use (Dairy Australia & Murray Dairy 2017).

Case Study: Dairy Land and Water Use

Ryan and Sarah* amalgamated 10 separate dairy and beef properties to form their 1000ha dairy farm, near Shepparton. They have 160ha of perennial pasture, with the remainder a mix of annual pasture and fodder crops. They run 750 dairy cows that they milk using an 80-stand rotary dairy. They are connected to the main irrigation channel, have reduced their outlets from 40 to 10 and accessed government funding to upgrade their irrigation system. This includes 180ha of travelling and pivot irrigation infrastructure, re-use systems, 270ha of automation and large-scale earthworks. During the Millennium drought they sold 1,600ML of HRWS and although they have access to over 500ML of groundwater, they are very exposed to changes in water availability and price. They feel that as it has turned out, their current water trading situation has had a large negative impact on the ease of operating their business and their ability to plan and implement a water budget.

**names have been changed*

- Almost two-thirds (63.6%) of dairy farmers identified uncertainty about water allocations as the main barrier to changing their irrigation practices, compared with 53.9% of GMID irrigators in general; followed by lack of financial resources (57% dairy versus 52.6% GMID) and inadequate water availability (52.9% dairy versus 46.1% GMID).

2. Further Opportunities

The dataset collected as part of this project was extensive. This project provides initial analysis and interpretation of the dataset and (where possible) draws comparisons with data previously collected in irrigator interviews (GMW 2006) and land use mapping (HMC Property Group 2010).

However, beyond this initial analysis and interpretation, the extensiveness and complexity of the dataset will enable opportunity for further testing, including additional comparisons and analysis of land and water use change in the GMID. For example, further immediate opportunities include an evaluation of land use change for each land use since 2000-04; industry water use change since 2000/01; social changes to understand the role of water in communities; and resilience and persistence of farming systems. Its ability to inform planning and policy is extensive.

3. Conclusion

The overarching picture is that the **land and water use profile in the GMID is changing** in response to many factors such as seasonal fluctuations, climate change, commodity prices and changes in water and planning policy (i.e. implementation of the Murray-Darling Basin Plan).

In 2015/16 less water was being used by irrigators across the GMID. Irrigators were **more reliant on the allocation trade market** to meet their production needs and therefore were more **exposed to higher water prices** than in 2004/05. Irrigators were highly **sensitive to allocation trade water price** which they said impacted their ability to make a profit. More than 76% of irrigators said it was unviable for their business to participate in the water market once the price reaches $201/ML and almost half of all respondents (47.2%) said that allocation trade was having a negative impact on their farm business. Different industries were willing to pay higher prices (e.g. orchards) compared to other land uses.

There was evidence of irrigators **upgrading their irrigation infrastructure** to increase productivity and use water more efficiently. Some have undertaken works with government funding, others have financed works privately. The majority of irrigators had developed and were implementing a professionally prepared whole farm plan, which shows **willingness to improve their water use efficiency**.

There is an association between respondents who have implemented on-farm irrigation upgrades and respondents who have a long-term plan to use allocation trade. Respondents who have a long-term plan to use allocation trade for their business, also tend to be willing to pay a higher price for water on the water market. Allocation trade now forms a large part of farm water use for many irrigators. More than 50% of irrigators' long term business plan is to use allocation trade to manage through the irrigation season

Significant barriers remain for irrigators in upgrading their irrigation infrastructure including **uncertainty of water allocation**, **lack of financial resources** and **inadequate water availability**. These barriers were evident in 2004/05 but have increased significantly.

At the time of survey, **allocation trade was having a negative impact** on irrigators in the GMID, including on their ability to plan and implement water budgets, make a profit and ease of operation. The impact of allocation trade was significantly higher in 2015/16 than 2004/05.

Irrigators interviewed had been on average farming **for more than 35 years** and most owned their own properties. More than 70% of irrigators interviewed believed that they would be farming their property in the next 5-10 years, and half expected to pass their property to a family member. The ageing demographic highlights the importance of understanding the barriers and encouraging **transition of younger generations** in to agriculture.

This project identified many properties (defined as land parcels or titles) that were operating at an **enterprise level** (i.e. multiple properties) across the GMID, suggesting that some farming businesses are expanding to accommodate changing needs.

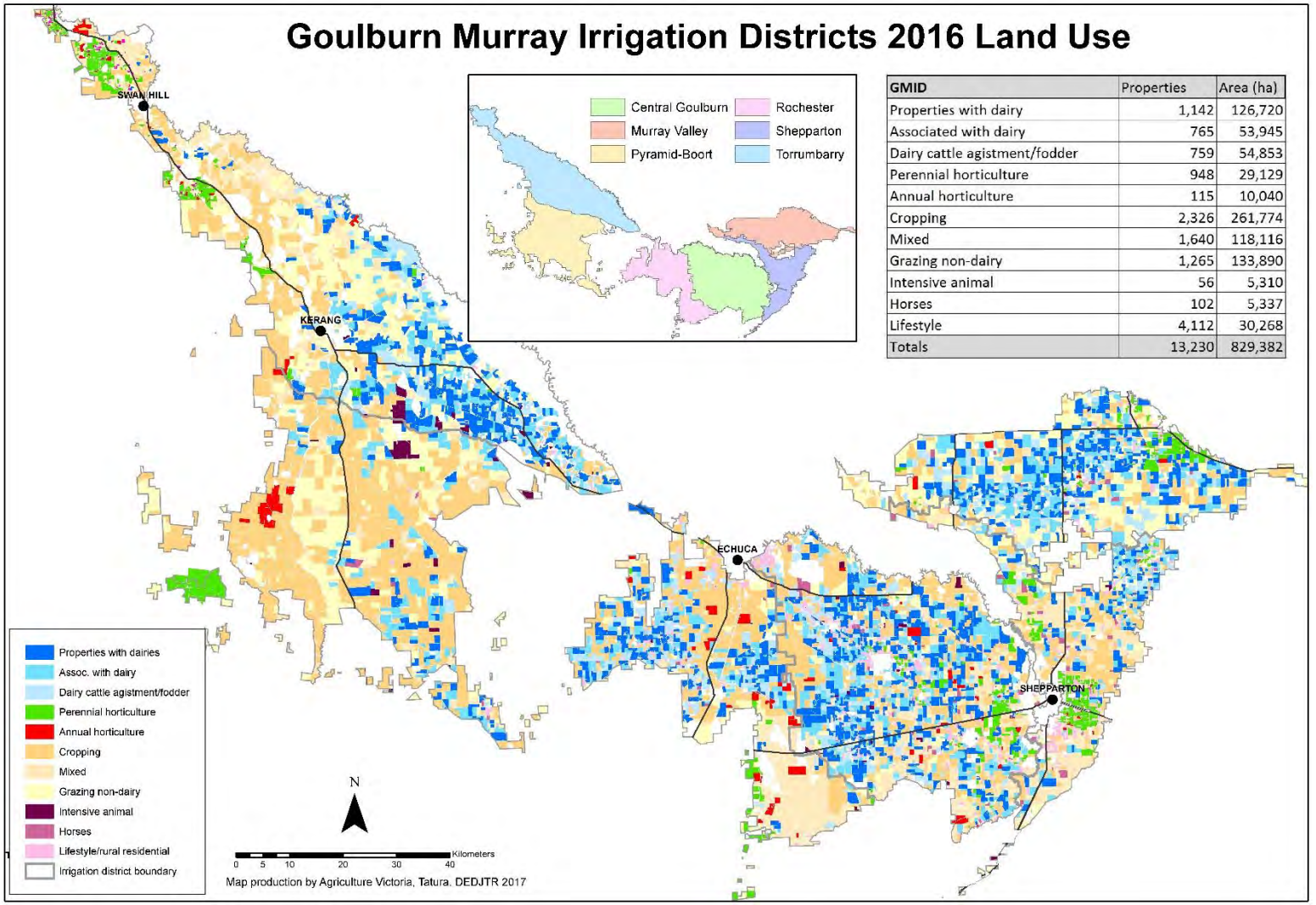
Irrigation systems remain **predominantly gravity channel fed**, with some **modernisation to pipe and riser and pressurised systems**. This shows evidence of different industries attempting to increase their **flexibility to cope with seasonal water market volatility**. The challenge for industries is to adopt integrated and flexible production systems able to adjust from one year to the next to make best use of the water available, and still remain profitable – that is, turn short-term survival strategies in to profitable business management strategies.

The challenge for the GMID is how to **help productive industries to remain resilient** and adaptable to **withstand the increasing pressures** of more frequent weather extremes as a result of climate change, as well as changing water policy, market volatility and competition in the water market, which over the last decade, have led to reduced water use in the GMID. For example, opportunities exist to assist irrigators and industry groups to prepare for and adapt to change, through regional and on-farm infrastructure investments and business planning to enhance decision making.

This project is considered a first phase in the ongoing assessment and reporting on land and water use in the GMID, to inform regional, national and state water policy. Analysis and interpretation of the data collated will continue, providing a valuable and extensive resource to inform future planning and policy across a range of industries in the GMID.

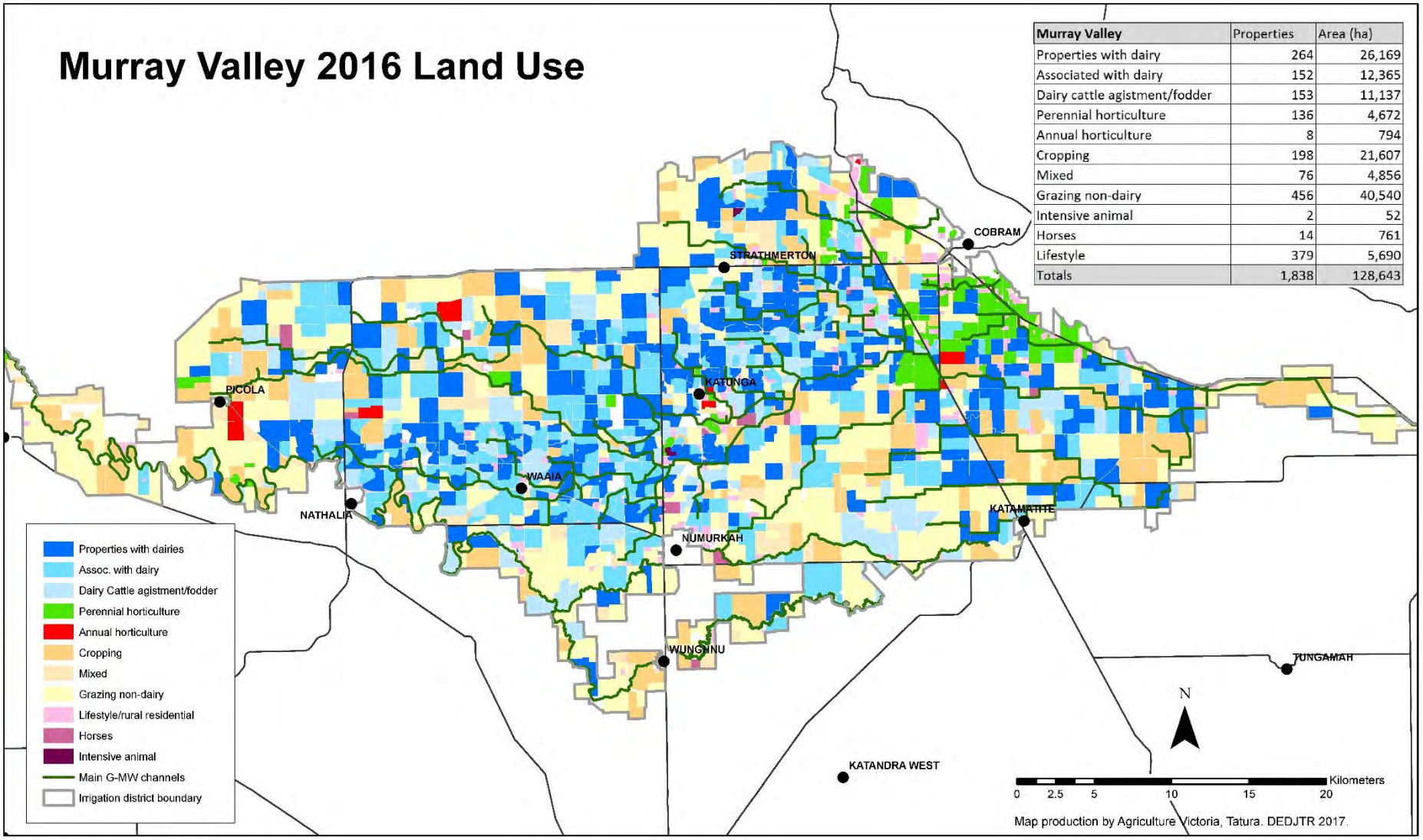
Appendices

Appendix 1: GMID land use and extent

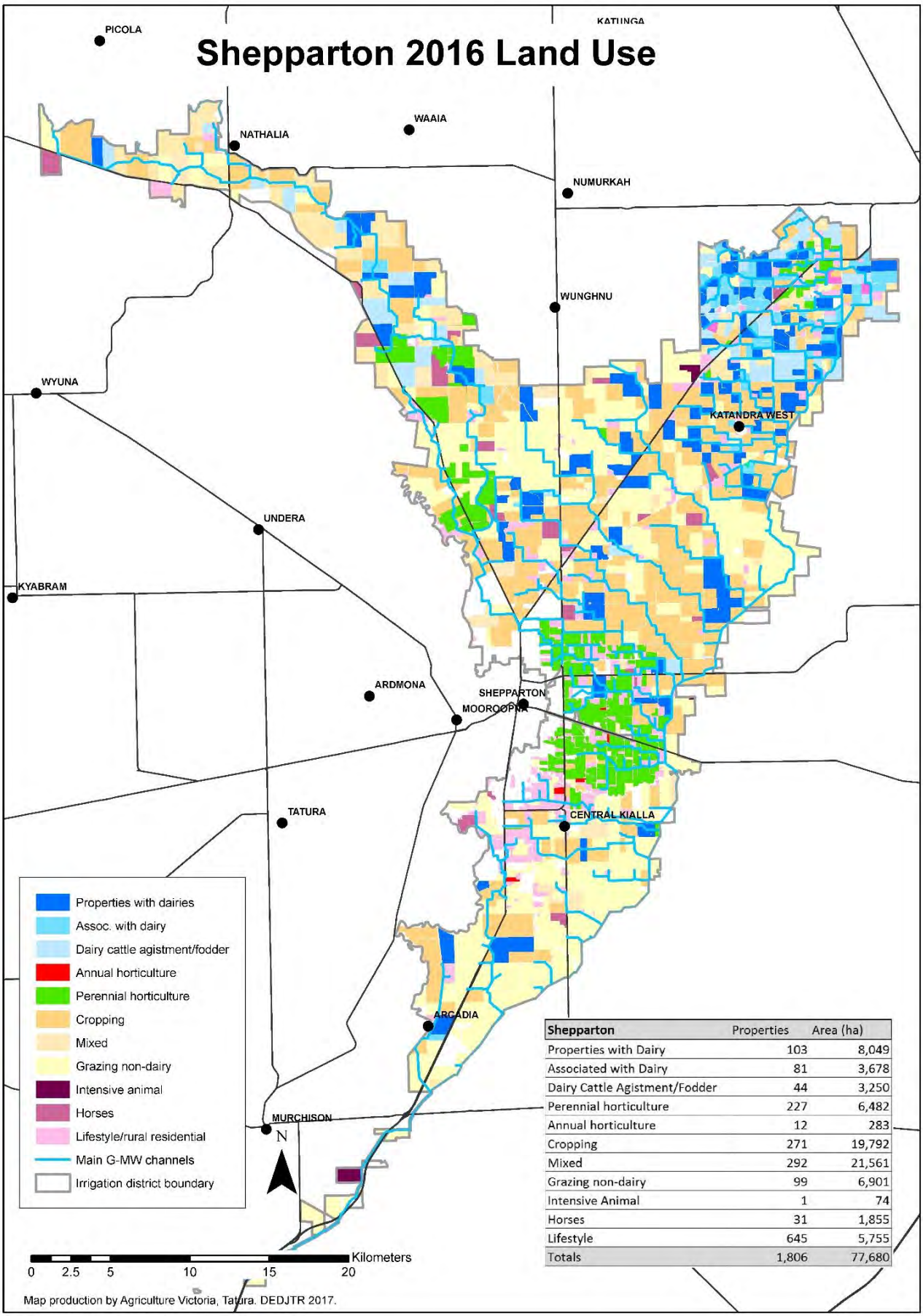


GMID	Properties	Area (ha)
Properties with dairy	1,142	126,720
Associated with dairy	765	53,945
Dairy cattle agistment/fodder	759	54,853
Perennial horticulture	948	29,129
Annual horticulture	115	10,040
Cropping	2,326	261,774
Mixed	1,640	118,116
Grazing non-dairy	1,265	133,890
Intensive animal	56	5,310
Horses	102	5,337
Lifestyle	4,112	30,268
Totals	13,230	829,382

Appendix 2: Murray Valley water service area land use and extent

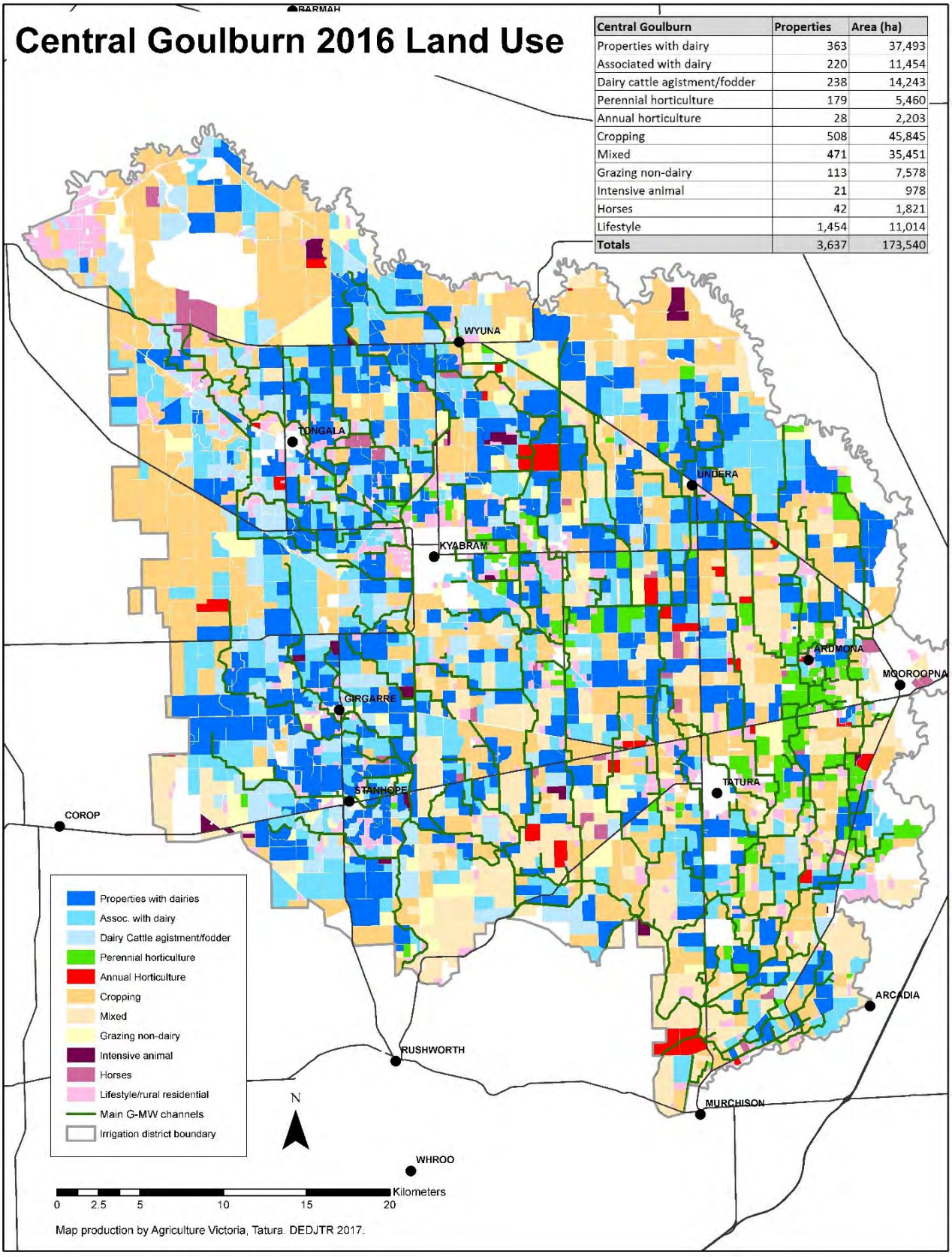


Appendix 3: Shepparton water service area land use and extent

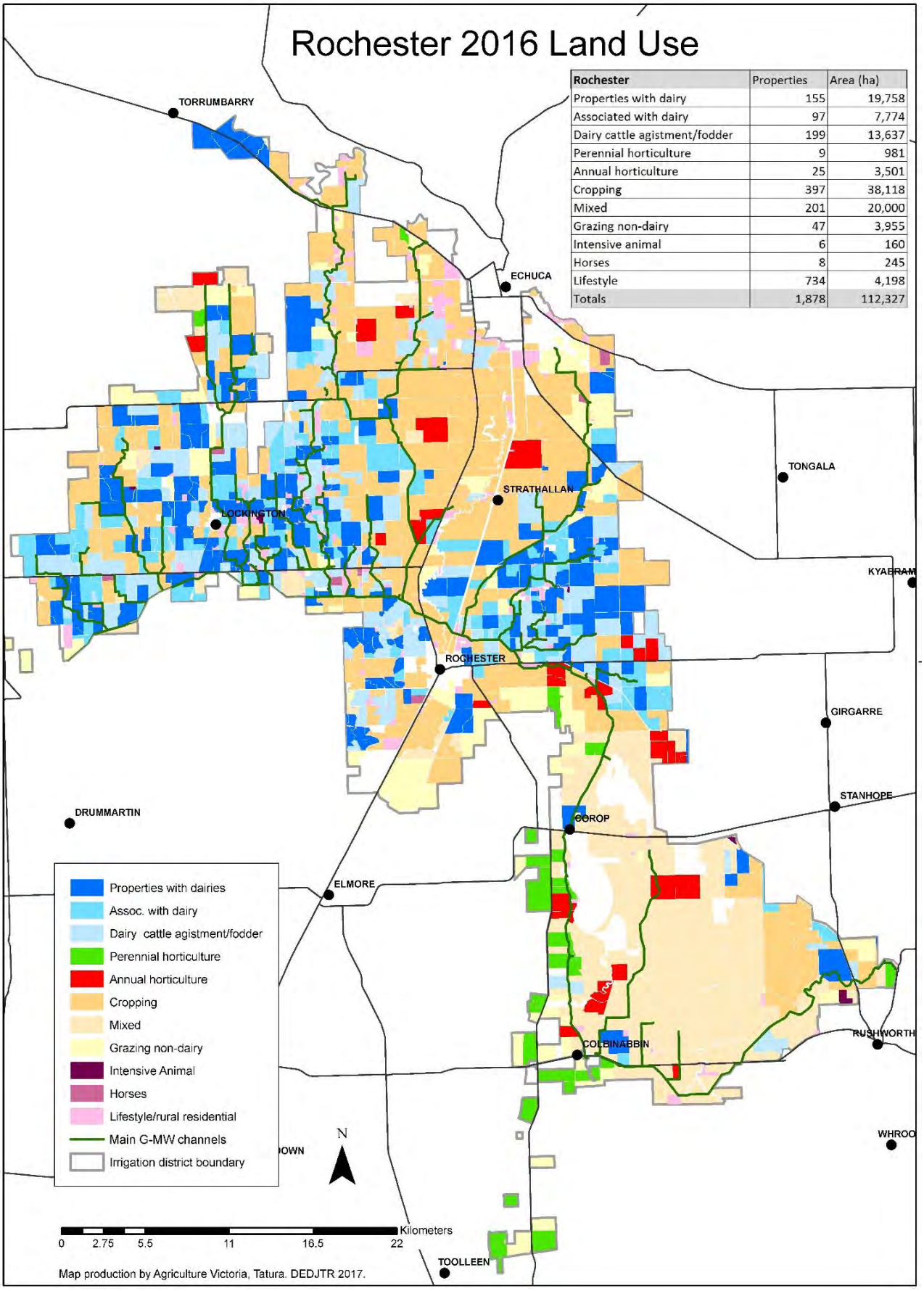


Shepparton	Properties	Area (ha)
Properties with Dairy	103	8,049
Associated with Dairy	81	3,678
Dairy Cattle Agistment/Fodder	44	3,250
Perennial horticulture	227	6,482
Annual horticulture	12	283
Cropping	271	19,792
Mixed	292	21,561
Grazing non-dairy	99	6,901
Intensive Animal	1	74
Horses	31	1,855
Lifestyle	645	5,755
Totals	1,806	77,680

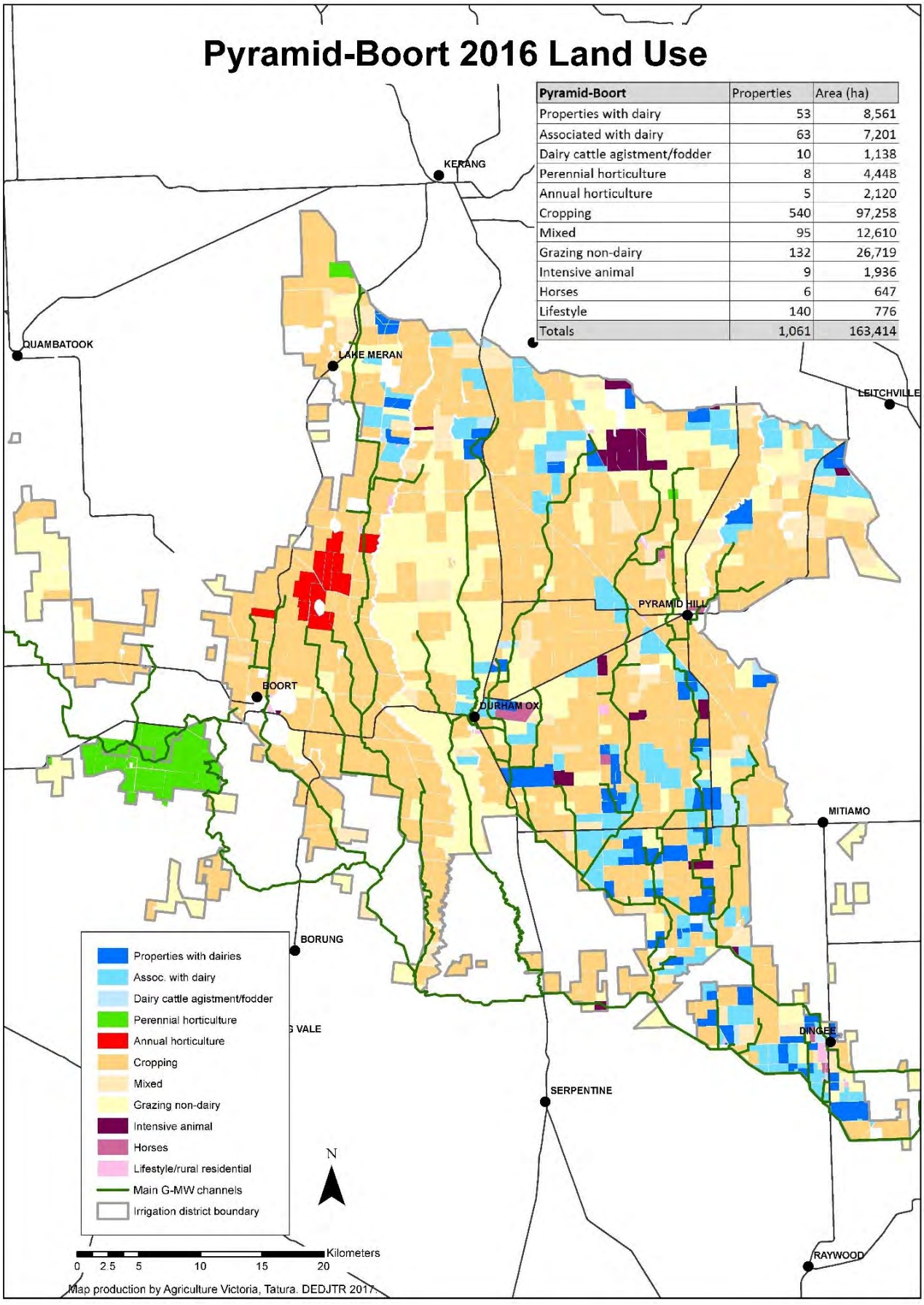
Appendix 4: Central Goulburn water service area land use and extent



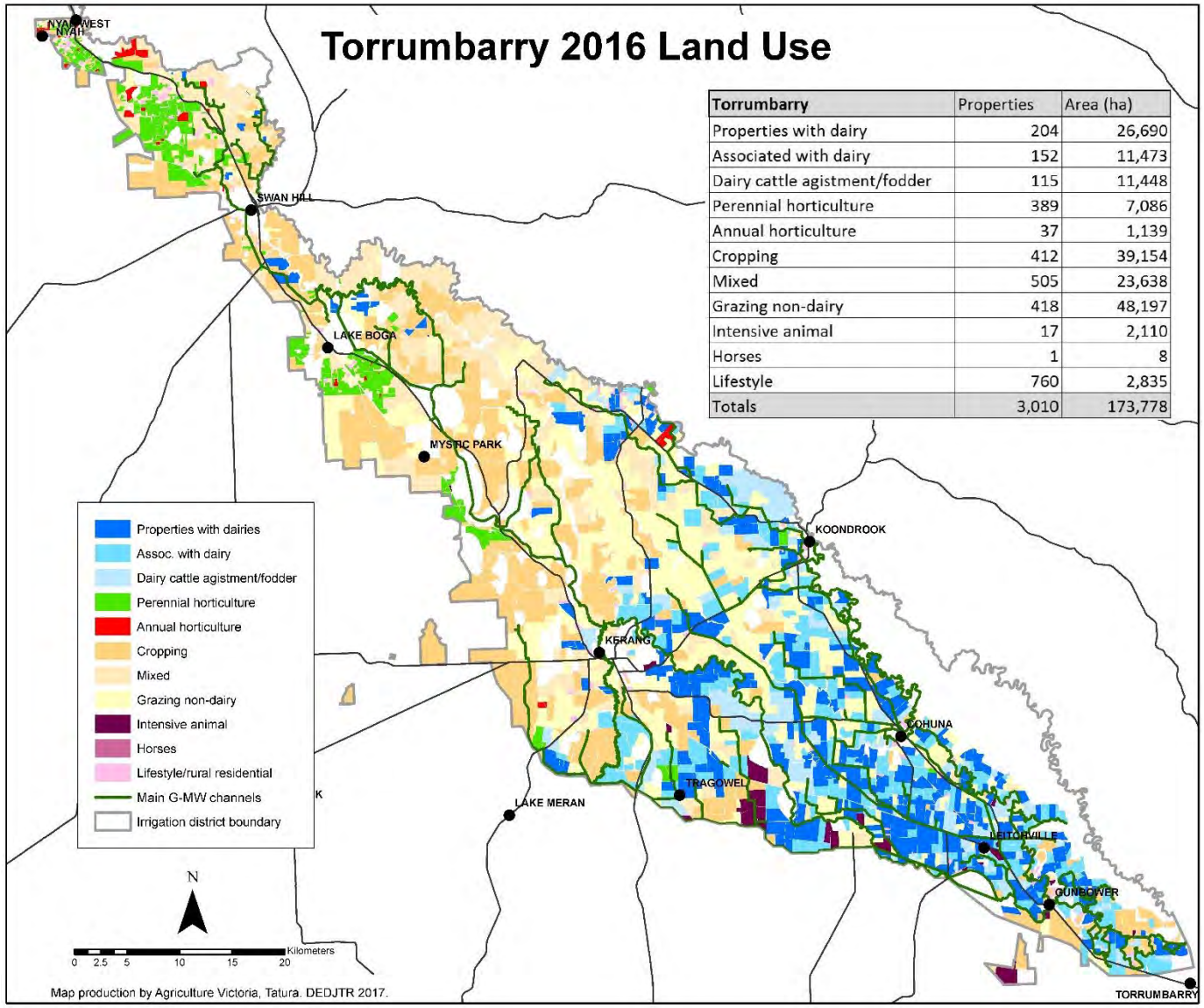
Appendix 5: Rochester water service area land use and extent



Appendix 6: Pyramid-Boort water service area land use and extent



Appendix 7: Torrumbarry water service area land use and extent

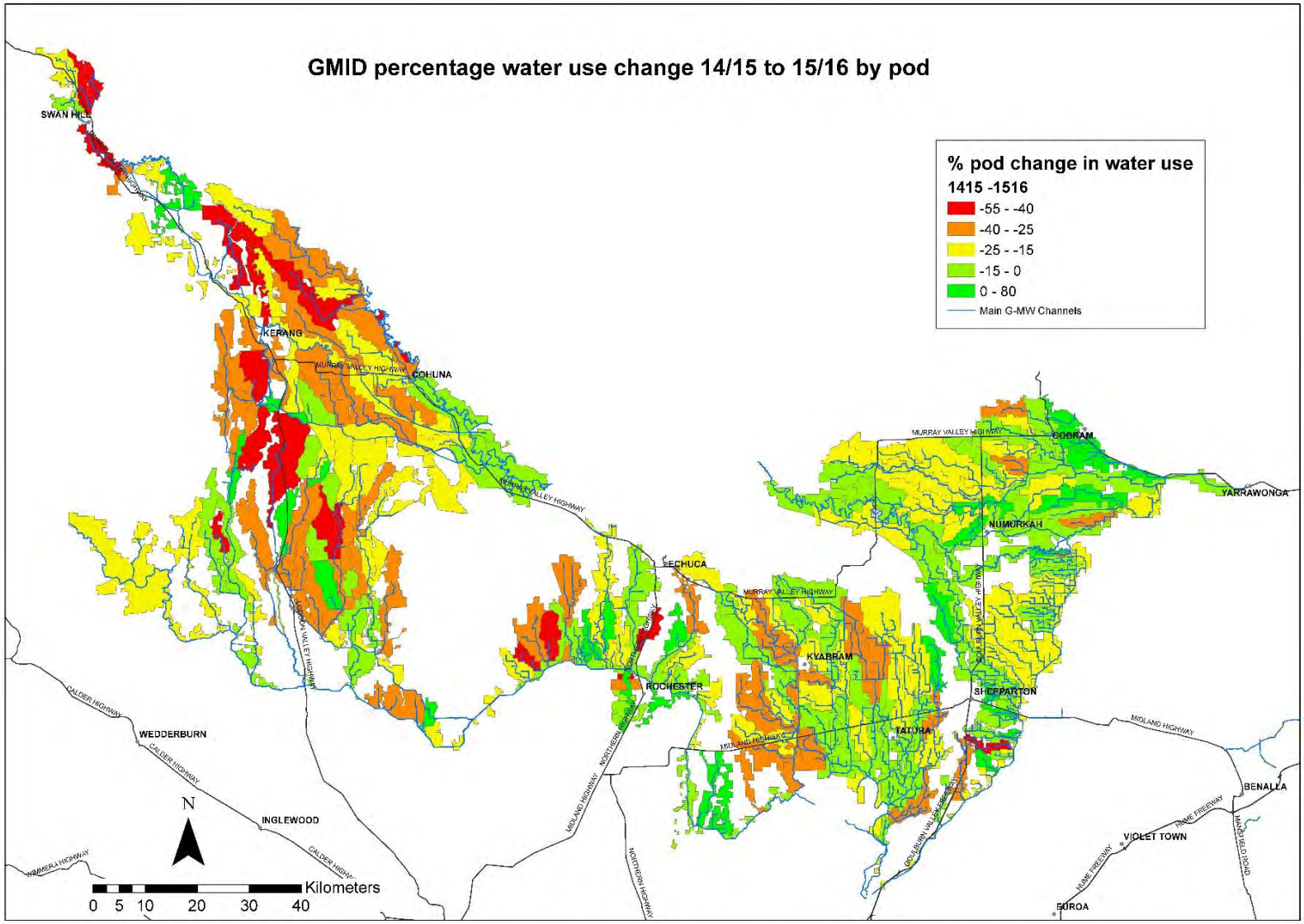


Torrumbarry	Properties	Area (ha)
Properties with dairy	204	26,690
Associated with dairy	152	11,473
Dairy cattle agistment/fodder	115	11,448
Perennial horticulture	389	7,086
Annual horticulture	37	1,139
Cropping	412	39,154
Mixed	505	23,638
Grazing non-dairy	418	48,197
Intensive animal	17	2,110
Horses	1	8
Lifestyle	760	2,835
Totals	3,010	173,778

Appendix 8: Tabulated data for GMID land use

Categories	Murray Valley		Shepparton		Central Goulburn		Rochester		Torrumbarry		Pyramid-Boort		Totals	
	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	Properties (Number)	Area (ha)	**Properties (Number)**	**Area (ha)**
Properties with dairy	264	26,169	103	8,049	363	37,493	155	19,758	204	26,690	53	8,561	**1,142**	**126,720**
Associated with dairy	152	12,365	81	3,678	220	11,454	97	7,774	152	11,473	63	7,201	**765**	**53,945**
Dairy cattle agistment/fodder	153	11,137	44	3,250	238	14,243	199	13,637	115	11,448	10	1,138	**759**	**54,853**
Perennial horticulture	136	4,672	227	6,482	179	5,460	9	981	389	7,086	8	4,448	**948**	**29,129**
Annual horticulture	8	794	12	283	28	2,203	25	3,501	37	1,139	5	2,120	**115**	**10,040**
Cropping	198	21,607	271	19,792	508	45,845	397	38,118	412	39,154	540	97,258	**2,326**	**261,774**
Mixed	76	4,856	292	21,561	471	35,451	201	20,000	505	23,638	95	12,610	**1,640**	**118,116**
Grazing non-dairy	456	40,540	99	6,901	113	7,578	47	3,955	418	48,197	132	26,719	**1,265**	**133,890**
Intensive animal	2	52	1	74	21	978	6	160	17	2,110	9	1,936	**56**	**5,310**
Horses	14	761	31	1,855	42	1,821	8	245	1	8	6	647	**102**	**5,337**
Lifestyle	379	5,690	645	5,755	1,454	11,014	734	4,198	760	2,835	140	776	**4,112**	**30,268**
Totals	1,838	128,643	1,806	77,680	3,637	173,540	1,878	112,327	3,010	173,778	1,061	163,414	**13,230**	**829,382**

Appendix 9: Water use change in the GMID by 'pod'



Appendix 10: Water use change in the GMID and dairy industry

Year	GMID HRWS (GL)	GMID water use (GL)	Dairy HRWS (GL)	Dairy water use (GL)
2001/02	1597	2053	819	1065
2002/03	1598	1450		
2003/04	1567	1652	709	922
2004/05	1543	1534		
2005/06	1517	1739		
2006/07	1480	945		
2007/08	1585	769		
2008/09	1490	574		
2009/10	1365	774		
2010/11	1273	772		
2011/12	1103	1286		
2012/13	1068	1622	470	746
2013/14	1068	1295		
2014/15	1000	1456	465	740
2015/16	1000	1230	465	600

Source: GMW & DEDJTR

Appendix 11: Statistical relationships

To understand and examine associations and relationships between two variables (e.g. those who trade water versus those who pay a higher amount of water) statistical tests were undertaken. The investigation of relationships is an important step in the explanation of how two variables relate to each other, which contributes to the building of theories about the nature of their interaction. It does not tell cause and effect of a relationship (e.g. variable A causes variable B) but it can show whether variable A and variable B are related. The relationships are shown below.

Relationships	*Test*	*Test value*	*Statistical significance*
There is an association between 'those who trade water as a large part of farm water use' and 'those who pay higher amount for allocation water'	Chi-square test	18.396	Significant at 0.00 probability level
There is an association between 'those who have implemented on-farm irrigation upgrades' and 'those who have a long-term plan to use allocation trade'	Chi-square test	8.204	Significant at 0.00 probability level
There is an association between 'those who have implemented on-farm irrigation upgrades' and 'those who are reliant on allocation trade'	Chi-square test	6.597	Significant at 0.05 probability level
There is an association between 'those who have a long-term plan to use allocation trade' and the 'price paid for allocation water'	Chi-square test	20.873	Significant at 0.00 probability level
There is an association between 'reliance on allocation trade' and 'expected period of operating the property'	Chi-square test	2.501	Not sig. at 0.10 probability level
There is an association between a 'long- term plan to use allocation trade' and the 'expected period of operating the property'	Chi-square test	2.213	Not sig. at 0.10 probability level
For dairy, there is an association between 'growing perennial pasture' and 'having the sufficient amount of water entitlement (HRWS)'	Chi-square test	5.914	Significant at 0.05 probability level
For dairy, there is a correlation between 'herd size' and 'amount of High Reliability Water Share'	Correlations	r value = 0.70	Significant at 0.01 probability level
For dairy, there is a correlation between 'the size of the property' and 'herd size'	Correlations	r value = 0.80	Significant at 0.01 probability level
There is no correlation between 'size of irrigated land-owned' and 'amount of High Reliability Water Share owned'	Correlations	R = 0.226	Correlation value low
There is no association between 'growing perennial pasture' and 'allocation trade forms a large part of farm water use'	Chi-square test	2.78	Not significant at 0.10 level

Relationships	*Test*	*Test value*	*Statistical significance*
For dairy, there is a correlation between 'size of the property' and 'ownership of High Reliability Water Share'	Correlations	0.621	Sig. at 0.01 probability level
For dairy, an analysis of variance showed that the 'herd size' for different types of 'dairy sheds' was significant. Analyses using Scheffe test indicated that the average number of herd size was significantly higher for Rotary sheds (M=980, SE=197) than the other two dairy types	ANOVA (analysis of variance)	F(2,105) = 16.76	0.001
There is no association between 'years of farming' and 'ownership of High Reliability Water Share'	Chi-square test	0.022	Correlation value low
The 'mean years of farming' differ between those who agree with the statement 'I have the amount of water entitlements to irrigate my property that I require'	t-test	3.247	Significant at 0.01 probability level
There is no correlation between 'size of irrigated land-owned' and 'amount of High Reliability Water Share ownership'	Correlations	0.226	Correlation value low
For dairy farms, there is an association between 'those who trade water as a large part of water use' and 'those who pay a higher amount for water'	Chi-square test	14.267	Significant at 0.00 probability level
For dairy farms, there is an association between 'those who have a long-term plan to use allocation trade' and 'those who pay a higher amount for water'	Chi-square test	17.192	Significant at 0.00 probability level
The 'mean years of farming' differ between those who responded to the statement that they have a 'long-term plan to use allocation trade to manage through the irrigation season'	t-test	4.177	Significant at 0.00 probability level
There is no difference in the 'mean years of farming' who responded to the statement that 'the entitlement you have is enough to cover your production needs'	t-test	0.381	Not significant at 0.10 level
There is no association between 'expected period of operating the property' and 'industry group'	Chi-square test	23.494	Not sig. at 0.10 probability level
There is no association between 'expectation for family succession' and 'industry group'	Chi-square test	1.321	Not sig. at 0.10 probability level
The mean 'years of farming' differ between those who agree with the statement 'I have the amount of water entitlements to irrigate my property that I require'	t-test	3.247	Sig. at 0.00 probability level

References

Aither (2016). Water Markets Report. 2015-16 review and 2016-17 outlook. Sourced from www.aither.com.au

GB CMA (2017). Goulburn Broken Catchment Management Authority & Partners (2017). 'Regional Irrigated Land and Water Use Mapping in the GMID 2015/16 Technical Report. Goulburn Broken CMA and partners.

Dairy Australia & Murray Dairy (2017). 'Regional Irrigated Land and Water Use Mapping in the GMID 2015/16 Dairy Evaluation'. Dairy Australia, Murray Dairy and partners.

GMW (2006). 'Irrigation Farm Survey 2004/2005. Final Date: 5/12/06.' Report by Goulburn Murray Water (GMW), Goulburn Broken Catchment Management Authority, North Central Catchment Management Authority, with contribution from Department of Primary Industries and Australian Bureau of Statistics.

GMW (2015). Goulburn Murray Irrigation District – GMW Connections Project Fact Sheet. November 2015 – Fact Sheet 10. Goulburn Murray Water, Tatura, Victoria.

HMC Property Group (2010). 'Changing land use in the GMID 2006-2010. Where have all the dairies gone? Report for Northern Victoria Irrigation Renewal Project and the Department of Primary Industries, by HMC Property Group. July 2010.

Victorian water trade data (2016). (http://waterregister.vic.gov.au/water-trading/allocation-trading), sourced August 2016.

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