



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

2019/20

SPATIAL MAPPING
TECHNICAL REPORT - SEPTEMBER 2021



This Technical Report can be found at
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- Goulburn Broken Catchment Management Authority (GB CMA)
- Department of Environment, Land, Water and Planning (DELWP)
- Agriculture Victoria
- Goulburn-Murray Water (GMW)
- North Central Catchment Management Authority (NCCMA)
- Murray Dairy
- HMC Property Group

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- GB CMA – Carl Walters and Bek Caldwell
- DELWP – Bonnie Glaister

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Contents

List of Figures	4
List of Tables.....	5
1. Executive Summary	6
2. Introduction	7
2.1. Project Outcomes.....	7
2.2. Project Background	8
2.3. Project Objectives	9
2.4. Project Deliverables.....	9
3. Methodology.....	10
3.1. Tool Development.....	10
3.2. End User Training	10
3.3. Data Capture	10
3.4. Analysis of Data	10
3.5. Data Collection Period.....	12
3.6. Privacy Statement	12
3.7. Qualifications/Limitations of Data.....	12
4. Results.....	14
4.1. Primary Land Use Across the GMID.....	14
4.2. Primary Land Use Change by Industry.....	19
5. Primary Land Use Change by Irrigation Area.....	28
5.1. Murray Valley Irrigation Area.....	28
5.2. Shepparton Irrigation Area.....	31
5.3. Central Goulburn Irrigation Area.....	34
5.4. Rochester Irrigation Area	37
5.5. Loddon Valley Irrigation Area.....	40
5.6. Torrumbarry Irrigation Area.....	43
6. Water Use across the Goulburn Murray Irrigation District (GMID)	46
7. Water Use Licences in the GMID.....	49
8. Conclusion.....	51
9. References.....	53
10. Appendices	54

List of Figures

- Figure 1: The project area, the Goulburn Murray Irrigation District (GMID)
- Figure 2. Primary Land Use in the GMID (ha), 2015/16, 2018/19 and 2019/20
- Figure 3. Goulburn Murray Irrigation District (GMID) 2019/20 Primary Land Use
- Figure 4. Goulburn Murray Irrigation District (GMID) 2018/19 Primary Land Use
- Figure 5. Goulburn Murray Irrigation District (GMID) 2015/16 Primary Land Use
- Figure 6. Dairy, Dairy Associated, Dairy Agistment & Fodder Land Use (ha) - GMID Irrigation Areas
- Figure 7. Horticulture – Annual and Perennial Land Use (ha) - GMID Irrigation Areas
- Figure 8. Cropping Land Use (ha) - GMID Irrigation Areas
- Figure 9. Grazing Non-Dairy Land Use (ha) - GMID Irrigation Areas
- Figure 10. Mixed Farming & Grazing (ha) - GMID Irrigation Areas
- Figure 11. Intensive – Animals (ha) - GMID Irrigation Areas
- Figure 12. Horses (ha) - GMID Irrigation Areas
- Figure 13. Rural Lifestyle/Residential (ha) - GMID Irrigation Areas
- Figure 14. Primary Land Use - Murray Valley Irrigation Area, 2015/16, 2018/19 and 2019/20
- Figure 15. Primary Land Use - Murray Valley Irrigation Area, 2015/16 (bottom), 2018/19 (middle) and 2019/20 (top)
- Figure 16. Primary Land Use - Shepparton Irrigation Area, 2015/16, 2018/19 and 2019/20
- Figure 17. Primary Land Use - Shepparton Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)
- Figure 18. Primary Land Use - Central Goulburn Irrigation Area, 2015/16, 2018/19 and 2019/20
- Figure 19. Primary Land Use - Central Goulburn Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)
- Figure 20. Primary Land Use - Rochester Water Irrigation 2015/16, 2018/19 and 2019/20
- Figure 21. Primary Land Use - Rochester Water Irrigation 2015/16 (left), 2018/19 (middle) and 2019/20 (right)
- Figure 22. Primary Land Use - Loddon Valley Irrigation Area, 2015/16, 2018/19 and 2019/20
- Figure 23. Primary Land Use - Loddon Valley Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)
- Figure 24. Primary Land Use - Torrumbarry Irrigation Area, 2015/16, 2018/19 and 2019/20
- Figure 25. Primary Land Use - Torrumbarry Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)
- Figure 26. Water Use in the GMID (hectare - ha) for each Primary Land Use, 2015/16, 2018/19 and 2019/20
- Figure 27. Percentage GMID Water Use by Primary Land Use, 2015/16, 2018/2019, 2019/20

List of Tables

Table 1. Australian Valuation Property Classification Code (AVPCC) and Land Use Categorisation

Table 2. Management of Data Limitations

Table 3. Primary Land Use in the GMID (ha), 2015/16, 2018/19 and 2019/20

Table 4. Analysis of Reclassification of Mixed Farming & Grazing Land Use to Primary Land Use in 2018/19

Table 5. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Murray Valley Irrigation Area

Table 6. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Shepparton Irrigation Area

Table 7. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Central Goulburn Irrigation Area

Table 8. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Rochester Irrigation Area

Table 9. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Loddon Valley Irrigation Area

Table 10. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Torrumbarry Irrigation Area

Table 11. GMID Water Use (ML) and Water Use Change (ML and %) by Primary Land Use category, 2015/16, 2018/19 and 2019/20

Table 12. Water Use Licence (WUL) (number and change %) in the GMID by Land Use category, 2015/16, 2018/19 and 2019/20

1. Executive Summary

The Goulburn Murray Irrigation District (GMID) is a major irrigation system in Australia, supporting diverse agricultural commodities such as dairy, horticulture, beef, sheep and cropping. The interaction of land and water use in the GMID is complex with the region undergoing significant transition over the last decade. The demand and competition for water, based on market drivers and seasonal conditions, remains a key driver of land and water use change. The pattern of land use change is uneven across the GMID, with land and water use shifting significantly in areas compared. This is based on access to water, as well as broader socio-economic factors. While dry conditions in northern Victoria eased with early Autumn rain in 2020, the 2019/20 season saw very low allocations on the Murray and Goulburn systems and high water prices. A 50 percent (%) reduction in water use between the past two irrigation seasons (2018/19 and 2019/20) is indicative of seasonal variability, and the complexities faced by irrigators. The result of shifting water use directly impacts on the commodities grown, and the pattern of land use across the GMID. This 2019/20 report has identified the following key attributes of land and water use in the GMID and changes since previous project reporting in 2015/16 and 2018/19. Assumptions and data limitations to assist in interpretation of the data appropriately is provided in the methodology.

Land Use findings:

- The irrigated land use area of the GMID is 842,542ha.
- Cropping remains the most extensive land use (by area) across the GMID and comprises 42% of the 842,542ha irrigated property area.
- Dairy (Combined)¹ was the second largest land use, with data showing adjustment in the industry, with less land associated with active dairies (approximate decrease of 6-8% per year since 2015/16). Nonetheless, Dairy (Combined) continues to be a dominant land use in the GMID comprising 26.5% of the 842,542ha survey area.
- Rural Lifestyle/Residential and 'Other' land uses increased by 18,632ha and 7,040ha respectively since 2018/19, suggesting broader socio-economic changes in irrigation communities such as farms transitioning to lifestyle properties.
- Overall, both Horticulture - Perennial and Horticulture - Annual remain relatively stable in terms of area, although Horticulture - Annual continues to move geographically, given its transient nature.
- Mixed Farming and Grazing was reclassified to primary land uses such as Cropping and Grazing Non-Dairy, to more accurately acknowledge the primary land use.

Water Use findings:

- There were 14,401 Water Use Licences across the GMID in 2019/20, mostly attributed to Rural Lifestyle/Residential (6,905), Cropping (2,769) and Dairy (Combined) (1,940).
- Total water use in the GMID in 2019/20 (513GL) was approximately half the amount used in 2018/19 (1,074GL) and 2015/16 (1,003GL) due to early dry conditions and low allocations.
- In 2019/20 Dairy (Combined) was the largest water user across the GMID, using 220GL (43% of total water used), compared to 550GL in 2015/16 and 484GL in 2018/19. Cropping was the second largest water user in the GMID, using 109GL (21% water use).
- Horticulture - Perennial used 75GL in 2019/20, the third largest water use, and the percentage water use almost doubled between 2015/16 (9%) and 2019/20 (15%) despite Horticulture - Perennials total water use decreasing by 12GL (from 87GL to 75GL).

¹ The combined dairy footprint (Dairy, Dairy Associated, and Dairy Agistment & Fodder land uses combined)

2. Introduction

The Regional Irrigated Land and Water Use Mapping (RILWUM) project collects information on irrigated land and water use as a tool to support decision makers. This project builds on collaborative work undertaken in the Shepparton Irrigation Region and more recently the GMID, for over two decades (e.g. 2018/19, 2015/16, 2009/10, 2004/05 and pre-2000). The 2019/20 project is being undertaken through existing partnerships between the Goulburn Broken Catchment Management Authority (GB CMA), Goulburn-Murray Water (GMW), Agriculture Victoria (AgVic), Department of Environment, Land, Water and Planning (DELWP), HMC Valuations, Murray Dairy, and North Central CMA (NCCMA), in collaboration with the Irrigated Cropping Council, and Fruit Growers Victoria.

The spatial mapping process involves remote and on-ground land use survey in the GMID and the matching of water register data, to determine seasonal water use by Water Use Licence and industry (e.g. Dairy, Cropping, Grazing Non-Dairy and Horticulture). This data is then used to produce land and water use maps as provided in this report. This mapping is complemented by Farm Irrigation Surveys of irrigators, regarding land and water use change. This data is provided in a complementary report (GB CMA 2021b) and is critical to understanding the linkage between what the project is seeing spatially and what decisions irrigators are making.

2.1. Project Outcomes

Mapping of land and water use in the GMID enables continued assessment of shifting water demands and land use change, and will:

- Build understanding of how the GMID is changing and adapting to reduced water availability;
- Inform water, agriculture and planning policy at the local, regional, state and national level;
- Provide essential input for economic modelling and analysis;
- Guide regional economic development investment;
- Inform the broader community and help landowners looking to expand, redevelop or contemplating exit options make informed decisions;
- Support Goulburn-Murray Water strategic planning for infrastructure rationalisation and renewal and efforts to reduce operating and capital costs for long term viability; and
- Contribute to Water for Victoria Actions including 4.1 (Support regional development and change), 4.2 (Help irrigation districts adapt), 4.4 (Reduce barriers to change and support communities in irrigation districts) and 4.7 (Manage irrigation development) (DELWP 2016).

2.2. Project Background

For the purpose of this report, the project area is referred to collectively as the Goulburn Murray Irrigation District (GMID), which includes the Goulburn Murray Irrigation District (including Woorinen Irrigation District), Nyah Irrigation District and Tresco Irrigation District. The GMID is a major irrigation district comprising 15,000 properties over 9,950 square kilometres (Figure 1). The main enterprises are cropping, dairy, mixed grazing and horticulture. There are major food processors with the region supporting a population of 170,000 people and the gross value of agricultural production around \$2.1 billion per year (ABS, 2019). Approximately 842,542ha is classified as irrigation properties, with 14,401 Water Use Licenses.

Seasonal fluctuations and commodity prices, along with changes in water and planning policy, 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.

This report provides technical data on spatial mapping and analysis, which involved the collection of data describing the land use for every Water Use Licence (14,401) in the GMID, between August 2019 and May 2020.

This project was made possible through collaboration between stakeholders including a Stakeholder Reference Group and Technical Working Group, representing participating stakeholders who provided oversight and technical expertise to the project (Appendix 1).

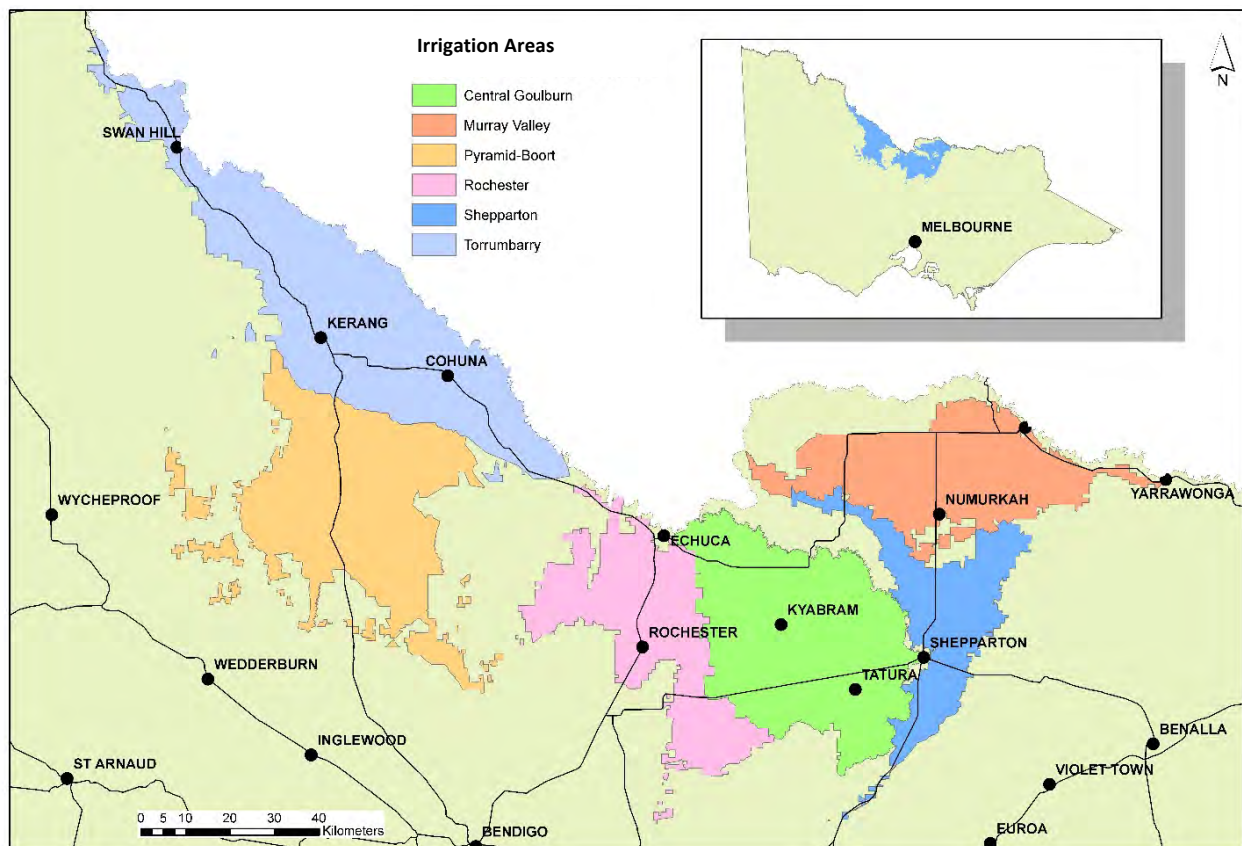


Figure 1: The project area, the Goulburn Murray Irrigation District (GMID)

2.3. Project Objectives

The project objectives were to:

- Renew through spatial analysis, the land and water use data for all irrigated (as defined by Water Use Licence) properties in the GMID;
- Conduct a comparative analysis between the 2018/19 and 2015/16 irrigation seasons, and/or with annual data as available from that point;
- Allow decision makers to trace changes in irrigation land use over time; and,
- Communicate key messages to inform regional, national and state water policy.

2.4. Project Deliverables

The key project deliverables were to:

- Re-convene stakeholders through involvement in a Technical Working Group and Stakeholder Reference Group;
- Provide 2019/20 spatial mapping data for each of the 14,401 Water Use Licences in the GMID; and
- Develop technical reports and associated documents, to communicate findings.

3. Methodology

The method of data collection in 2019/20 consisted of the following steps:

3.1. Tool Development

An interactive Geocortex tool developed by Goulburn-Murray Water (GMW) Geographical Information System (GIS) staff for the 2018/19 project, was used to capture 2019/20 land use change data. The Geocortex tool incorporated the 2018/19 land use layer as the reference point. The classification occurred at the Water Use Licence (WUL) level, with data standardised against 2019/20 WUL data. For this project, we refer to Water Use Licences as the collective, which also includes some Water Use Registrations.

3.2. End User Training

GMW Customer Service Officers (Field Officers) allocated to their respective irrigation areas (Shepparton, Murray Valley, Central Goulburn, Loddon Valley, Rochester, and Torrumbarry) were re-trained, to build consistent interpretation in the land use classifications. Staff from each irrigation area then completed the mapping individually for their respective areas.

3.3. Data Capture

The Geocortex tool uses standardised lists (drop downs) to enable the end user to capture the following data using desktop assessment:

- a. Primary Land Use (by Industry e.g. cropping) (refer to Table 1)
- b. Secondary Land Use (by Industry)
- c. Other Land Use (to capture new land use not already listed)
- d. On-Farm Irrigation Modernisation Assessment (Yes or No)
- e. Irrigation Methods
 - i. Pivot/Linear move
 - ii. Gravity channel
 - iii. Pipes and Risers
- f. Comments (to assist with analysis)

Not all the data captured is covered in this report. This report focuses on comparing the 2019/20 dataset with the 2018/19 and 2015/16 datasets. The water use information has been collected from GMW Water Use Licence (WUL) data and from information sourced from the Victorian Water Register. A single enterprise can have one WUL covering several land properties titles.

3.4. Analysis of Data

The data was analysed by GMW and the Spatial Information Sciences team at Agriculture Victoria, to compare 2019/20, 2018/19 and 2015/16 data. A selection of Australian Valuation Property Classification Codes (AVPCC) was applied to each WUL and then further grouped to refine the classification (Table 1). This was consistent with the land use categories used in 2018/19 and 2015/16, except for the removal of 'Mixed Farming and Grazing', which was aligned to other primary land uses such as 'Cropping'. This is because the primary land use is critical to the analysis and 'Mixed Farming and Grazing' was determined not to be a secondary land use. A new land use 'Other' was added to the 2019/20 dataset, to ensure collection of land and water use for this category (refer to Table 1 for further explanation).

Table 1. Australian Valuation Property Classification Code (AVPCC) and Land Use Categorisation

AVPCC ²	Summary categories for this project	Description
Domestic livestock grazing	Grazing Non-Dairy	Land used for grazing domestic and commercial livestock.
Livestock production - beef cattle		
Livestock production - sheep		
Crop production - fodder crops	Cropping	Land used for broadacre crops, e.g. grains, oilseeds.
Crop production - mixed/other		
General cropping		
Cattle feed lot	Intensive - Animals	Land developed with specialist infrastructure for intensive feeding of cattle, pigs, or poultry. It does not include intensive dairy as they are included in the dairy category.
Piggery		
Poultry (broiler or egg production)		
Horse stud/training facilities/stables	Horses	Land developed with specialist infrastructure for a horse stud farm or training facility. May include recreational equestrian.
Livestock production - dairy cattle	Dairy	WUL with active dairy (milking) shed (at time of survey in May 2019-July 2020).
	Dairy Associated	Land linked to the active dairy shed WUL; may include some cropping and other dairy uses.
	Dairy Agistment & Fodder	No clear link to a Dairy WUL, but dairy cattle were present during survey or a former dairy farm may be in transition.
	Dairy (Combined)	The combined dairy footprint (Dairy, Dairy Associated and Dairy Agistment & Fodder).
Market garden - vegetables	Horticulture - Annual	Land used for growing vegetable crops e.g. tomatoes.
Orchards, groves, and plantations	Horticulture - Perennial	Land planted to grow fruit and nuts, e.g. olives, stone fruits, tropical fruits, citrus, grapes.
Vineyards		
Rural Residential	Rural Lifestyle/ Residential	A Lifestyle/Residential use dwelling on land in a rural, semi-rural or bushland setting. Primary production uses and associated improvements are secondary to the residential/lifestyle use. Rural residential <0.5ha; Rural Lifestyle <0.5 delivery share and <20ha property size.
N/A	Other	Includes areas such as sports ovals, schools, town water, retirement village, cemeteries, showgrounds, factories, caravan parks, solar farms and vacant/inactive land.

² HMC Property Group (2010). Changing land use in the GMID 2006-2010. HMC Property Group. July 2010.

3.5. Data Collection Period

The assessment period was the 2019/20 irrigation season from August 2019 to May 2020. Data was collected primarily during August 2019 to January 2020. The data was validated against other available sources, to ensure consistency of interpretation. The report measures activity at a point in time and should be interpreted with this in mind.

3.6. Privacy Statement

Irrigated enterprises will only be identified by a generic identification and no identifying information will be shared publicly.

3.7. Qualifications/Limitations of Data

Data collection was completed using the field knowledge of GMW Customer Service Officers, to integrate field knowledge into the spatial mapping tool. The process has some inherent challenges in interpretation; however, all measures were undertaken to minimise objectivity. Table 2 highlights some of the data limitations and how limitations were managed.

Table 2. Management of Data Limitations

Issue	Risk	Management of Limitations
Incorrect assessment of land use or modernisation status.	Potential for minimal land use categorisation inaccuracy.	Acknowledged high level of local knowledge among GMW Customer Service Officers. Consistent staff training about categorisation. Application of uniform Yes/No answer to Modernisation. Inclusion of secondary land use (not shown in this report).
Seasonality issues and context.	Land use requires a continued iteration depending on timing of inspection and interpretation.	Acknowledgement that results are a snapshot in time. The benefit of the Geocortex tool and data collection methodology is that it allows for consistent assessment of the same units in the future. Mixed Farming & Grazing was removed to force choice of primary land use.
Data mismatches.	Integrating datasets such as information from GMW, AgVic and the Victorian Water Register, to the Land Victoria Vic Map parcel dataset, and WULs can result in minimal data mismatches.	All attempts to correct data inconsistencies have occurred during the linking of datasets, including rechecking data. GMW and Agriculture Victoria staff continually work to improve datasets, which is why data is expected to continually improve. As part of this, data from 2015/16 and 2018/19 was standardised against current WUL information.
Limitations exist in the accuracy of determining AVPCC codes and sub-categorisation to the 'Dairy cattle agistment/ fodder' land use.	Potential for minimal Dairy land use categorisation inaccuracy, noting that data is not reflective of formal exits from the industry and is not reflective of dairy licence data, but instead, against WUL data.	Consistent methodology in categorisation of properties linked to Dairy. e.g. properties were categorised as linked to Dairy in one of four ways: <ul style="list-style-type: none"> • 'Dairy' – defined as WULs linked with a functioning milking shed at the time of survey; • 'Dairy Associated' – linked to 'Dairy' through customer data (WUL) and therefore forming part of a dairy enterprise.

		<ul style="list-style-type: none"> • ‘Dairy Agistment & Fodder’ – Land use defined as servicing the dairy industry or in transition (but have not been linked to an active dairy WUL). The land use may be used by another AVPCC land use code such as Cropping; or a link may exist with a dairy enterprise that was not found through integration with existing datasets. The decision was made to group these together as ‘Dairy Agistment & Fodder’ and document the methodology, to enable future investigation. • Dairy (Combined) – Amalgamation of Dairy, Dairy Associated and Dairy Agistment & Fodder land uses.
Removing ‘Mixed Farming & Grazing’ as a primary land use; and the addition of ‘Other’.	Change in methodologies may lead to some confusion; but we need to ensure primary land use is mapped.	‘Mixed Farming & Grazing’ was removed as a primary land use, as it was deemed a secondary land use. Instances where this reclassification may lead to inconsistencies in the interpretation of data will be noted throughout the report. Table 4 shows where the ‘Mixed Farming & Grazing’ category has been reclassified.
Combination of ‘Rural Residential’ and ‘Lifestyle’ land uses to form the one land use.	Combining ‘Rural Residential and Lifestyle’ may lead to some confusion in 2019/20 but will be beneficial for future comparisons.	This project continually improves the way data is mapped and analysed, that will enable improved comparisons for the future of the project. Instances where this reclassification may lead to inconsistencies in the interpretation of data will be noted throughout the report.
Standardisation of previous datasets (2018/19 and 2015/16) to the current Water Use Licence footprint.	May cause short term confusion.	The data was standardised against the 2019/20 Water Use Licence (WUL) data, to enable comparisons and provide improved time series, and compare what land use has transitioned against each WUL.
There is a cohort (Corporations) that are not detailed in this report.	That we have not detailed this cohort in this report.	We acknowledge that further analysis of this cohort needs to occur, to improve understanding of the broader land and water use change profile in the GMID.

4. Results

4.1. Primary Land Use Across the GMID

Primary land use as defined by industry type was mapped and analysed between three datasets, 2015/16, 2018/19 and 2019/20, according to hectares and percentage change (Table 3). Cropping increased (99,917ha) between 2015/16 and 2019/20, due in part to Mixed Farming and Grazing being reclassified into primary land uses. Dairy (Combined) area increased between 2018/19 and 2019/20, despite a decline in Dairy (active sheds) of 8% and significant change between 2015/16 and 2018/19. Total land use by area is shown graphically in Figure 2.

Table 3. Primary Land Use in the GMID (ha), 2015/16, 2018/19 and 2019/20

Primary Land Use	2015/16	2018/19	2019/20	2015/16-2018/19		2018/19-2019/20		2015/16-2019/20	
	Area (ha)	Area (ha)	Area (ha)	Change in Area (ha)	Change in Area (%)	Change in Area (ha)	Change in Area (%)	Change in Area (ha)	Change in Area (%)
Cropping	255,918	258,146	355,835	2,228	0.9	97,689	37.8	99,917	39
Dairy	156,633	119,102	109,658	-37,531	-24.0	-9,445	-7.9	-46,976	-30
Dairy Agistment & Fodder	48,750	30,885	38,138	-17,865	-36.6	7,253	23.5	-10,612	-21.8
Dairy Associated	80,373	61,160	75,788	-19,213	-23.9	14,628	23.9	-4,585	-5.7
Dairy (Combined)	285,756	211,147	223,584	-74,609	-26	12,706	6.0	-62,173	-21.8
Grazing Non-Dairy	106,868	125,412	150,026	18,544	17.4	24,614	19.6	43,158	40.4
Horses	4,528	5,523	5,505	995	22.0	-18	-0.3	977	21.6
Horticulture - Annual	12,356	10,946	12,867	-1,409	-11.4	1,920	17.5	511	4.1
Horticulture - Perennial	31,477	31,413	31,620	-64	-0.2	207	0.7	143	0.5
Intensive - Animals	7,014	4,852	4,735	-2,162	-30.8	-117	-2.4	-2,279	-32.5
Mixed Farming & Grazing*	105,926	148,788	-	42,862	40.5	-	-	-	-
Rural Lifestyle/Residential	28,531	36,121	47,163	7,590	26.6	11,042	30.6	18,632	65.3
Other (e.g. municipal infrastructure)	4,167	10,194	11,208	6,026	144.6	1,014	9.9	7,040	168.9
Total	842,542	842,542	842,542#						

#Data was standardised according to current Water Use Licence footprint for 2019/20, 2018/9 and 2015/6. *Mixed Farming & Grazing reclassified in 2019/20.

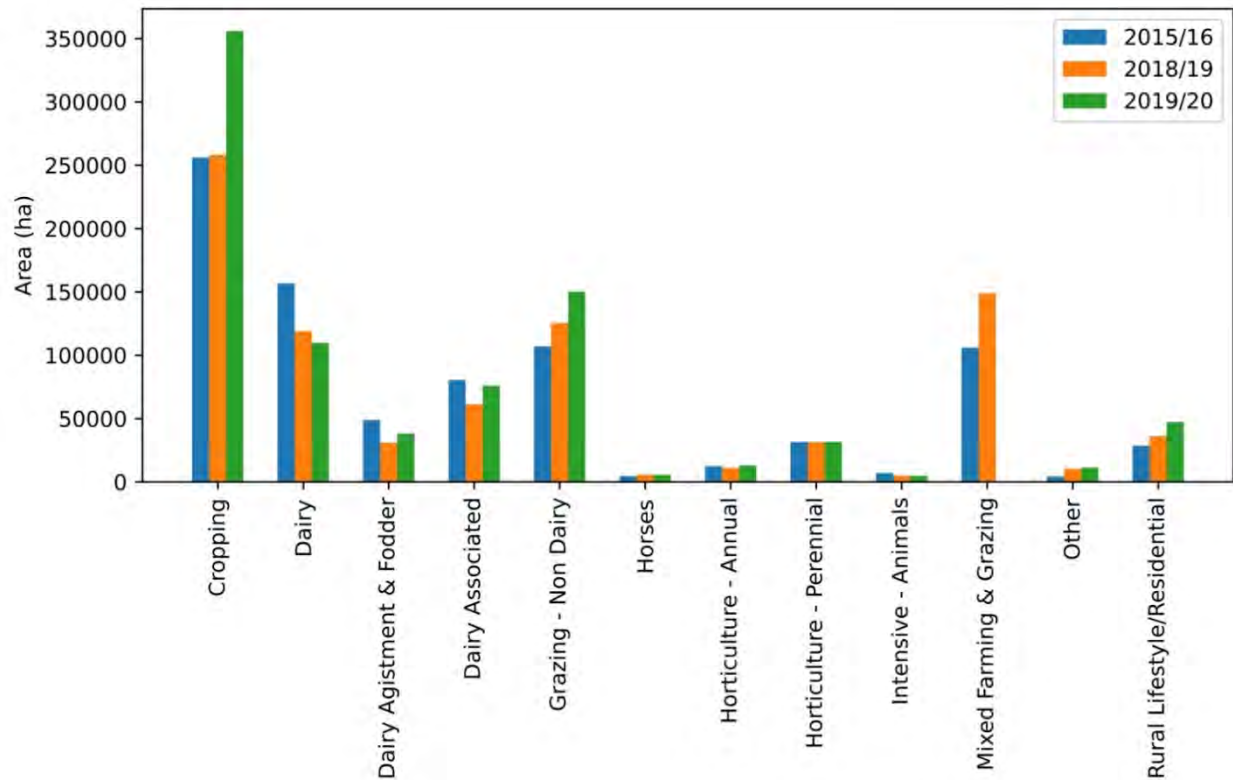


Figure 2. Primary Land Use in the GMID (ha), 2015/16, 2018/19 and 2019/20

As shown in Figure 2, land use such as Horses, Horticulture - Annual, Horticulture - Perennial and Intensive – Animals have stayed relatively stable by area (ha) since 2015/16. Cropping and Grazing Non-Dairy increased in area by 99,917ha (39%) and 43,158ha (40%) respectively since 2015/16 due largely to the reclassification of 148,788ha of Mixed Farming and Grazing into primary land use.

Land use mapping results for the GMID for 2019/20 (Figure 3), 2018/19 (Figure 4) and 2015/16 (Figure 5) are illustrated below. Collectively they provide a picture of how land use is changing.

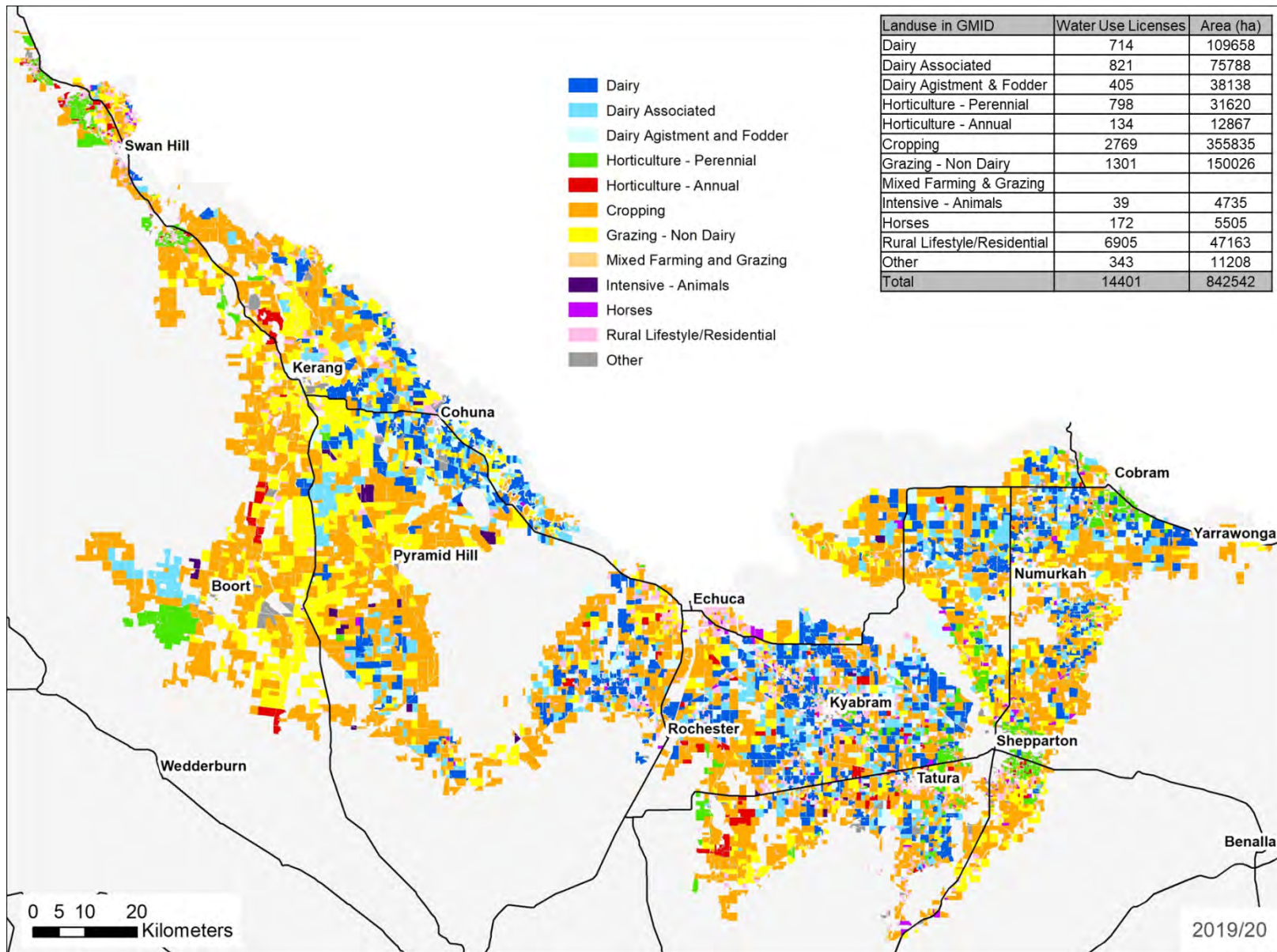


Figure 3. Goulburn Murray Irrigation District (GMID) 2019/20 Primary Land Use

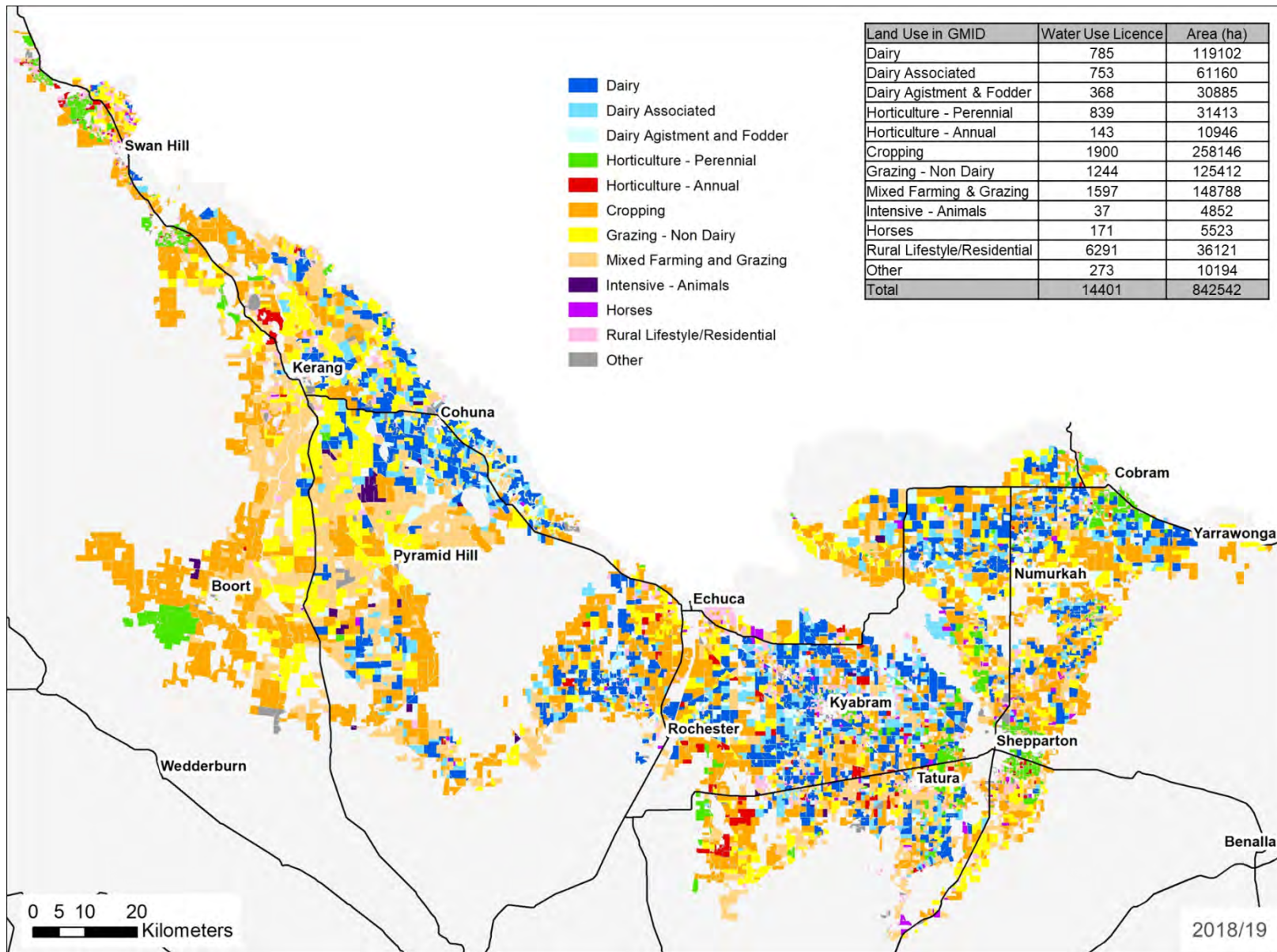


Figure 4. Goulburn Murray Irrigation District (GMID) 2018/19 Primary Land Use

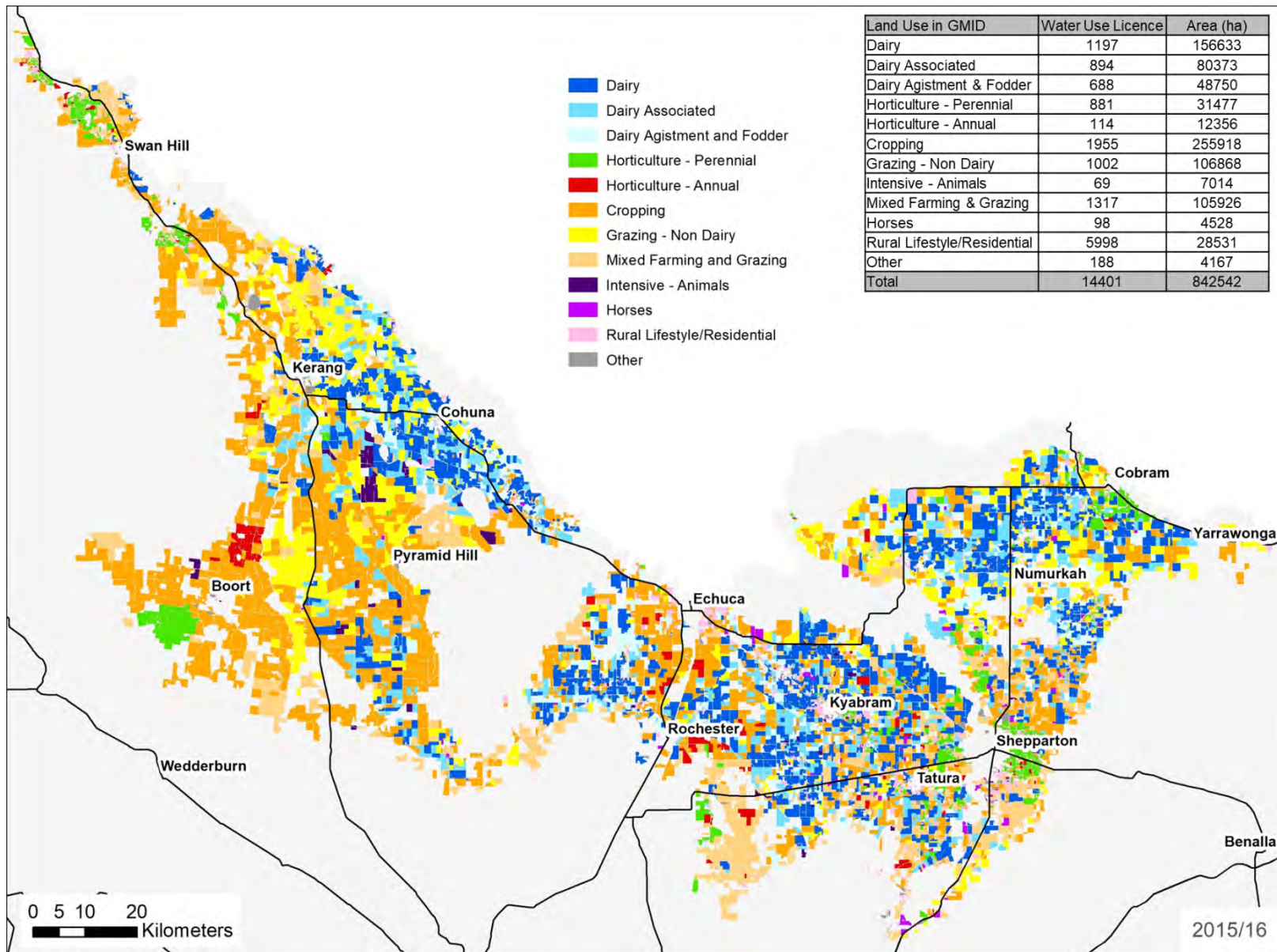


Figure 5. Goulburn Murray Irrigation District (GMID) 2015/16 Primary Land Use

4.2. Primary Land Use Change by Industry

Comparison of Figures 3, 4 and 5 suggest that the primary land use mix across the GMID has changed in area (ha) and distribution between 2015/16, 2018/19 and 2019/20. This change was more obvious in some primary land use categories (e.g. Dairy and Cropping) than others (e.g. Horticulture). This is examined further in the following sections (4.2.1 – 4.2.8) for each primary land use.

4.2.1. Dairy

Figure 6 shows the area of Dairy, Dairy Agistment and Fodder, and Dairy Associated land use categories for the 2015/16, 2018/19 and 2019/20 irrigation seasons across the GMID's six irrigation areas. Dairy land use (active dairy) was predominantly located in Central Goulburn, Murray Valley and Torrumbarry irrigation areas. The area of Dairy land use (active dairy) has been declining roughly 6-8% per year since 2015/16. This is a measurement of dairy activity at a point in time and does not necessarily represent formal exits. The fluctuation in Dairy Associated and Dairy Agistment and Fodder land use since 2015/16 suggests that the decline in Dairy land use is due in part to restructuring of dairy businesses. For instance, where an adjoining property with an active dairy shed is amalgamated into a larger property (if the WUL is not merged through other processes) for the purposes of this project, the WUL was reclassified from Dairy to Dairy Associated (i.e. linked to a property with an active dairy).

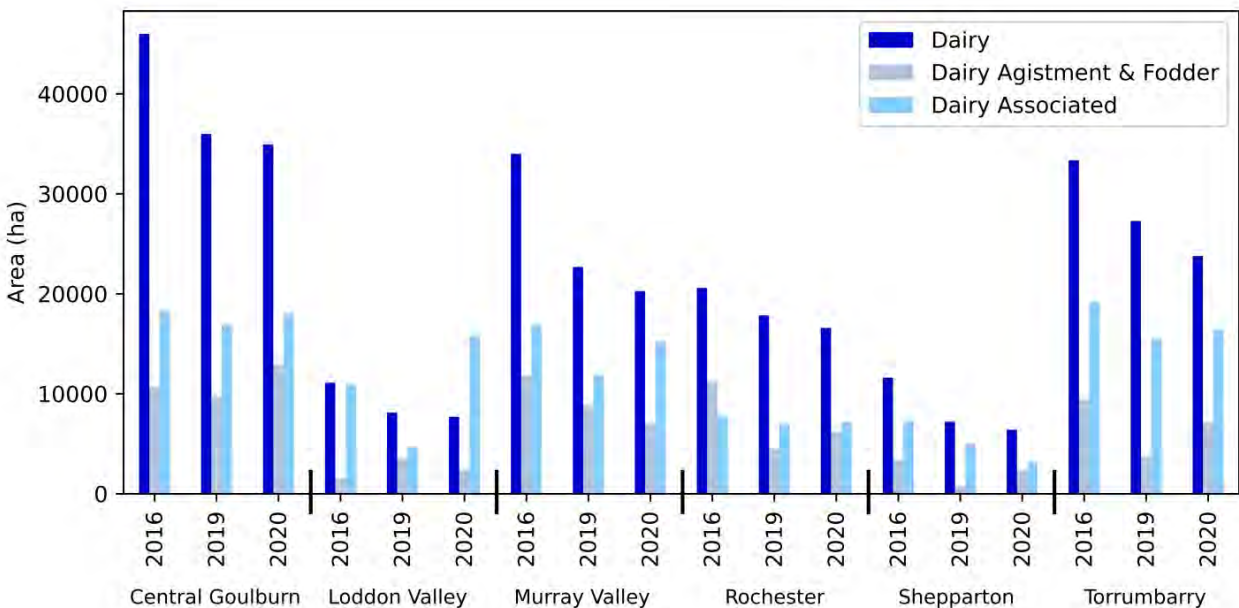


Figure 6. Dairy, Dairy Associated, and Dairy Agistment & Fodder Land Use (ha) - GMID Irrigation Areas

4.2.2. Horticulture – Annual and Perennial

As illustrated in Figure 7, Horticulture - Perennial was found across all irrigation areas in the GMID, particularly Shepparton, Torrumbarry, Loddon Valley and Central Goulburn, but less so in Rochester, where Horticulture - Annual was more prevalent. The total area of Horticulture – Annual declined between 2015/16 and 2018/19 by 11% but steadied after an increase in 2019/20 to an overall change between 2015/16 and 2019/20 of 4% (Table 3).

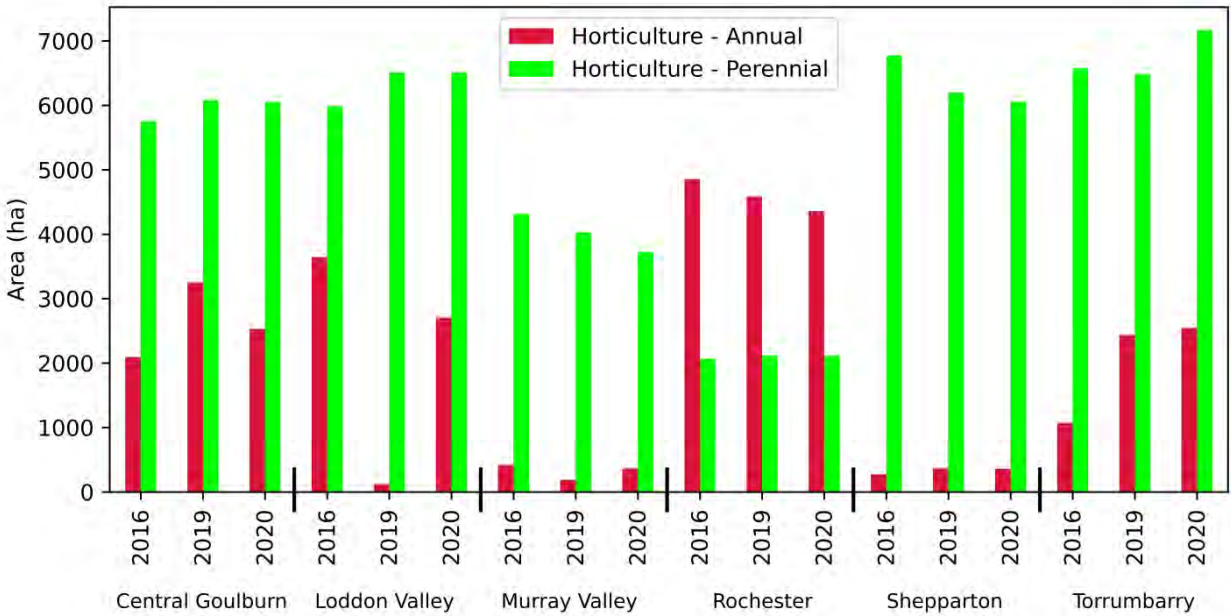


Figure 7. Horticulture – Annual and Perennial Land Use (ha) - GMID Irrigation Areas

4.2.3. Cropping

Cropping land use increased between 2015/16 and 2019/20 in all irrigation areas, except for Loddon Valley (Figure 8). Cropping was the largest land use by area in Loddon Valley, with the least found in the Shepparton irrigation area. There was a 99,917ha increase (Table 3) in Cropping between 2015/16 and 2019/20. This was due largely to the reclassification of 97,494ha of Mixed Farming and Grazing land use to Cropping in 2019/20 (Table 4). This change was necessary to ensure that the primary land use of each WUL was correctly identified, in place of Mixed Farming and Grazing which is a secondary land use. The reclassification does not account for 2,423ha of the Cropping changes seen across each of the irrigation areas between 2015/16 and 2019/20 (see Chapter 5).

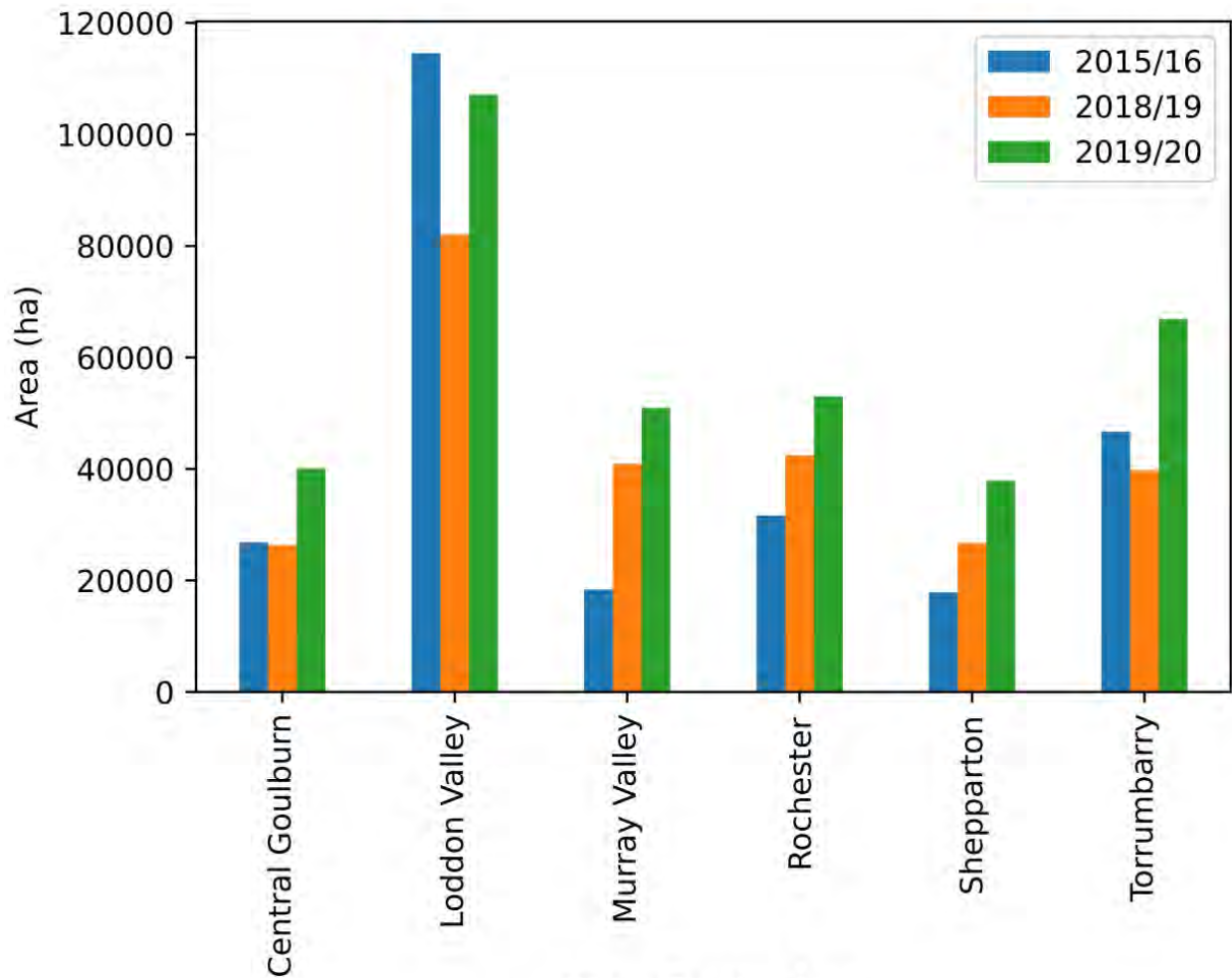


Figure 8. Cropping Land Use (ha) - GMID Irrigation Areas

Table 4 shows the reclassification of the secondary land use Mixed Farming and Grazing to a primary land use for 2019/20. Sixty-five percent was reclassified to Cropping (97,494ha), followed by 22% to Grazing Non-Dairy (33,430ha) and 4.5% to Rural Lifestyle/Residential (6,699ha). Fifty-five percent (22,539ML) of 2018/19 Mixed Farming and Grazing water use was reclassified in 2019/20 to Cropping and 28% (11,569ML) to Grazing Non-Dairy.

Table 4. Analysis of Reclassification of Mixed Farming & Grazing Land Use to Primary Land Use in 2018/19

2018/19 Land Use	2019/20 Primary Land Use	Water Use Licence (No.)	Area		Water Use 2019/20 (ML)	Water Use 2018/19 (ML)
			(ha)	(%)		
Mixed Farming & Grazing	Cropping	858	97,494	65.53%	22,539.1	100,545.6
	Dairy	1	95	0.06%	122.1	
	Dairy Agistment & Fodder	33	3,375	2.27%	1,362.1	
	Dairy Associated	16	4,572	3.07%	171.1	
	Grazing Non-Dairy	313	33,430	22.47%	11,569.1	
	Horses	14	238	0.16%	166.4	
	Horticulture - Annual	2	26	0.02%	26.2	
	Horticulture - Perennial	3	44	0.03%	151.1	
	Intensive - Animals	3	622	0.42%	21.2	
	Rural Lifestyle/Residential	330	6,699	4.50%	3,522.7	
	Other (e.g. municipal infrastructure)	24	2,192	1.47%	1,123.1	
	Total		1597	148,788	100%	

4.2.4. Grazing Non-Dairy

Grazing Non-Dairy refers to properties that have livestock other than dairy or horses, such as sheep and beef cattle and excluding Intensive – Animals. Grazing Non-Dairy increased in all irrigation areas between 2015/16 and 2019/20 except for Murray Valley (Figure 9). The largest increase in Grazing Non-Dairy land use was in Loddon Valley, followed by Shepparton and Torrumbarry irrigation areas. It is noted that the reclassification of Mixed Farming and Grazing in 2019/20 resulted in an overall increase in Grazing Non-Dairy of 33,430ha (Table 4), which accounts for roughly half of the 62,173ha increase identified between 2015/16 and 2019/20 (Table 3).

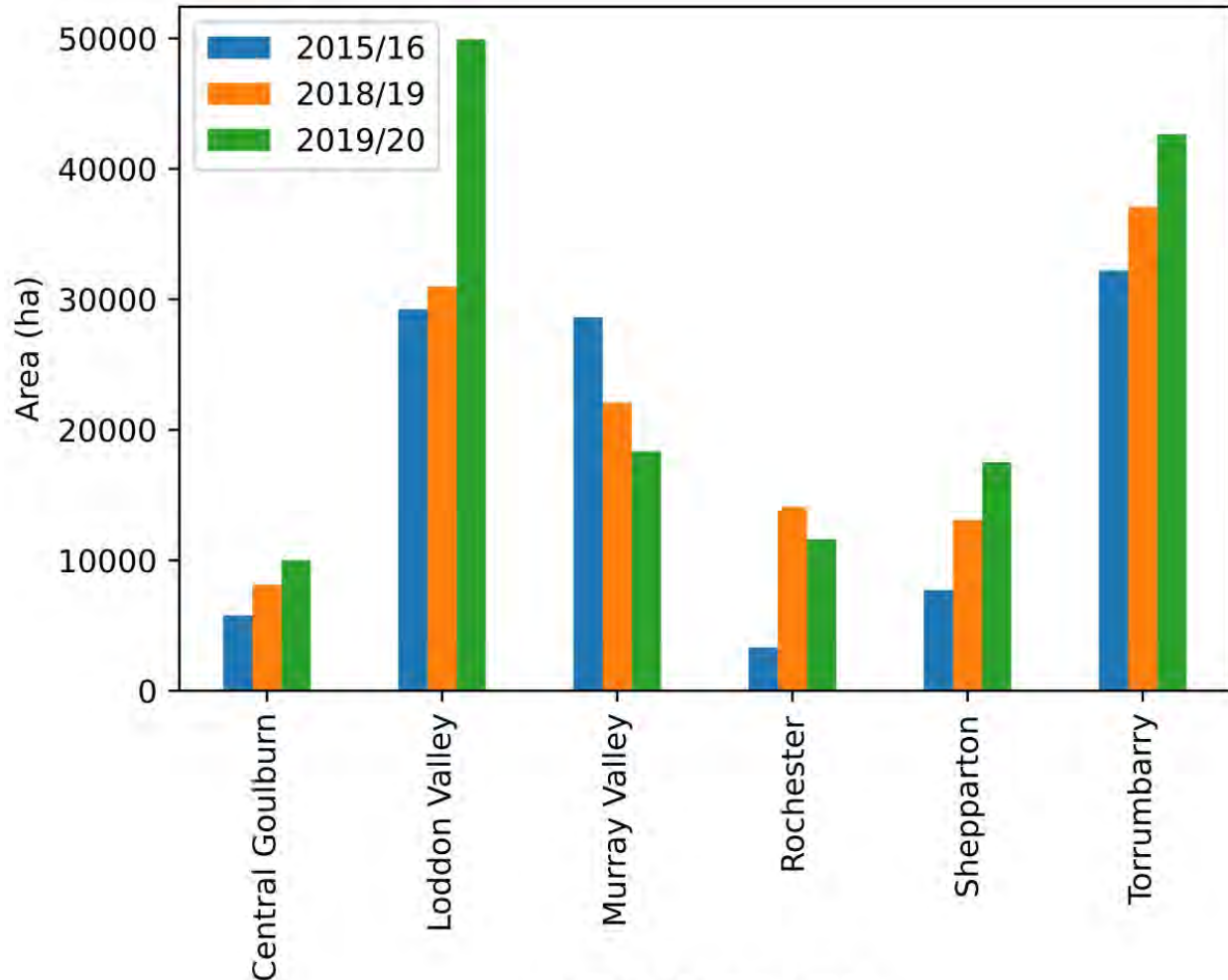


Figure 9. Grazing Non-Dairy Land Use (ha) - GMID Irrigation Areas

4.2.5. Mixed Farming & Grazing

Figure 10 shows the Mixed Farming and Grazing total land use for 2015/16 and 2018/19 by irrigation area. In 2019/20 Mixed Farming and Grazing was determined a secondary land use and was reclassified to primary land uses (Table 4) and is therefore not shown in Figure 10. Table 4 shows where this category was reclassified to, which primarily (in terms of area) includes Cropping (97,494ha) and Grazing Non-Dairy (33,430ha). Mixed Farming and Grazing increased all irrigation areas between 2015/16 and 2018/19 except for Rochester and Shepparton.

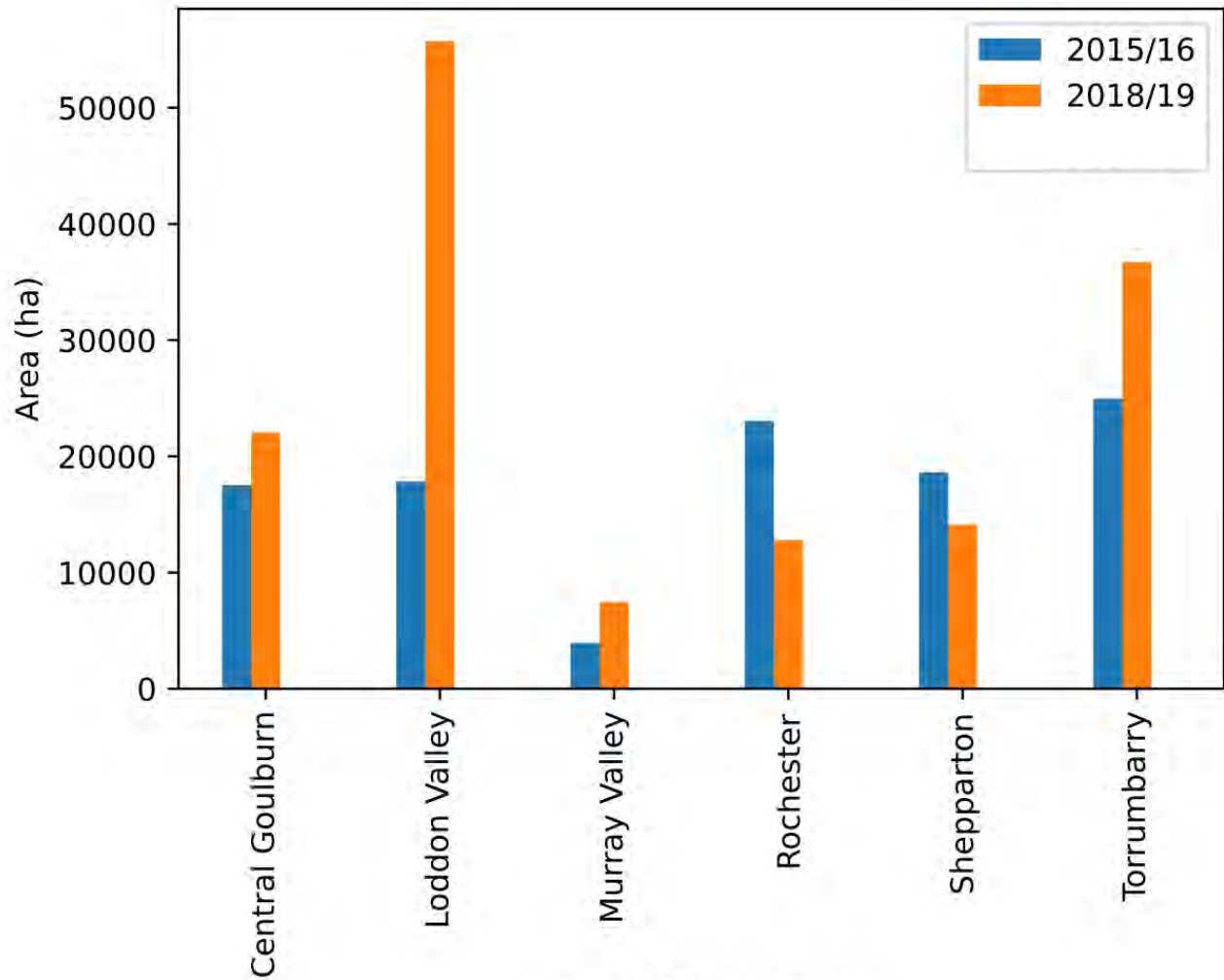


Figure 10. Mixed Farming & Grazing (ha) - GMID Irrigation Areas

4.2.6. Intensive – Animals

Intensive - Animals land use for this project refers to land used for animal production where the animals' food is imported from outside the immediate building, enclosure, paddock or pen (excluding grazing production), such as poultry and pigs. It does not include intensive dairy as outlined in Table 1.

Intensive - Animals land use reduced by approximately 2,279ha (32.5%) between 2015/16 and 2019/20 (Table 3). This is evident in Figure 11, which shows a reduction in Intensive - Animals land use in all irrigation areas between 2015/16 and 2019/20 except Murray Valley. Loddon Valley irrigation area has the largest area (ha) of Intensive - Animals land use (despite a decline since 2015/16), with Shepparton having the least. Torrumbarry irrigation area had the second highest area of Intensive - Animals land use, followed by Central Goulburn (Figure 11).

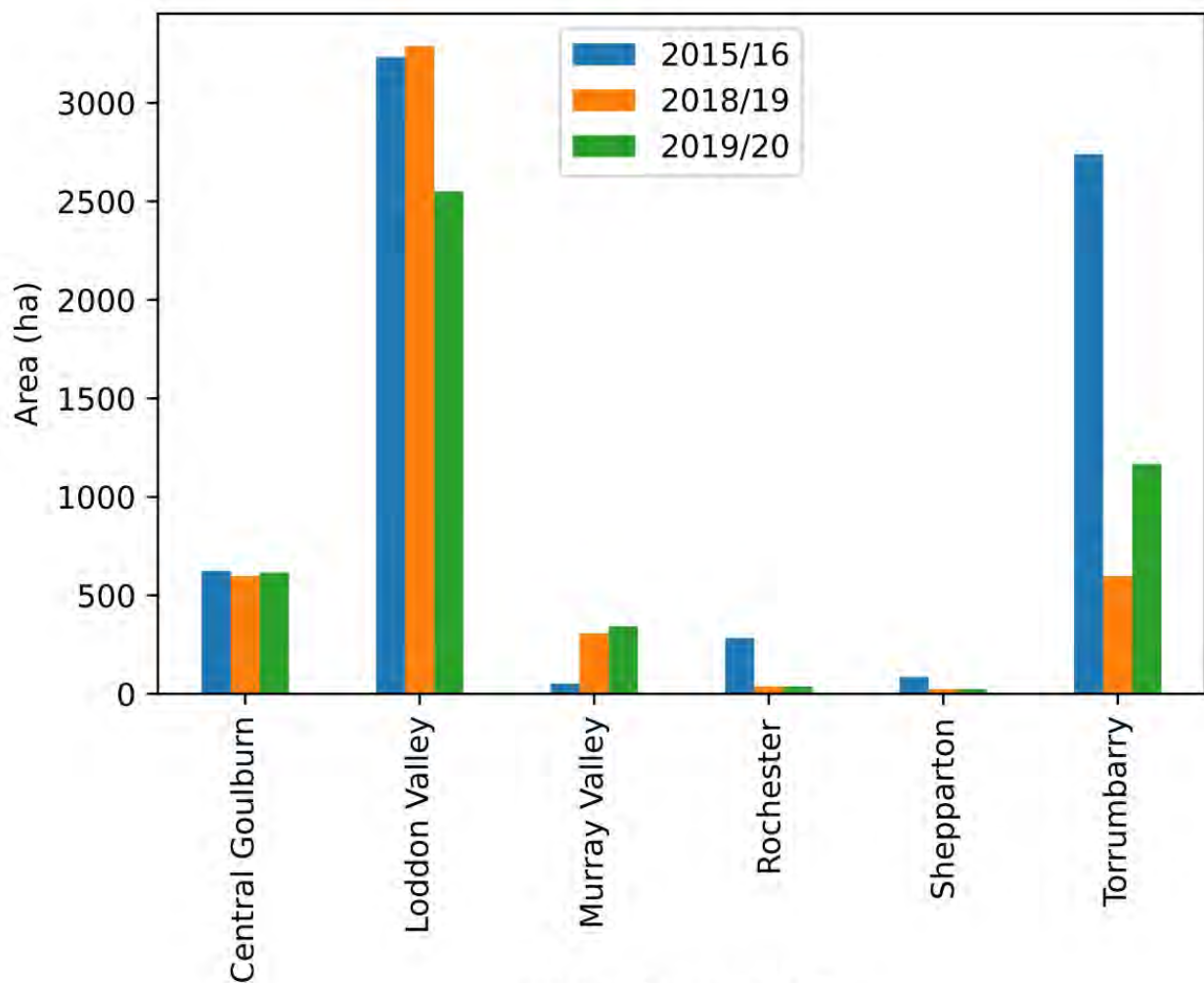


Figure 11. Intensive – Animals (ha) - GMID Irrigation Areas

4.2.7. Horses

Horses land use in the GMID increased by 977ha or 212% to 5,505ha between 2015/16 and 2019/20 (Table 3). Figure 12 shows the spread of Horses as a primary land use across each of the irrigation areas. The 977ha increase between 2015/16 and 2019/20 was spread across each of the irrigation areas (particularly Central Goulburn and Torrumbarry), except Shepparton. Horses land use remains highest in Central Goulburn and Shepparton, and lowest in Loddon Valley and Rochester (Figure 12).

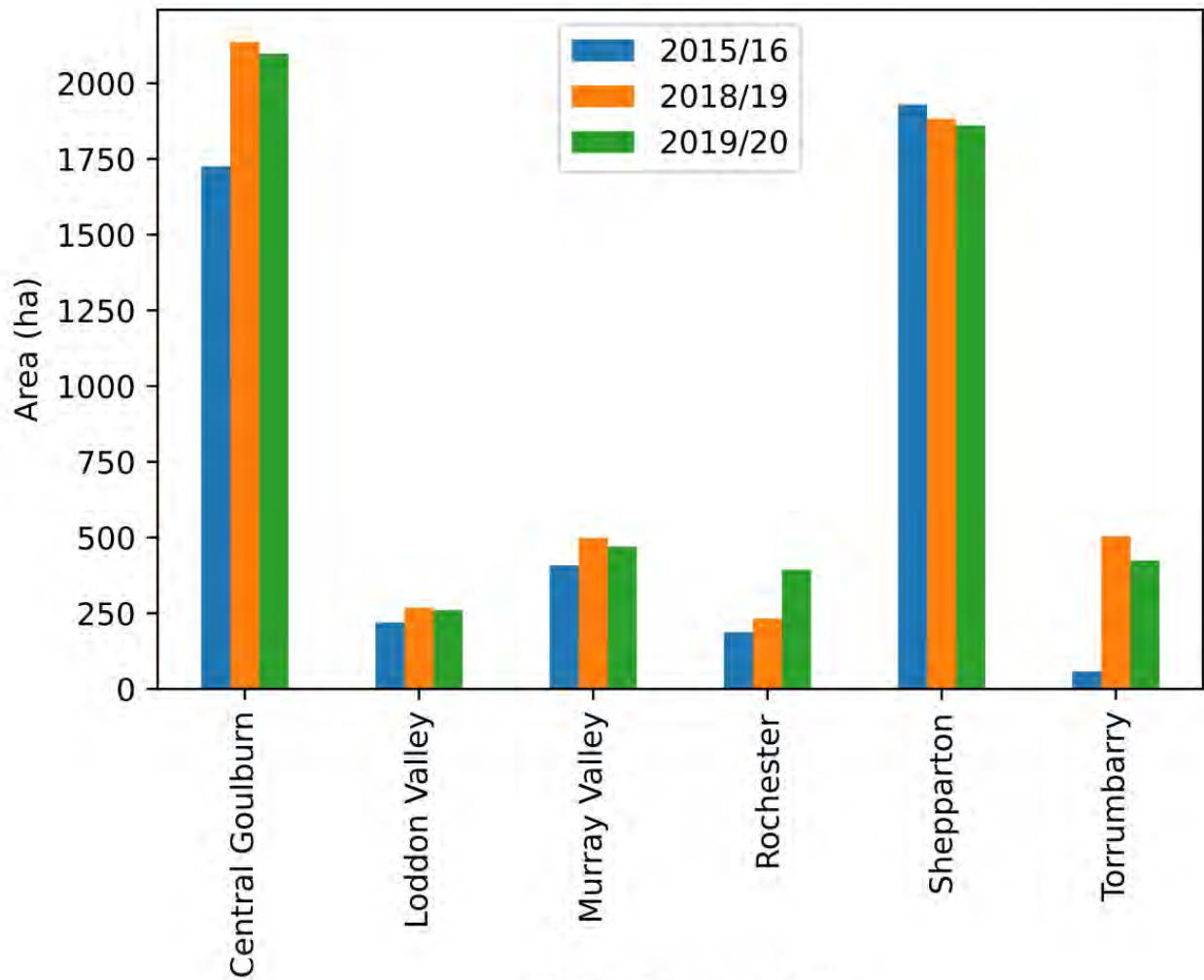


Figure 12. Horses (ha) - GMID Irrigation Areas

4.2.8. Rural Lifestyle/Residential

Rural Lifestyle/Residential land use increased between 2015/16 and 2019/20 in each irrigation area, except for Shepparton which experienced a slight decline. The largest area of Rural Lifestyle/Residential land use was in Central Goulburn. There was a 69% increase in Rural Lifestyle/Residential land use in Central Goulburn between 2015/16 and 2019/20 (Table 3), suggesting a transition of properties in this area from farming to lifestyle.

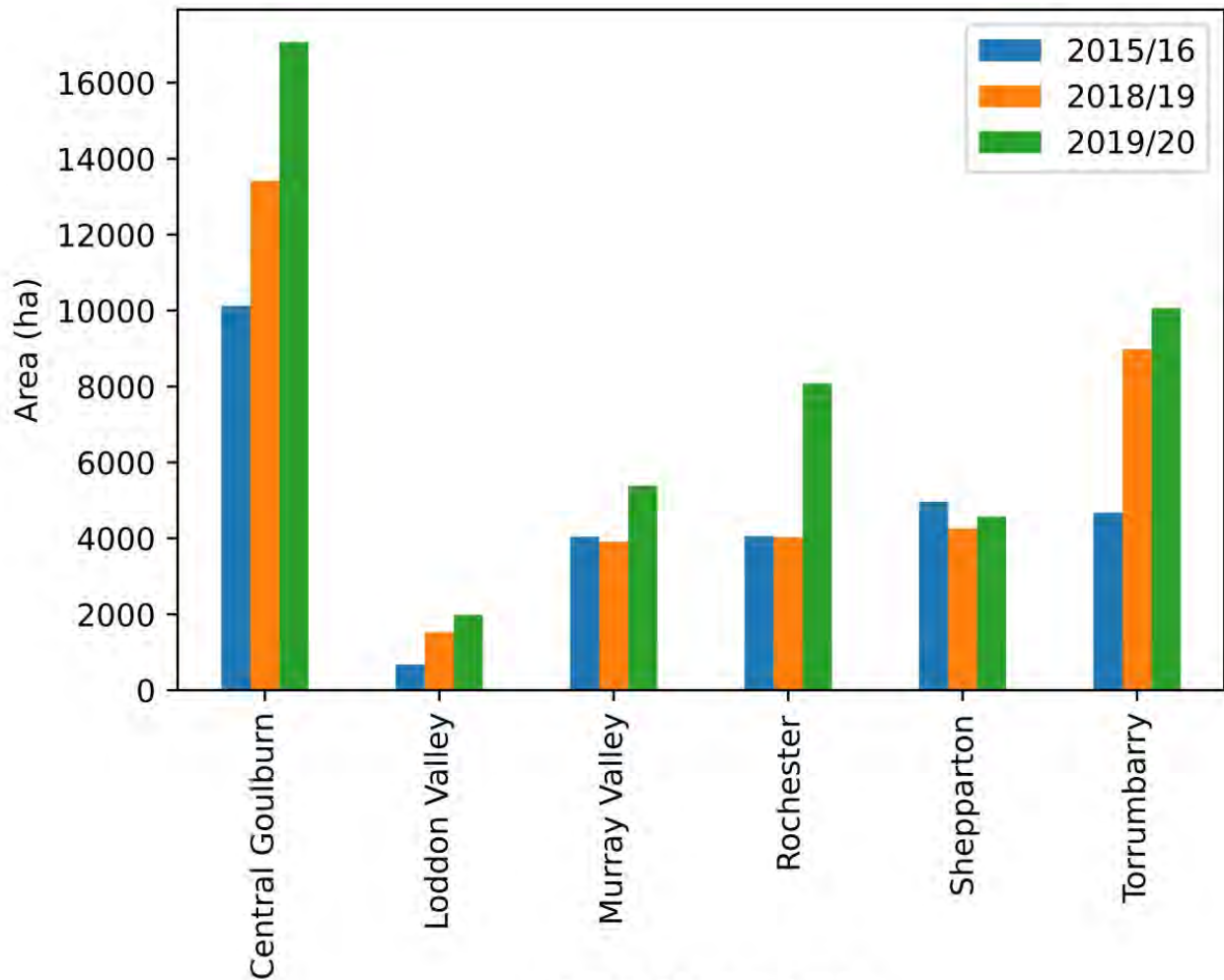


Figure 13. Rural Lifestyle/Residential (ha) - GMID Irrigation Areas

5. Primary Land Use Change by Irrigation Area

The following section presents a comparison of primary land use (hectares and percentage change) between 2015/16, 2018/19, and 2019/20 across each of the irrigation areas (including Murray Valley, Shepparton, Central Goulburn, Rochester, Loddon Valley, and Torrumbarry). Detail is provided for each irrigation area, including a table, graph and maps; and a combined table can be found in Appendix 2.

5.1. Murray Valley Irrigation Area

Murray Valley has undergone considerable land use change since 2015/16 (Table 5). Cropping increased by 22,523ha (or 123%) between 2015/16 and 2018/19. A further increase in Cropping land use was observed between 2018/19 and 2019/20 (10,005ha), although 7,435ha was attributed to the reclassification of Mixed Farming and Grazing to Cropping. Cropping is now the most extensive land use in Murray Valley accounting for 50,920ha or 41% of the total irrigation area.

Dairy (Combined) remained a dominant land use in Murray Valley, accounting for approximately 35% of the total irrigation area despite reducing by 30% (or 19,260ha) between 2015/16 and 2018/19 (Table 5). Dairy (Combined) remained relatively stable between 2018/19 and 2019/20, reducing less than 2%.

Figure 14 provides a histogram of the land use change in the Murray Valley irrigation area between 2015/16, 2018/19 and 2019/20 for visual comparison. The increase in Cropping is particularly obvious, as are the changes to Dairy.

Figure 15 shows the pattern of land use change across the Murray Valley irrigation area between 2015/16, 2018/19 and 2019/20, which illustrates the data shown in Table 5.

Table 5. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Murray Valley Irrigation Area

Primary Land Use	2015/16 (ha)	2018/19 (ha)	2019/20 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	18,391.9	40,915.6	50,920.8	122.5	24.5	176.9
Dairy	34,003.0	22,686.0	20,263.8	-33.3	-10.7	-40.4
Dairy Agistment & Fodder	11,764.6	8,801.8	7,042.9	-25.2	-20.0	-40.1
Dairy Associated	16,878.5	11,897.5	15,250.4	-29.5	28.2	-9.6
Dairy (Combined)	62,646.1	43,385.3	42,557.1	-30.7	-1.9	-32.1
Grazing Non-Dairy	28,621.7	22,056.1	18,352.7	-22.9	-16.8	-35.9
Horses	407.8	499.1	470.2	22.4	-5.8	15.3
Horticulture - Annual	421.1	187.6	365.8	-55.4	95.0	-13.1
Horticulture - Perennial	4,317.7	4,029.8	3,724.0	-6.7	-7.6	-13.7
Intensive - Animals	51.7	306.7	341.7	493.1	11.4	560.7
Mixed Farming & Grazing*	3,947.6	7,439.4	-	88.5	-	-
Rural Lifestyle/Residential	4,041.7	3,906.7	5,388.7	-3.3	37.9	33.3
Other (e.g. municipal infrastructure)	240.2	361.2	966.5	50.4	167.6	302.3
Total	123,087.5	123,087.5	123,087.5			

*Mixed Farming & Grazing reclassified in 2019/20

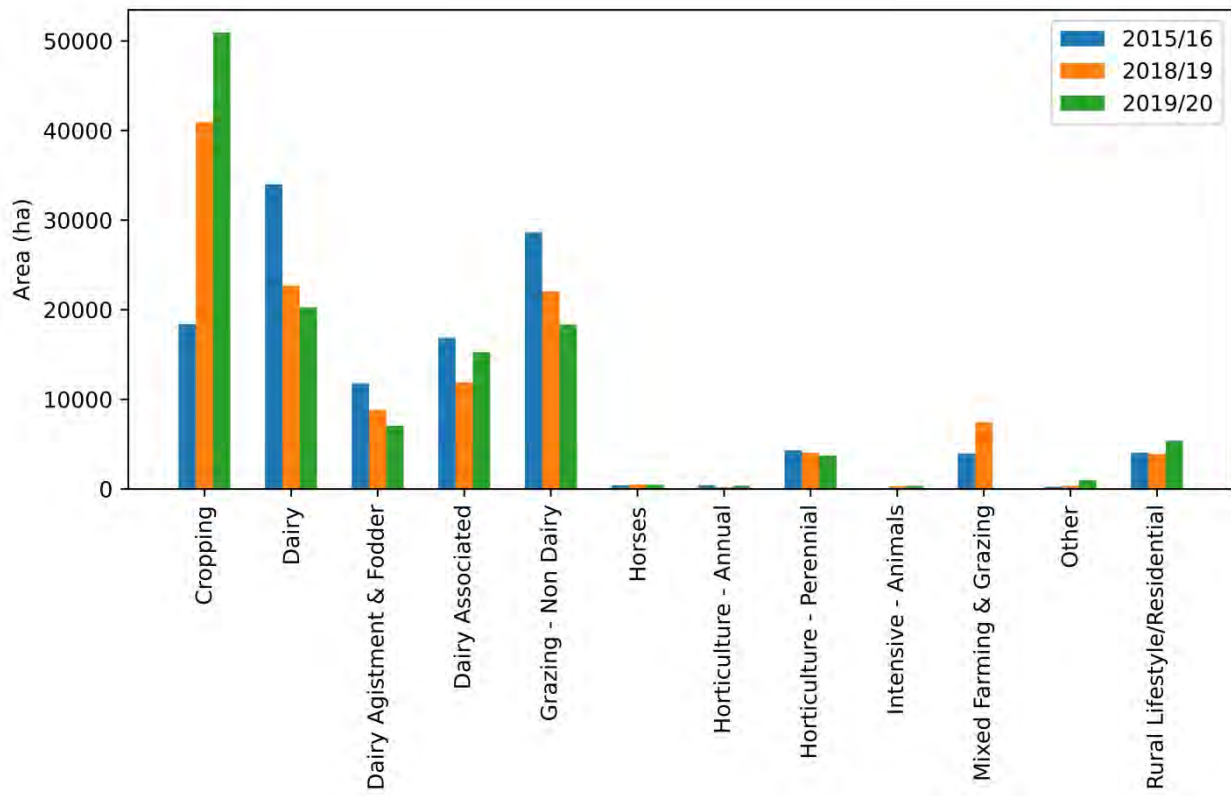


Figure 14. Primary Land Use - Murray Valley Irrigation Area, 2015/16, 2018/19 and 2019/20

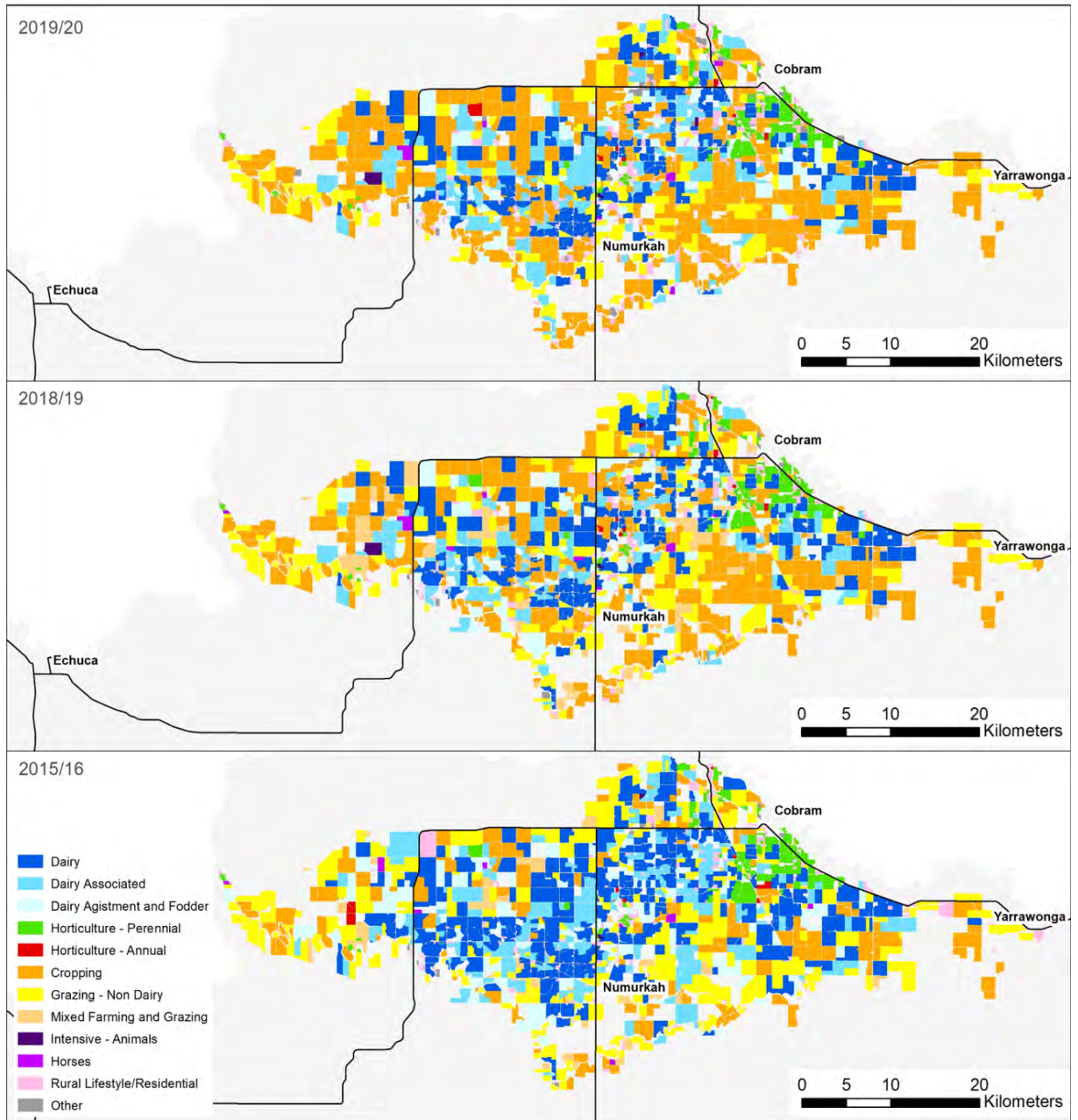


Figure 15. Primary Land Use - Murray Valley Irrigation Area, 2015/16 (bottom), 2018/19 (middle) and 2019/20 (top)

5.2. Shepparton Irrigation Area

Land use in the Shepparton Irrigation Area between 2015/16, 2018/19 and 2019/20 is shown in Table 6. Cropping remained the dominant land use in Shepparton accounting for 37,869ha or 46.5% of the total area. Dairy (Combined) decreased slightly (7%) between 2018/19 and 2019/20 (Figure 16) but reduced by 46% since 2015/16.

Figure 16 presents a histogram of the data for Shepparton, which shows a clear increase in Cropping and Grazing Non-Dairy since 2015/16. Grazing Non-Dairy and Cropping increased by 127% and 112% respectively since 2015/16. Part of the increase observed since 2018/19 is attributable to the reclassification of Mixed Farming and Grazing, which added approximately 14,089ha to Cropping and/or Grazing Non-Dairy in Shepparton. Horticulture – Annual and Horticulture - Perennial, along with Horses, remained relatively stable.

Figure 17 shows that much of the Dairy (Combined) changes were in the south of Shepparton (e.g. near Karamomus/Arcadia where there was transition of some larger dairies) and in the Katandra/Invergordon areas.

Table 6. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Shepparton Irrigation Area

Primary Land Use	2015/2016 (ha)	2018/2019 (ha)	2019/2020 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	17,859.8	26,705.0	37,868.8	49.5	41.8	112.0
Dairy	11,612.2	7,214.7	6,400.3	-37.9	-11.3	-44.9
Dairy Agistment & Fodder	3,374.5	699.9	2,412.0	-79.3	244.6	-28.5
Dairy Associated	7,328.1	5,018.9	3,167.1	-31.5	-36.9	-56.8
Dairy (Combined)	22,314.7	12,933.5	11,979.5	-42.0	-7.4	-46.3
Grazing Non-Dairy	7,708.8	13,089.9	17,511.5	69.8	33.8	127.2
Horses	1,929.6	1,882.8	1,860.2	-2.4	-1.2	-3.6
Horticulture - Annual	274.2	367.9	360.6	34.2	-2.0	31.5
Horticulture - Perennial	6,777.2	6,199.6	6,056.7	-8.5	-2.3	-10.6
Intensive - Animals	85.1	23.7	23.7	-72.1	0.0	-72.1
Mixed Farming & Grazing*	18,614.3	14,089.5	-	-24.3	-	-
Rural Lifestyle/Residential	4,959.4	4,263.3	4,571.2	-14.0	7.2	-7.8
Other (e.g. municipal infrastructure)	843.0	1,810.7	1,133.8	114.8	-37.4	34.5
Total	81,366.0	81,366.0	81,366.0			

*Mixed Farming & Grazing reclassified in 2019/20

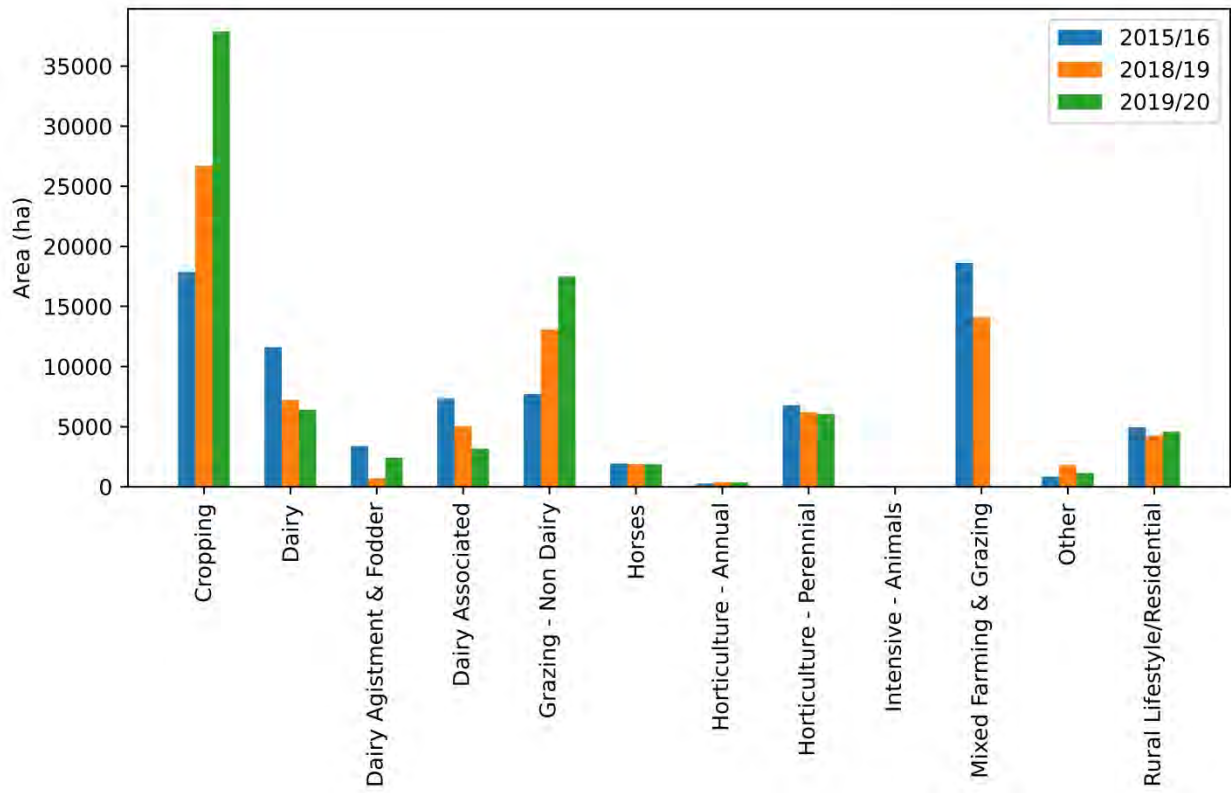


Figure 16. Primary Land Use - Shepparton Irrigation Area, 2015/16, 2018/19 and 2019/20

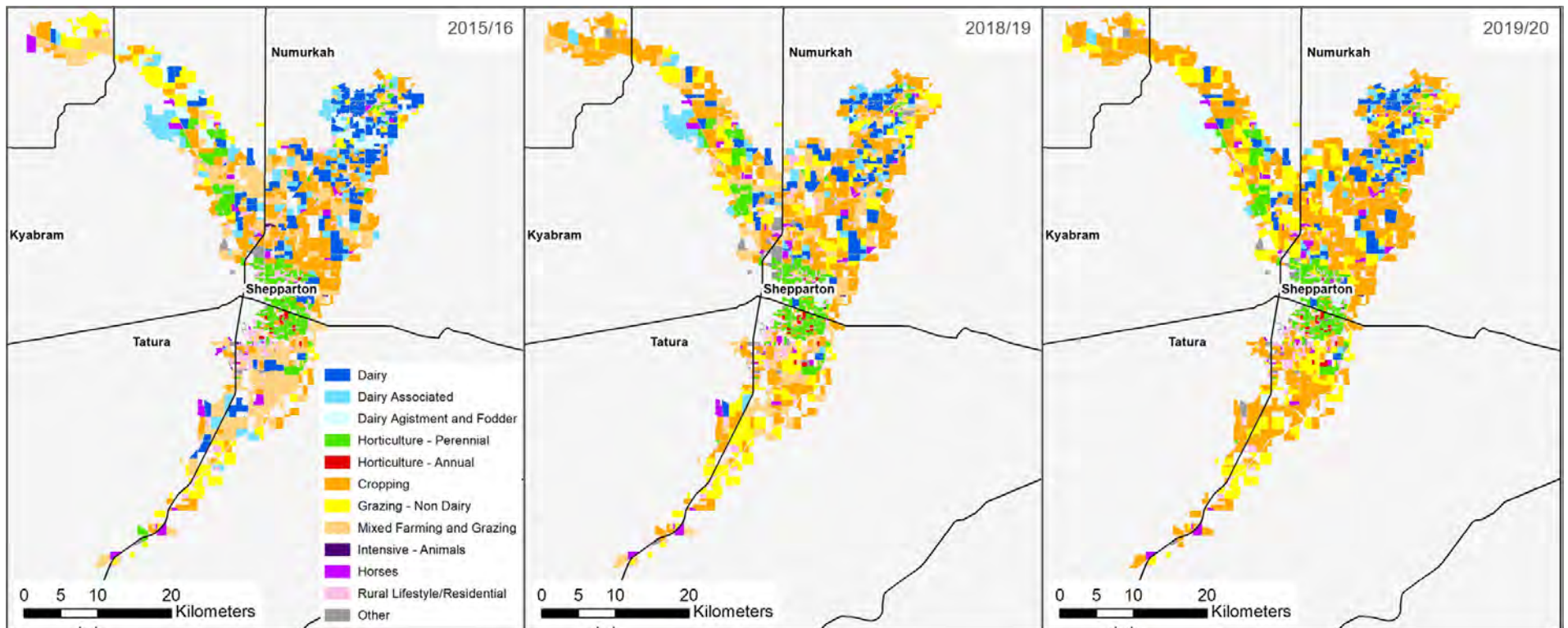


Figure 17. Primary Land Use - Shepparton Irrigation Area 2015/16 (left), 2018/19 (middle) and 2019/20 (right)

5.3. Central Goulburn Irrigation Area

Land use continued to change in the Central Goulburn Irrigation Area, with significant increases in Cropping, Grazing Non-Dairy, Rural Lifestyle/Residential and Other (e.g. municipal infrastructure) since 2015/16 (Figure 18). The area remains a diverse mix of land use, as shown in Figure 19.

Table 7 provides further detail, indicating that Dairy (Combined) remains the largest land use by area (ha) in Central Goulburn totaling 65,913ha in 2019/20. Dairy (Combined) experienced some fluctuation in recent years, reducing by 16.5% between 2015/16 and 2018/19, but increasing by 5% between 2018/19 and 2019/20. Cropping increased by 52% since 2018/19 to be the second largest land use by area with 40,071ha. Up to 22,000ha of the increase in Cropping/Grazing Non-Dairy between 2018/19 and 2019/20 was attributable to the reclassification of Mixed Farming and Grazing.

Central Goulburn had the largest area of Rural Lifestyle/Residential land use in the GMID in 2019/20. Rural Lifestyle/Residential increased by 69% between 2015/16 and 2019/20 and accounts for 17,072ha (12%) of the Central Goulburn area (Table 7).

Table 7. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Central Goulburn Irrigation Area

Primary Land Use	2015/16 (ha)	2018/19 (ha)	2019/20 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	26,828.6	26,331.4	40,071.4	-1.9	52.2	49.4
Dairy	45,986.2	35,978.0	34,930.7	-21.8	-2.9	-24.0
Dairy Agistment & Fodder	10,680.0	97,18.0	12,949.4	-9.0	33.3	21.2
Dairy Associated	18,338.2	16,902.6	18,032.4	-7.8	6.7	-1.7
Dairy (Combined)	75,004.3	62,598.5	65,912.5	-16.5	5.3	-12.1
Grazing Non-Dairy	5,776.4	8,111.0	9,995.6	40.4	23.2	73.0
Horses	1,725.7	2,136.1	2,097.2	23.8	-1.8	21.5
Horticulture - Annual	2,094.6	3,251.2	2,531.0	55.2	-22.2	20.8
Horticulture - Perennial	5,750.3	6,079.0	6,052.2	5.7	-0.4	5.2
Intensive - Animals	623.7	597.7	615.7	-4.2	3.0	-1.3
Mixed Farming & Grazing*	17,520.0	22,046.1	-	25.8	-	-
Rural Lifestyle/Residential	10,120.4	13,416.1	17,072.6	32.6	27.3	68.7
Other (e.g. municipal infrastructure)	955.6	1,832.5	2,051.4	91.8	11.9	114.7
Total	146,399.6	146,399.6	146,399.6			

*Mixed Farming & Grazing reclassified in 2019/20

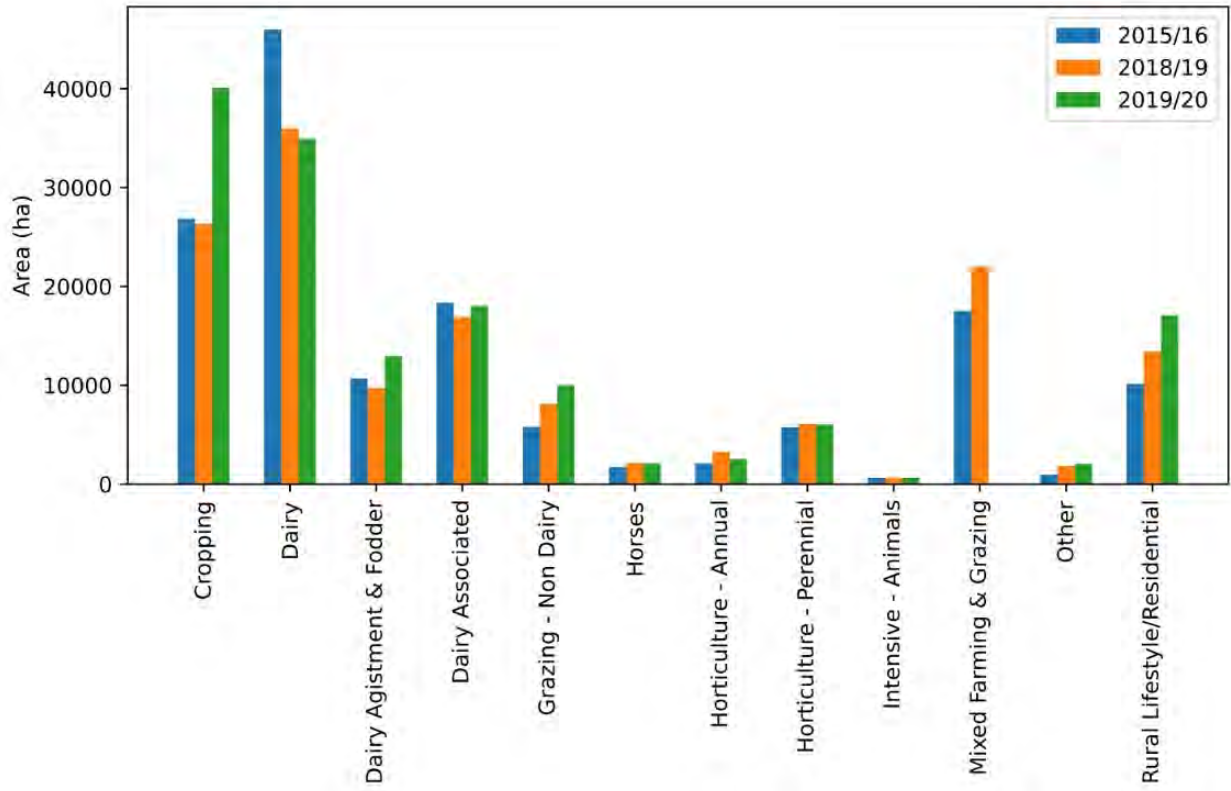


Figure 18. Primary Land Use - Central Goulburn Irrigation Area, 2015/16, 2018/19 and 2019/20

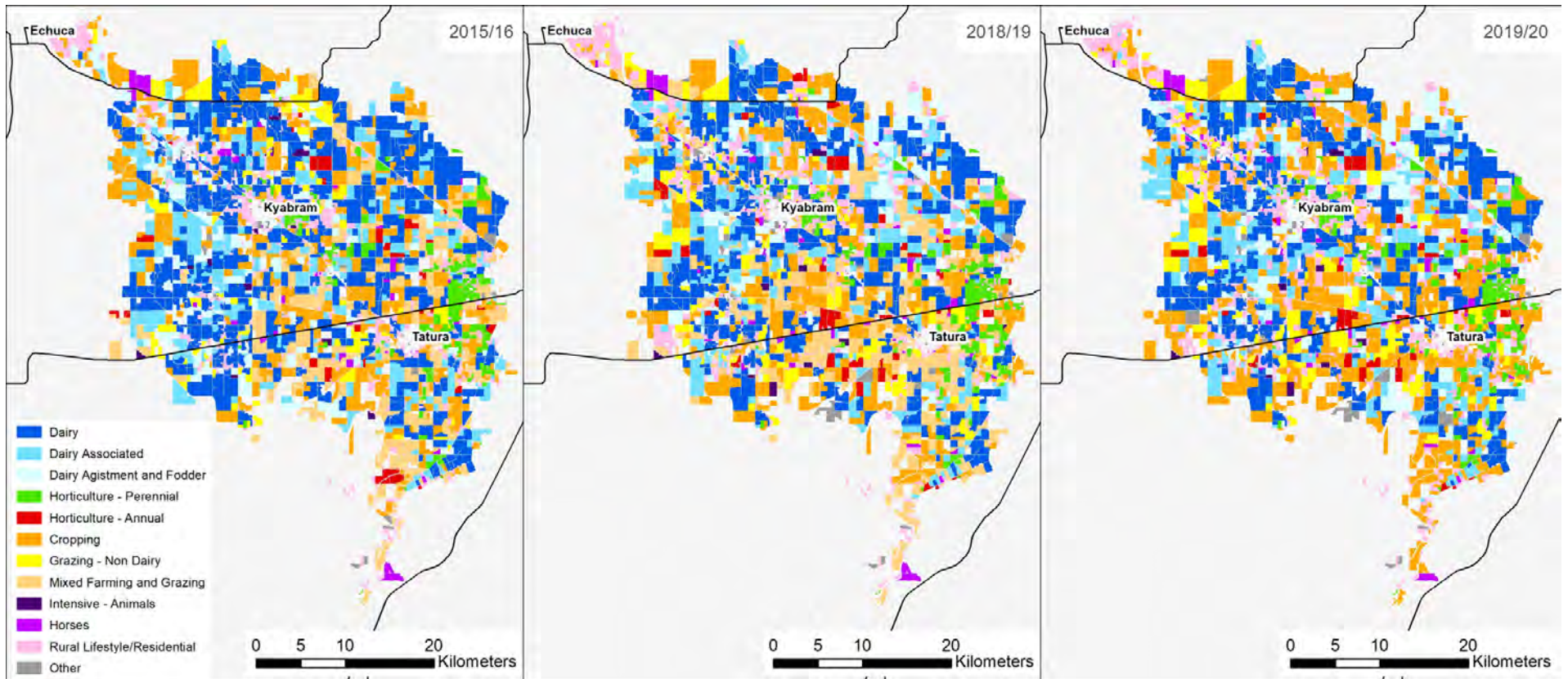


Figure 19. Primary Land Use - Central Goulburn Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)

5.4. Rochester Irrigation Area

Change in primary land use in the Rochester Irrigation Area between 2015/16 and 2019/20 is illustrated in Figures 20 and 21 and detailed in Table 8. In 2019/20, Cropping was the largest land use category in Rochester, accounting for 53,000ha or 48% of total area (Figure 20). Similar to other irrigation areas, Rochester has seen Cropping and Grazing Non-Dairy increase in area between 2015/16 and 2019/20, by 21,386ha and 8,288ha respectively (Table 8).

Dairy fluctuated since 2015/16 in Rochester with an overall decline in Dairy (Combined) of 10,316ha or 27% mainly due to reduced land use of Dairy Agistment and Fodder (5,756ha) and Dairy (3,987ha).

Rural Lifestyle/Residential land use almost doubled in Rochester since 2015/16 (Figure 20), increasing by 4,024ha. Horses doubled since 2015/16, although remains a relatively small component of land use (394ha), concentrated mainly around Echuca Village and Echuca West (Figure 21). Horticulture - Annual and Horticulture - Perennial land use remained relatively constant. Large Horticulture - Annual and Horticulture - Perennial properties occur in the south of the Rochester Irrigation Area with annuals (e.g. tomatoes) scattered throughout (Figure 21).

Table 8. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Rochester Irrigation Area

Primary Land Use	2015/16 (ha)	2018/19 (ha)	2019/20 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	31,622.7	42,412.5	53,009.0	34.1	25.0	67.6
Dairy	20,574.5	17,831.8	16,587.1	-13.3	-7.0	-19.4
Dairy Agistment & Fodder	11,954.9	4,440.1	6,198.3	-62.9	39.6	-48.2
Dairy Associated	7,737.5	7,008.7	7,165.3	-9.4	2.2	-7.4
Dairy (Combined)	40,266.8	29,280.6	29,950.7	-27.3	2.3	-25.6
Grazing Non-Dairy	3,308.8	14,088.7	11,597.1	325.8	-17.7	250.5
Horses	187.8	232.6	393.5	23.9	69.2	109.6
Horticulture - Annual	4,850.8	4,582.3	4,358.5	-5.5	-4.9	-10.1
Horticulture - Perennial	2,069.3	2,115.2	2,112.1	2.2	-0.1	2.1
Intensive - Animals	282.6	37.3	37.3	-86.8	0.0	-86.8
Mixed Farming & Grazing*	23,038.4	12,780.1	-	-44.5	-	-
Rural Lifestyle/Residential	4,057.7	4,031.8	8,082.0	-0.6	100.5	99.2
Other (e.g. municipal infrastructure)	302.5	426.2	447.1	40.9	4.9	47.8
Total	109,987.3	109,987.3	109,987.3			

*Mixed Farming & Grazing reclassified in 2019/20

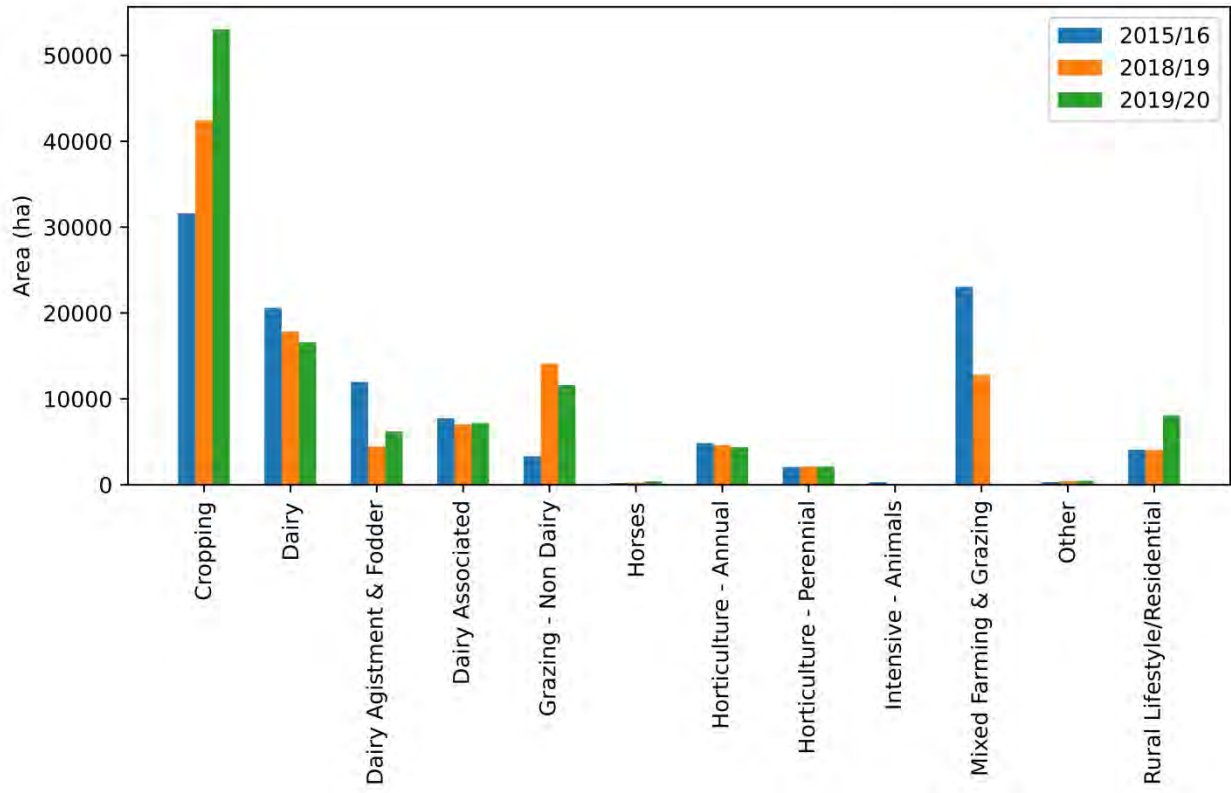


Figure 20. Primary Land Use - Rochester Irrigation Area, 2015/16, 2018/19 and 2019/20

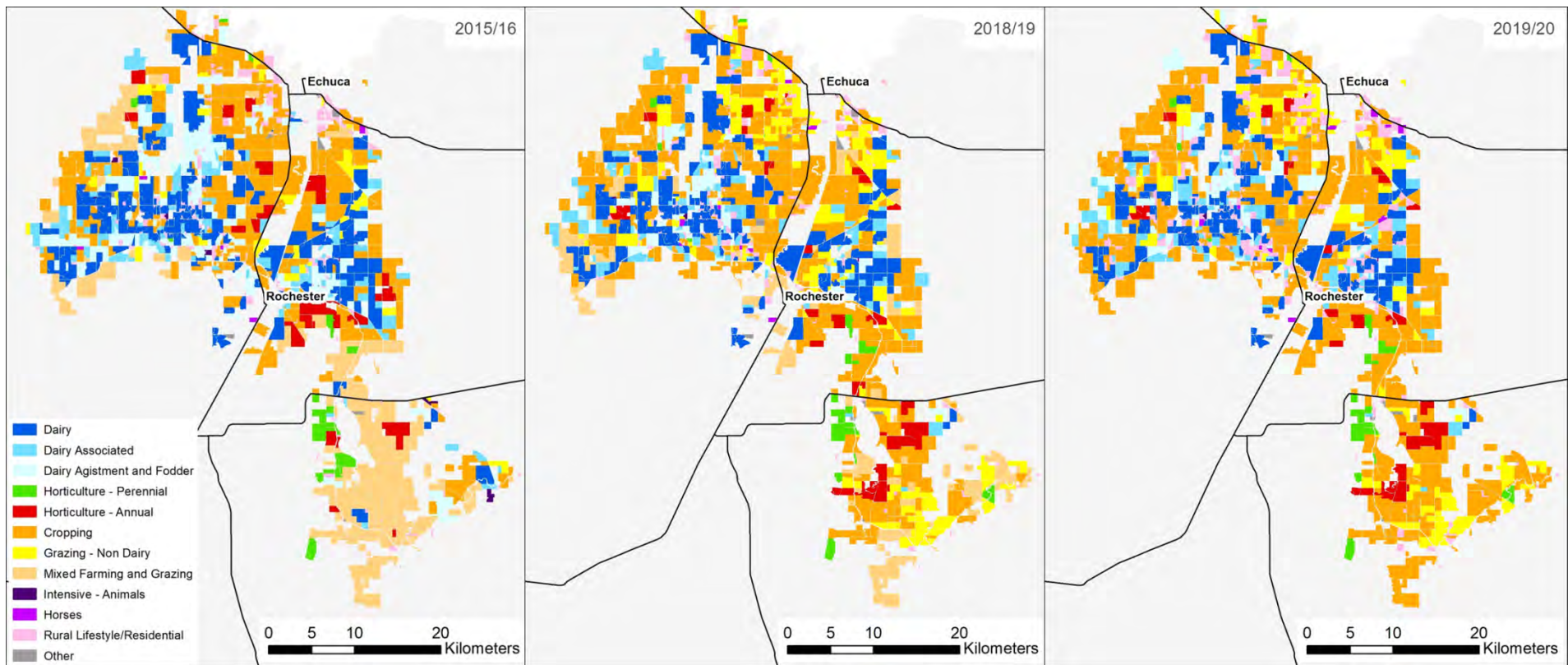


Figure 21. Primary Land Use - Rochester Irrigation Area 2015/16 (left), 2018/19 (middle) and 2019/20 (right)

5.5. Loddon Valley Irrigation Area

Table 9 shows primary land use change in the Loddon Valley Irrigation Area between 2015/16, 2018/19 and 2019/20. Dairy (Combined) increased 2,323ha between 2015/16 and 2019/20, despite experiencing a 30% decline between 2015/16 and 2018/19. The overall increase was due to growth in Dairy Agistment and Fodder (837ha) and Dairy Associated (4,893ha). The increase in Dairy Associated was particularly evident west of Boort and south of Kerang (Figure 23).

Loddon Valley maintained the highest area of Cropping land use in the GMID, despite being the only irrigation area where Cropping declined since 2015/16 (Table 9). However, Cropping land use increased between 2018/19 and 2019/20 by 25,106ha, while Grazing Non-Dairy increased by 18,942ha during the same time. This combined increase was mostly associated with the reclassification of 55,729ha of Mixed Farming and Grazing to primary land uses such as Cropping and Grazing Non-Dairy (Table 4).

Horticulture – Annual land use in Loddon Valley decreased by 25% between 2015/16 and 2019/20 (Figure 22), particularly in areas north and south of Boort. Horticulture - Perennial land use increased slightly (9%) between 2015/16 and 2018/19 and was comprised mainly of the large properties south west of Boort (Figure 23).

Table 9. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Loddon Valley Irrigation Area

Primary Land Use	2015/16 (ha)	2018/19 (ha)	2019/20 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	114,544.5	82,014.5	107,120.5	-28.4	30.6	-6.5
Dairy	11,103.9	8,111.0	7,697.1	-27.0	-5.1	-30.7
Dairy Agistment & Fodder	1,551.7	3,556.9	2,388.8	129.2	-32.8	53.9
Dairy Associated	10,923.6	4,777.6	15,816.7	-56.3	231.1	44.8
Dairy (Combined)	23,579.1	16,445.5	25,902.5	-30.3	57.5	9.9
Grazing Non-Dairy	29,233.2	30,986.9	49,929.1	6.0	61.1	70.8
Horses	219.9	267.9	260.3	21.8	-2.8	18.4
Horticulture - Annual	3,644.6	121.2	2,704.1	-96.7	2130.7	-25.8
Horticulture - Perennial	5,984.4	6,507.6	6,507.6	8.7	0.0	8.7
Intensive - Animals	3,232.3	3,288.6	2,549.6	1.7	-22.5	-21.1
Mixed Farming & Grazing*	17,847.2	55,729.0	-	212.3	-	-
Rural Lifestyle/Residential	674.5	1,526.8	1,985.4	126.3	30.0	194.3
Other (e.g. municipal infrastructure)	365.2	2437.1	2,365.9	567.4	-2.9	547.8
Total	199,325	199,325	199,325			

*Mixed Farming & Grazing reclassified in 2019/20

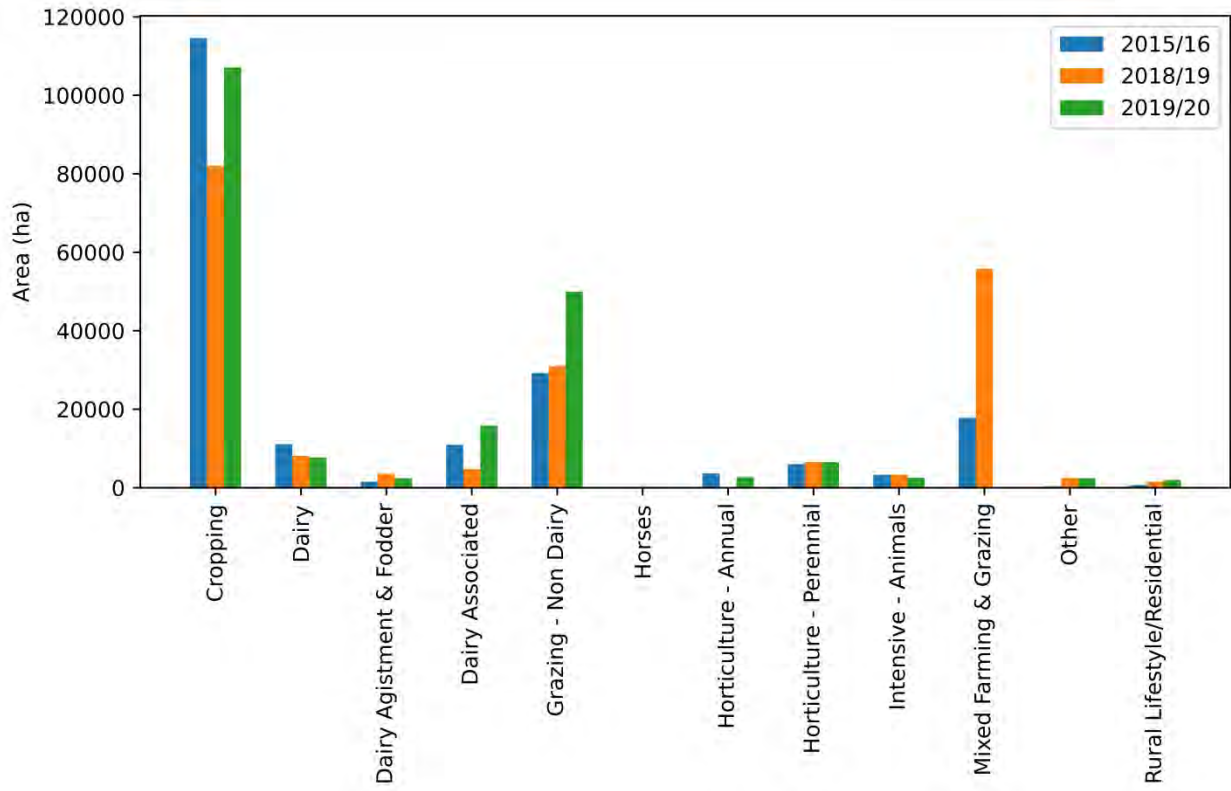


Figure 22. Primary Land Use - Loddon Valley Irrigation Area, 2015/16, 2018/19 and 2019/20

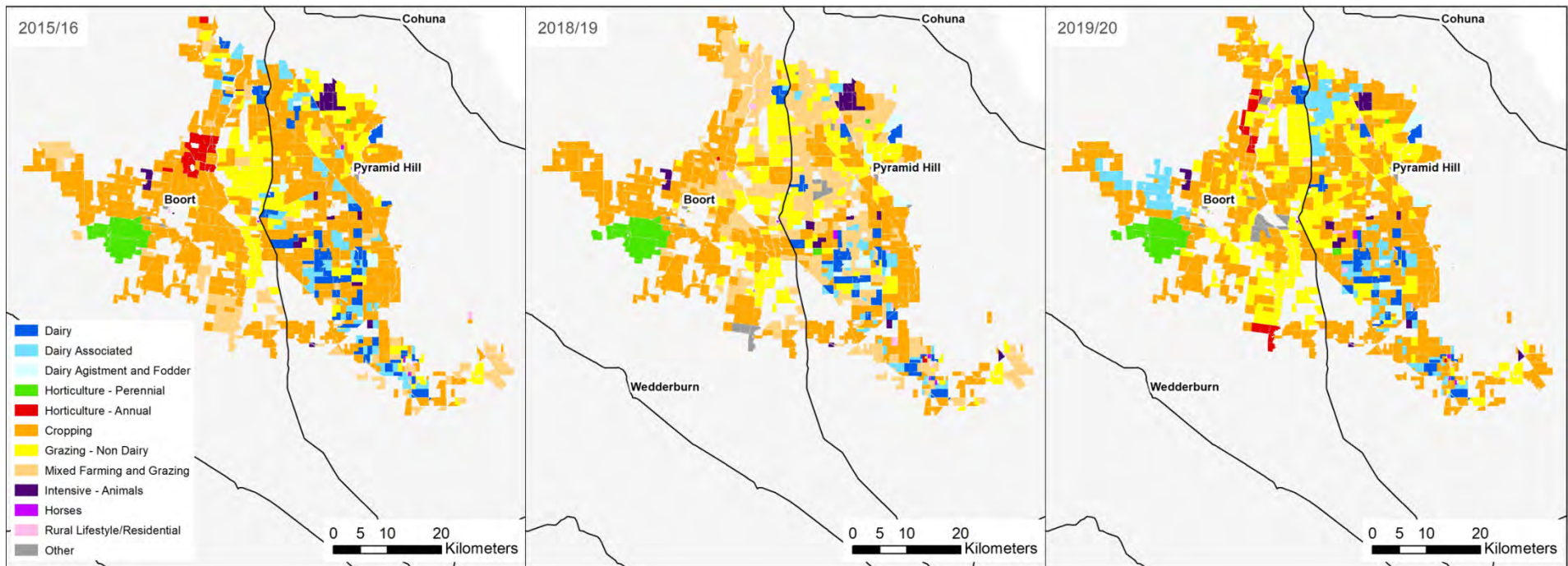


Figure 23. Primary Land Use - Loddon Valley Irrigation Area 2015/16 (left), 2018/19 (middle) and 2019/20 (right)

5.6. Torrumbarry Irrigation Area

Table 10 shows primary land use change in the Torrumbarry Irrigation Area between 2015/16, 2018/19 and 2019/20. The area maintains a diverse mix of land use as shown in Figure 24. Dairy (Combined) remains a dominant land use in Torrumbarry, accounting for over 25% of the total irrigation area. Dairy (Combined) land use reduced by 25% (or 15,442ha) between 2015/16 and 2018/19 (Table 10) but remained relatively stable between 2018/19 and 2019/20, increasing by 2%. As shown in Figure 25, Dairy properties continue to be found near the existing dairy footprint (e.g. Kerang and Cohuna).

Cropping land use increased 43% between 2015/16 and 2019/20. This increase occurred between 2018/19 and 2019/20 due in part to the reclassification of Mixed Farming and Grazing which accounted for 36,704ha of land use in Torrumbarry in 2018/19. Part of this was also reclassified to Grazing Non-Dairy, which increased 15% between 2018/19 and 2019/20 (Table 10).

Intensive - Animals increased significantly (95%) between 2018/19 and 2019/20 but accounts for less than half the area identified in 2015/16 (Table 10).

Rural Lifestyle/Residential land use in Torrumbarry increased by 5,386ha or 115% between 2015/16 and 2019/20, indicating a transition of farming to lifestyle land use in this area. Other (e.g. municipal infrastructure) has also increased considerably (190%) since 2015/16 (Table 10). This land use includes areas such as sporting ovals, schools, cemeteries, vacant land and solar farms.

Table 10. Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20, Torrumbarry Irrigation Area

Primary Land Use	2015/16 (ha)	2018/19 (ha)	2019/20 (ha)	2015/16- 2018/19 (%)	2018/19- 2019/20 (%)	2015/16- 2019/20 (%)
Cropping	46,671.0	39,767.4	66,844.5	-14.8	68.1	43.2
Dairy	33,353.6	27,280.9	23,778.6	-18.2	-12.8	-28.7
Dairy Agistment & Fodder	9,424.8	3,668.3	7,147.0	-61.1	94.8	-24.2
Dairy Associated	19,167.1	15,554.5	16,356.1	-18.8	5.2	-14.7
Dairy (Combined)	61,945.5	46,503.7	47,281.7	-24.9	1.7	-23.7
Grazing Non-Dairy	32,219.0	37,079.6	42,639.8	15.1	15.0	32.3
Horses	57.4	504.3	423.8	778.5	-16.0	638.2
Horticulture - Annual	1,070.6	2,436.3	2,546.8	127.6	4.5	137.9
Horticulture - Perennial	6,578.6	6,482.0	7,167.6	-1.5	10.6	9.0
Intensive - Animals	2,738.4	597.9	1,166.9	-78.2	95.2	-57.4
Mixed Farming & Grazing*	24,958.5	36,703.5	-	47.1	-	-
Rural Lifestyle/Residential	4,676.8	8,976.3	10,062.6	91.9	12.1	115.2
Other (e.g. municipal infrastructure)	1,460.9	3,325.8	4,243.1	127.7	27.6	190.4
Total	182,376.8	182,376.8	182,376.8			

*Mixed Farming & Grazing reclassified in 2019/20

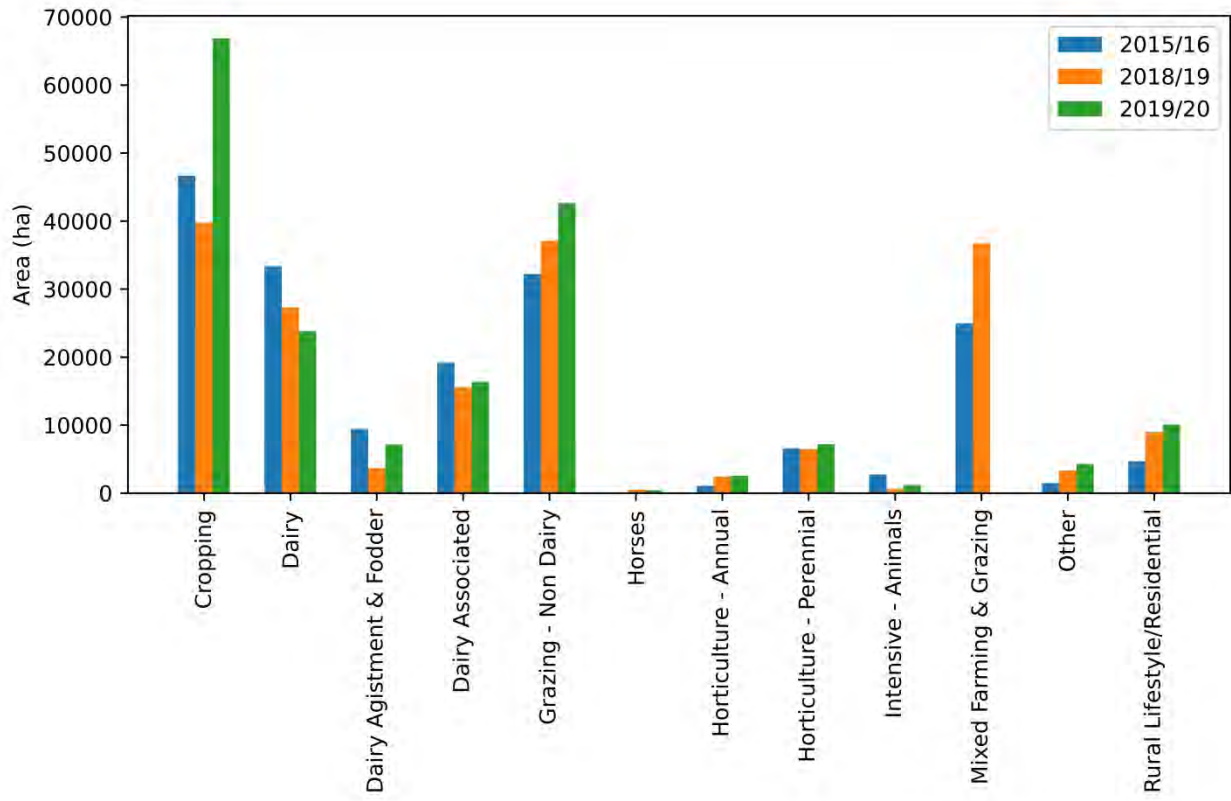


Figure 24. Primary Land Use - Torrumbarry Irrigation Area, 2015/16, 2018/19 and 2019/20

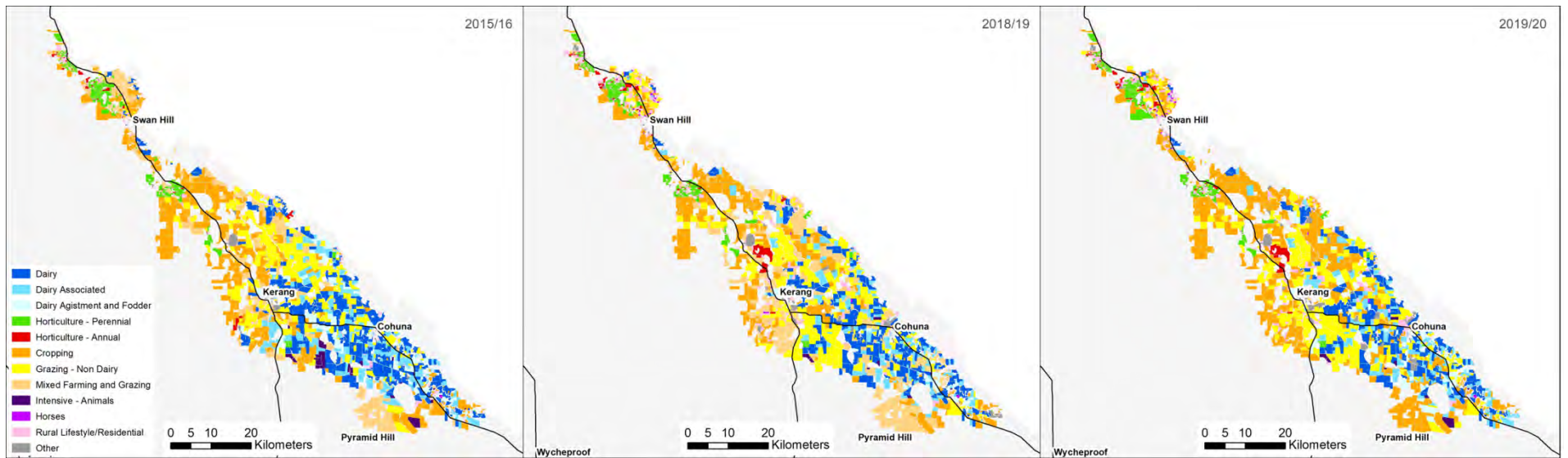


Figure 25. Primary Land Use - Torrumbarry Irrigation Area, 2015/16 (left), 2018/19 (middle) and 2019/20 (right)

6. Water Use across the Goulburn Murray Irrigation District (GMID)

The 2019/20 irrigation season followed successive years of low inflow into Murray and Goulburn storages. While dry conditions in northern Victoria eased with early Autumn rain in 2020, the 2019/20 season saw very low allocations on the Murray and Goulburn systems. This resulted in very low water use in the GMID in 2019/20 (513GL), compared with 2018/19 (1,074GL) and 2015/16 (1,004GL).

Between 2015/16 and 2018/19 water use increased across all primary land uses in the GMID except for Dairy (Combined), Intensive – Animals and Rural Lifestyle/Residential, which decreased by 36.5%, 30% and 15% respectively. Water use reduced across all primary land uses in the GMID between 2018/19 and 2019/20, 52% on average overall. Dairy (Combined) water use reduced by 263,775ML (or 54.5%) between 2018/19 and 2019/20. Nevertheless, Dairy (Combined) was the highest water user in the GMID using a total of 219,948ML in 2019/20 (Table 11). The reclassification of Mixed Farming and Grazing redistributed water use (and reductions in water use) into other primary land use categories, mainly Cropping and Grazing Non-Dairy (Table 4).

Table 11. GMID Water Use (ML) and Water Use Change (ML and %) by Primary Land Use category, 2015/16, 2018/19 and 2019/20

Primary Land Use	2015/16	2018/19	2019/20	2015/16-2018/19		2018/19-2019/20		2015/16-2019/20	
	Water Use (ML)			Change (ML)	Change (%)	Change (ML)	Change (%)	Change (ML)	Change (%)
Cropping	165,681.7	204,298.1	109,529.7	38,616.4	23.3	-94,768.4	-46.4	-56,152.0	-33.9
Dairy	388,438.1	337,614.0	154,628.5	-50,824.1	-13.1	-182,985.5	-54.2	-233,809.7	-60.2
Dairy Agistment & Fodder	72,773.9	48,897.0	25,497.8	-23,877.0	-32.8	-23,399.1	-47.9	-47,276.1	-65.0
Dairy Associated	88,827.7	97,211.7	39,821.2	8,384.0	9.4	-57,390.5	-59.0	-49,006.5	-55.2
Dairy (Combined)	550,039.7	483,722.7	219,947.5	-66,317	-12.1	-263,775	-54.5	-330,092	-60
Grazing Non-Dairy	87,176.2	114,416.1	61,230.5	27,239.9	31.2	-53,185.6	-46.5	-25,945.7	-29.8
Horses	4,665.1	6,628.9	3,497.8	1,963.9	42.1	-3,131.1	-47.2	-1,167.3	-25.0
Horticulture - Annual	12,794.4	19,008.2	12,981.3	6,213.8	48.6	-6,027.0	-31.7	186.9	1.5
Horticulture - Perennial	87,052.1	107,526.7	75,438.6	20,474.6	23.5	-32,088.1	-29.8	-11,613.5	-13.3
Intensive - Animals	7,000.7	4,840.6	2,021.6	-2,160.1	-30.9	-2,819.0	-58.2	-4,979.1	-71.1
Mixed Farming & Grazing	54,383.8	100,545.6	-	46,161.7	84.9	-	-	-	-
Rural Lifestyle/ Residential	31,989.7	27,310.1	23,471.7	-4,679.7	-14.6	-3,838.4	-14.1	-8,518.0	-26.6
Other (e.g. municipal infrastructure)	2,917.8	6,094.1	5,126.6	3,176.3	108.9	-967.4	-15.9	2,208.9	75.7
Total ML	1,003,701.2	1,074,391.1	513,245.3	70,689.8	7.0	-561,145.7	-52.2	-490,455.9	-48.9
Total GL	1004GL	1074GL	513GL						

Water use (ML) across each of the irrigation areas reduced between 38% and 57.5% between 2015/16 and 2019/20 (Appendix 3). Murray Valley irrigation area had the largest percentage water use change, reducing by 98GL or 57.5%, while Shepparton had the least percentage change reducing 38GL or 38%. Central Goulburn had the largest total water use reduction by volume (-120GL), followed by Torrumbarry (112GL). Further information on water use between 2015/16, 2018/19 and 2019/20, across each of the six GMID irrigation areas is provided in Appendix 3.

Figure 26 illustrates water use by primary land uses between 2015/16, 2018/19 and 2019/20. This shows that water use in 2018/19 was typically higher than in 2015/16 for many land uses and higher for all land uses than in 2019/20 (Figure 26). Decreases in water use between 2018/19 and 2019/20 was particularly evident for Cropping, Dairy, Dairy Agistment and Fodder, Dairy Associated and Grazing Non-Dairy.

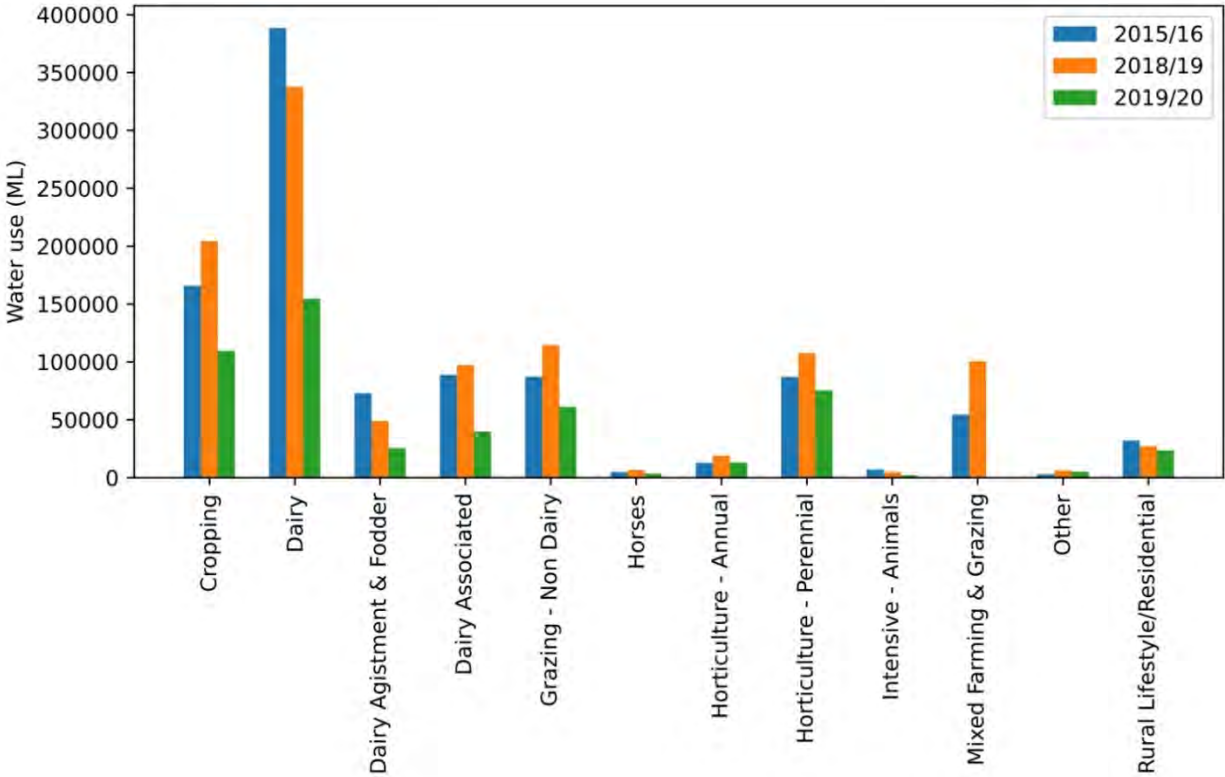


Figure 26. Water Use in the GMID (hectare - ha) for each Primary Land Use, 2015/16, 2018/19 and 2019/20

Figure 27 shows the distribution of water use in the GMID by primary land use in 2015/16, 2018/19 and 2019/20, as well as the total GMID water use. Dairy (Combined) had the largest percentage water use in the GMID in each of these irrigation seasons, despite a progressive decline in percentage of total water use from 55% to 43%. The proportion of water use by Cropping increased slightly, from 16.5% in 2015/16; to 19% in 2018/19; and 21% in 2019/20. Grazing Non-Dairy and Horticulture - Perennial increased from 9% of total GMID water use in 2015/16 to 15% in 2019/20, despite a decline in overall water use by 12GL. The proportion of water use by Horticulture - Annual, Other (e.g. municipal infrastructure) and Horses remained relatively similar across the three irrigation seasons, while Rural Lifestyle/Residential water use increased slightly between 2015/16 and 2019/20.

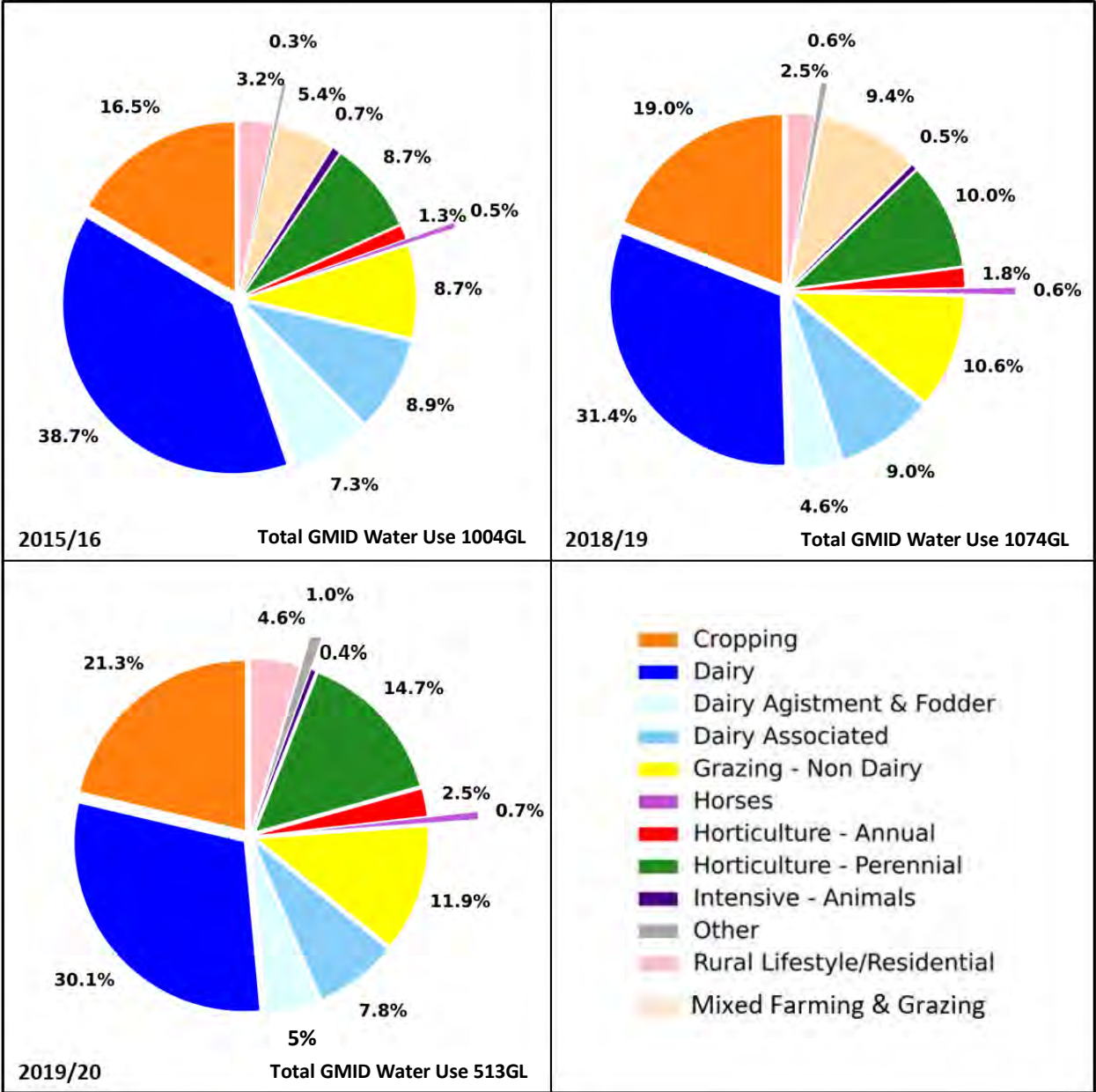


Figure 27. Percentage GMID Water Use by Primary Land Use, 2015/16, 2018/2019, 2019/20

7. Water Use Licences in the GMID

There were 14,401 Water Use Licences (WUL) in the GMID at the time of survey in 2019/20 (Table 12) (this includes some Water Use Registrations as noted in the methodology). This project standardised the 2015/16 and 2018/19 datasets against the 2019/20 WUL data, to allow direct comparison between years and enable time series to be developed.

Rural Lifestyle/Residential had the highest number of WULs (6,905), followed by Cropping (2,769) and Dairy (Combined) (1,940). Mixed Farming and Grazing WULs (1,597) were reclassified in 2019/20 to primary land use, mainly Cropping and Grazing Non-Dairy (Table 4). In 2019/20, Rural Lifestyle/Residential, Cropping, Dairy (Combined) and Grazing Non-Dairy accounted for 90% of the WULs in the GMID.

The number of WULs increased for all land uses between 2015/16 and 2019/20 except for Dairy (Combined) (-839 WULs), Horticulture - Perennial (-83 WULs) and Intensive - Animals (-30 WULs) (Table 12). The decline in Dairy (Combined) WULs was recorded between 2015/16 and 2018/19 (-873 WULs). Between 2018/19 and 2019/20, WULs increased for Dairy Associated (68 WULs) and Dairy Agistment and Fodder (37 WULs) but decreased for Dairy (-71 WULs). As noted in section 4.2.1, this is indicative of the restructuring of dairy businesses. For instance, where an adjoining property with an active dairy shed is amalgamated into a larger property (if the WUL is not merged through other purposes) the WUL was reclassified from Dairy to Dairy Associated (i.e. linked to a property with an active dairy).

Appendix 4 shows WULs by primary land use category for each GMID irrigation area, and the percentage change in WULs between 2015/16, 2018/19 and 2019/20. Central Goulburn (3,987 WULs) and Torrumbarry (3,248 WULs) had the highest number of WULs. Central Goulburn had the highest number of Dairy (Combined) WULs (699 WULs in 2019/20). Dairy (Combined) WULs decreased the most in Shepparton between 2015/16 (261 WULs) and 2019/20 (143 WULs). Cropping WULs increased the most in Murray Valley between 2015/16 (137 WULs) and 2019/20 (414 WULs).

Table 12. Water Use Licence (WUL) (number and change %) in the GMID by Land Use category, 2015/16, 2018/19 and 2019/20

Primary Land Use	2015/16	2018/19	2019/20	2015/16-2018/19		2018/19-2019/20		2015/16-2019/20	
				Change (Number)	Change (%)	Change (Number)	Change (%)	Change (Number)	Change (%)
Cropping	1,955	1,900	2,769	-55	-2.8	869	45.7	814	41.6
Dairy	1,197	785	714	-412	-34.4	-71	-9.0	-483	-40.4
Dairy Agistment & Fodder	688	368	405	-320	-46.5	37	10.1	-283	-41.1
Dairy Associated	894	753	821	-141	-15.8	68	9.0	-73	-8.2
Dairy (Combined)	2,779	1,906	1,940	-873	-31.4	34	1.8	-839	-30.2
Grazing Non-Dairy	1,002	1,244	1,301	242	24.2	57	4.6	299	29.8
Horses	98	171	172	73	74.5	1	0.6	74	75.5
Horticulture - Annual	114	143	134	29	25.4	-9	-6.3	20	17.5
Horticulture - Perennial	881	839	798	-42	-4.8	-41	-4.9	-83	-9.4
Intensive - Animals	69	37	39	-32	-46.4	2	5.4	-30	-43.5
Mixed Farming & Grazing*	1,317	1597	0	280	21.3	0	0	0	0
Rural Lifestyle/ Residential	5,998	6,291	6,905	293	4.9	614	9.8	907	15.1
Other (e.g. municipal infrastructure)	188	273	343	85	45.2	70	25.6	155	82.4
Total	14,401	14,401	14,401						

*Mixed Farming & Grazing reclassified in 2019/20

8. Conclusion

The interaction of land and water use in the GMID remains complex and continues to undergo rapid transition. The demand and competition for water, based on market drivers and seasonal conditions, remains a key driver of land and water use change in the GMID. A 50% reduction in water use between 2018/19 and 2019/20 was indicative of this volatility, and the complexities faced by irrigators making business decisions. The pattern of land use change was uneven across the GMID, with land and water use shifting significantly in some irrigation areas compared to others, due to reasons such as access to water, as well as broader socio-economic factors.

Dairy (Combined) continued to undergo industry adjustment as evidenced by fewer active dairies, particularly in Shepparton and Murray Valley. However, Dairy (Combined) remains the second largest land use in the GMID accounting for approximately one-quarter of total land use. Dairy remains dominant in the Central Goulburn irrigation area, with large active dairy properties visible in the spatial mapping.

Despite a reduction in water use in 2019/20, Dairy (Combined) remains the largest water user in the GMID, accounting for 43% of total water use. Although there has been a decline in the number of WULs attached to Dairy as a primary land use (785 in 2018/19 to 714 in 2019/20), this does not represent formal exits from the industry. Dairy Licence data from Dairy Australia (2021) indicates that in 2019/20 there were 953 active dairy licenses in the GMID Council areas. This difference in these datasets is due to active dairy farms being classified by either WUL or dairy licence and potential lag time between ceasing active dairying and cancelling dairy licences. Inactive dairy farms may have temporarily ceased operating and plan to return when conditions improve or may have transitioned into larger enterprises. Further investigation to compare both datasets is planned.

Cropping had the largest land use area in every irrigation area except Central Goulburn where Dairy (Combined) land use was larger. This marks a change for Rochester and Torrumbarry where historically Dairy (Combined) has been the dominant land use. Cropping increased significantly in area since 2015/16, particularly in Murray Valley and Torrumbarry. However, like many land uses, there was a significant reduction in Cropping water use in the 2019/20 irrigation season, measuring roughly half the amount used in 2018/19.

The area of Horticulture – Perennial in the GMID remained relatively stable since 2015/16. Horticulture – Perennial increased in number of WULs, and despite using slightly less water in 2019/20, was the third largest water user in the GMID (after Dairy (Combined) and Cropping).

The reclassification of Mixed Farming and Grazing in 2019/20 led to an increase in the area associated with primary land uses such as Cropping and Grazing Non-Dairy. However, the reclassification does not account for the full extent of the changes in these primary land uses observed between 2018/19 and 2019/20. A shift towards these land uses was already being seen between 2015/16 and 2018/19, particularly an increase in Grazing Non-Dairy in Central Goulburn, Rochester and Shepparton, and Cropping in Murray Valley, Rochester and Shepparton.

Since 2015/16 Rural Lifestyle/Residential has increased in each irrigation area except for Shepparton, indicating a transition of properties from farming to lifestyle. Area of Rural Lifestyle/Residential more than doubled in the west of the GMID in areas such as Rochester, Torrumbarry and Loddon Valley. The ageing demographic of farmers, and the trend towards leasing properties, is a potential explanation for the observed increase in Rural Lifestyle/Residential land use generally (GB CMA 2021b).

The 2019/20 Regional Irrigated Land and Water Use Mapping in the GMID project demonstrates the value of mapping land and water use changes, to inform strategic planning by government and industry. The dataset will continue to be queried beyond this report, to assist in planning for the future of irrigated agriculture in the GMID.

9. References

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10. Appendices

Appendix 1 – Land Use Mapping in the GMID – Stakeholder Reference Group and Technical Working Group representatives

Stakeholder Reference Group	
Stakeholder	Representatives
Goulburn-Murray Water (GMW)	John Weber, Matthew O'Farrell, Geoff Coburn
Agriculture Victoria	Andy McAllister, Mardi Tress, Terry Batey, Rebecca Pike, Matthew Hawken, Rabi Maskey
DELWP	Bonnie Glaister, Sasha Johnson, Sara Bundze
Goulburn Broken CMA (GB CMA)	Carl Walters (chair), Bek Caldwell, Vicki Mackenzie (minute taker)
North Central CMA (NCCMA)	Rachel Murphy, Mandy Coulson
NECMA (observers until 2021)	Lachlan Campbell
Murray Dairy	Jenny Wilson
HMC Property Group	Marcus Hann
Fruit Growers (Vic)	Michael Crisera, Mel Floyd
Irrigated Cropping Council	Damian Jones and Charlie Aves
Spatial Mapping Technical Working Group	
Stakeholder	Representatives
Agriculture Victoria	Andy McAllister, Rabi Maskey
GMW	John Weber, Peter King
DELWP	Bonnie Glaister
GB CMA	Carl Walters (chair), Bek Caldwell, Vicki Mackenzie (minute taker)
NCCMA	Mandy Coulson

Appendix 2 - Primary Land Use Change (%) between 2015/16, 2018/19, and 2019/20 in each GMID Irrigation Area

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Hectares)			Change (%)		
Central Goulburn Total Hectares = 146,399.6	Cropping	26,828.6	26,331.4	40,071.4	-1.9	52.2	49.4
	Dairy	45,986.2	35,978.0	34,930.7	-21.8	-2.9	-24.0
	Dairy Agistment & Fodder	10,680.0	9,718.0	12,949.4	-9.0	33.3	21.2
	Dairy Associated	18,338.2	16,902.6	18,032.4	-7.8	6.7	-1.7
	Dairy (Combined)	75,004.3	62,598.5	65,912.5	-16.5	5.3	-12.1
	Grazing Non-Dairy	5,776.4	8,111.0	9,995.6	40.4	23.2	73.0
	Horses	1,725.7	2,136.1	2,097.2	23.8	-1.8	21.5
	Horticulture - Annual	2,094.6	3,251.2	2,531.0	55.2	-22.2	20.8
	Horticulture - Perennial	5,750.3	6,079.0	6,052.2	5.7	-0.4	5.2
	Intensive - Animals	623.7	597.7	615.7	-4.2	3.0	-1.3
	Mixed Farming & Grazing*	17,520.0	22,046.1	0	25.8	0	0
	Other (e.g. municipal infrastructure)	955.6	1,832.5	2,051.4	91.8	11.9	114.7
Rural Lifestyle/Residential	10,120.4	13,416.1	17,072.6	32.6	27.3	68.7	
Loddon Valley Total Hectares = 199,325.0ha	Cropping	114,544.5	82,014.5	107,120.5	-28.4	30.6	-6.5
	Dairy	11,103.9	8,111.0	7,697.1	-27.0	-5.1	-30.7
	Dairy Agistment & Fodder	1,551.7	3,556.9	2,388.8	129.2	-32.8	53.9
	Dairy Associated	10,923.6	4,777.6	1,5816.7	-56.3	231.1	44.8
	Dairy (Combined)	23,579.1	16,445.5	25,902.5	-30.3	57.5	9.9
	Grazing Non-Dairy	29,233.2	30,986.9	49,929.1	6.0	61.1	70.8
	Horses	219.9	267.9	260.3	21.8	-2.8	18.4
	Horticulture - Annual	3,644.6	121.2	2,704.1	-96.7	2130.7	-25.8
	Horticulture - Perennial	5,984.4	6,507.6	6,507.6	8.7	0.0	8.7
	Intensive - Animals	3,232.3	3,288.6	2,549.6	1.7	-22.5	-21.1
	Mixed Farming & Grazing*	17,847.2	5,5729.0	0	212.3	0	0
	Other (e.g. municipal infrastructure)	365.2	2,437.1	2,365.9	567.4	-2.9	547.8
Rural Lifestyle/Residential	674.5	1,526.8	1,985.4	126.3	30.0	194.3	

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Hectares)			(Change %)		
Murray Valley Total Hectares = 123,087.5ha	Cropping	18,391.9	40,915.6	50,920.8	122.5	24.5	176.9
	Dairy	34,003.0	22,686.0	20,263.8	-33.3	-10.7	-40.4
	Dairy Agistment & Fodder	11,764.6	8,801.8	7,042.9	-25.2	-20.0	-40.1
	Dairy Associated	16,878.5	11,897.5	15,250.4	-29.5	28.2	-9.6
	Dairy (Combined)	62,646.1	43,385.3	42,557.1	-30.7	-1.9	-32.1
	Grazing Non-Dairy	28,621.7	2,2056.1	18,352.7	-22.9	-16.8	-35.9
	Horses	407.8	499.1	470.2	22.4	-5.8	15.3
	Horticulture - Annual	421.1	187.6	365.8	-55.4	95.0	-13.1
	Horticulture - Perennial	4,317.7	4,029.8	3,724.0	-6.7	-7.6	-13.7
	Intensive - Animals	51.7	306.7	341.7	493.1	11.4	560.7
	Mixed Farming & Grazing*	3,947.6	7,439.4	-	88.5	-	-
	Other (e.g. municipal infrastructure)	240.2	361.2	966.5	50.4	167.6	302.3
Rural Lifestyle/Residential	4,041.7	3,906.7	5,388.7	-3.3	37.9	33.3	
Rochester Total Hectares = 109,987.3ha	Cropping	31,622.7	42,412.5	53,009.0	34.1	25.0	67.6
	Dairy	20,574.5	17,831.8	16,587.1	-13.3	-7.0	-19.4
	Dairy Agistment & Fodder	11,954.9	4,440.1	6,198.3	-62.9	39.6	-48.2
	Dairy Associated	7,737.5	7,008.7	7,165.3	-9.4	2.2	-7.4
	Dairy (Combined)	40,266.8	29,280.6	29,950.7	-27.3	2.3	-25.6
	Grazing Non-Dairy	3,308.8	14,088.7	11,597.1	325.8	-17.7	250.5
	Horses	187.8	232.6	393.5	23.9	69.2	109.6
	Horticulture - Annual	4,850.8	4,582.3	4,358.5	-5.5	-4.9	-10.1
	Horticulture - Perennial	2,069.3	2,115.2	2,112.1	2.2	-0.1	2.1
	Intensive - Animals	282.6	37.3	37.3	-86.8	0.0	-86.8
	Mixed Farming & Grazing*	23,038.4	12,780.1	-	-44.5	-	-
	Other (e.g. municipal infrastructure)	302.5	426.2	447.1	40.9	4.9	47.8
Rural Lifestyle/Residential	4,057.7	4,031.8	8,082.0	-0.6	100.5	99.2	

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Hectares)			(Change %)		
Shepparton Total Hectares = 81,366.0ha	Cropping	17,859.8	26,705.0	37,868.8	49.5	41.8	112.0
	Dairy	11,612.2	7,214.7	6,400.3	-37.9	-11.3	-44.9
	Dairy Agistment & Fodder	3,374.5	699.9	2,412.0	-79.3	244.6	-28.5
	Dairy Associated	7,328.1	5,018.9	3,167.1	-31.5	-36.9	-56.8
	Dairy (Combined)	22,314.7	12,933.5	11,979.5	-42.0	-7.4	-46.3
	Grazing Non-Dairy	7,708.8	13,089.9	17,511.5	69.8	33.8	127.2
	Horses	1,929.6	1,882.8	1,860.2	-2.4	-1.2	-3.6
	Horticulture - Annual	274.2	367.9	360.6	34.2	-2.0	31.5
	Horticulture - Perennial	6,777.2	6,199.6	6,056.7	-8.5	-2.3	-10.6
	Intensive - Animals	85.1	23.7	23.7	-72.1	0.0	-72.1
	Mixed Farming & Grazing*	18,614.3	14,089.5	-	-24.3	-	-
Other (e.g. municipal infrastructure)	843.0	1,810.7	1,133.8	114.8	-37.4	34.5	
Rural Lifestyle/Residential	4,959.4	4,263.3	4,571.2	-14.0	7.2	-7.8	
Torrumbarry Total Hectares = 182,376.8ha	Cropping	4,6671.0	39,767.4	66,844.5	-14.8	68.1	43.2
	Dairy	33,353.6	27,280.9	23,778.6	-18.2	-12.8	-28.7
	Dairy Agistment & Fodder	9,424.8	3,668.3	7,147.0	-61.1	94.8	-24.2
	Dairy Associated	19,167.1	15,554.5	16,356.1	-18.8	5.2	-14.7
	Dairy (Combined)	61,945.5	46,503.7	47,281.7	-24.9	1.7	-23.7
	Grazing Non-Dairy	32,219.0	37,079.6	42,639.8	15.1	15.0	32.3
	Horses	57.4	504.3	423.8	778.5	-16.0	638.2
	Horticulture - Annual	1,070.6	2,436.3	2,546.8	127.6	4.5	137.9
	Horticulture - Perennial	6,578.6	6,482.0	7,167.6	-1.5	10.6	9.0
	Intensive - Animals	2,738.4	597.9	1,166.9	-78.2	95.2	-57.4
	Mixed Farming & Grazing*	24,958.5	36,703.5	-	47.1	-	-
Other (e.g. municipal infrastructure)	1,460.9	3,325.8	4,243.1	127.7	27.6	190.4	
Rural Lifestyle/Residential	46,76.8	8,976.3	10,062.6	91.9	12.1	115.2	

*Mixed Farming & Grazing reclassified in 2019/20

Appendix 3. Water Use (ML) Change (%) between 2015/16, 2018/19 and 2019/20 in each GMID Irrigation Area

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(ML)			(Change %)		
Central Goulburn	Cropping	27,557.9	25,010.4	14,309.8	-9.2	-42.8	-48.1
	Dairy	128,509.9	112,841.2	57,904.2	-12.2	-48.7	-54.9
	Dairy Agistment & Fodder	15,951.3	16,455.0	11,319.6	3.2	-31.2	-29.0
	Dairy Associated	25,638.1	32,539.6	12,516.0	26.9	-61.5	-51.2
	Dairy (Combined)	170,099.3	161,835.9	81,739.9	-4.9	-49.5	-51.9
	Grazing – Non-Dairy	6,768.3	13,999.3	7,762.5	106.8	-44.6	14.7
	Horses	2,216.6	2,954.1	1,552.3	33.3	-47.5	-30.0
	Horticulture - Annual	2,299.0	3,232.4	2,612.3	40.6	-19.2	13.6
	Horticulture - Perennial	21,177.9	23,147.1	17,580.4	9.3	-24.0	-17.0
	Intensive - Animals	831.7	559.7	312.2	-32.7	-44.2	-62.5
	Mixed Farming & Grazing*	13,809.7	20,842.0	-	50.9	-	-
	Other (e.g. municipal infrastructure)	398.1	1,453.2	1,926.0	265.1	32.5	383.8
	Rural Lifestyle/Residential	12,231.8	11,368.4	9,764.5	-7.1	-14.1	-20.2
	Total	257,390.4	264,402.6	137,559.9	2.7	-48.0	-46.6
Loddon Valley	Cropping	58,825.0	41,994.4	27,337.0	-28.6	-34.9	-53.5
	Dairy	21,606.9	19,120.9	9,652.2	-11.5	-49.5	-55.3
	Dairy Agistment & Fodder	1,190.4	3,018.0	519.0	153.5	-82.8	-56.4
	Dairy Associated	5,214.1	2,714.1	2,339.9	-47.9	-13.8	-55.1
	Dairy (Combined)	2,8011.4	2,4853.0	12,511.1	-11.3	-49.7	-55.3
	Grazing – Non-Dairy	18,543.8	18,515.8	16,426.4	-0.2	-11.3	-11.4
	Horses	320.4	293.8	203.9	-8.3	-30.6	-36.4
	Horticulture - Annual	916.5	61.3	1,120.2	-93.3	1726.6	22.2
	Horticulture - Perennial	1,794.3	1,4194.1	2,009.7	691.1	-85.8	12.0
	Intensive - Animals	3,306.4	3,600.5	1,480.4	8.9	-58.9	-55.2
	Mixed Farming & Grazing	5,177.3	29,124.7	-	462.5	-	-
	Other (e.g. municipal infrastructure)	724.0	938.5	1,287.3	29.6	37.2	77.8

	Rural Lifestyle/Residential	408.9	435.3	287.8	6.5	-33.9	-29.6
	Total	118,027.8	134,011.2	62,663.7	13.5	-53.2	-46.9
Murray Valley	Cropping	14,679.7	40,555.0	16,654.1	176.3	-58.9	13.4
	Dairy	74,784.5	50,249.2	21,174.5	-32.8	-57.9	-71.7
	Dairy Agistment & Fodder	18,066.7	12,585.4	5,545.8	-30.3	-55.9	-69.3
	Dairy Associated	19,483.1	15,955.5	6,573.2	-18.1	-58.8	-66.3
	Dairy (Combined)	112,334.2	78,790.2	33,293.6	-29.9	-57.7	-70.4
	Grazing – Non-Dairy	21,011.7	23,314.5	8,228.1	11.0	-64.7	-60.8
	Horses	523.6	483.1	170.5	-7.7	-64.7	-67.4
	Horticulture - Annual	340.9	203.3	596.1	-40.4	193.2	74.9
	Horticulture - Perennial	13,801.6	15,173.3	10,557.7	9.9	-30.4	-23.5
	Intensive - Animals	5.0	15.8	13.9	216.0	-11.7	178.9
	Mixed Farming & Grazing*	2,090.9	6,383.0	-	205.3	-	-
	Other (e.g. municipal infrastructure)	275.5	368.4	292.6	33.7	-20.6	6.2
	Rural Lifestyle/Residential	5,285.7	3,760.9	2,519.8	-28.8	-33.0	-52.3
	Total	170,348.8	169,047.5	72,326.5	-0.8	-57.2	-57.5
Rochester	Cropping	24,307.4	27,215.2	12,337.0	12.0	-54.7	-49.2
	Dairy	48,590.8	53,165.9	21,893.8	9.4	-58.8	-54.9
	Dairy Agistment & Fodder	16,438.7	5,212.1	2,288.8	-68.3	-56.1	-86.1
	Dairy Associated	8,968.1	9,744.1	4,257.3	8.7	-56.3	-52.5
	Dairy (Combined)	73,997.6	68,122.0	2,8440.0	-7.9	-58.3	-61.6
	Grazing – Non-Dairy	3,467.8	13,109.7	5,064.7	278.0	-61.4	46.0
	Horses	64.2	242.3	245.6	277.3	1.3	282.3
	Horticulture - Annual	7,006.1	1,0125.2	4,490.0	44.5	-55.7	-35.9
	Horticulture - Perennial	2,252.9	3,308.0	2,936.0	46.8	-11.2	30.3
	Intensive - Animals	80.8	51.9	20.9	-35.8	-59.6	-74.1
	Mixed Farming & Grazing*	9,355.8	8,956.2	-	-4.3	-	-
	Other (e.g. municipal infrastructure)	151.7	156.1	82.9	2.9	-46.9	-45.4
	Rural Lifestyle/Residential	4,654.4	3,589.9	4,660.9	-22.9	29.8	0.1

	Total	125,338.7	134,876.6	58,278.0	7.6	-56.8	-53.5
Shepparton	Cropping	16,109.6	30,710.3	14,567.9	90.6	-52.6	-9.6
	Dairy	28,815.2	22,596.2	9,996.3	-21.6	-55.8	-65.3
	Dairy Agistment & Fodder	4,961.7	2,614.6	1,878.4	-47.3	-28.2	-62.1
	Dairy Associated	5,762.4	6,710.6	2,395.4	16.5	-64.3	-58.4
	Dairy (Combined)	39,539.3	31,921.3	14,270.1	-19.3	-55.3	-63.9
	Grazing – Non-Dairy	2,582.2	12,418.7	6,981.1	380.9	-43.8	170.3
	Horses	1,527.0	1,652.8	775.6	8.2	-53.1	-49.2
	Horticulture - Annual	412.9	775.2	712.2	87.7	-8.1	72.5
	Horticulture - Perennial	25,694.8	27,506.6	21,933.4	7.1	-20.3	-14.6
	Intensive - Animals	10.5	0.0	0.0	-100.0	0.0	-100.0
	Mixed Farming & Grazing*	10,435.3	9,717.1	-	-6.9	-	-
	Other (e.g. municipal infrastructure)	513.2	918.1	676.6	78.9	-26.3	31.8
	Rural Lifestyle/Residential	3,981.7	2,756.5	2,622.3	-30.8	-4.9	-34.1
	Total	100,806.5	118,376.5	62,539.2	17.4	-47.2	-38.0
Torrumbarry	Cropping	24,202.1	38,812.8	24,323.8	60.4	-37.3	0.5
	Dairy	86,130.9	79,640.7	34,007.4	-7.5	-57.3	-60.5
	Dairy Agistment & Fodder	16,165.2	9,011.8	3,946.1	-44.3	-56.2	-75.6
	Dairy Associated	23,761.8	29,547.8	11,739.4	24.3	-60.3	-50.6
	Dairy (Combined)	126,058.0	118,200.3	49,693.0	-6.2	-58.0	-60.6
	Grazing – Non-Dairy	34,802.3	33,058.1	16,767.8	-5.0	-49.3	-51.8
	Horses	13.2	1,002.8	549.9	7497.3	-45.2	4066.3
	Horticulture - Annual	1,819.0	4,610.8	3,450.5	153.5	-25.2	89.7
	Horticulture - Perennial	22,330.7	24,197.6	20,421.4	8.4	-15.6	-8.5
	Intensive - Animals	2,766.3	612.7	194.1	-77.9	-68.3	-93.0
	Mixed Farming & Grazing*	13,514.8	25,522.6	-	88.8	-	-
	Other (e.g. municipal infrastructure)	855.3	2,259.8	861.3	164.2	-61.9	0.7
	Rural Lifestyle/Residential	5,427.3	5,399.0	3,616.3	-0.5	-33.0	-33.4
	Total	231,789.0	25,3676.7	119,878.1	9.4	-52.7	-48.3

*Mixed Farming & Grazing reclassified in 2019/20

Appendix 4. Water Use Licence (WUL) Change (%) by Primary Land Use category and Irrigation Area between 2015/16, 2018/19 and 2019/20

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Number)			(Change %)		
Central Goulburn Total WUL = 3,987	Cropping	417	371	603	-11.0	62.5	44.6
	Dairy	412	278	263	-32.5	-5.4	-36.2
	Dairy Agistment & Fodder	215	127	170	-40.9	33.9	-20.9
	Dairy Associated	283	254	266	-10.2	4.7	-6.0
	Dairy (Combined)	910	659	699	-27.6	6.1	-23.2
	Grazing – Non-Dairy	98	153	144	56.1	-5.9	46.9
	Horses	38	70	67	84.2	-4.3	76.3
	Horticulture - Annual	30	40	32	33.3	-20.0	6.7
	Horticulture - Perennial	174	173	167	-0.6	-3.5	-4.0
	Intensive - Animals	21	10	11	-52.4	10.0	-47.6
	Mixed Farming & Grazing*	321	499	-	55.5	-	-
	Other (e.g. municipal infrastructure)	56	71	81	26.8	14.1	44.6
Rural Lifestyle/Residential	1,922	1,941	2,183	1.0	12.5	13.6	
Loddon Valley Total WUL = 890	Cropping	402	247	387	-38.6	56.7	-3.7
	Dairy	45	26	25	-42.2	-3.8	-44.4
	Dairy Agistment & Fodder	9	13	8	44.4	-38.5	-11.1
	Dairy Associated	65	35	61	-46.2	74.3	-6.2
	Dairy (Combined)	119	74	94	-37.8	27.0	-21.0
	Grazing – Non-Dairy	104	98	180	-5.8	83.7	73.1
	Horses	5	6	5	20.0	-16.7	0.0
	Horticulture - Annual	5	3	8	-40.0	166.7	60.0
	Horticulture - Perennial	4	8	8	100.0	0.0	100.0
	Intensive - Animals	12	10	9	-16.7	-10.0	-25.0
	Mixed Farming & Grazing*	75	254	-	238.7	-	-
	Other (e.g. municipal infrastructure)	15	21	29	40.0	38.1	93.3
Rural Lifestyle/Residential	149	169	170	13.4	0.6	14.1	

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Number)			(Change %)		
Murray Valley Total WUL = 2,002	Cropping	137	328	414	139.4	26.2	202.2
	Dairy	258	139	124	-46.1	-10.8	-51.9
	Dairy Agistment & Fodder	132	97	80	-26.5	-17.5	-39.4
	Dairy Associated	170	129	153	-24.1	18.6	-10.0
	Dairy (Combined)	560	365	357	-34.8	-2.2	-36.3
	Grazing – Non-Dairy	323	250	180	-22.6	-28.0	-44.3
	Horses	8	8	7	0.0	-12.5	-12.5
	Horticulture - Annual	7	8	8	14.3	0.0	14.3
	Horticulture - Perennial	115	107	96	-7.0	-10.3	-16.5
	Intensive - Animals	2	3	4	50.0	33.3	100.0
	Mixed Farming & Grazing*	54	91	-	68.5	-	-
Other (e.g. municipal infrastructure)	18	21	43	16.7	104.8	138.9	
Rural Lifestyle/Residential	778	821	893	5.5	8.8	14.8	
Rochester Total WUL = 1,783	Cropping	325	319	377	-1.8	18.2	16.0
	Dairy	155	118	110	-23.9	-6.8	-29.0
	Dairy Agistment & Fodder	170	75	68	-55.9	-9.3	-60.0
	Dairy Associated	110	92	98	-16.4	6.5	-10.9
	Dairy (Combined)	435	285	276	-34.5	-3.2	-36.6
	Grazing – Non-Dairy	49	217	125	342.9	-42.4	155.1
	Horses	5	8	11	60.0	37.5	120.0
	Horticulture - Annual	21	21	19	0.0	-9.5	-9.5
	Horticulture - Perennial	14	18	17	28.6	-5.6	21.4
	Intensive - Animals	8	3	3	-62.5	0.0	-62.5
	Mixed Farming & Grazing*	138	118	-	-14.5	-	-
Other (e.g. municipal infrastructure)	8	12	25	50.0	108.3	212.5	
Rural Lifestyle/Residential	780	782	930	0.3	18.9	19.2	

Irrigation Area	Primary Land Use	2015/16	2018/19	2019/20	2016-2019	2019-2020	2016-2020
		(Number)			(Change %)		
Shepparton Total WUL = 2,491	Cropping	293	351	510	19.8	45.3	74.1
	Dairy	111	72	65	-35.1	-9.7	-41.4
	Dairy Agistment & Fodder	46	13	14	-71.7	7.7	-69.6
	Dairy Associated	104	70	64	-32.7	-8.6	-38.5
	Dairy (Combined)	261	155	143	-40.6	-7.7	-45.2
	Grazing – Non-Dairy	96	165	274	71.9	66.1	185.4
	Horses	40	51	59	27.5	15.7	47.5
	Horticulture - Annual	20	25	22	25.0	-12.0	10.0
	Horticulture - Perennial	293	262	245	-10.6	-6.5	-16.4
	Intensive - Animals	6	2	2	-66.7	0.0	-66.7
	Mixed Farming & Grazing*	292	280	-	-4.1	-	-
	Other (e.g. municipal infrastructure)	43	75	60	74.4	-20.0	39.5
Rural Lifestyle/Residential	1,147	1,125	1,176	-1.9	4.5	2.5	
Torrumbarry Total WUL = 3,248	Cropping	381	284	478	-25.5	68.3	25.5
	Dairy	216	152	127	-29.6	-16.4	-41.2
	Dairy Agistment & Fodder	116	43	65	-62.9	51.2	-44.0
	Dairy Associated	162	173	179	6.8	3.5	10.5
	Dairy (Combined)	494	368	371	-25.5	0.8	-24.9
	Grazing – Non-Dairy	332	361	398	8.7	10.2	19.9
	Horses	2	28	23	1300.0	-17.9	1050.0
	Horticulture - Annual	31	46	45	48.4	-2.2	45.2
	Horticulture - Perennial	281	271	265	-3.6	-2.2	-5.7
	Intensive - Animals	20	9	10	-55.0	11.1	-50.0
	Mixed Farming & Grazing*	437	355	-	-18.8	-	-
	Other (e.g. municipal infrastructure)	48	73	105	52.1	43.8	118.8
Rural Lifestyle/Residential	1,222	1,453	1,553	18.9	6.9	27.1	

*Mixed Farming & Grazing reclassified in 2019/20



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