



2021 Mallee Horticulture Crop Report

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Sustainable Irrigation Program

Cover image

Lemon harvest, winter vineyards,
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Executive summary

This report is the continuation of a series of triennial crop reports first produced in 1997 with the aim of accurately measuring irrigation status and development in the Mallee catchment.

The Mallee catchment has irrigated horticulture along the Murray River from Woorinen South to the South Australian border and in the Murrayville Groundwater Management Area (GMA).

The report presents maps and information on irrigated horticulture in the Mallee catchment from 1997 to 2021.

Key findings

Crop types in 2021

Almond trees were the dominant crop type in the Mallee catchment in 2021. 99% of almond plantings were grown in the private diverter river reaches.

The top ten crop types in the Mallee catchment in 2021 were:

1. almonds, 26,405 hectares (30% of the irrigable area). 72% of plantings were in the Boundary Bend and Wemen river reaches;
2. table grapes, 10,480 hectares (12% of the irrigable area). 71% of plantings were in the Mildura, Robinvale and Red Cliffs irrigation districts and the Boundary Bend river reach;
3. wine grapes, 8,165 hectares (9% of the irrigable area). 60% of plantings were in the Colignan to Yatpool river reach, the Nyah river reach and the Red Cliffs irrigation district;
4. field crops, 6,170 hectares (7% of the irrigable area) predominantly grown in the Nyah and Boundary Bend river reaches;
5. citrus, 4,600 hectares (5% of the irrigable area). 72% of plantings were in the Colignan to Yatpool river reach;
6. olives, 3,765 hectares (4% of the irrigable area). 73% of plantings were in the Boundary Bend river reach;
7. potatoes, 2,615 hectares (3% of the irrigable area) grown in the Boundary Bend river reach and the Murrayville Groundwater Management Area;
8. dried grapes, 2,415 hectares (3% of the irrigable area). 89% of plantings were in the Colignan to Yatpool river reach and the Mildura, Merbein and Red Cliffs irrigation districts;
9. vegetables other than carrots and potatoes, 2,005 hectares (2% of the irrigable area). 75% of plantings were in the Wemen and Colignan river reaches and the Red Cliffs irrigation district; and
10. fruit trees other than olives (mainly stone fruit and avocados), 1,930 hectares (2% of the irrigable area).

Crop types 1997 to 2021

The dominant crop in the Mallee catchment was wine grapes from 1997 to 2006, then almonds from 2009 to 2021.

Almond plantings increased by 24,660 hectares, from 1,745 hectares in 1997 to 26,405 hectares in 2021. Over the same period plantings of table grapes and olives also increased significantly, by 6,330 hectares and 3,610 hectares respectively.

Over the same period the largest removal of plantings was in dried and wine grape plantings with a net decrease of 3,915 hectares and 1,810 hectares respectively.

Key findings

From 1997 to 2021, the dominant crop type changed in eight out of the twelve study areas.

In the Red Cliffs, Mildura and Merbein irrigation districts the dominant crop changed from wine or dried grapes to table grapes. In the Nyah, Boundary Bend and Wemen river reaches the dominant crop changed from seasonal crops (vegetables and field crops) to almonds. In the Colignan to Yatpool river reach the change was from wine grapes to citrus and in the Mildura private diverters river reach, from wine grapes to table grapes.

Irrigation development - new and retired areas

From 1997 to 2021, the irrigable area in the Mallee catchment increased by 47,185 hectares, a 115% increase from 40,940 to 88,125 hectares. The net increase of 47,185 hectares was the balance of 2,595 hectares retired from irrigation and 49,780 hectares of expansion. In the last three years the irrigable area increased by 3070 ha.

Expansion was predominantly in the private diverter river reaches where 43,135 hectares of expansion occurred; 16,735 hectares were in the Boundary Bend river reach and 11,830 hectares were in the Wemen river reach.

Retirement was mainly due to urban development in the irrigation districts where 1,480 hectares were retired from irrigation; 990 hectares of which were in the Mildura irrigation district.

Development of permanent plantings (new or redeveloped in the previous three years)

Three-year development activity across the Mallee catchment fell from 16.7% of 55,430 (9,250 ha) of permanent plantings in 2018 to 13.1% of 59,130 (7,750 ha) in 2021. This was largely influenced by a decline in activity in the private diverter river reaches, as development of permanent plantings in 2021 across the pumped irrigation districts was at its highest since 2006.

The 7,750 hectares of new permanent plantings in 2021 were mainly table grapes (2,690 ha), almonds (2,155 ha), wine grapes (905 ha) and citrus (855 ha). These are conservative figures as three-year old, top worked plantings can look deceptively mature from aerial imagery.

Planting trends - permanent plantings, seasonal crops and vacant areas

The irrigable area includes permanent plantings, seasonal crops and vacant areas. Vacant areas are not irrigated; they may be in redevelopment, temporarily abandoned or permanently abandoned and would eventually be retired from irrigation.

From 1997 to 2021, permanent plantings increased by 31,170 hectares (111%), seasonal crops increased by 35 hectares, vacant areas that were previously irrigated permanent plantings increased by 5,365 hectares and vacant areas that were previously irrigated seasonal crops increased by 10,615 hectares.

The area of irrigated permanent and seasonal crops in 2021 was 31,205 hectares greater than in 1997 and 99.9% of the additional area irrigated was permanent plantings.

Seasonal cropping areas almost doubled from 1997 to 2021 from 12,545 ha to 23,195 ha. The active area, i.e. the area currently irrigated, in the recorded years remained relatively constant, within 10% of 12,000 hectares. The exception was 2009, when seasonal cropping greatly reduced due to impacts of the Millennium drought.

In 1997, 57% of permanent crops were in the pumped irrigation districts, but by 2021, 80% of permanent crops were in the private diverter river reaches.

Key findings

Table 1 shows the area in 2021 of permanent plantings, seasonal crops and vacant areas in the private diverter river reaches, the pumped irrigation districts and the Murrayville GMA.

In 2021, 73% of the irrigable area was in the private diverter river reaches, 19% in the pumped irrigation districts and 8% in the Murrayville GMA.

Table 1: Permanent and seasonal cropping areas in the Mallee catchment in 2021

2021 (ha)	Private diverters	Pumped districts	Murrayville GMA	Mallee total
Permanent plantings	47,440	11,645	45	59,130
Seasonal crops	8,305	995	2,170	11,470
Total irrigated	55,745	12,640	2,215	70,600
Vacant P (was permanent)	2,570	3,230	0	5,800
Vacant S (was seasonal)	6,070	1,085	4,570	11,725
Total irrigable	64,385	16,955	6,785	88,125
% of 2021 irrigable area	73%	19%	8%	100%

Potential future irrigation development

Actual and potential irrigation developments, post June 2021, were mapped from observation of soil survey pits and on-ground works in recent aerial and satellite imagery. Areas mapped were:

- 700 hectares planted or likely to be planted between July 2021 and June 2022. These were areas where on-ground works including new plantings were visible in recent aerial or satellite imagery. Areas were predominantly in the Colignan to Yatpool and Nyah river reaches; and
- 6,500 hectares of land with soil survey pits visible in recent aerial or satellite imagery. These sites were mainly in the Colignan to Yatpool, Darling to SA and Wemen river reaches. Note that irrigation development might not proceed and the surveyed area does not reflect the area that might be planted.

Key findings

Irrigation methods

The dominant irrigation method changed from furrow in 1997, to overhead in 2003, then to drip from 2006 to 2021.

In 2021, drippers were the dominant irrigation method in ten out of twelve study areas. Low level sprinklers were dominant in Robinvale and pivot irrigation was dominant in the Murrayville GMA.

The use of pressurised systems (drip, low level and overhead irrigation) increased from 61% of the irrigated area in 1997 to 97% by 2021.

Gravity systems (furrow and flood) decreased from 39% of the irrigated area in 1997 to 3% in 2021.

Salinity impact zones (*does not apply to the Murrayville GMA*)

The dominant salinity impact zone across irrigable areas in the Mallee catchment (excluding the Murrayville GMA) changed from the high impact zone (HIZ) in 1997 to the lowest impact zone (L1) from 2003 to 2021.

In 2021, 87% of the irrigable area was in low salinity impact zones (L1, L2, L3 and L4), and 13% was in the HIZ.

From 1997 to 2021, areas irrigated in low impact zones increased by 33,635 hectares, a 121% increase from 27,685 to 61,320 hectares. Areas irrigated in the HIZ decreased by 3,770 hectares, a 35% decrease from 10,835 to 7,065 hectares.

Salinity impact zones – new and retired areas

Irrigation expansion since 1997 was predominantly in the lowest salinity impact zone (L1) and areas retired from irrigation were predominantly in the high impact zone (HIZ).

From 1997 to 2021:

- 64% (1,600 ha) of areas retired from irrigation were in the high impact zone (HIZ); and
- 73% of expansion areas were in the lowest salinity impact zone (L1).

Irrigation properties

In 2021, there were approximately 1,790 irrigation properties in the Mallee catchment with an average irrigable area of 49 hectares. 77% of the irrigation properties were in the pumped irrigation districts, 22% were private diverters and 1% were Murrayville GMA irrigators.

Average property size (irrigable area) in the private diverter areas increased from 45 hectares in 1997 to 159 hectares in 2021 and in the pumped districts it increased from 9 hectares to 12 hectares. In the Murrayville GMA, it increased from approximately 121 hectares to 377 hectares.

Across the Mallee catchment from 1997 to 2021, the number of properties decreased by 658, while average property size (irrigable area) increased from 17 to 49 hectares.

Properties with an irrigable area less than 40 hectares decreased by 748, while the number over 40 hectares increased by 90 properties.

Introduction

This report was commissioned by the Mallee Catchment Management Authority (Mallee CMA) to provide an accurate snapshot of irrigation status and change in the Mallee catchment over twenty-four years, from 1997 to 2021. The study will enhance understanding of the dynamics of irrigation and its impact on salinity and water quality.

The study area is all irrigated horticulture in the Mallee catchment, along the Murray River from Woorinen South to the South Australian border and in the Murrayville Groundwater Management Area (GMA).

The project was identified as a key action (#1, #2 and #3) within the Victorian Mallee Irrigation Region Land and Water Management Plan 2020-29 with respect to planning and management of water availability issues.

Purpose of the report

The report will inform the Mallee CMA with respect to:

- Monitoring and evaluating implementation of the Mallee Land and Water Management Plan 2020-29;
- Planning for future irrigation and salinity management programs;
- Analysis and modelling of salinity impacts from irrigation developments;
- Mallee region reporting to State and Commonwealth Governments including review of regional items on the Basin Salinity Management 2030 Strategy registers;
- Achieving high-level, long-term goals of the Mallee Regional Catchment Strategy 2013-2019; and
- Investment priorities of the Sustainable Irrigation Program and other State programs.

Outputs

Outputs from the 2021 Mallee Horticulture Crop Report and its associated spatial crop mapping include:

- A draft and final report;
- A fact sheet;
- A MS Excel file with data analysis summaries and charts; and
- Spatial mapping with meta data and a data share agreement

Method

SunRISE Mapping and Research (SunRISE) - crop mapping

SunRISE crop mapping is captured to the individual patch or variety level using a map base of high-resolution, scale-accurate aerial imagery. Details for each crop patch such as type, variety, year planted and irrigation method are collected from irrigators, field surveys and aerial imagery interpretation. Some details are discernible from the imagery while others such as variety are provided by property owners or managers.

Details are also collected in collaboration with local agencies and industry bodies to support specific programs, such as planting statistics for industry planning and management, and spatial information for infrastructure development, biosecurity, economic assessments and environmental monitoring.

SunRISE records crop and property details from irrigators on an on-going basis. This is generally a part of the process of providing maps and plans for property management activities such as irrigation design, development, property sales, soil surveys, spray records, export registration, organic certification and environmental management. Confidentiality of individual property details is maintained and only aggregated information is published.

Aerial imagery

SunRISE crop mapping is based on aerial imagery that has been updated every three years since 1997.



Figure 1: Three-yearly aerial imagery used by SunRISE to map irrigated horticulture

Method

Adjustments made since earlier reports

Information for previous years published in this 2021 report may vary from earlier reports because:

- SunRISE collates crop and property details on an on-going basis. As more details are collected, earlier databases are backfilled where relevant and continually improved.
- The boundary between the Nyah and Boundary Bend private diverter river reaches was adjusted based on better information on diversion points and their delivery extents.
- In October 2020, the Mallee CMA employed staff¹ to conduct field surveys of crop types and irrigation methods visible from public roads. It was estimated that 45% of the irrigated area was observed, resulting in a correction to 3% of crop types and 5% of irrigation methods.
- Additional pivots were added to the Murrayville GMA. Earlier mapping only had active pivots which wasn't consistent with mapping of pivots in other districts. All pivot sites where the central pivot infrastructure is in place are mapped regardless of whether the site was active in the recorded year.
- Additional mapped areas were 'retired from irrigation'. The definition of areas 'retired' from irrigation was extended to also include areas that no longer had irrigation infrastructure in place or had not been irrigated for over ten years. This scenario was applied to areas that were returned to dryland agriculture. The original definition for retired was a change in land use that precluded use for irrigation and dryland agriculture does not necessarily preclude future irrigation.

All the above corrections/adjustments were backfilled to earlier databases where relevant.

Winter and summer field crops

In the 2021 mapping of irrigated areas, field crops were recorded as 'winter' irrigated (active July-October or April-June) or 'summer' irrigated (active from November to March). This detail is only presented in information on 2021 crop types and information on change from 1997 to 2021 with respect to field crops does not include the summer/winter split.

Irrigation areas in the Mallee catchment

All irrigation areas within the Mallee catchment boundary were mapped from a map base of aerial imagery. The 2021 crop mapping was based on aerial imagery flown between the 21st of January 2021 and 28th of February 2021. The imagery was acquired through the Coordinated Imagery Program, Department of Environment, Land, Water and Planning.

Irrigation seasons

Information presented in this report refers to the years: 1997, 2003, 2006, 2009, 2012, 2015, 2018 and 2021. The aerial imagery used for each of these years was captured at the start of the year and the information represents the 1996-97, 2002-03, 2005-06, 2008-09, 2011-12, 2014-15, 2017-18 and 2020-21 seasons respectively.

¹ Working for Victoria, Employment Program – Ground truthing crop data

Method

Positional and area accuracies

The aerial imagery is generally processed to sub-metre positional accuracy and the crop mapping has been captured at a scale of 1:2,000 or better from the imagery.

Hectares for seasonal plantings of vegetables and field crops (such as pasture) have a lesser reliability as the imagery provides only one snapshot of the season, making it difficult to determine irrigation activity across the relevant twelve-month period.

This is particularly the case for the Murrayville Groundwater Management Area (GMA) where 98% of crops are seasonal. Information for the Murrayville GMA should be treated as estimates only. There was limited imagery available for each of the report years from 1997 to 2021 and there were difficulties in differentiating between vegetable/potato crops and field crops.

Hectare totals were rounded to the nearest five hectares.

Development of permanent crops

The report includes information on permanent crops planted or redeveloped in the previous three-year period. The information provides an indication of development activity that is otherwise not reflected in information on changes in areas and crop types, i.e. the same area re-planted to the same crop type, but with a new variety.

This particularly applies in the pumped irrigation districts. Expansion of the irrigable area is limited, so it may appear that little development or change has occurred, however, redevelopment and top-working to different varieties can be significant.

The information on three-year development in permanent plantings is an indication only of the level of activity. In addition, the figures are conservative, as top-worked plantings can be difficult to interpret from the three-yearly aerial imagery.

Definitions

The following definitions apply in this report.

Irrigable area Irrigable area is the irrigated area and vacant, not irrigated areas that were irrigated and still could be irrigated. Some vacant areas may eventually be retired or they may be in redevelopment. An increase in irrigable area can arise from new 'greenfield' development and/or from an increase in the area irrigated following redevelopment to a new planting layout, often after the removal of furrow irrigation, drying racks etc.

Property One property is a holding with the one owner or corporate entity. A property generally comprises more than one 'farm', 'fruit block' or land parcel. Property numbers are determined from grower/owner input and are estimates only due to difficulties in maintaining change in ownership details.

Some property owners irrigate in more than one irrigation district or river reach. Hence, property numbers across the Mallee catchment are less than the sum of property numbers for each of the study areas.

Retired Areas 'retired' from irrigation have undergone a change in land use and no longer have irrigation infrastructure in place or have not been irrigated for over ten years. SunRISE generally relies on updated aerial imagery, or digital cadastre, for evidence of land use change such as residential development, buildings, sheds and dams. Areas set aside for conservation purposes or returned to dryland agriculture are also 'retired' from the crop mapping. 'Retired' areas are excluded from the 'irrigable' area.

Vacant The crop mapping includes a crop type of 'vacant'. Vacant areas were irrigated, but not in the season that the crop mapping refers to. Where the vacant area was previously a permanent planting, it is termed **Vacant P**. Where the vacant area was previously a seasonal planting, such as pasture or vegetables, it is termed **Vacant S**.

Salinity impact zones Salinity impact zones are mapped zones in north-west Victoria that correlate to tonnes of salt displaced to the Murray River from new irrigation. Salinity impact zones in this report refer to 'Salinity Offset Charging Zones', comprising four low impact zones (L1, L2, L3 and L4) and one high impact zone (HIZ).

Charging zones are used to determine levy charges for new developments, and have been used in this study, for ease of presentation, rather than the twelve 'Salinity Accountability Zones' (seven low impact zones and 5 high impact zones) which are used for reporting river salinity impacts to the Murray-Darling Basin Authority (salinity register). The relationship between salinity offset charging zones and salinity accountability zones is shown in Table 2.

Table 2: Salinity impact zones

	Salinity offset charging zones	Salinity accountability zones
Low salinity impact zones	L1	LIZ 1, LIZ 2
	L2	LIZ 3
	L3	LIZ 4, LIZ 5
	L4	LIZ 6, LIZ 7
High salinity impact zones	HIZ	HIZ 1, HIZ 2, HIZ 3, HIZ 4, HIZ 5

Crop type descriptions

Table 3 describes the crop types listed in this report.

Table 3: Description of irrigated crop types

Crop type		Description	
Permanent plantings	Grapevine	Dried	
		Table	
		Wine	Includes a very small proportion of juiced grapes
	Citrus		Includes: grapefruit, lemon, lime, mandarin, navel, blood orange, common orange, pummelo, tangelo, valencia
	Fruit tree	Olive	
		Other	Includes: avocado, date palm, fig, jujube, mango, persimmon, pome fruit, pomegranate, stone fruit
	Nut tree	Almond	
		Other	Includes: pistachio, walnut
	Other	Miscellaneous	Includes: aquaculture, berry, flowers, herbs, native plants, nursery, passionfruit, tree plantation
Seasonal crops	Field crop	Summer	Field crops irrigated/active between November and March
		Winter	Field crops irrigated/active July-October or April-June
	Vegetable	Carrot	
		Potato	
		Other	Includes: asparagus, bean, beetroot, broccoli, cabbage, capsicum, cauliflower, chilli, cucumber, eggplant, garlic, lettuce, melon, onion, pea, pumpkin, salad greens, sweet corn, tomato, zucchini
Vac.	Vacant P		Vacant (not irrigated), previously an irrigated permanent crop
	Vacant S		Vacant (not irrigated), previously an irrigated seasonal crop

Irrigation type descriptions

Irrigation methods are grouped as drip, low level, overhead and furrow as described in Table 4. Many irrigators use dual systems, such as drip with overhead sprinklers or cooling sprays, however, only the main irrigation method is used in this report.

Table 4: Description of irrigation methods

Irrigation method	Description
Drip	Includes: subsurface-drip, trickle
Low level	Includes: micro jet, micro sprinkler, sprinkler
Overhead	Includes: pivot, travel (lateral move)
Furrow	Gravity systems including flood
Vacant	Vacant (not irrigated) areas that were previously irrigated and could still be irrigated

Study area

The report covers twelve study areas in the Mallee catchment: five pumped irrigation districts, six river reaches of private diverters and the Murrayville Groundwater Management Area (GMA) as shown in Map 1. References to the 'Mallee catchment' in this report refer to the twelve study areas.

Pumped irrigation districts

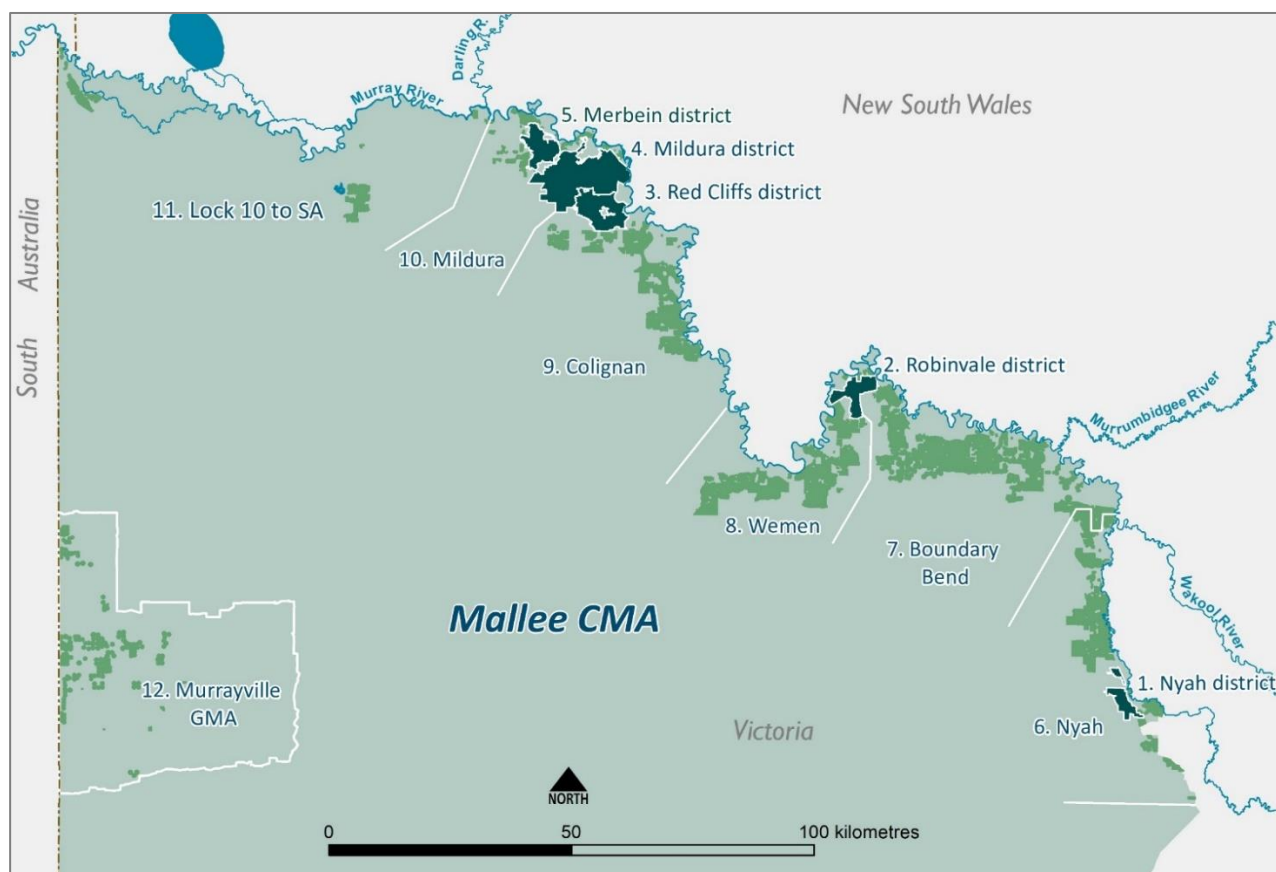
1. Nyah irrigation district
2. Robinvale irrigation district
3. Red Cliffs irrigation district
4. Mildura irrigation district
5. Merbein irrigation district

River reaches (private diverters)

6. Nyah river reach - Woorinen South to the Wakool River junction
7. Boundary Bend river reach - Wakool River junction to the Euston weir
8. Wemen river reach - Euston weir to Liparoo
9. Colignan river reach - Colignan to Yatpool
10. Mildura river reach - Mildura to Lock 10
11. Lock 10 to SA river reach - Lock 10 to the South Australian border

Murrayville Groundwater Management Area (GMA)

12. Murrayville GMA



Map 1: Map of the twelve study areas in the Mallee catchment

1. Mallee catchment summary

In summary for irrigated horticulture in the Mallee catchment from 1997 to 2021

Crop types 2021

The main crop types in the Mallee catchment in 2021 were:

1. almonds, 26,405 ha (30% of the irrigable area);
2. table grapes, 10,480 ha (12% of the irrigable area);
3. wine grapes, 8,165 ha (9% of the irrigable area);
4. winter field crops, 5,190 ha (6% of the irrigable area);
5. citrus, 4,600 ha (5% of the irrigable area);
6. olives, 3,765 ha (4% of the irrigable area);
7. potatoes, 2,615 ha (3% of the irrigable area);
8. dried grapes, 2,415 ha (3% of the irrigable area);
9. vegetables other than carrots and potatoes², 2,005 ha (2% of the irrigable area); and
10. fruit trees other than olives (mainly stone fruit and avocados), 1,930 ha (2% of the irrigable area).

Crop types 1997 to 2021

Wine grapes were the dominant crop from 1997 to 2006, followed by almonds from 2009 to 2021.

The main crop type changes from 1997 to 2021 were:

- almond trees increased by 24,660 ha, a 1,413% increase from 1,745 to 26,405 ha;
- table grape plantings increased by 6,330 ha, a 153% increase from 4,150 to 10,480 ha;
- dried grape plantings decreased by 3,915 ha, a 62% decrease from 6,330 to 2,415 ha;
- olive trees increased by 3,610 ha, a 2,329% increase from 155 to 3,765 ha; and
- wine grape plantings decreased by 1,810 ha, an 18% decrease from 9,975 to 8,165 ha. Plantings peaked around 2006 at 15,860 ha then continued to decrease until 2018. There was a slight, 65 ha, net increase between 2018 and 2021.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 7,750 ha (13%) of permanent crops were planted or top worked within the previous three years. These new plantings were predominantly (63%) table grapes and almonds:

1. table grapes (2,690 ha);
2. almonds (2,155 ha);
3. wine grapes (905 ha);
4. citrus (855 ha);
5. fruit trees (485 ha, including avocados, stone fruit and mangos);
6. pistachios and walnuts (a total of 300 ha);

² Carrots and potatoes are significant crops in the Mallee catchment and are reported on separately to 'other' vegetables

7. dried grapes (285 ha); and
8. nurseries and tree plantations (a total of 75 ha).

In summary for irrigated horticulture in the Mallee catchment

The area of these new plantings in each irrigation district was 820 ha in Mildura, 515 ha in Red Cliffs, 430 ha in Merbein, 280 ha in Robinvale and 65 ha in the Nyah irrigation district.

The area in each of the private diverter river reaches was 1,775 ha in Colignan, 1,410 ha Wemen, 915 ha in Nyah, 870 ha in Boundary Bend, 465 ha in the Lock 10 to SA reach and 205 ha in the Mildura private diverters' reach.

Three-year development activity across the Mallee catchment fell from 16.7% of 55,430 (9,250 ha) of permanent plantings in 2018 to 13.1% of 59,130 (7,750 ha) in 2021.. This was largely influenced by a decline in activity in the private diverter river reaches, as activity in 2021 across the pumped irrigation districts was at its highest since 2006.

Planting trends - permanent plantings, seasonal crops and vacant areas

The area of irrigated permanent and seasonal crops in 2021 was 31,205 ha greater than in 1997 and 99.9% of the additional area irrigated was permanent plantings.

Seasonal cropping areas almost doubled from 1997 to 2021, but the active area, i.e. the area irrigated, in the recorded years remained relatively constant, within 10% of 12,000 ha. The exception was 2009, when seasonal cropping was greatly reduced due to drought conditions.

From 1997 to 2021:

- irrigated permanent crops increased by 31,170 ha, from 27,960 to 59,130 ha;
- irrigated seasonal crops increased by 35 ha, from 11,435 to 11,470 ha;
- vacant areas, previously irrigated permanent plantings increased by 5,365 ha, from 435 to 5,800 ha; and
- vacant areas, previously irrigated seasonal crops increased by 10,615 ha, from 1,110 to 11,725 ha.

In 2021, 73% of the irrigable area was in the private diverter river reaches, 19% in the pumped irrigation districts and 8% in the Murrayville GMA.

80% of permanent plantings and 72% of seasonal crops were in the private diverter river reaches in 2021.

Irrigation development - new and retired areas

From 1997 to 2021, the irrigable area in the Mallee catchment increased by 47,185 ha, a 115% increase from 40,940 to 88,125 ha. The net increase of 47,185 ha was the balance of 2,595 ha retired from irrigation and 49,780 ha of expansion.

Expansion was predominantly in the private diverter river reaches where 43,135 hectares of expansion occurred; 16,735 hectares were in the Boundary Bend river reach and 11,830 hectares were in the Wemen river reach.

Retirement was mainly due to urban development in the irrigation districts where a total 1,480 hectares were retired from irrigation; 990 hectares of which were in the Mildura irrigation district.

In summary for irrigated horticulture in the Mallee catchment

Potential future irrigation development

Actual and potential irrigation developments, post June 2021, were mapped from observation of soil survey pits and on-ground works in recent aerial and satellite imagery. Areas mapped were:

- 700 ha planted or likely to be planted between July 2021 and June 2022. These were areas where on-ground works including new plantings were visible in recent aerial or satellite imagery. Areas were predominantly in the Colignan to Yatpool and Nyah river reaches; and
- 6,500 ha of land with soil survey pits visible in recent aerial or satellite imagery. These sites were mainly in the Colignan to Yatpool, Darling to SA and Wemen river reaches. Note that irrigation development might not proceed and the surveyed area does not reflect the area that might be planted.

Irrigation methods

The dominant irrigation method across the Mallee catchment changed from furrow in 1997 to overhead sprinklers in 2003, then drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 88,125 ha comprised:

- 58% (51,195 ha) drip irrigation;
- 9% (7,840 ha) low level irrigation;
- 11% (9,410 ha) overhead sprinklers and pivots;
- 2% (2,155 ha) furrow irrigation; and
- 20% (17,525 ha) vacant, not irrigated.

From 1997 to 2021 (Figure 2):

- drip irrigation increased by 47,240 ha, a 1,194% increase from 3,955 to 51,195 ha;
- low level irrigation increased by 1,930 ha, a 33% increase from 5,910 to 7,840 ha;
- overhead irrigation decreased by 4,885 ha, a 34% decrease from 14,295 to 9,410 ha; and
- furrow irrigation decreased by 13,080 ha, an 86% decrease from 15,235 to 2,155 ha.

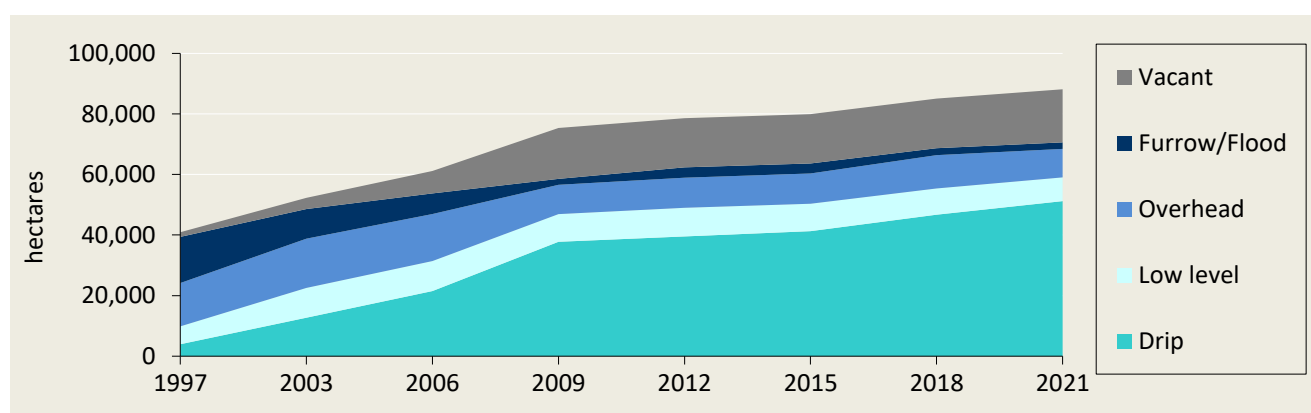


Figure 2: Change in irrigation methods from 1997 to 2021 in the Mallee catchment

In summary for irrigated horticulture in the Mallee catchment

Salinity impact zones (does not apply to the Murrayville GMA)

The dominant salinity impact zone, across irrigated and non-irrigated areas, changed from the high impact zone (HIZ) in 1997 to the lowest impact zone (L1) from 2003 to 2021.

In 2021, 87% of the irrigable area was in low salinity impact zones; L1, L2, L3 and L4, and 13% was in the high impact zone, HIZ.

Figure 3 shows the change in salinity impact zones in irrigated areas. From 1997 to 2021, areas irrigated in low impact zones increased by 33,635 ha, a 121% increase from 27,685 to 61,320 ha. Areas irrigated in the HIZ decreased by 3,770 ha, a 35% decrease from 10,835 to 7,065 ha.

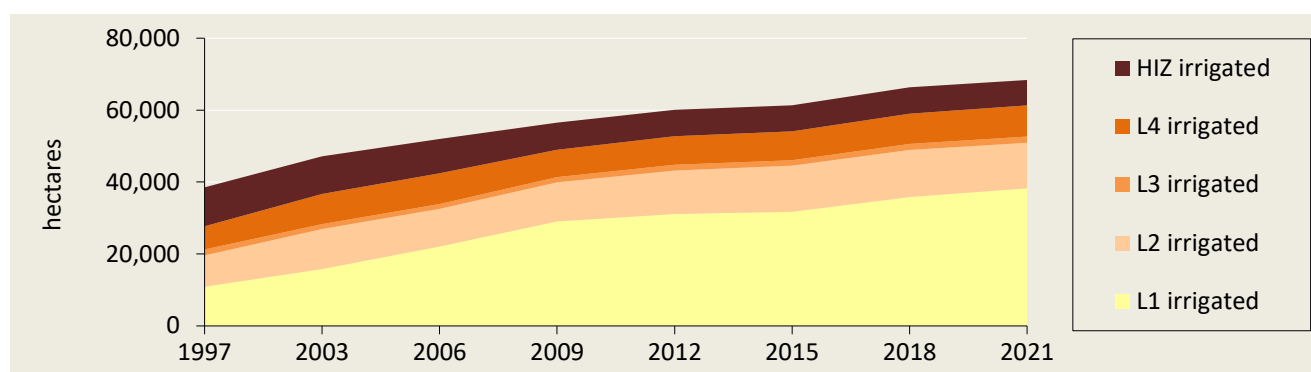


Figure 3: Change in salinity impact zones for irrigated areas in the Mallee catchment, 1997 to 2021

Salinity impact zones – new and retired areas

Irrigation expansion since 1997 was predominantly in the lowest salinity impact zone (L1) and areas retired from irrigation were predominantly in the high impact zone (HIZ).

From 1997 to 2021:

- 64% (1,600 ha) of areas retired from irrigation were in the high impact zone (HIZ); and
- 73% of expansion areas were in the lowest salinity impact zone (L1), 26% were in zones L2 to L4 and 1% were in the high impact zone, HIZ. (Expansion in the HIZ was development on existing irrigation properties.)

Irrigation properties

In 2021, there were approximately 1,790 irrigation properties in the Mallee catchment and the average property size (irrigable area) was 49 ha.

77% of properties were in the pumped irrigation districts, 22% were private diverters and 1% were in the Murrayville GMA.

From 1997 to 2021, the number of properties decreased by 658 (27%), while average property size (irrigable area) increased from 17 to 49 ha.

Properties with an irrigable area less than 40 ha decreased by 748, while the number over 40 ha increased by 90.

1.1 Mallee catchment - crop types in 2021

Table 5 lists irrigated crop types in the Mallee catchment (i.e. pumped irrigation districts, private diverter river reaches and the Murrayville GMA) in 2021.

The top ten crop types in 2021 were:

1. almonds, 26,405 ha (30% of the irrigable area);
2. table grapes, 10,480 ha (12% of the irrigable area);
3. wine grapes, 8,165 ha (9% of the irrigable area);
4. winter field crops, 5,190 ha (6% of the irrigable area);
5. citrus, 4,600 ha (5% of the irrigable area);
6. olives, 3,765 ha (4% of the irrigable area);
7. potatoes, 2,615 ha (3% of the irrigable area);
8. dried grapes, 2,415 ha (3% of the irrigable area);
9. vegetables other than carrots and potatoes, 2,005 ha (2% of the irrigable area); and
10. fruit trees other than olives (mainly stone fruit and avocados), 1,930 ha (2% of the irrigable area).

Table 5: Mallee catchment - irrigated crop types in 2021

Crop type		2021 (ha)	2021 %	Description
Permanent plantings	Grapevine	Dried	2,415	3%
		Table	10,480	12%
		Wine	8,165	9%
	Citrus		4,600	5%
	Fruit tree	Olive	3,765	4%
		Other	1,930	2%
	Nut tree	Almond	26,405	30%
		Other	830	1%
	Other	Miscellaneous	540	1%
Permanent crops (sub-total)		59,130	67%	
Seasonal crops	Field crop	Summer	980	1%
		Winter	5,190	6%
	Vegetable	Carrot	680	1%
		Potato	2,615	3%
		Other	2,005	2%
	Seasonal crops (sub-total)		11,470	13%
Vac.	Vacant P		5,800	7%
	Vacant S		11,725	13%
Total all crop areas		88,125	100%	

1.2 Mallee catchment - crop types from 1997 to 2021

Figure 4 summarises irrigated crop types in the Mallee catchment from 1997 to 2021. Wine grapes were the dominant crop from 1997 to 2006, followed by almonds from 2009 to 2021.

From 1997 to 2021, the main planting changes were:

- almond trees increased by 24,660 ha, a 1,413% increase from 1,745 to 26,405 ha;
- table grape plantings increased by 6,330 ha, a 153% increase from 4,150 to 10,480 ha;
- dried grape plantings decreased by 3,915 ha, a 62% decrease from 6,330 to 2,415 ha;
- olive trees increased by 3,610 ha, a 2,329% increase from 155 to 3,765 ha; and
- wine grape plantings decreased by 1,810 ha, an 18% decrease from 9,975 to 8,165 ha. Plantings peaked around 2006 at 15,860 ha then continued to decrease until 2018. There was a slight, 65 ha, net increase in area between 2018 and 2021.

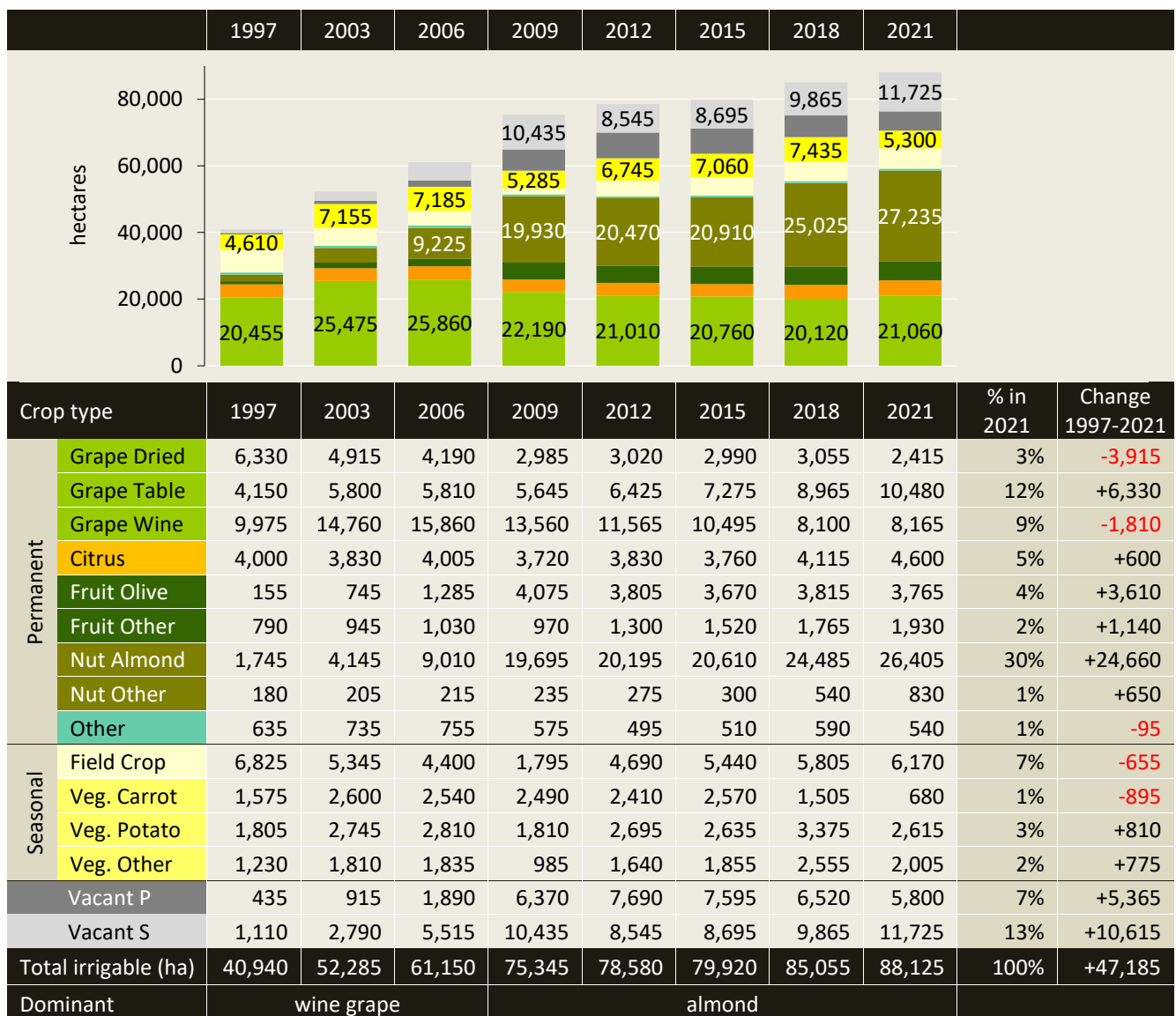


Figure 4: Mallee catchment - crop types from 1997 to 2021

1.3 Mallee catchment - development of permanent crops

Figure 5 shows the proportion of permanent crops planted or redeveloped within the previous three years in the Mallee catchment from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 7,750 ha (13%) of permanent crops were planted or top worked within the previous three years.
- These new or redeveloped plantings were:
 1. table grapes (2,690 ha);
 2. almonds (2,155 ha);
 3. wine grapes (905 ha);
 4. citrus (855 ha);
 5. fruit trees (485 ha, includes avocados, stone fruit and mangos);
 6. pistachios and walnuts (a total of 300 ha);
 7. dried grapes (285 ha); and
 8. nurseries and tree plantations (a total of 75 ha).
- Three-year new or redeveloped permanent plantings by irrigation district was; Mildura 820 ha, Red Cliffs 515 ha, Merbein 430 ha, Robinvale 280 ha and Nyah 65 ha.
- Three-year new or redeveloped permanent plantings by river reach was; Colignan 1,775 ha, Wemen 1,410 ha, Nyah 915 ha, Boundary Bend 870 ha, Lock 10 to SA 465 ha and Mildura private diverters 205 ha.

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was at its lowest in 2012 with 4,525 ha (9%) planted in the previous three years and highest in 2009 with 16,130 ha (31%) planted in the previous three years.

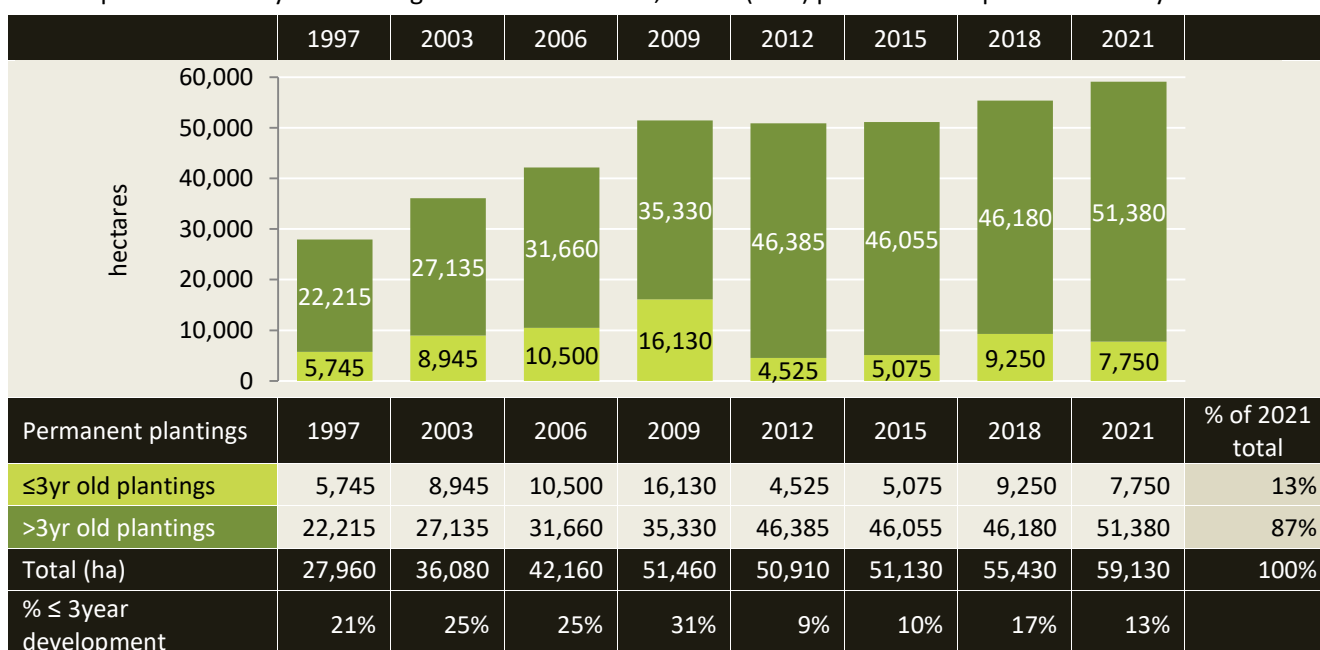


Figure 5: Mallee catchment - three-year development of permanent crops from 1997 to 2021

1.4 Mallee catchment - planting trends

The area irrigated in 2021 was 31,205 ha greater than in 1997 and 99.9% of the additional area irrigated was permanent plantings.

Seasonal cropping areas almost doubled from 1997 to 2021, but the area irrigated in the recorded years remained relatively constant, within 10% of 12,000 ha. The exception was 2009, when seasonal cropping was greatly reduced due to impacts of the Millennium drought.

Figure 6 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Mallee catchment from 1997 to 2021.

In 2021, the irrigable area of 88,125 ha comprised:

- 67% (59,130 ha) irrigated permanent plantings;
- 13% (11,470 ha) irrigated seasonal crops;
- 7% (5,800 ha) vacant, previously an irrigated permanent planting; and
- 13% (11,725 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- irrigated permanent crops increased by 31,170 ha, from 27,960 to 59,130 ha;
- irrigated seasonal crops increased by 35 ha, from 11,435 to 11,470 ha;
- vacant areas, previously irrigated permanent plantings increased by 5,365 ha, from 435 to 5,800 ha; and
- vacant areas, previously irrigated seasonal crops increased by 10,615 ha, from 1,110 to 11,725 ha.

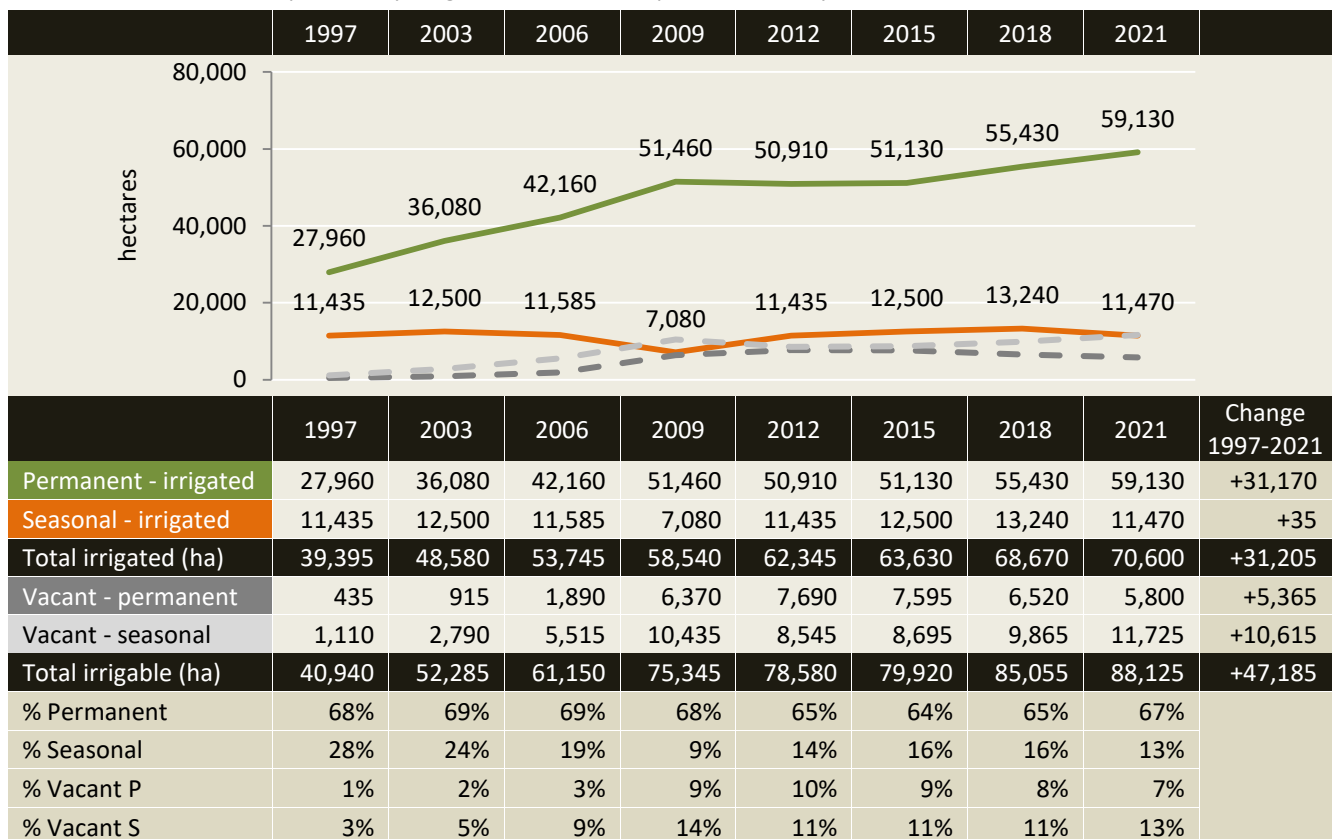


Figure 6: Mallee catchment - planting trends from 1997 to 2021

1.4.1 Mallee catchment – 2021 plantings in each study area

In 2021:

- 73% of the irrigable area was in the private diverter river reaches;
 - 19% of the irrigable area was in the pumped irrigation districts; and
 - 8% of the irrigable area was in the Murrayville GMA.
- 80% of permanent plantings were irrigated in private diverter river reaches, 20% in the irrigation districts and less than 1% in the Murrayville GMA.
 - 72% of seasonal crops were irrigated in private diverter river reaches, 9% in the irrigation districts and 19% in the Murrayville GMA.
 - 56% of vacant areas, previously irrigated permanent crops (Vacant P) were in the irrigation districts and 44% in the private diverter river reaches.
 - 52% of vacant areas, previously irrigated seasonal crops (Vacant S) were in private diverter areas, 39% in the Murrayville GMA and 9% in the irrigation districts.

Figure 7 shows the proportion of permanent crops, seasonal crops and vacant areas in each of the Mallee catchment study areas in 2021.

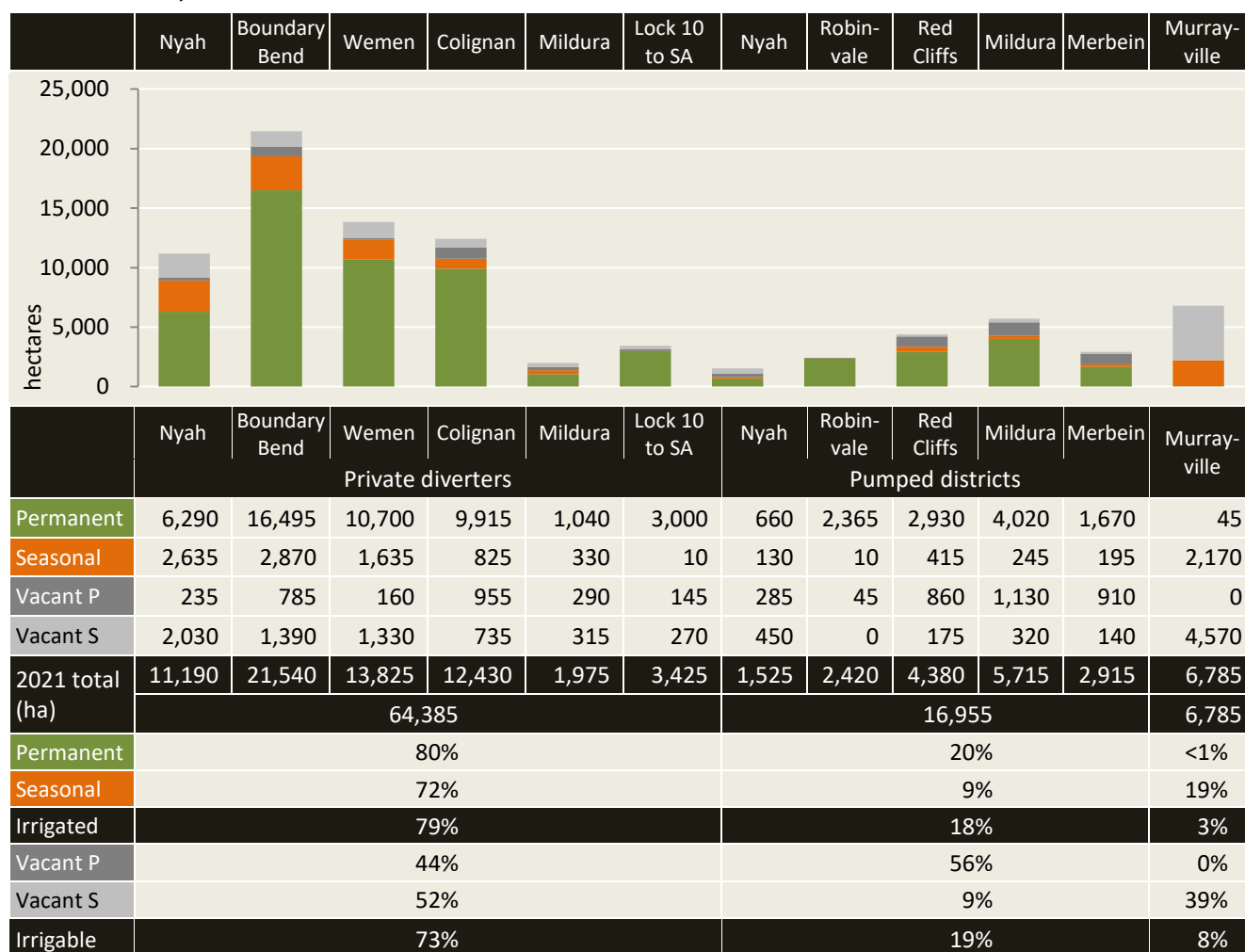


Figure 7: Mallee catchment - permanent plantings, seasonal crops and vacant areas in 2021

1.5 Mallee catchment - irrigation development

Table 6 summarises irrigation development with respect to new development (expansion) and areas retired from irrigation in the Mallee catchment from 1997 to 2021.

From 1997 to 2021, the irrigable area in the Mallee catchment increased by 47,185 ha, a 115% increase from 40,940 to 88,125 ha. The net increase of 47,185 ha was the balance of 2,595 ha retired from irrigation and 49,780 ha of expansion.

Across the pumped districts the irrigable area decreased by 525 ha, a 3% decrease from 17,480 ha in 1997 to 16,955 ha in 2021. The net decrease was the balance of 1,480 ha retired from irrigation and 955 ha of expansion.

In the private diverter river reaches, the irrigable area increased by 42,130 ha, a 189% increase from 22,255 ha in 1997 to 64,385 ha in 2021. The net increase of 42,130 ha was the balance of 1,005 ha retired from irrigation and 43,135 ha of expansion.

In the Murrayville GMA, the irrigable area increased by 5,580 ha, a 463% increase from 1,205 ha in 1997 to 6,785 ha in 2021. The net increase of 5,580 ha was the balance of 110 ha retired from irrigation and 5,690 ha of expansion.

Table 6: Mallee catchment – summary of irrigation development from 1997 to 2021

	Study area	1997 (ha)	1997 to 2021		2021 (ha)	Net change 1997-2021	Growth % 1997-2021
			Retired ³	New			
Pumped irrigation districts	Nyah	1,120	-45	+450	1,525	+405	+36%
	Robinvale	2,320	-30	+130	2,420	+100	+4%
	Red Cliffs	4,450	-170	+100	4,380	-70	-2%
	Mildura	6,445	-990	+260	5,715	-730	-11%
	Merbein	3,145	-245	+15	2,915	-230	-7%
	Sub-total (ha)	17,480	-1,480	+955	16,955	-525	-3%
Private diverters	Nyah	4,970	-60	+6,280	11,190	+6,220	+125%
	Boundary Bend	5,125	-320	+16,735	21,540	+16,415	+320%
	Wemen	2,150	-155	+11,830	13,825	+11,675	+543%
	Colignan	6,925	-85	+5,590	12,430	+5,505	+79%
	Mildura	1,445	-90	+620	1,975	+530	+37%
	Lock10 to SA	1,640	-295	+2,080	3,425	+1,785	+109%
	Sub-total (ha)	22,255	-1,005	+43,135	64,385	+42,130	+189%
Murrayville GMA (ha)		1,205	-110	+5,690	6,785	+5,580	+463%
Mallee catchment total (ha)		40,940	-2,595	+49,780	88,125	+47,185	+115%

³ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure or have not been irrigated for over ten years e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

1.5.1 Mallee catchment - potential future irrigation development

Figure 8 shows irrigation expansion from mid-2018 to mid-2021 along the Murray River in the Mallee catchment and potential future development areas. Areas do not include the Murrayville GMA.

From 2018 to 2021, the irrigable area increased by 2,785 ha, from 78,555 to 81,340 ha. The net increase of 2,785 ha was the balance of 440 ha retired from irrigation and 3,225 ha of expansion. Expansion areas are coloured bright green in Figure 8.

Potential future development areas are coloured orange in Figure 8. They represent actual and potential developments post June 2021. Areas include:

- 700 ha that were planted or are likely to be planted between July 2021 and June 2022. These are areas where on-ground works were visible in recent aerial or satellite imagery. Plantings are likely to be; almonds, field crops, table grapes, potatoes, citrus and wine grapes predominantly in the Colignan to Yatpool and Nyah river reaches; and
- 6,500 ha of land that have had soil surveys from mid-2018 to mid-2021, i.e. survey pits were visible in aerial or satellite imagery. These sites are mainly in the Colignan to Yatpool, Darling to SA and Wemen river reaches. Note that irrigation development might not proceed and the surveyed area does not reflect the area that might be planted.

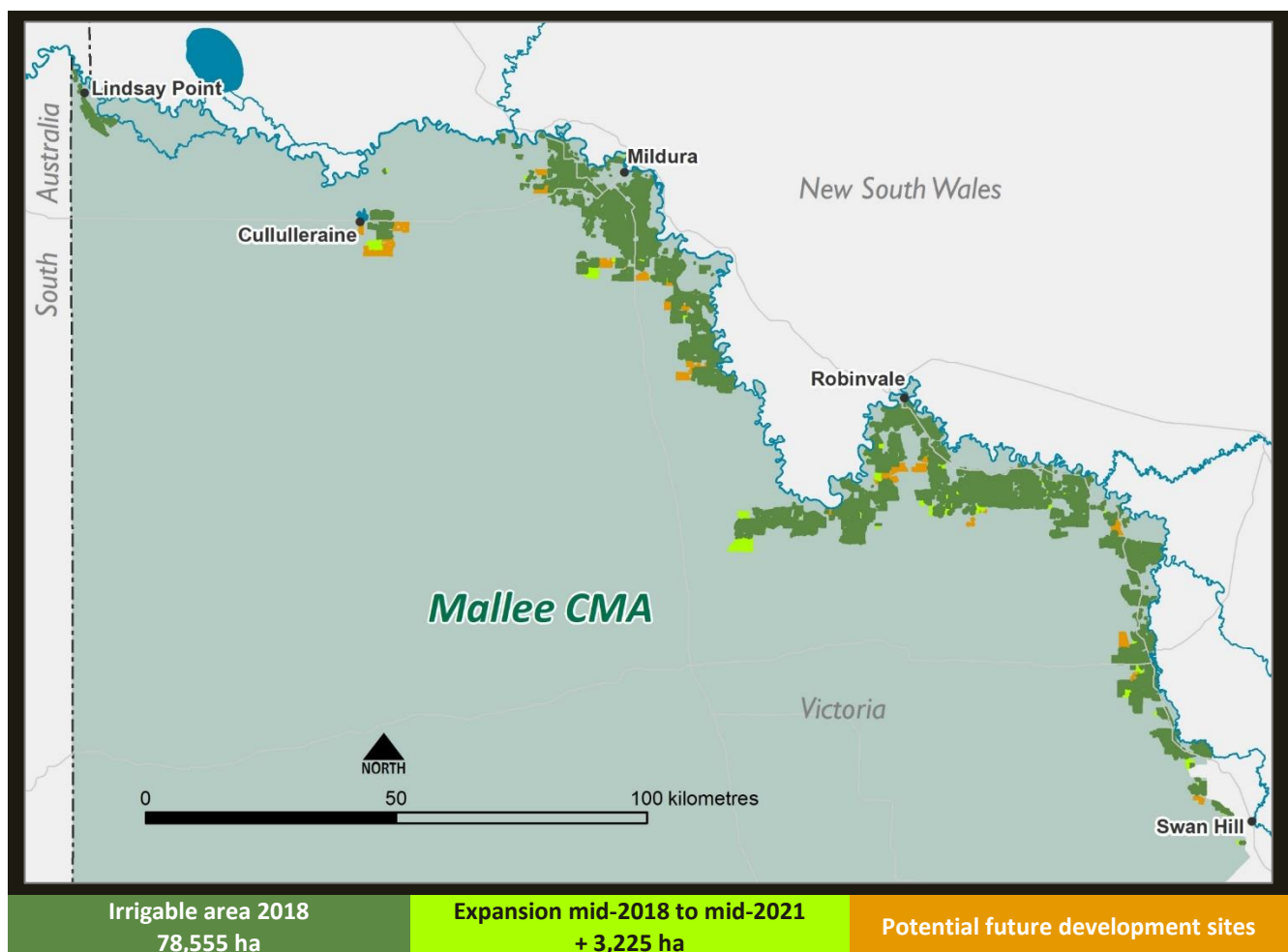


Figure 8: Mallee catchment – irrigation expansion and potential future development sites

1.6 Mallee catchment - irrigation methods

Figure 9 summarises irrigation methods across the Mallee catchment from 1997 to 2021.

The dominant irrigation method across the Mallee catchment was furrow in 1997, followed by overhead sprinklers in 2003 then drip irrigation from 2006 to 2021.

Drip irrigation was the dominant method in each of the study areas in 2021, except for the Robinvale district where low level sprinklers were dominant and the Murrayville GMA where pivots were dominant.

In 2021, the irrigable area of 88,125 ha comprised:

- 58% (51,195 ha) drip irrigation;
- 9% (7,840 ha) low level irrigation;
- 11% (9,410 ha) overhead sprinklers and pivots;
- 2% (2,155 ha) furrow irrigation; and
- 20% (17,525 ha) vacant, not irrigated.

From 1997 to 2021:

- drip irrigation increased by 47,240 ha, a 1,194% increase from 3,955 to 51,195 ha;
- low level irrigation increased by 1,930 ha, a 33% increase from 5,910 to 7,840 ha;
- overhead irrigation decreased by 4,885 ha, a 34% decrease from 14,295 to 9,410 ha; and
- furrow irrigation decreased by 13,080 ha, an 86% decrease from 15,235 to 2,155 ha.

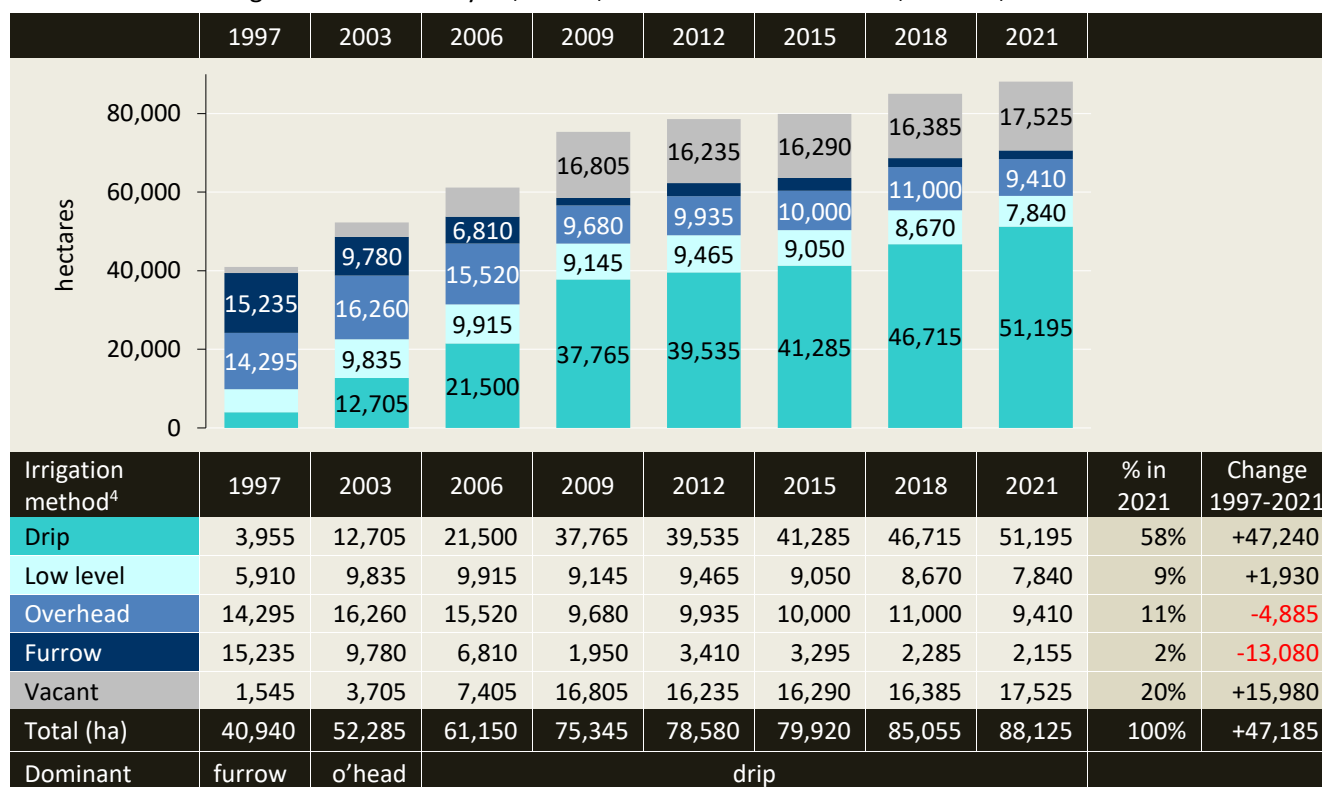


Figure 9: Mallee catchment - irrigation methods from 1997 to 2021

⁴ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

1.7 Mallee catchment - salinity impact zones

Figure 10 summarises the irrigable area in each Murray River salinity impact zone in the Mallee catchment (excluding the Murrayville GMA⁵) from 1997 to 2021. The dominant salinity impact zone, across irrigated and non-irrigated areas, changed from the high impact zone (HIZ) in 1997 to the lowest impact zone (L1) by 2003.

In 2021, the irrigable area of 81,340 ha comprised:

- 53% (43,055 ha) in the lowest impact zone, L1;
- 19% (15,660 ha) in L2;
- 3% (2,515 ha) in L3;
- 12% (9,855 ha) in L4; and
- 13% (10,255 ha) in the high impact zone, HIZ.

From 1997 to 2021, the area irrigated in:

- L1 to L4 increased by 33,635 ha, a 121% increase from 27,685 to 61,320 ha; and
- HIZ decreased by 3,770 ha, a 35% decrease from 10,835 to 7,065 ha.

From 1997 to 2021, the irrigable area in:

- L1 to L4 increased by 42,780 ha, a 151% increase from 28,305 to 71,085 ha; and
- HIZ decreased by 1,175 ha, a 10% decrease from 11,430 to 10,255 ha.

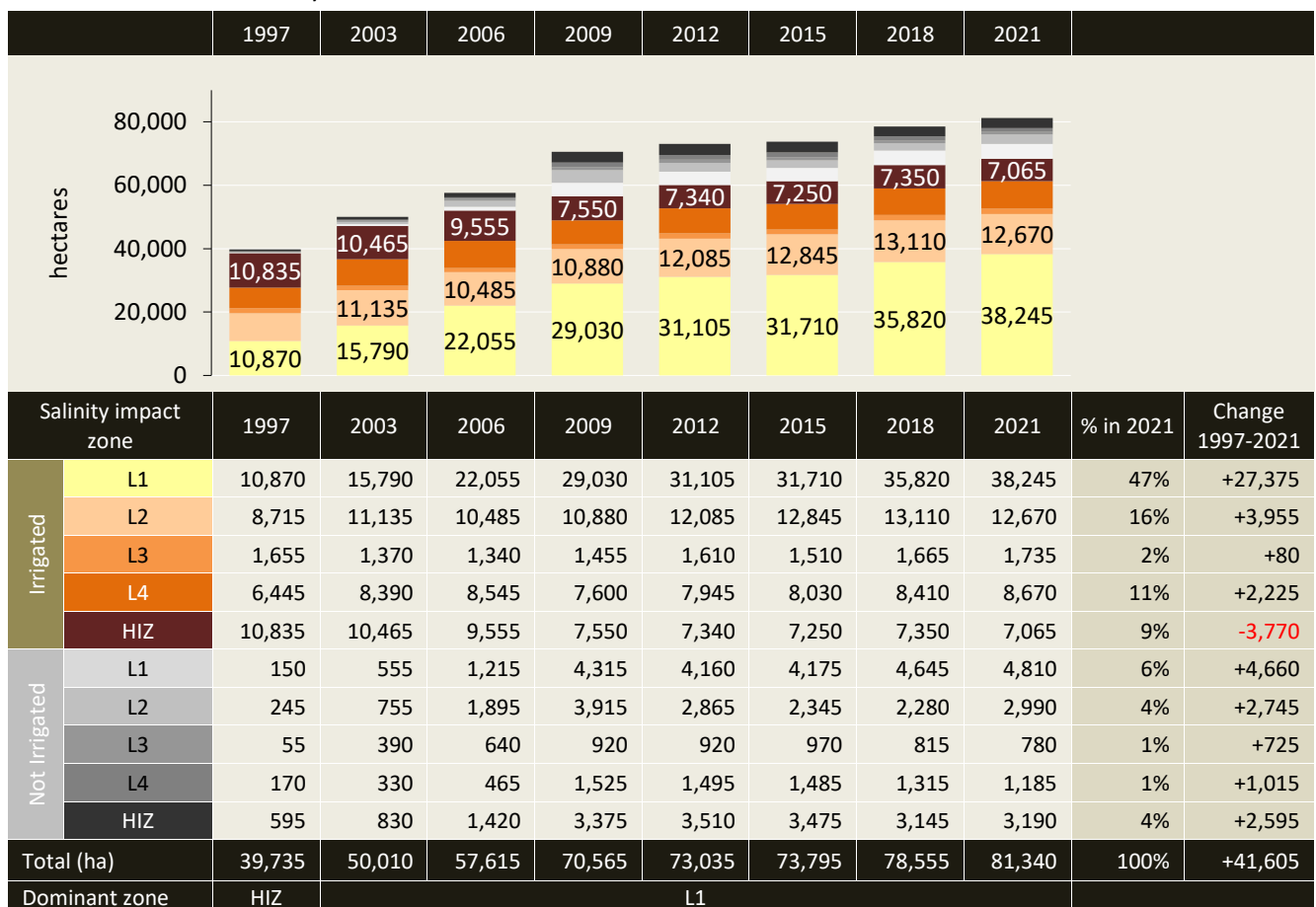


Figure 10: Mallee catchment - irrigable area in each salinity impact zone from 1997 to 2021

⁵ Salinity impact zones do not apply in the Murrayville GMA.

Salinity zones – new and retired areas

Irrigation expansion since 1997 was predominantly in the lowest salinity impact zone (L1) and areas retired from irrigation were predominantly in the high impact zone (HIZ).

From 1997 to 2021:

- 64% (1,600 ha) of areas retired from irrigation were in the high impact zone (HIZ); and
- 73% of expansion areas were in the lowest salinity impact zone (L1), 26% were in zones L2 to L4 and 1% were in the high impact zone, HIZ. (Expansion in the HIZ was development on existing irrigation properties.)

Salinity zones in each study area in 2021

Figure 11 show salinity impact zones in each private diverter river reach and irrigation district in 2021. Salinity zones do not apply in the Murrayville GMA.

In 2021, the total irrigable area in the high salinity impact zone was 10,255 ha:

- 28% (2,860 ha) of HIZ areas were in the private diverter river reaches of Colignan to Karadoc, Mildura and Lock 10 to SA; and
- 72% (7,395 ha) of HIZ areas were in the irrigation districts of Red Cliffs, Mildura and Merbein.

The Mildura irrigation district had the highest proportion of HIZ areas, 35% (3,610 ha) in 2021.

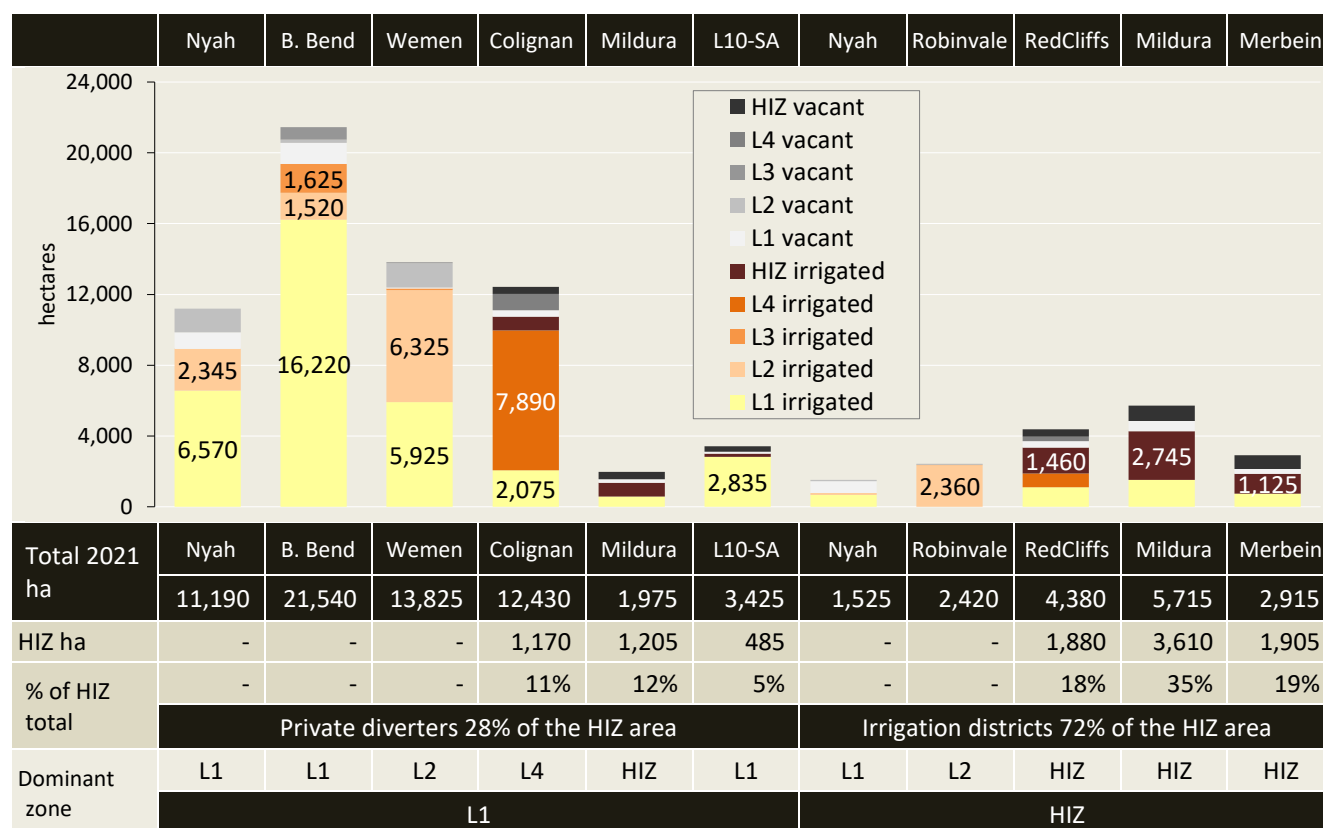


Figure 11: Mallee catchment - salinity impact zones in each study area in 2021

1.8 Mallee catchment - property change

Figure 12 provides estimates of property numbers and average property size (irrigable area) in the Mallee catchment from 1997 to 2021.

In 2021:

- there were approximately 1,790 irrigation properties;
- most properties (86%) had an irrigable area less than 40 ha; and
- 77% of properties were in the pumped irrigation districts, 22% were private diverters and 1% Murrayville GMA irrigators. Average property size was 12 ha, 159 ha and 377 ha respectively (Figure 21, Figure 61 and Figure 102).

From 1997 to 2021:

- the number of properties decreased by 658, a 27% decrease from 2,448 to 1,790 properties;
- properties with an irrigable area less than 40 ha decreased by 748, while the number over 40 ha increased by 90; and
- average property size (irrigable area) increased from 17 to 49 ha.

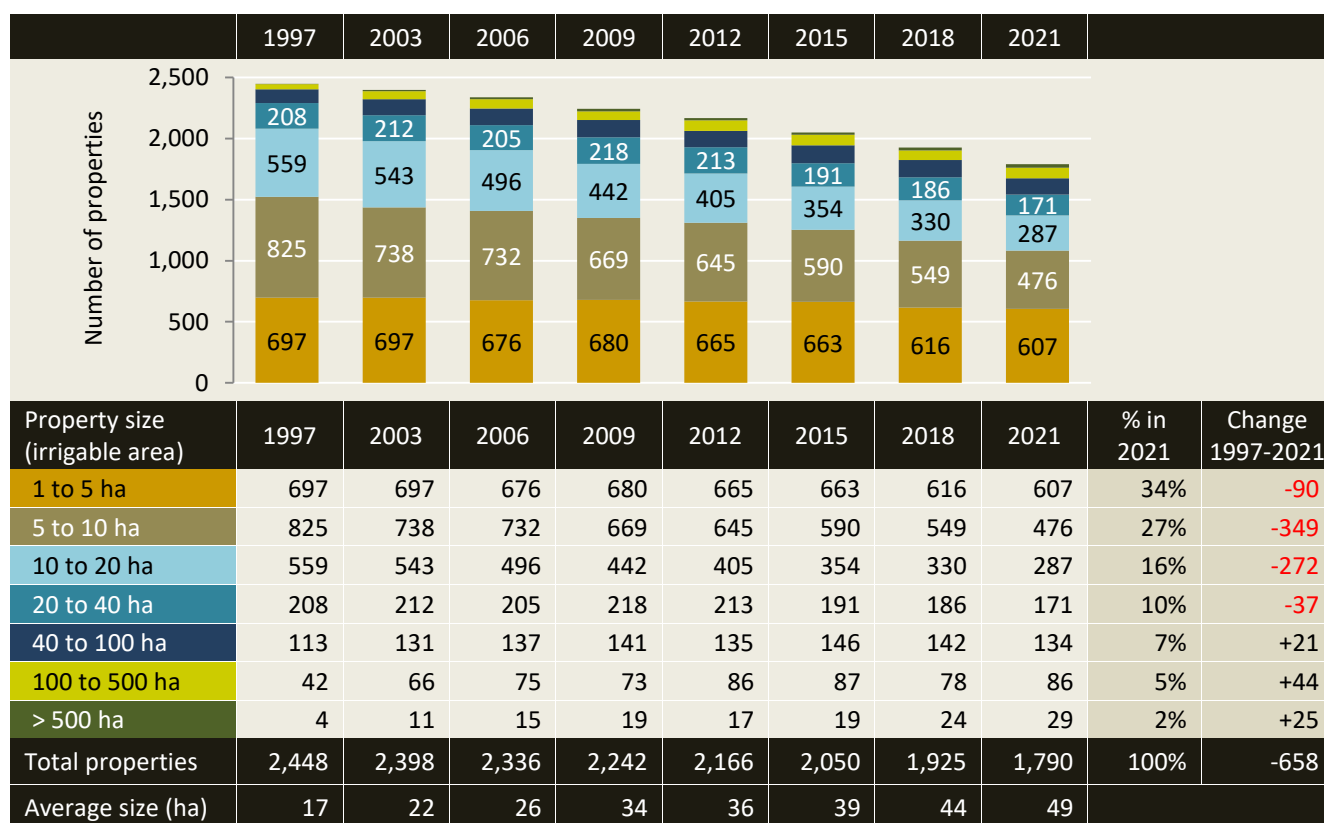


Figure 12: Mallee catchment - property numbers and sizes from 1997 to 2021

Note: Total property numbers across the Mallee catchment are less than the sum of property numbers in each of the twelve study areas as some property owners irrigate in more than one study area.

2. Pumped irrigation districts

2.1 Pumped irrigation districts summary

In summary for the pumped irrigation districts; Nyah, Robinvale, Red Cliffs, Mildura and Merbein

Crop types in 2021

The main plantings in the pumped irrigation districts in 2021 were:

1. table grapes, 6,400 ha (38% of the irrigable area);
2. wine grapes, 2,725 ha (16% of the irrigable area);
3. dried grapes, 1,240 ha (7% of the irrigable area);
4. vegetables other than carrots and potatoes, 525 ha (3% of the irrigable area);
5. field crops, summer and winter, 460 ha (3% of the irrigable area); and
6. citrus, 405 ha (2% of the irrigable area).

Crop types 1997 to 2021

The dominant crop changed from dried grape plantings in 1997 to wine grapes from 2003 to 2009, then table grapes from 2012 to 2021.

The main crop type changes from 1997 to 2021 were:

- dried grapes decreased by 4,720 ha, a 79% decrease from 5,960 to 1,240 ha;
- table grapes increased by 3,360 ha, a 111% increase from 3,040 to 6,400 ha; and
- wine grapes decreased by 3,160 ha, a 54% decrease from 5,885 to 2,725 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 2,110 ha (18%) of permanent crops in the irrigation districts were planted or redeveloped within the previous three years.

The 2,110 ha was the highest area of new or redeveloped permanent plantings since 2006.

The new permanent plantings in 2021 were mainly (72%) table grapes:

1. table grapes (1,525 ha);
2. wine grapes (170 ha);
3. citrus (170 ha);
4. dried grapes (120 ha);
5. almonds, pistachios and walnuts (a total of 60 ha);
6. fruit trees (35 ha); and
7. nurseries (30 ha).

The proportion of these new plantings in each irrigation district was; 39% in Mildura, 24% in Red Cliffs, 20% in Merbein, 13% in Robinvale and 3% in the Nyah irrigation district.

In summary for the pumped irrigation districts; Nyah, Robinvale, Red Cliffs, Mildura and Merbein

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 16,955 ha comprised:

- 69% (11,645 ha) permanent plantings;
- 6% (995 ha) seasonal crops;
- 19% (3,230 ha) vacant, previously an irrigated permanent planting; and
- 6% (1,085 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings decreased from 92% to 69% of the irrigable area;
- seasonal crops were 6% of the irrigable area in 1997 and in 2021;
- vacant areas, previously irrigated permanent plantings increased from 1% to 19% of the irrigable area; and
- vacant areas, previously irrigated seasonal crops increased from 1% to 6% of the irrigable area.

Irrigation development - new and retired areas

The irrigable area in the pumped districts decreased by 525 ha, a 3% decrease from 17,480 ha in 1997 to 16,955 ha in 2021.

The net decrease of 525 ha was the balance of 1,480 ha retired from irrigation and 955 ha of expansion. Areas retired were mainly for urban development.

Irrigation methods

The dominant irrigation method in the pumped irrigation districts was furrow irrigation from 1997 to 2003. Low level irrigation replaced furrows as the dominant method from 2006 to 2009, followed by drip irrigation from 2012 to 2021.

In 2021, the irrigable area of 16,955 ha comprised:

- 44% (7,420 ha) drip irrigation;
- 23% (3,850 ha) low level irrigation;
- 6% (1,065 ha) overhead sprinklers;
- 2% (305 ha) furrow irrigation; and
- 25% (4,315 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 6,655 ha, an 870% increase from 765 to 7,420 ha;
- low level irrigation increased by 1,155 ha, a 43% increase from 2,695 to 3,850 ha;
- overhead irrigation decreased by 3,265 ha, a 75% decrease from 4,330 to 1,065 ha; and
- furrow irrigation decreased by 9,045 ha, a 97% decrease from 9,350 to 305 ha.

In summary for the pumped irrigation districts; Nyah, Robinvale, Red Cliffs, Mildura and Merbein

Salinity impact zones

The dominant zone across the irrigable area in the pumped irrigation districts was the high impact zone, HIZ, from 1997 to 2021.

In 2021, the irrigable area of 16,955 ha comprised:

- 35% (5,910 ha) in the lowest salinity impact zone, L1;
- 15% (2,595 ha) in L2;
- < 1% (25 ha) in L3;
- 6% (1,030 ha) in L4; and
- 44% (7,395 ha) in HIZ.

From 1997 to 2021, the irrigable area in:

- L1 to L4 increased by 575 ha, a 6% increase from 8,985 to 9,560 ha; and
- HIZ decreased by 1,100 ha, a 13% decrease from 8,495 to 7,395 ha.

Irrigation properties

In 2021, there were approximately 1,417 irrigation properties in the irrigation districts and the average property size (irrigable area) was 12 ha.

From 1997 to 2021:

- the number of properties decreased by 570, a 29% decrease from 1,987 to 1,417 properties;
- properties with an irrigable area less than 20 ha decreased by 642, while the number over 20 ha increased by 72; and
- average property size (irrigable area) increased from 9 to 12 ha.

2.1.1 Pumped districts summary - crop types in 2021

Table 7 lists irrigated crop types in the five pumped irrigation districts in 2021.

The dominant plantings in 2021 were:

1. table grapes, 6,400 ha (38% of the irrigable area);
2. wine grapes, 2,725 ha (16% of the irrigable area);
3. dried grapes, 1,240 ha (7% of the irrigable area);
4. vegetables other than carrots and potatoes, 525 ha (3% of the irrigable area);
5. field crops, summer and winter, 460 ha (3% of the irrigable area); and
6. citrus, 405 ha (2% of the irrigable area).

Table 7: Pumped irrigation districts – irrigated crop types in 2021

Crop type		2021 (ha)	2021 %	Description
Permanent plantings	Grapevine	Dried	1,240	7%
		Table	6,400	38%
		Wine	2,725	16%
	Citrus		405	2%
	Fruit tree	Olive	80	<1%
		Other	280	2%
	Nut tree	Almond	170	1%
		Other	185	1%
	Other	Miscellaneous	160	1%
Permanent crops (sub-total)		12,640	69%	
Seasonal crops	Field crop	Summer	190	1%
		Winter	270	2%
	Vegetable	Carrot	10	<1%
		Potato	-	-
		Other	525	3%
	Seasonal crops (sub-total)		995	6%
Vac.	Vacant P		3,230	19%
	Vacant S		1,085	6%
Total all crop areas		16,955	100%	

2.1.2 Pumped districts summary - crop types from 1997 to 2021

Figure 13 summarises horticultural crops in the Mallee pumped irrigation districts from 1997 to 2021. The dominant crop changed from dried grape plantings in 1997 to wine grapes from 2003 to 2009, then table grapes from 2012 to 2021.

From 1997 to 2021, the main planting changes were:

- dried grapes decreased by 4,720 ha, a 79% decrease from 5,960 to 1,240 ha;
- table grapes increased by 3,360 ha, a 111% increase from 3,040 to 6,400 ha;
- wine grapes decreased by 3,160 ha, a 54% decrease from 5,885 to 2,725 ha;
- field crops decreased by 175 ha, a 28% decrease from 635 to 460 ha;
- citrus decreased by 160 ha, a 28% decrease from 565 to 405 ha; and
- other nuts (pistachios and walnuts) increased by 150 ha, a 429% increase from 35 to 185 ha.

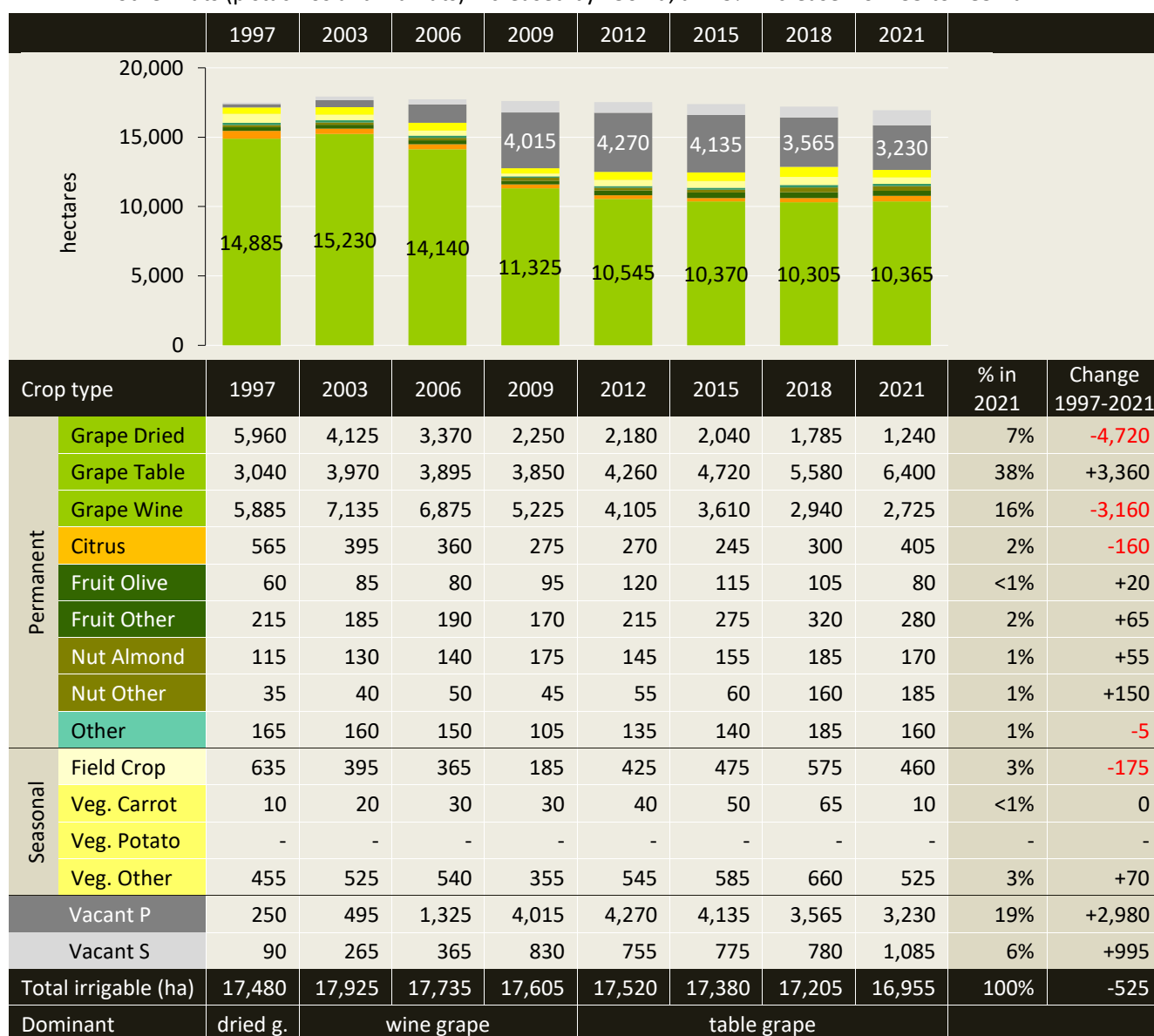


Figure 13: Pumped irrigation districts - crop types from 1997 to 2021

2.1.3 Pumped irrigation districts - development of permanent crops

Figure 14 shows the proportion of permanent crops planted or top-worked in the previous three years across the pumped irrigation districts from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 2,110 ha (18%) of permanent crops were planted or top-worked within the previous three years.
- The 2,110 ha was the highest area of new or redeveloped permanent plantings since 2006.
- The new 2021 plantings were:
 1. table grapes (1,525 ha);
 2. wine grapes (170 ha);
 3. citrus (170 ha);
 4. dried grapes (120 ha);
 5. almonds, pistachios and walnuts (a total of 60 ha);
 6. fruit trees (35 ha); and
 7. nurseries (30 ha).
- Three-year development of permanent plantings by irrigation district was; Mildura 820 ha, Red Cliffs 515 ha, Merbein 430 ha, Robinvale 280 ha and Nyah 65 ha.



Figure 14: Pumped irrigation districts - three-year development of permanent crops 1997 to 2021

2.1.4 Pumped irrigation districts - planting trends

Figure 15 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the irrigation districts from 1997 to 2021.

In 2021, the irrigable area of 16,955 ha comprised:

- 69% (11,645 ha) irrigated permanent plantings;
- 6% (995 ha) irrigated seasonal crops;
- 19% (3,230 ha) vacant, previously an irrigated permanent planting; and
- 6% (1,085 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- irrigated permanent crops decreased by 4,395 ha, from 16,040 to 11,645 ha;
- irrigated seasonal crops decreased by 105 ha, from 1,100 to 995 ha;
- vacant areas, previously irrigated permanent plantings increased by 2,980 ha, from 250 to 3,230 ha; and
- vacant areas, previously irrigated seasonal crops increased by 995 ha, from 90 to 1,085 ha.

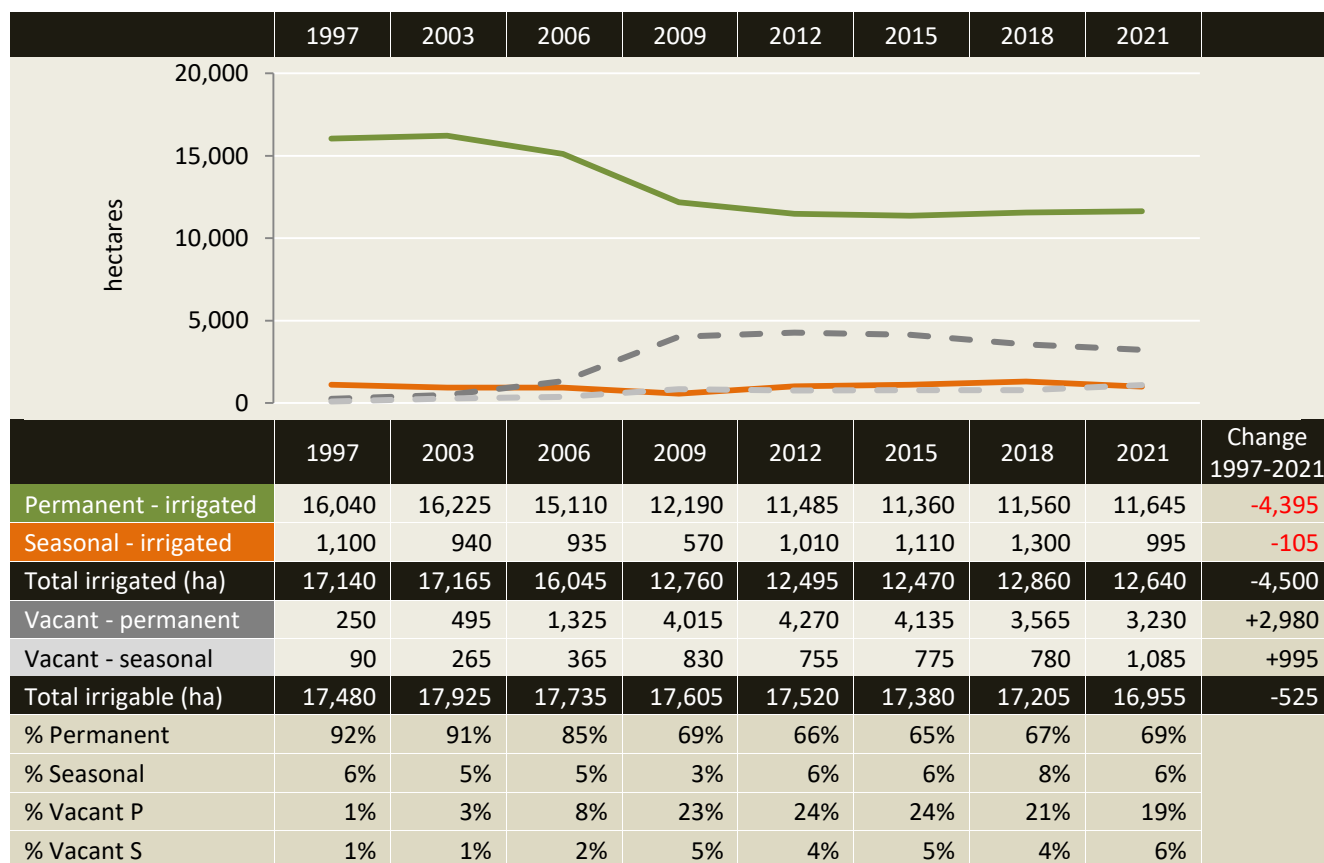


Figure 15: Pumped irrigation districts - planting trends from 1997 to 2021

2.1.5 Pumped districts summary - irrigation development

Figure 16 summarises irrigation development with respect to new development (expansion) and areas retired⁶ from irrigation in the pumped irrigation districts from 1997 to 2021.

- The irrigable area decreased by 525 ha, a 3% decrease from 17,480 ha in 1997 to 16,955 ha in 2021. The net decrease of 525 ha was the balance of 1,480 ha retired from irrigation and 955 ha of expansion.
- The irrigable area in the Nyah and Robinvale districts increased by 36% (405 ha) and 4% (100 ha) respectively.
- The irrigable area in the Mildura, Red Cliffs and Merbein districts decreased by 11% (730 ha), 2% (70 ha) and 7% (230 ha) respectively.

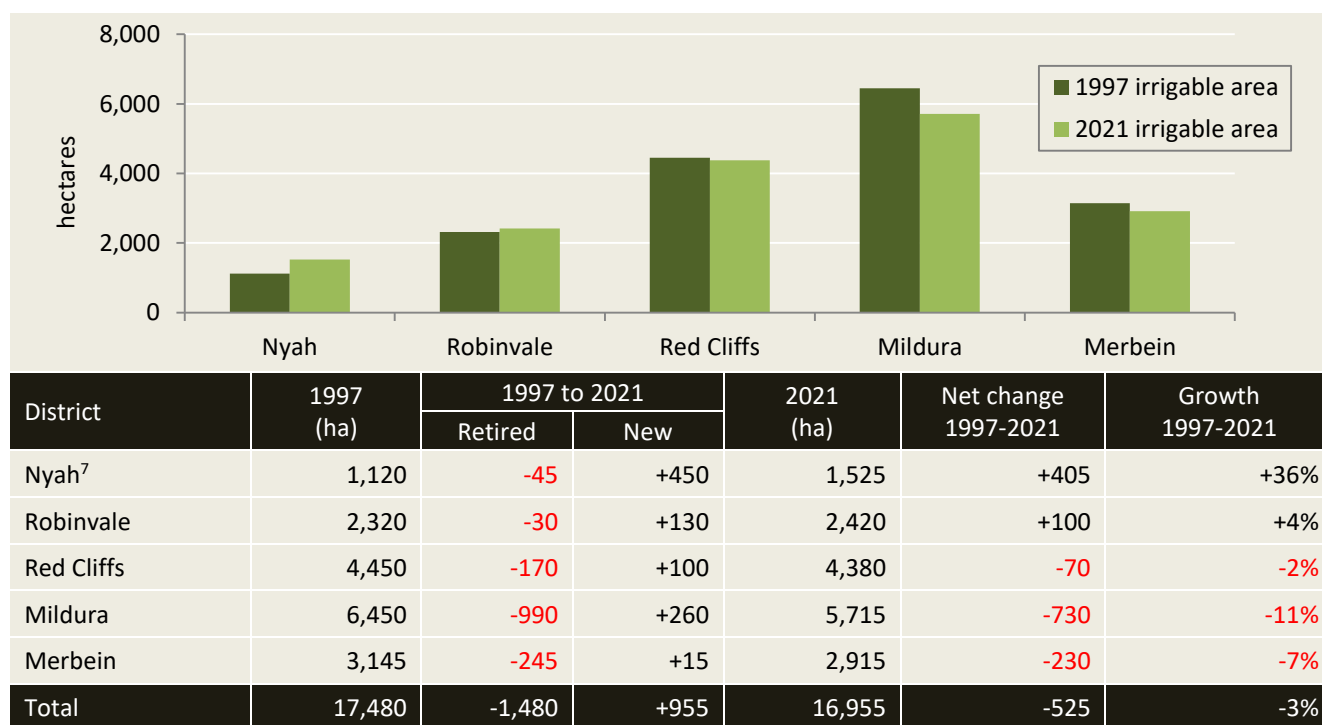


Figure 16: Pumped irrigation districts - irrigation development from 1997 to 2021

⁶ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

⁷ Hectares for the Nyah irrigation district include areas outside the district but supplied with water from the district, whereas figures for the other districts only include areas inside the district boundary.

2.1.6 Pumped districts summary - irrigation methods

Figure 17 summarises irrigation methods in the pumped irrigation districts from 1997 to 2021.

The dominant irrigation method in the pumped irrigation districts was furrow irrigation from 1997 to 2003. Low level irrigation replaced furrows as the dominant method from 2006 to 2009, followed by drip irrigation from 2012 to 2021.

In 2021, the irrigable area of 16,955 ha comprised:

- 44% (7,420 ha) drip irrigation;
- 23% (3,850 ha) low level irrigation;
- 6% (1,065 ha) overhead sprinklers;
- 2% (305 ha) furrow irrigation; and
- 25% (4,315 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 6,655 ha, an 870% increase from 765 to 7,420 ha;
- low level irrigation increased by 1,155 ha, a 43% increase from 2,695 to 3,850 ha;
- overhead irrigation decreased by 3,265 ha, a 75% decrease from 4,330 to 1,065 ha; and
- furrow irrigation decreased by 9,045 ha, a 97% decrease from 9,350 to 305 ha.

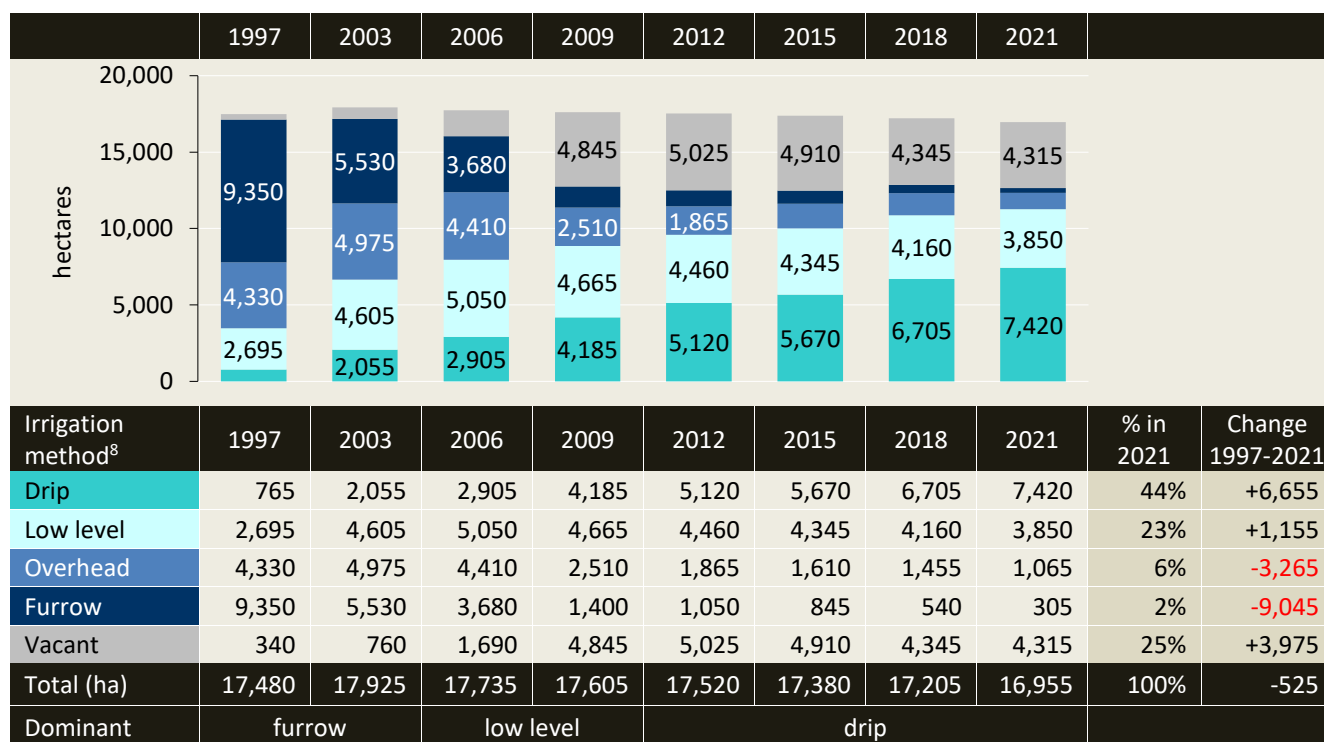


Figure 17: Pumped irrigation districts - irrigation methods from 1997 to 2021

⁸ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

Irrigation methods in each pumped irrigation district in 2021

Figure 18 shows irrigation methods in each pumped irrigation district in 2021.

- Drip irrigation was the dominant method in each of the pumped districts in 2021, except for the Robinvale district where low level sprinklers were dominant.

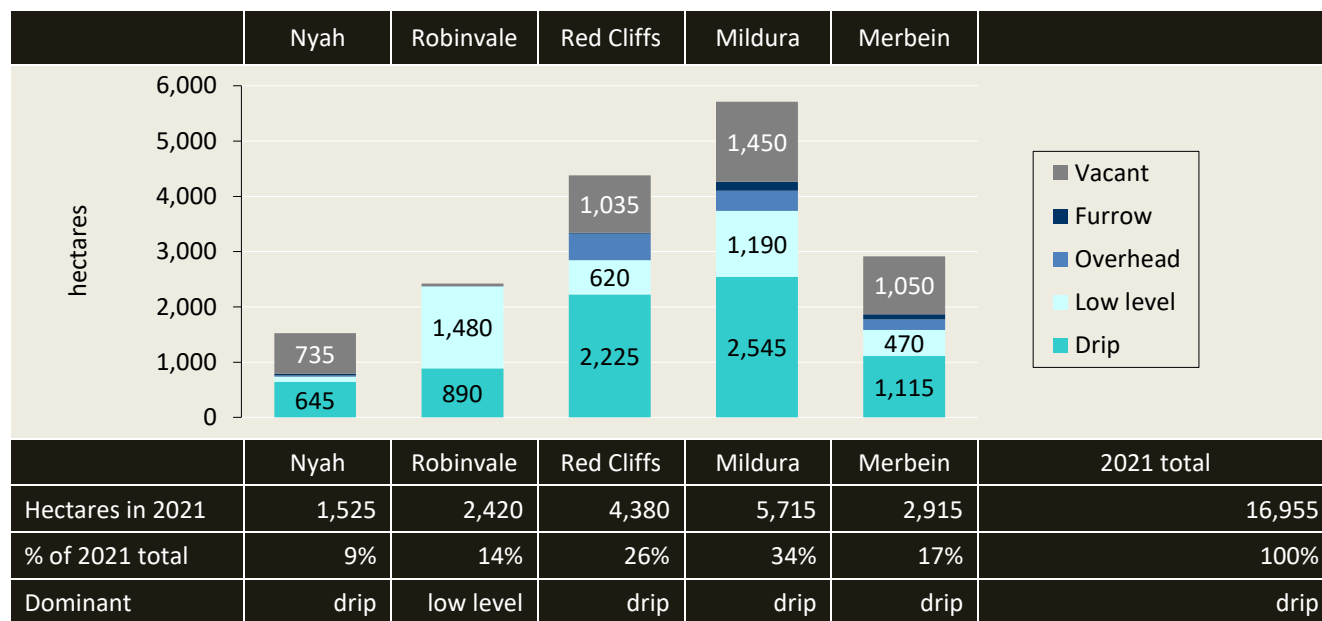


Figure 18: Pumped irrigation districts - irrigation methods in each district in 2021

2.1.7 Pumped districts summary - salinity impact zones

Figure 19 summarises river salinity impact zones of irrigated areas in the five pumped irrigation districts from 1997 to 2021. The dominant zone across the irrigable area was the high impact zone from 1997 to 2021.

In 2021, the irrigable area of 16,955 ha comprised:

- 35% (5,910 ha) in the lowest salinity impact zone, L1;
- 15% (2,595 ha) in L2;
- < 1% (25 ha) in L3;
- 6% (1,030 ha) in L4; and
- 44% (7,395 ha) in HIZ.

From 1997 to 2021, the area irrigated in:

- L1 to L4 decreased by 1,500 ha, a 17% decrease from 8,810 to 7,310 ha; and
- HIZ decreased by 3,000 ha, a 36% decrease from 8,330 to 5,330 ha. The area irrigated in HIZ continued to decrease from 1997 to 2015, but increased by 135 ha between 2015 and 2018 then decreased by 150 between 2018 and 2021. The increase between 2015 and 2018 was largely due to vacant areas in HIZ being brought back into production and the net decrease was mainly areas retired from irrigation for urban development.

From 1997 to 2021, the irrigable area in:

- L1 to L4 increased by 575 ha, a 6% increase from 8,985 to 9,560 ha; and
- HIZ decreased by 1,100 ha, a 13% decrease from 8,495 to 7,395 ha.

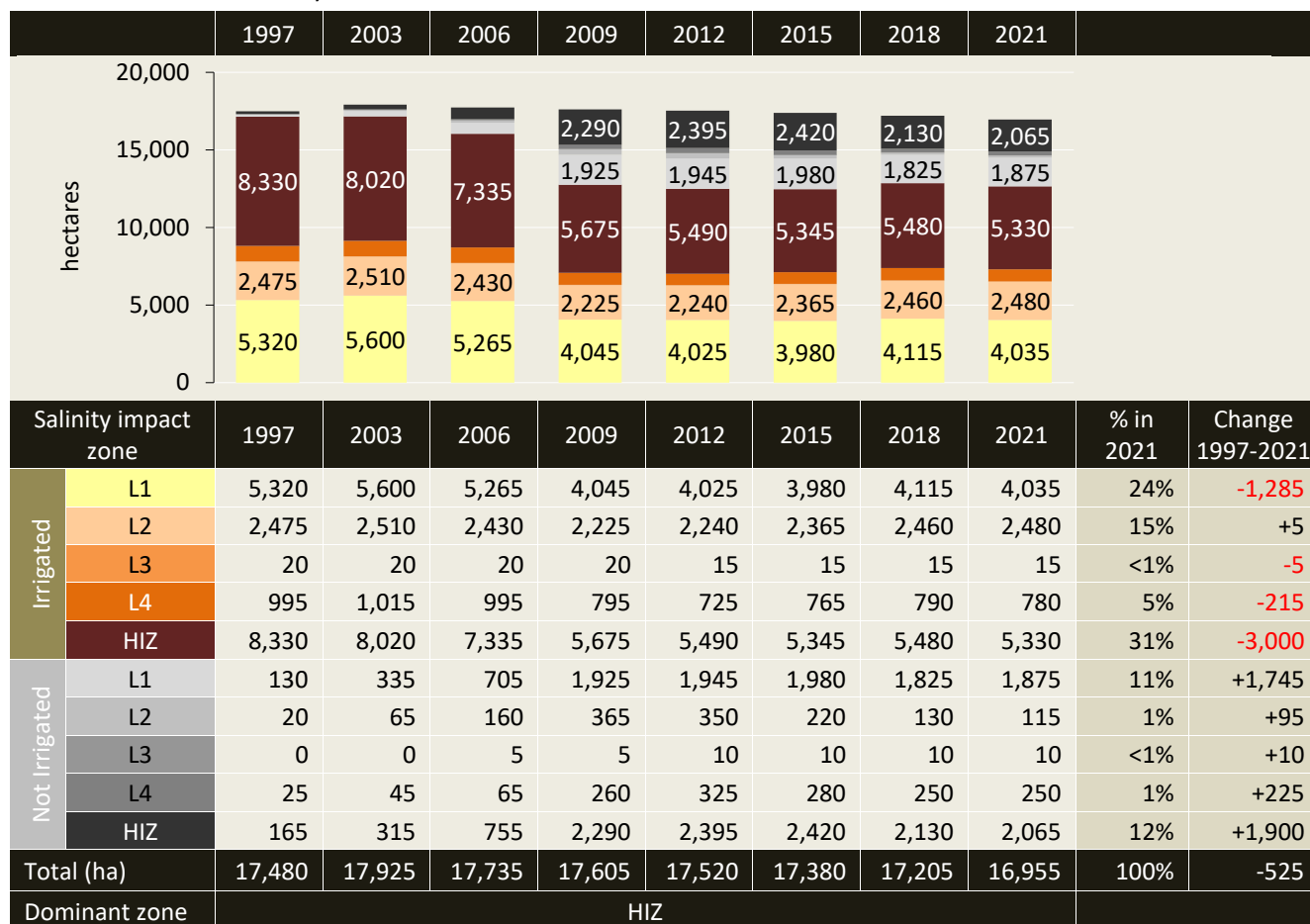


Figure 19: Pumped irrigation districts - irrigable area in each salinity impact zone from 1997 to 2021

Salinity impact zones in each pumped irrigation district

Figure 20 compares salinity impact zones in each of the pumped irrigation districts in 2021.

In 2021:

- the high salinity impact zone, HIZ, was the dominant zone in the Red Cliffs, Mildura and Merbein irrigation districts;
- the lowest salinity impact zone, L1, was the dominant zone in the Nyah irrigation district; and
- L2 was the dominant zone in the Robinvale irrigation district.

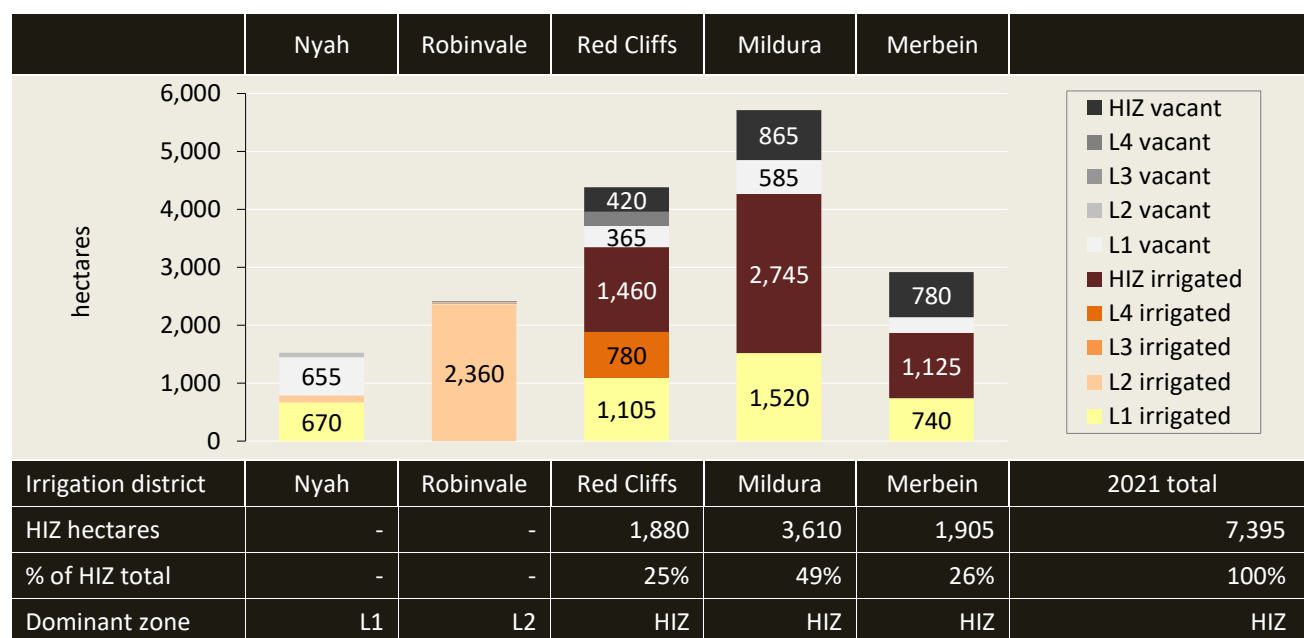


Figure 20: Pumped irrigation districts - salinity impact zones in each district in 2021

2.1.8 Pumped districts summary - property change

Figure 21 provides an estimate of property numbers and average property size (irrigable area) across the five pumped irrigation districts from 1997 to 2021.

In 2021:

- there were approximately 1,417 irrigation properties; and
- most properties (86%) had an irrigable area less than 20 ha.

From 1997 to 2021:

- the number of properties decreased by 570, a 29% decrease from 1,987 to 1,417 properties;
- properties with an irrigable area less than 20 ha decreased by 642, while the number over 20 ha increased by 72; and
- average property size (irrigable area) increased from 9 to 12 ha.

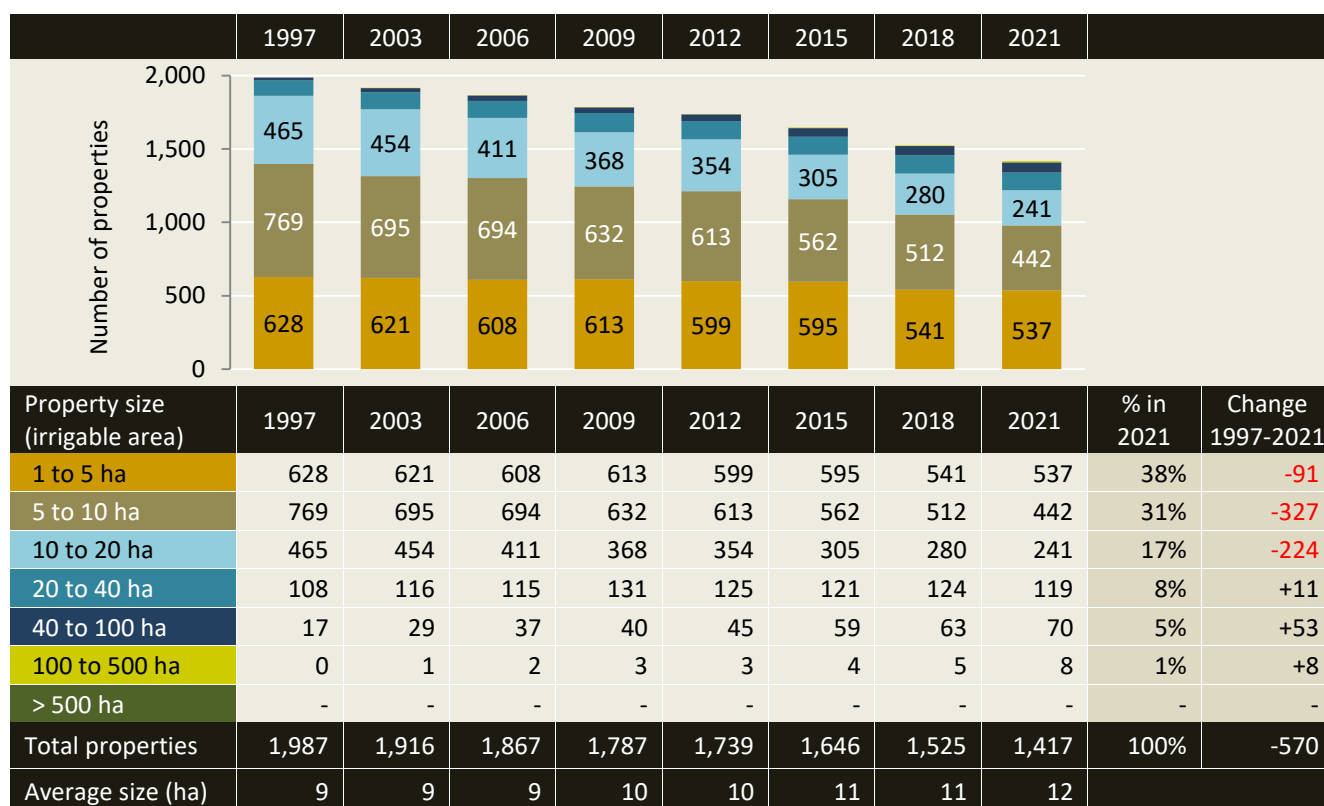


Figure 21: Pumped irrigation districts - property numbers and sizes from 1997 to 2021

Irrigation properties in each of the pumped districts in 2021

Figure 22 provides an estimate of property numbers and average property size (irrigable area) in each of the five pumped irrigation districts in 2021.

- The largest number of irrigation properties, 577 (40%), were in the Mildura irrigation district in 2021.
- Properties in the irrigation districts had an average irrigable area of 10 to 12 ha, except for the Robinvale district where the average irrigable area was 25 ha.

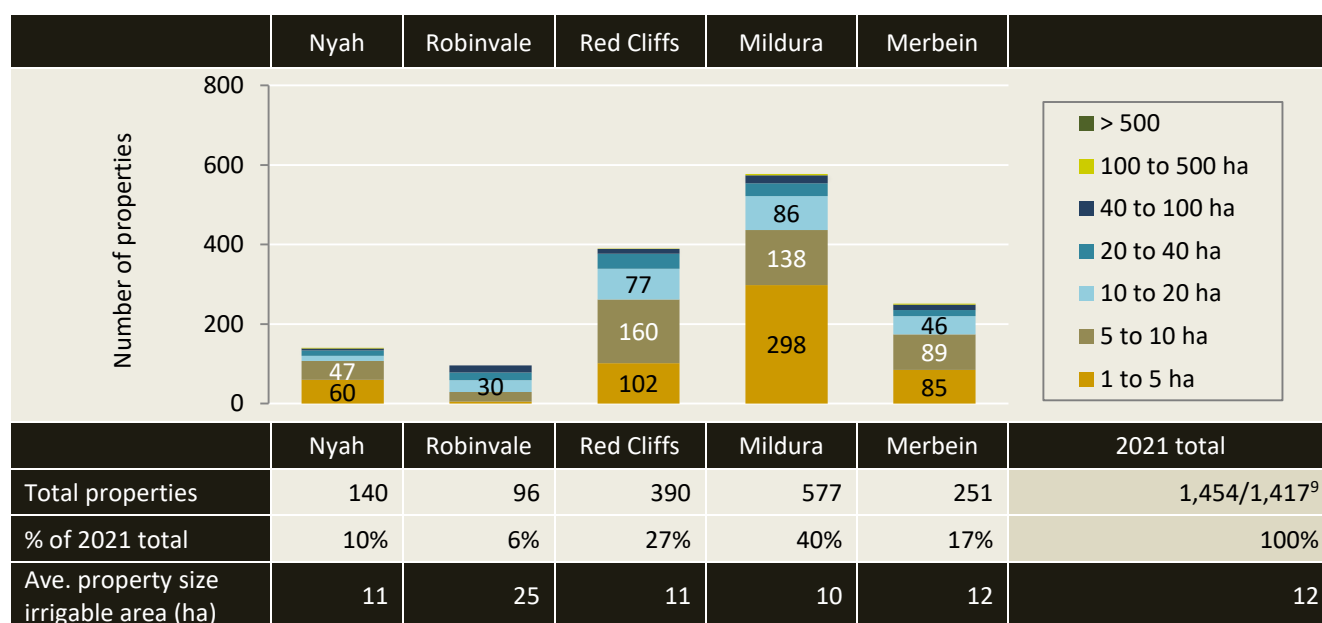


Figure 22: Pumped irrigation districts - property numbers and average size in each district in 2021

⁹ The total number of properties from each irrigation district (1,454 properties, Figure 22) is greater than the total number of properties across the irrigation districts (1,417 properties, Figure 21) as some property owners irrigate in more than one district.

2.2 Nyah irrigation district

In summary for the Nyah irrigation district

Crop types in 2021

The main plantings in the Nyah irrigation district in 2021 were:

1. wine grapes, 520 ha (34% of the irrigable area);
2. vegetables other than carrots or potatoes, 90 ha (6% of the irrigable area); and
3. dried grapes, 45 ha (3% of the irrigable area).

Crop types 1997 to 2021

Wine grapes were the dominant crop type from 1997 to 2021.

The main crop type changes from 1997 to 2021 were:

- field crops decreased by 240 ha, an 89% decrease from 270 to 30 ha;
- wine grapes increased by 200 ha, a 63% increase from 320 to 520 ha; and
- dried grapes decreased by 185 ha, an 80% decrease from 230 to 45 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 65 ha (10%) of permanent crops were planted or redeveloped in the previous three years. The 65 ha was the highest area of development activity since 2009.

The new 2021 plantings were:

1. wine grapes (50 ha); and
2. table grapes and pistachio nuts (a total of 15 ha).

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 1,525 ha comprised:

- 43% (660 ha) was irrigated permanent plantings;
- 9% (130 ha) was irrigated seasonal crops;
- 19% (285 ha) vacant, previously an irrigated permanent planting; and
- 29% (450 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings decreased from 60% to 43% of the irrigable area;
- seasonal crops decreased from 38% to 9% of the irrigable area; and
- vacant, not irrigated areas increased from 2% to 48% of the irrigable area.

In summary for the Nyah irrigation district

Irrigation development - new and retired areas

In the Nyah irrigation district the irrigable area increased by 405 ha, a 36% increase from 1,120 ha in 1997 to 1,525 ha in 2021. The increase was mainly due to expansion of the district to include adjacent areas irrigated with water from the district prior to 2015.

The net increase of 405 ha was the balance of 45 ha retired from irrigation and 450 ha of expansion.

Irrigation methods

The dominant irrigation method in the Nyah irrigation district was furrow irrigation from 1997 to 2003, followed by drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 1,525 ha comprised:

- 42% (645 ha) drip irrigation;
- 6% (90 ha) low level irrigation;
- 2% (25 ha) overhead sprinklers;
- 2% (30 ha) furrow irrigation; and
- 48% (735 ha) vacant, not irrigated.

Salinity impact zones

The Nyah irrigation district is in low salinity impact zones L1 and L2.

In 2021, the irrigable area of 1,525 ha comprised:

- 87% (1,325 ha) in the lowest salinity zone L1; and
- 13% (200 ha) in L2.

From 1997 to 2021 the irrigable area in:

- L1 increased by 400 ha, a 43% increase from 925 to 1,325 ha; and
- L2 increased by 5 ha, a 3% increase from 195 to 200 ha.

Irrigation properties

In 2021, there were approximately 140 irrigation properties, and the average property size (irrigable area) was 11 ha.

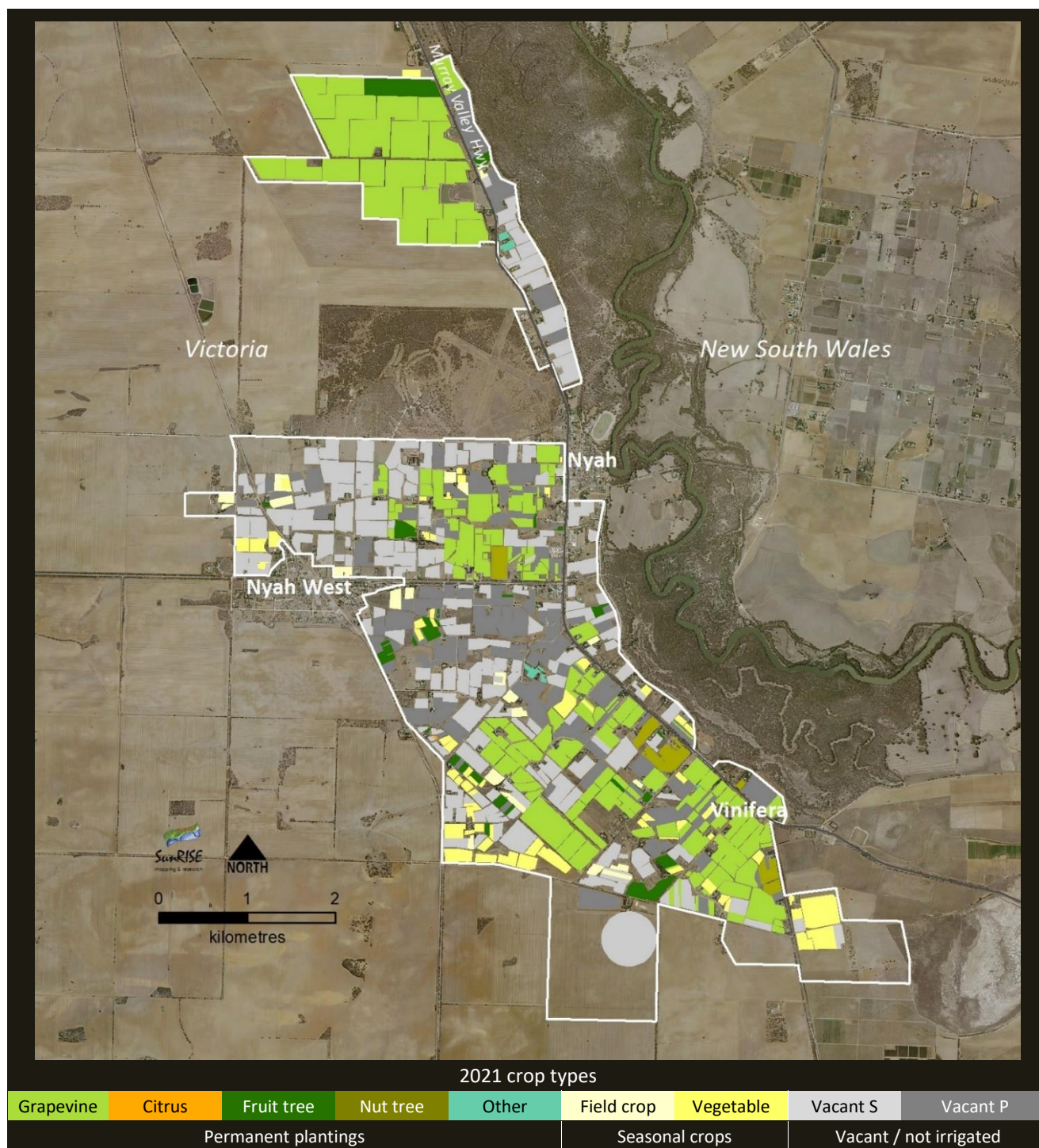
From 1997 to 2021:

- the number of properties decreased by 17, an 11% decrease from 157 to 140 properties;
- properties with an irrigable area less than 20 ha decreased by 29, while the number over 20 ha increased by 12; and
- average property size (irrigable area) increased from 7 to 11 ha.

2.2.1 Nyah irrigation district - crop types in 2021

Map 2 shows the Nyah irrigation district and crop types in 2021. The district shown in the map is the gazetted district plus adjacent areas irrigated with water from the district.

The aerial photography was flown in January 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 2: Nyah irrigation district showing 2021 crop types

2.2.2 Nyah irrigation district - crop types from 1997 to 2021

Figure 23 summarises crop types in the Nyah irrigation district from 1997 to 2021. Wine grapes were the dominant crop type from 1997 to 2021.

In 2021, the main plantings were:

1. wine grapes, 520 ha (34% of the irrigable area);
2. vegetables other than carrots and potatoes, 90 ha (6% of the irrigable area); and
3. dried grapes, 45 ha (3% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- field crops decreased by 240 ha, an 89% decrease from 270 to 30 ha;
- wine grapes increased by 200 ha, a 63% increase from 320 to 520 ha; and
- dried grapes decreased by 185 ha, an 80% decrease from 230 to 45 ha.

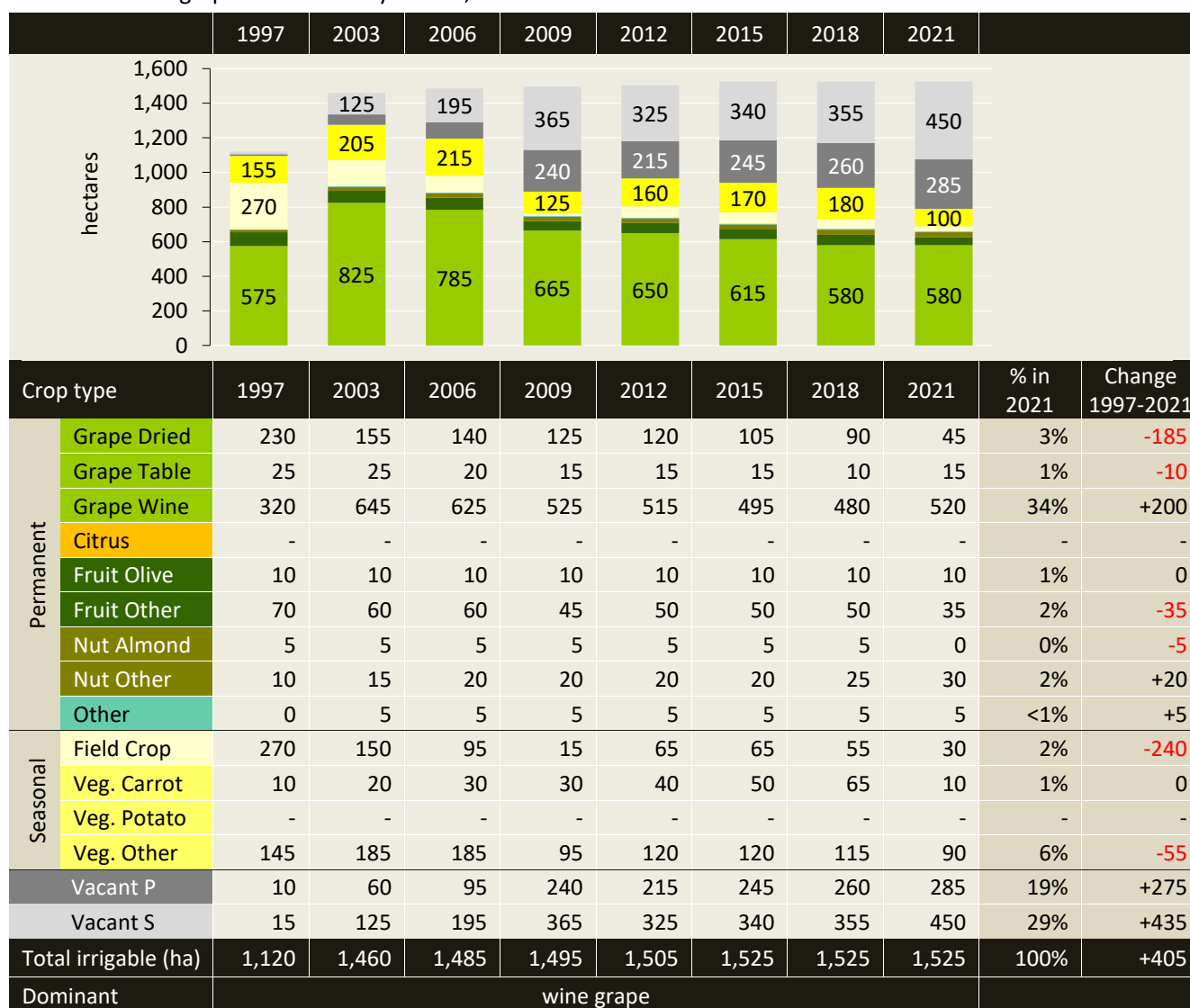


Figure 23: Nyah irrigation district - crop types from 1997 to 2021

2.2.3 Nyah irrigation district - development of permanent crops

Figure 24 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Nyah irrigation district from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 65 ha (10%) of permanent crops were planted or redeveloped within the previous three years.
- The 65 ha was the highest area of development activity since 2009.
- The new plantings were:
 1. wine grapes (50 ha); and
 2. table grapes and pistachio nuts (a total of 15 ha).

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was at its lowest in 2018 with 25 ha (4%) planted in the previous three years and highest in 2003 with 180 ha (20%) planted in the previous three years.

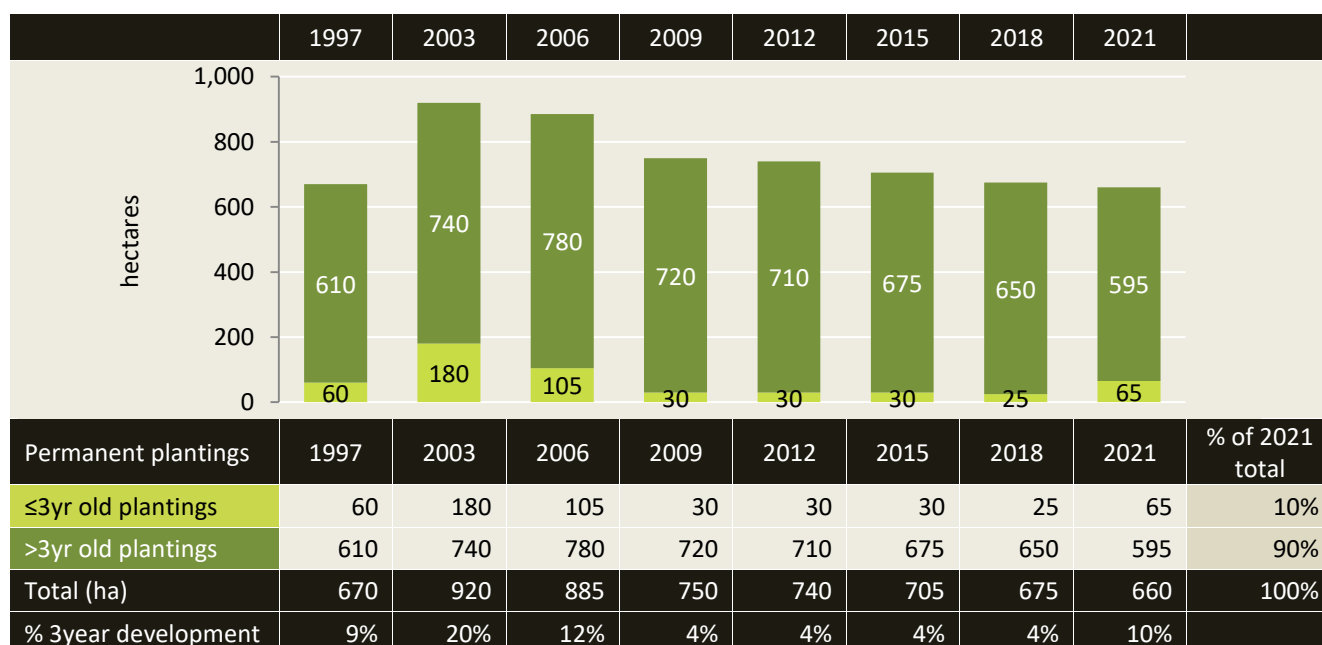


Figure 24: Nyah irrigation district - development of permanent crops from 1997 to 2021

2.2.4 Nyah irrigation district - planting trends

Figure 25 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Nyah irrigation district from 1997 to 2021.

In 2021, the irrigable area of 1,525 ha comprised:

- 43% (660 ha) irrigated permanent plantings;
- 9% (130 ha) irrigated seasonal crops;
- 19% (285 ha) vacant, previously an irrigated permanent planting; and
- 29% (450 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 60% permanent, 38% seasonal and 2% vacant in 1997; to
- 43% permanent, 9% seasonal and 48% vacant in 2021.

The area vacant was at its highest in 2021 with 48% of the irrigable area not irrigated.

From 1997 to 2021:

- irrigated permanent crops decreased by 10 ha, from 670 to 660 ha;
- irrigated seasonal crops decreased by 295 ha, 425 to 130 ha;
- vacant areas, previously irrigated permanent plantings increased by 275 ha, from 10 to 285 ha; and
- vacant areas, previously irrigated seasonal crops increased by 435 ha, from 15 to 450 ha.

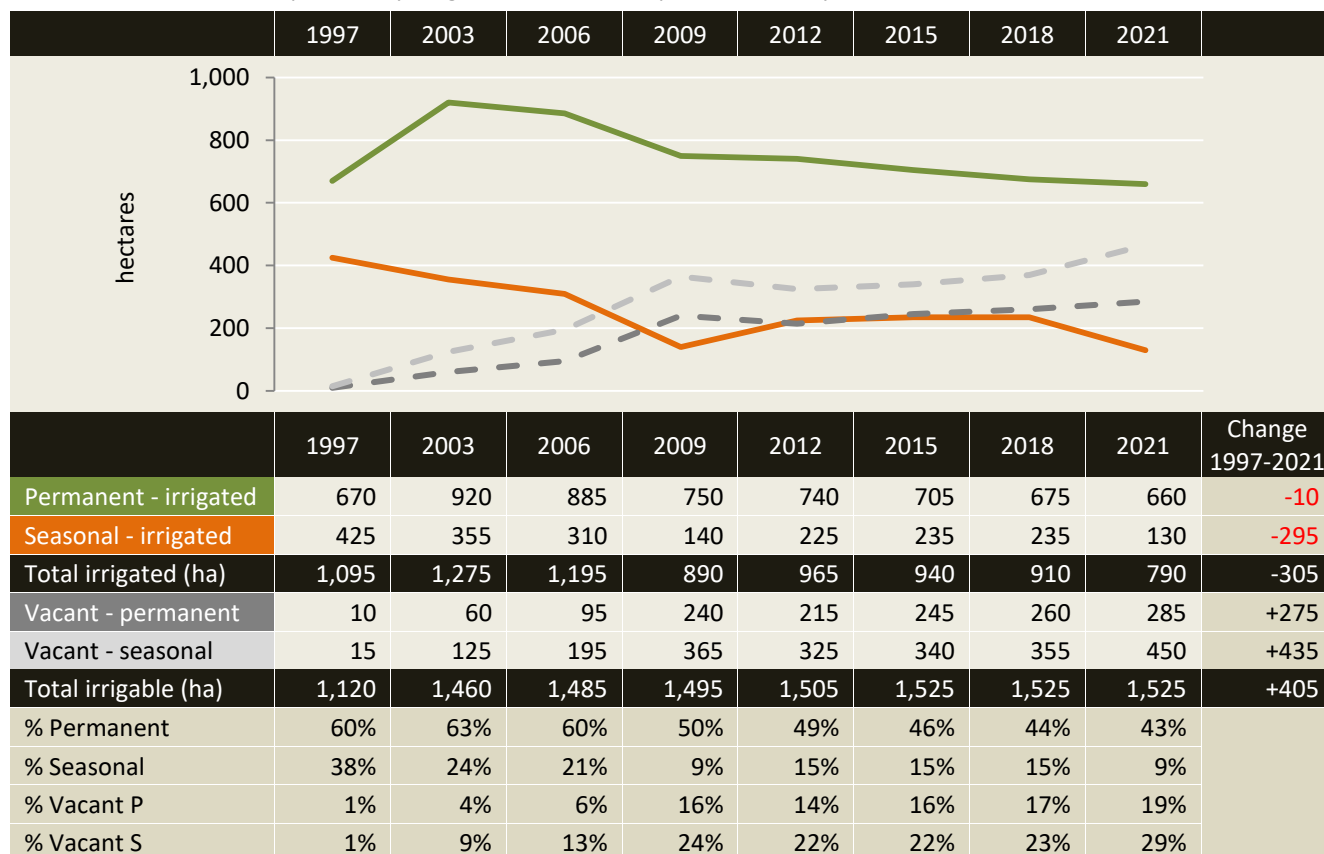
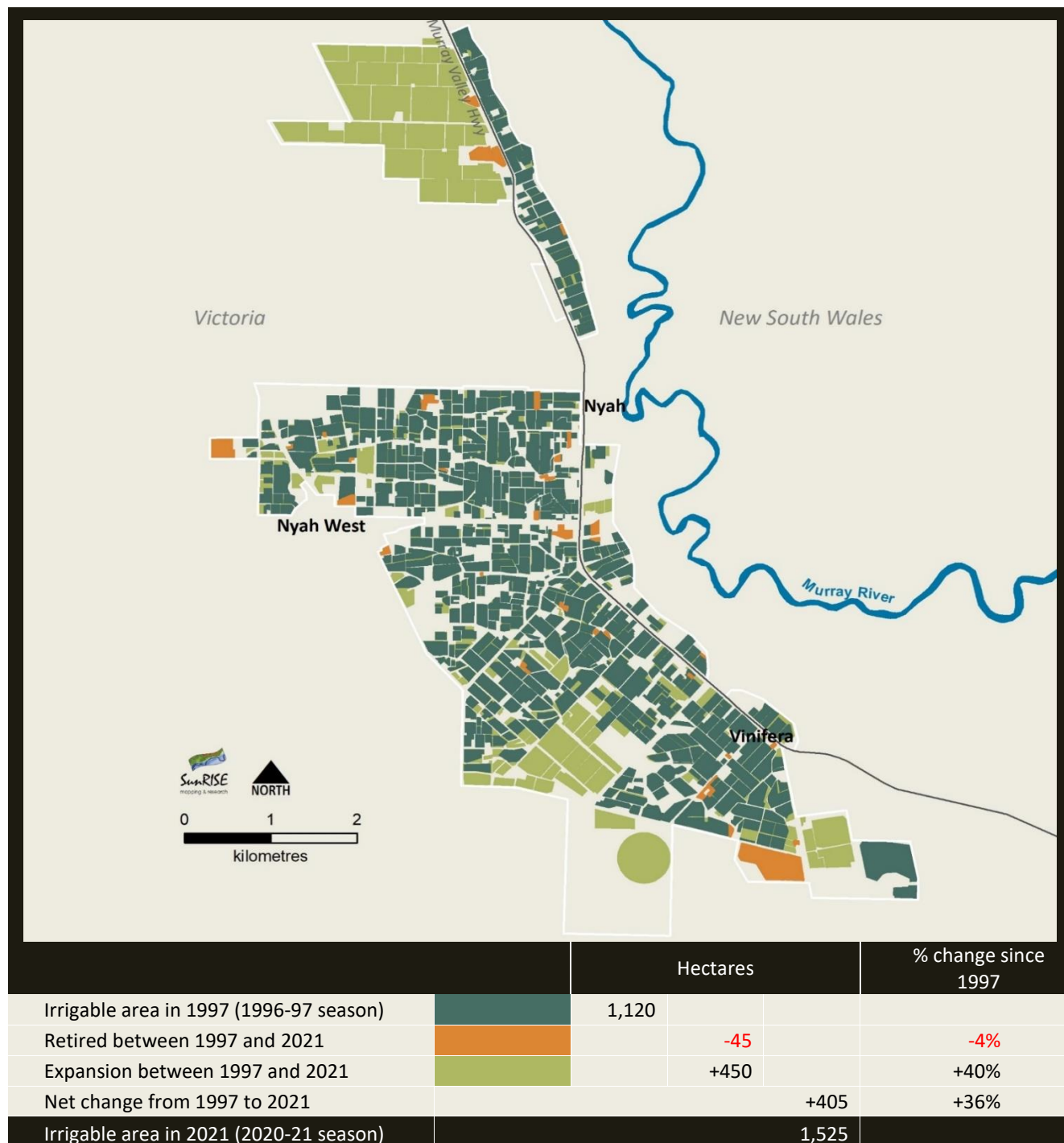


Figure 25: Nyah irrigation district - planting trends from 1997 to 2021

2.2.5 Nyah irrigation district - irrigation development

Map 3 shows irrigation development from 1997 to 2021 in the Nyah irrigation district with respect to new development (expansion) and areas retired¹⁰ from irrigation.

- The irrigable area increased by 405 ha, a 36% increase from 1,120 ha in 1997 to 1,525 ha in 2021.
- The net increase of 405 ha was the balance of 45 ha retired from irrigation and 450 ha of expansion.



Map 3: Nyah irrigation district - irrigation development from 1997 to 2021

¹⁰ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

2.2.6 Nyah irrigation district - irrigation methods

Figure 26 summarises irrigation methods in the Nyah irrigation district from 1997 to 2021.

The dominant irrigation method in the Nyah irrigation district was furrow irrigation from 1997 to 2003, followed by drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 1,525 ha comprised:

- 42% (645 ha) drip irrigation;
- 6% (90 ha) low level irrigation;
- 2% (25 ha) overhead sprinklers;
- 2% (30 ha) furrow irrigation; and
- 48% (735 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 560 ha, a 659% increase from 85 to 645 ha;
- low level irrigation decreased by 10 ha, a 10% decrease from 100 to 90 ha;
- overhead irrigation decreased by 220 ha, a 90% decrease from 245 to 25 ha; and
- furrow irrigation decreased by 635 ha, a 95% decrease from 665 to 30 ha.

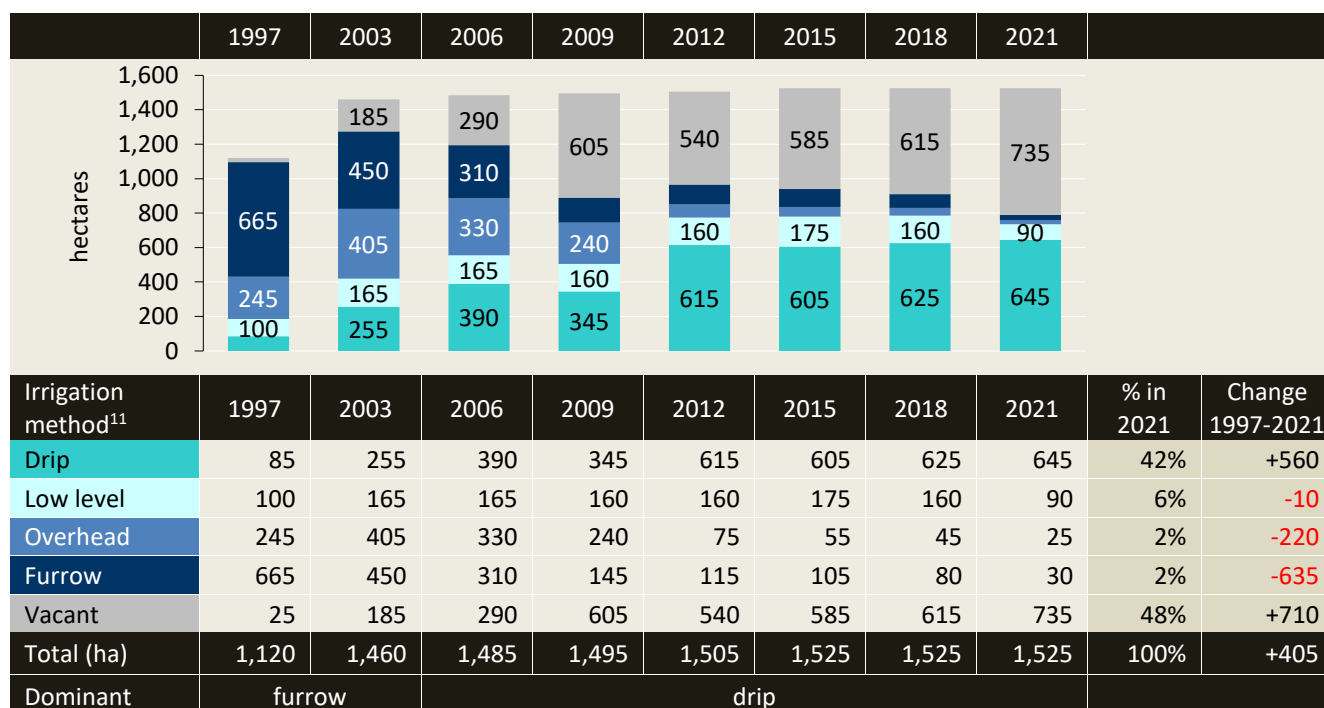


Figure 26: Nyah irrigation district - irrigation methods from 1997 to 2021

¹¹ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

2.2.7 Nyah irrigation district - salinity impact zones

Figure 27 summarises river salinity impact zones of irrigated areas in the Nyah irrigation district from 1997 to 2021. The Nyah district is in low salinity impact zones L1 and L2. No irrigable areas are in the high salinity impact zone.

In 2021, the irrigable area of 1,525 ha comprised:

- 87% (1,325 ha) in the lowest salinity impact zone, L1; and
- 13% (200 ha) in L2.

From 1997 to 2021, the area irrigated in:

- L1 decreased by 240 ha, a 26% decrease from 910 to 670 ha; and
- L2 decreased by 65 ha, a 35% decrease from 185 to 120 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 400 ha, a 43% increase from 925 to 1,325 ha; and
- L2 increased by 5 ha, a 3% increase from 195 to 200 ha.

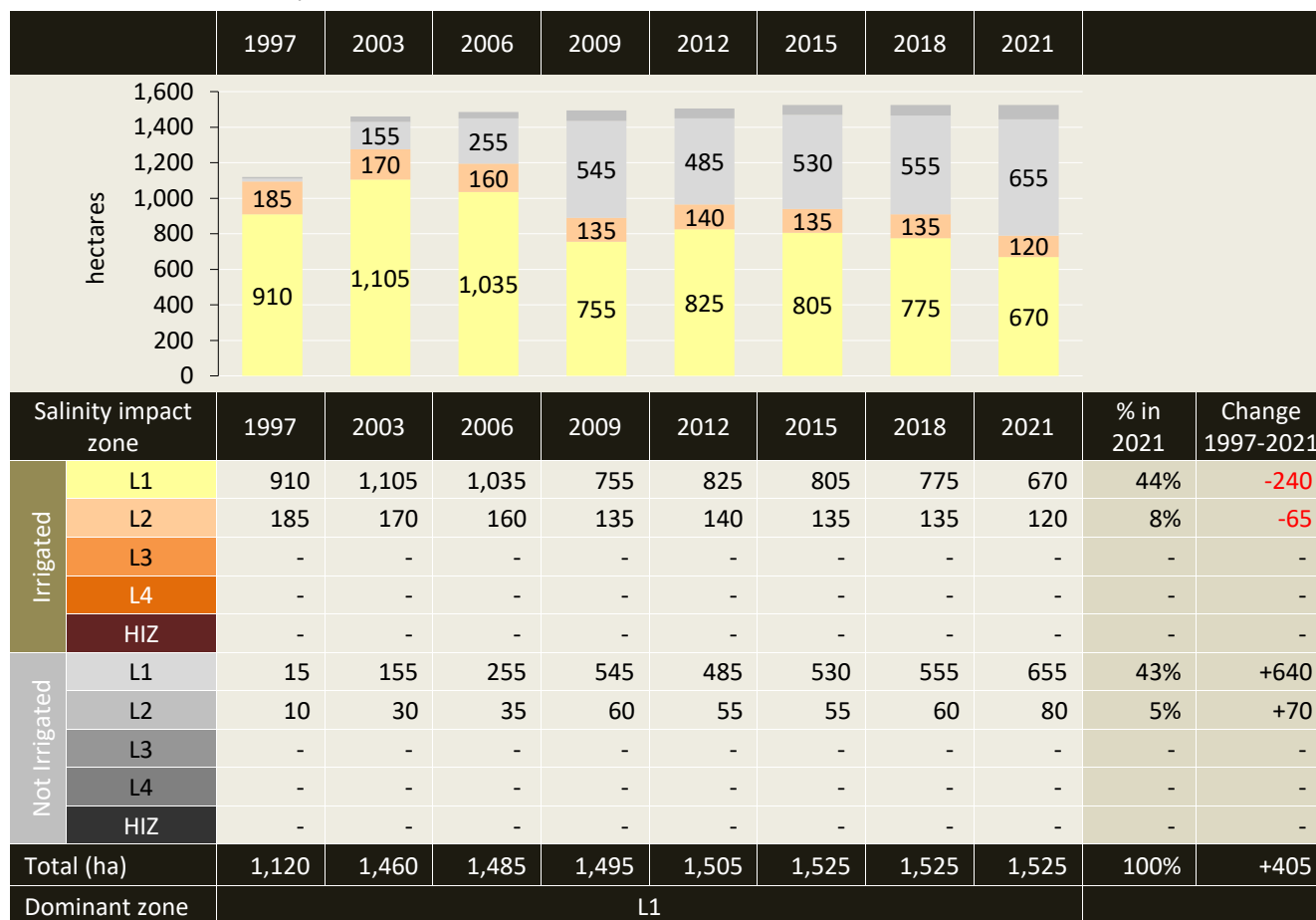


Figure 27: Nyah irrigation district - irrigable area in each salinity impact zone from 1997 to 2021

2.2.8 Nyah irrigation district - property change

Figure 28 provides estimates of property numbers and average property size (irrigable area) in the Nyah irrigation district from 1997 to 2021.

In 2021:

- there were approximately 140 irrigation properties; and
- most properties (86%) had an irrigable area less than 20 ha.

From 1997 to 2021:

- the number of properties decreased by 17, an 11% decrease from 157 to 140 properties;
- properties with an irrigable area less than 20 ha decreased by 29, while the number over 20 ha increased by 12; and
- average property size (irrigable area) increased from 7 to 11 ha.

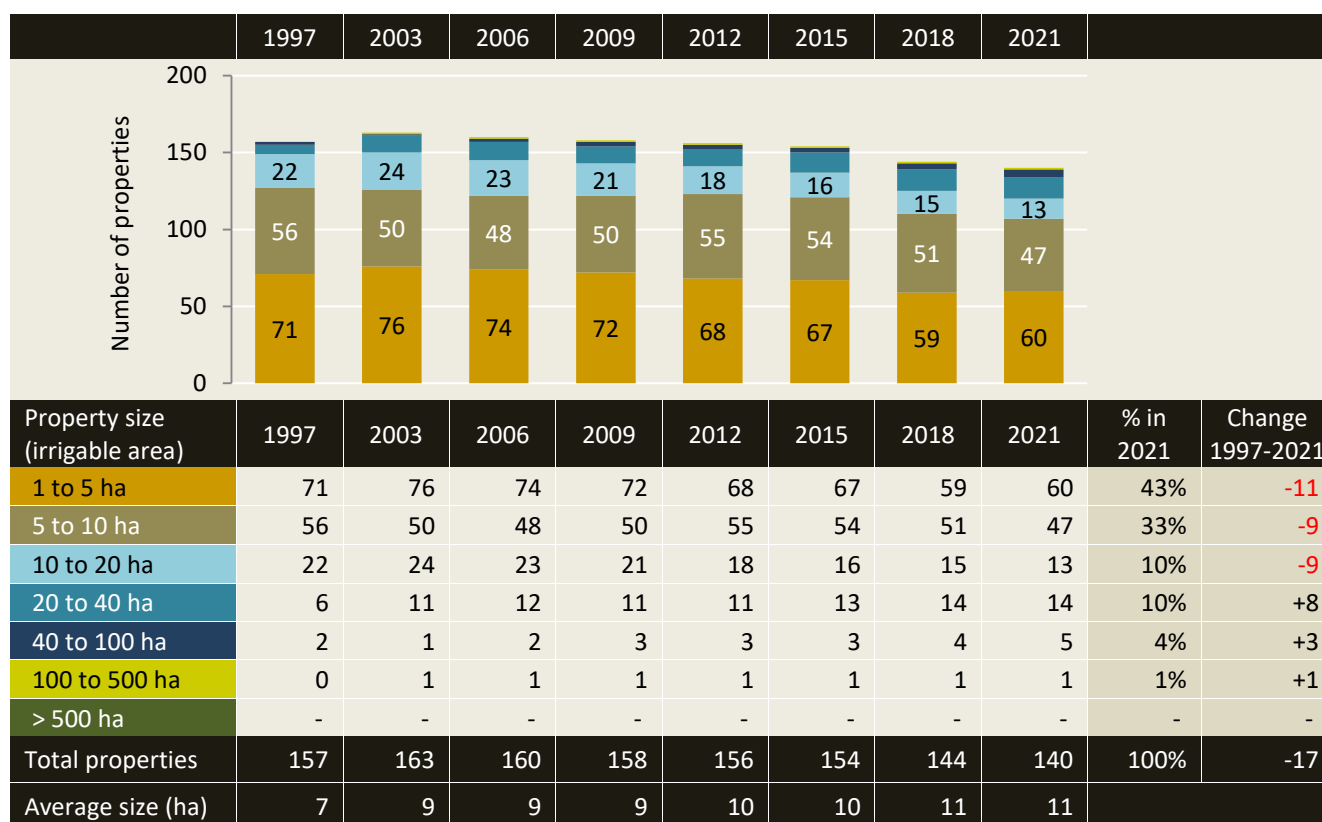


Figure 28: Nyah irrigation district - number of properties and average size from 1997 to 2021

2.3 Robinvale irrigation district

In summary for the Robinvale irrigation district

Crop types in 2021

The main plantings in the Robinvale irrigation district in 2021 were:

1. table grapes, 2,155 ha (89% of the irrigable area);
2. fruit trees, predominantly avocado, 115 ha (5% of the irrigable area); and
3. wine grapes, 65 ha (3% of the irrigable area).

Crop types 1997 to 2021

Table grapes were the dominant crop from 1997 to 2021. The main crop type changes from 1997 to 2021 were:

- table grape plantings increased by 750 ha, a 53% increase from 1,405 to 2,155 ha;
- wine grape plantings decreased by 395 ha, an 86% decrease from 460 to 65 ha;
- dried grape plantings decreased by 380 ha, a 99% decrease from 385 to 5 ha; and
- fruit trees, mainly avocados, increased by 100 ha, a 667% increase from 15 to 115 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 280 ha (12%) of permanent crops were planted or redeveloped in the previous three years. These new plantings were:

1. table grapes (260 ha); and
2. avocados, citrus and wine grapes (a total of 20 ha).

From 1997 to 2021, the area of new or redeveloped permanent plantings was at its lowest in 2009 with 240 ha (11%) planted in the previous three years and highest in 2006 with 490 ha (21%) planted in the previous three years.

Planting trends - permanent plantings, seasonal crops and vacant areas

The irrigable area in 2021 was 2,420 ha of which:

- 98% (2,365 ha) was irrigated permanent plantings;
- <1% (10 ha) was irrigated seasonal crops; and
- 2% (45 ha) was vacant, not irrigated.

From 1997 to 2021:

- permanent plantings decreased from 99% to 98% of the irrigable area;
- seasonal crops decreased from 1% to <1% of the irrigable area; and
- vacant, not irrigated areas increased from <1% to 2% of the irrigable area.

In summary for the Robinvale irrigation district

Irrigation development - new and retired areas

In the Robinvale irrigation district the irrigable area increased by 100 ha, a 4% increase from 2,320 ha in 1997 to 2,420 ha in 2021.

The net increase of 100 ha was the balance of 30 ha retired from irrigation and 130 ha of expansion.

Irrigation methods

The dominant irrigation method in the Robinvale irrigation district changed from furrow irrigation in 1997 to low level sprinklers from 2003 to 2021.

In 2021, the irrigable area of 2,420 ha comprised:

- 37% (890 ha) drip irrigation;
- 61% (1,480 ha) low level irrigation;
- <1% (5 ha) overhead sprinklers;
- 0% (0 ha) furrow irrigation; and
- 2% (45 ha) not irrigated.

Salinity impact zones

The Robinvale irrigation district is in low salinity impact zones L2 and L3.

In 2021, the irrigable area of 2,420 ha comprised:

- 99% (2,395 ha) in the second lowest salinity impact zone, L2; and
- 1% (25 ha) in L3.

From 1997 to 2021 the irrigable area in:

- L2 increased by 95 ha, a 4% increase from 2,300 ha to 2,395 ha; and
- L3 increased by 5 ha, a 25% increase from 20 ha to 25 ha.

Irrigation properties

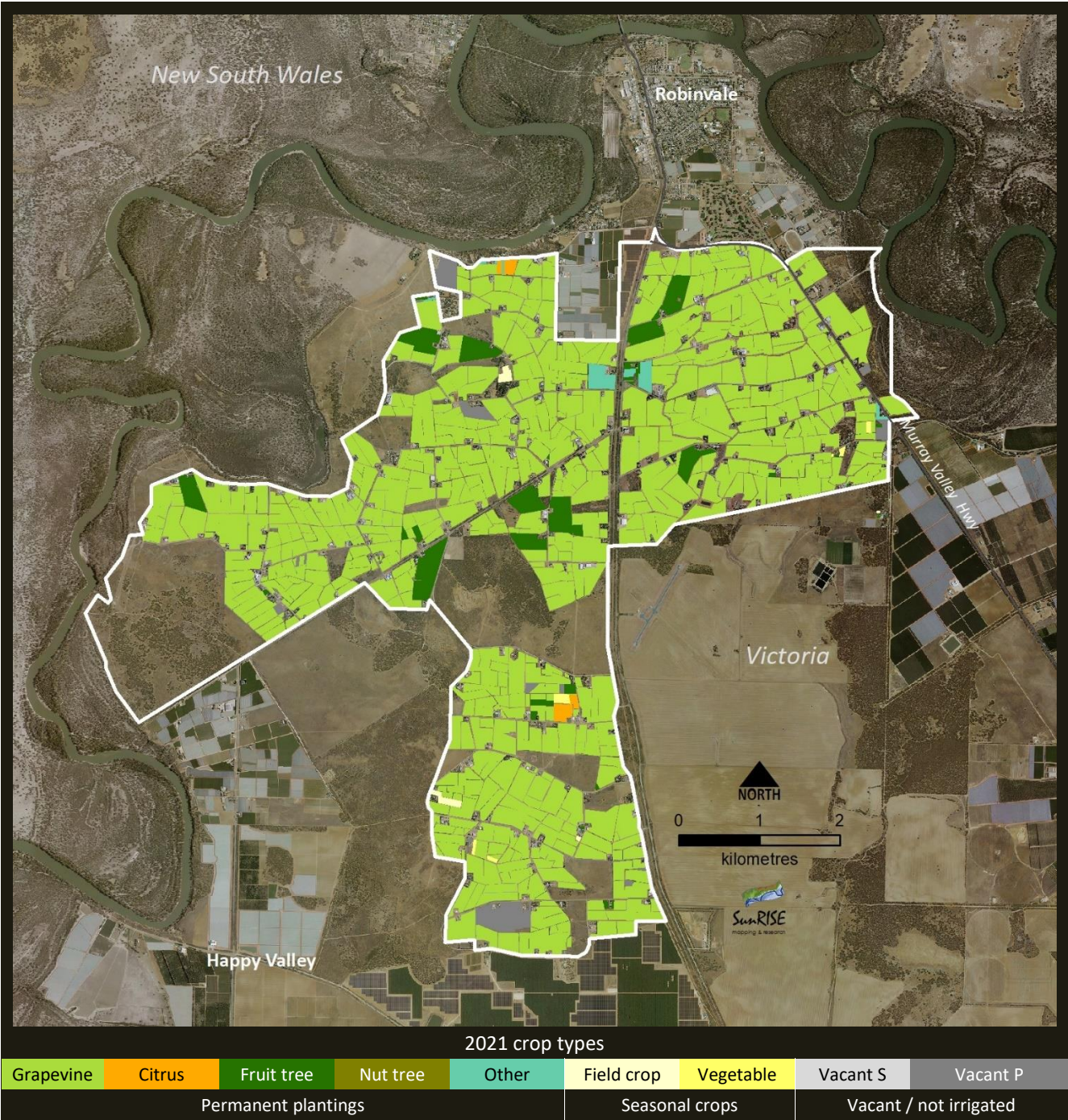
In 2021, there were approximately 96 irrigation properties in the Robinvale irrigation district and the average property size (irrigable area) was 25 ha.

From 1997 to 2021:

- the number of properties decreased by 73, a 43% decrease from 169 to 96 properties;
- properties with an irrigable area less than 40 ha decreased by 86, while the number over 40 ha increased by 13; and
- average property size (irrigable area) increased from 14 ha to 25 ha.

2.3.1 Robinvale irrigation district - crop types in 2021

Map 4 shows the Robinvale irrigation district and crop types in 2021.
The aerial photography was flown in January 2021 (source: Coordinated Imagery Program, DELWP Victoria).



Map 4: Robinvale irrigation district showing 2021 crop types

2.3.2 Robinvale irrigation district - crop types from 1997 to 2021

Figure 29 summarises crop types in the Robinvale irrigation district from 1997 to 2021. Table grapes remained the dominant crop from 1997 to 2021.

In 2021 the main plantings were:

1. table grapes, 2,155 ha (89% of the irrigable area);
2. fruit trees, mainly avocados, 115 ha (5% of the irrigable area); and
3. wine grapes, 65 ha (3% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- table grapes increased by 750 ha, a 53% increase from 1,405 to 2,155 ha;
- wine grapes decreased by 395 ha, an 86% decrease from 460 to 65 ha;
- dried grapes decreased by 380 ha, a 99% decrease from 385 to 5 ha; and
- fruit trees, mainly avocados, increased by 100 ha, a 667% increase from 15 to 115 ha.

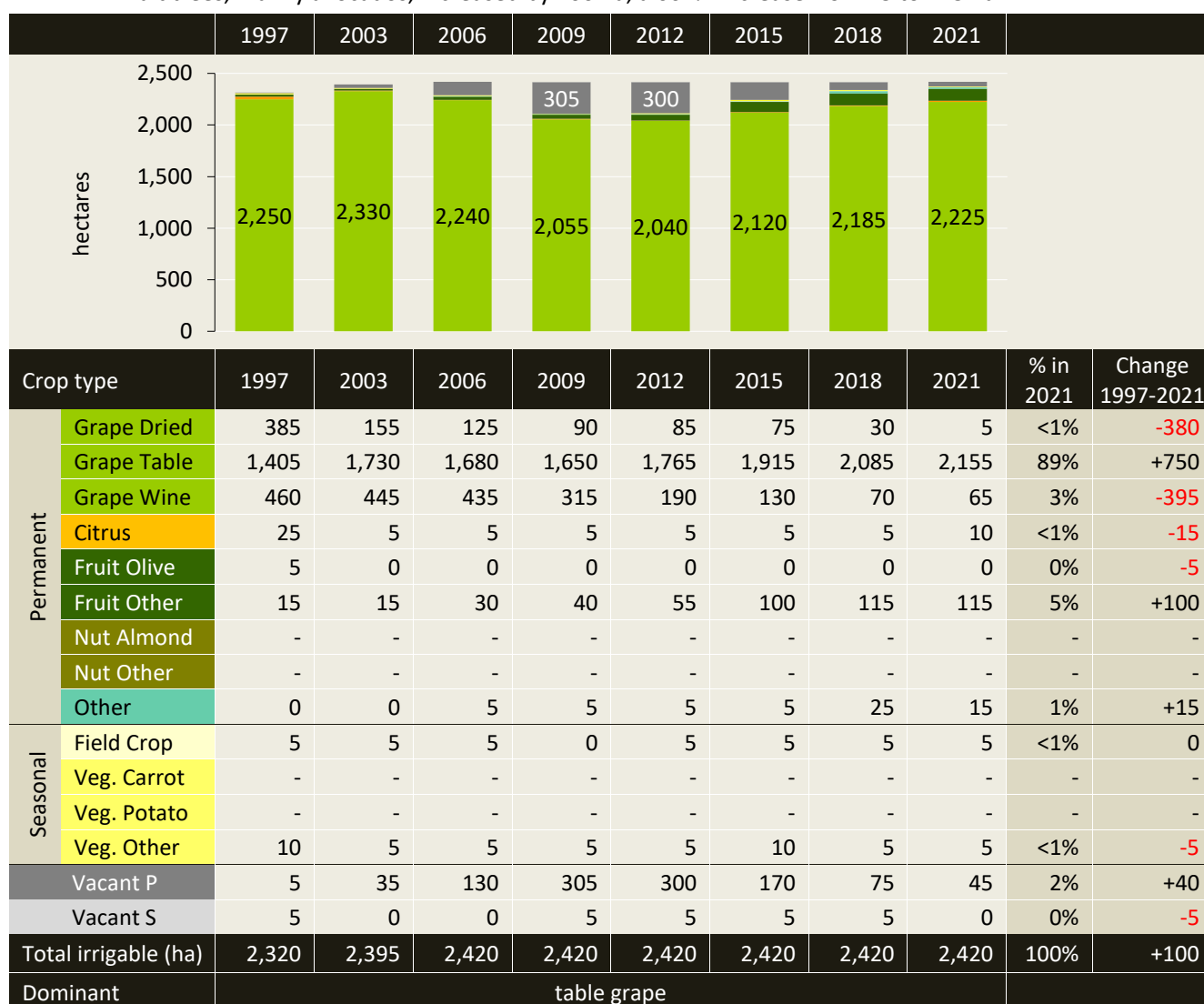


Figure 29: Robinvale irrigation district - crop types from 1997 to 2021

2.3.3 Robinvale irrigation district - development of permanent crops

Figure 30 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Robinvale irrigation district from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 280 ha (12%) of permanent crops were planted or redeveloped within the previous three years.
- These new plantings were:
 1. table grapes (260 ha); and
 2. avocados, citrus and wine grapes (a total of 20 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 2009 with 240 ha (11%) planted in the previous three years and highest in 2006 with 490 ha (21%) planted in the previous three years.

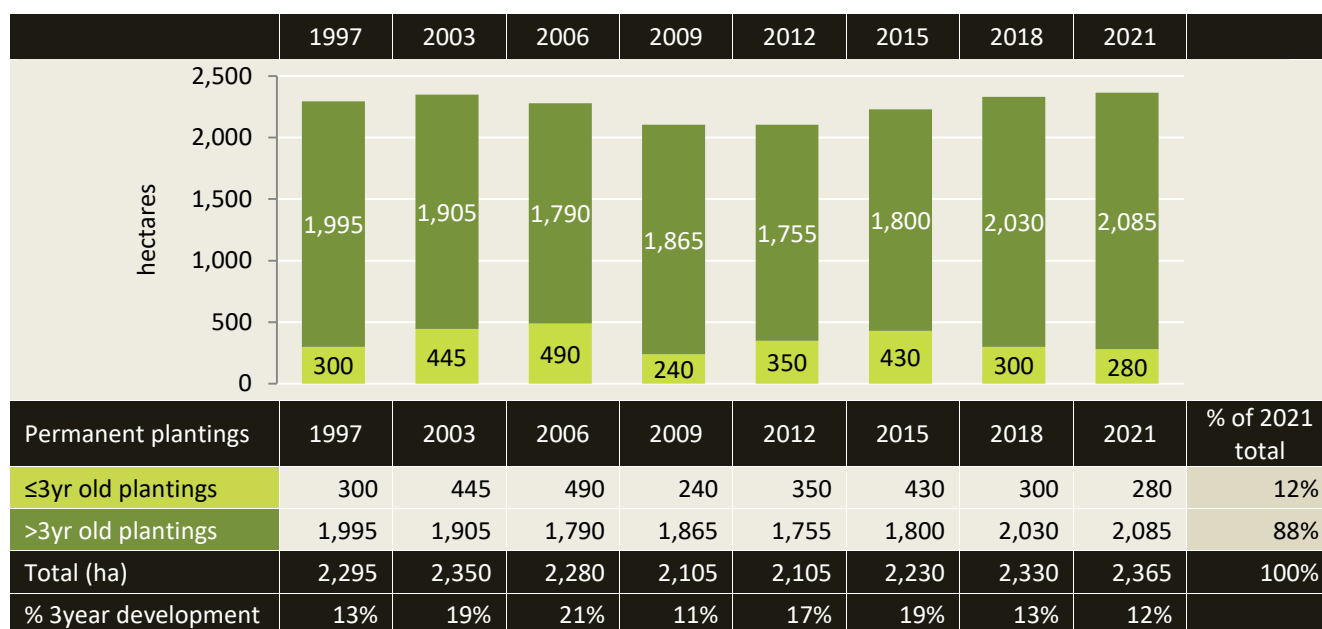


Figure 30: Robinvale irrigation district - development of permanent crops from 1997 to 2021

2.3.4 Robinvale irrigation district - planting trends

Figure 31 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Robinvale irrigation district from 1997 to 2021.

In 2021, the irrigable area of 2,420 ha comprised:

- 98% (2,365 ha) irrigated permanent plantings;
- <1% (10 ha) irrigated seasonal crops;
- 2% (45 ha) vacant, previously an irrigated permanent planting; and
- 0% (0 ha) vacant, previously an irrigated seasonal crop.

The area vacant was at its highest in 2009 with 13% of the irrigable area not irrigated. The proportion of vacant areas decreased to 2% by 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 70 ha, from 2,295 to 2,365 ha;
- irrigated seasonal crops decreased by 5 ha, from 15 to 10 ha;
- vacant areas, previously irrigated permanent plantings increased by 40 ha, from 5 to 45 ha; and
- vacant areas, previously irrigated seasonal crops decreased by 5 ha, from 5 to 0 ha.

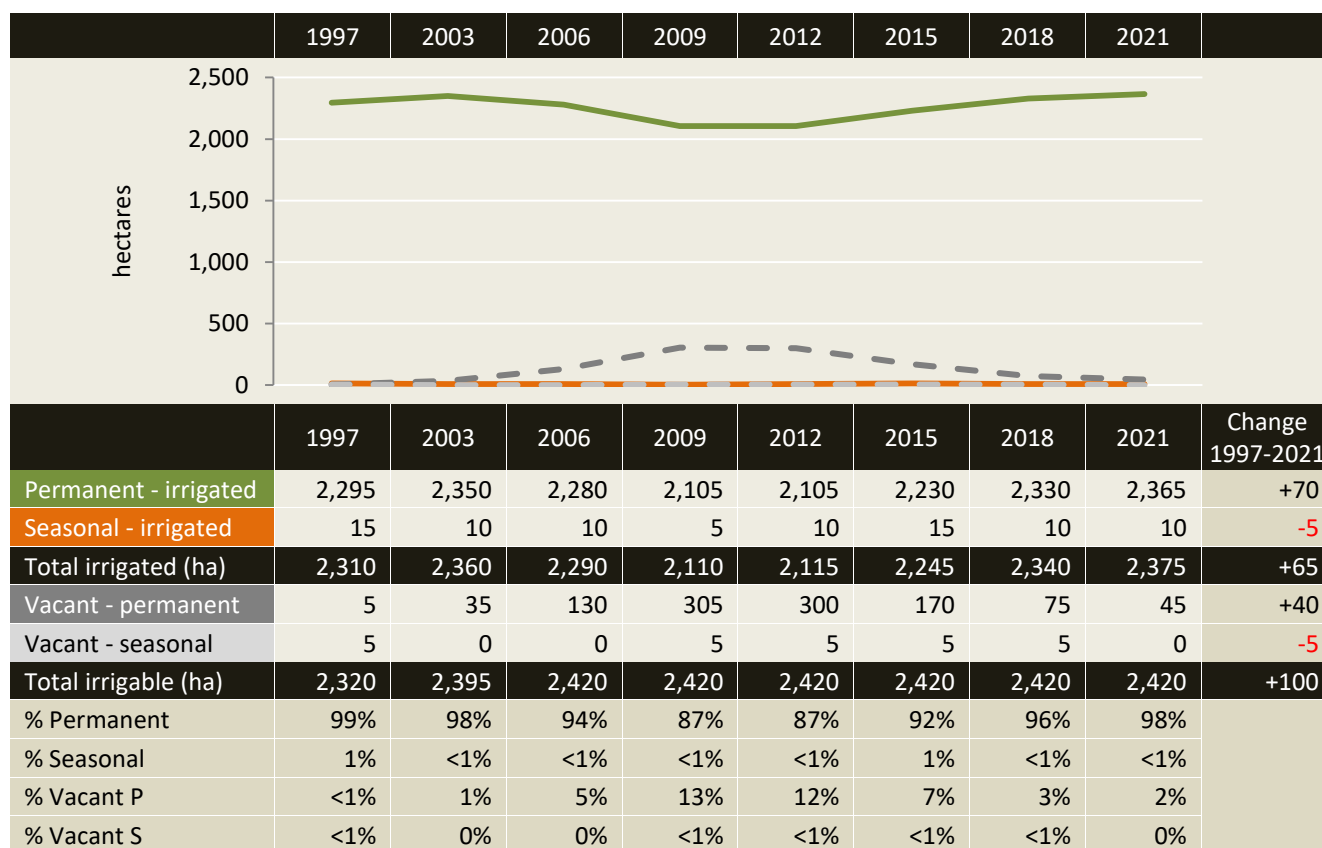
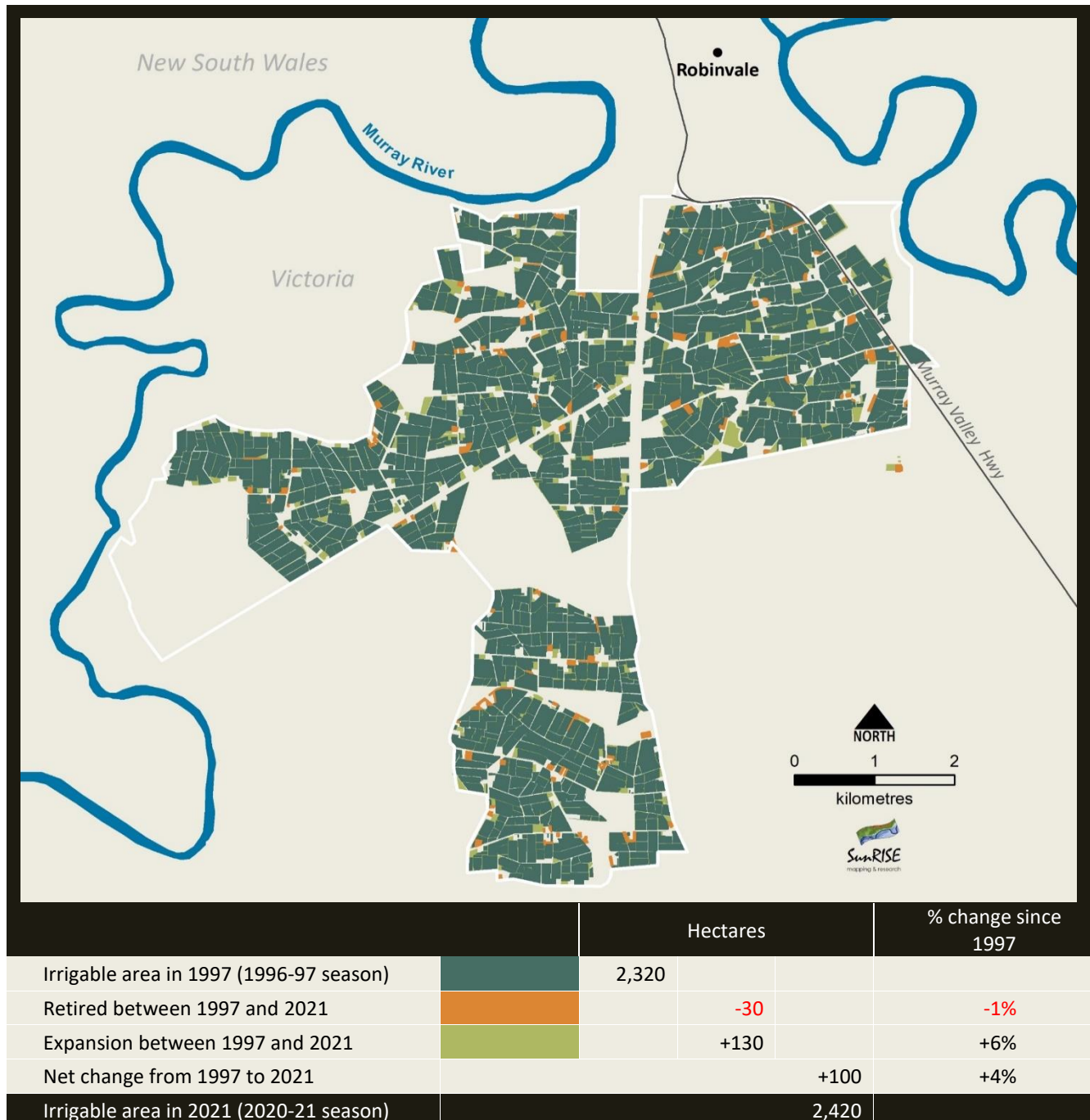


Figure 31: Robinvale irrigation district - planting trends from 1997 to 2021

2.3.5 Robinvale irrigation district - irrigation development

Map 5 shows irrigation development from 1997 to 2021 in the Robinvale irrigation district with respect to new development (expansion) and areas retired¹² from irrigation.

- The irrigable area increased by 100 ha, a 4% increase from 2,320 ha in 1997 to 2,420 ha in 2021.
- The net increase of 100 ha was the balance of 30 ha retired from irrigation and 130 ha of expansion.



Map 5: Robinvale irrigation district - irrigation development from 1997 to 2021

¹² Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

2.3.6 Robinvale irrigation district - irrigation methods

Figure 32 summarises irrigation methods in the Robinvale irrigation district from 1997 to 2021.

The dominant irrigation method in the Robinvale irrigation district changed from furrow irrigation in 1997 to low level sprinklers from 2003 to 2021.

In 2021, the irrigable area of 2,420 ha comprised:

- 37% (890 ha) drip irrigation;
- 61% (1,480 ha) low level irrigation;
- <1% (5 ha) overhead sprinklers;
- 0% (0 ha) furrow irrigation; and
- 2% (45 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 855 ha, a 2,443% increase from 35 to 890 ha;
- low level irrigation increased by 535 ha, a 57% increase from 945 to 1,480 ha;
- overhead irrigation decreased by 250 ha, a 98% decrease from 255 to 5 ha; and
- furrow irrigation decreased by 1,075 ha, a 100% decrease from 1,075 to 0 ha.

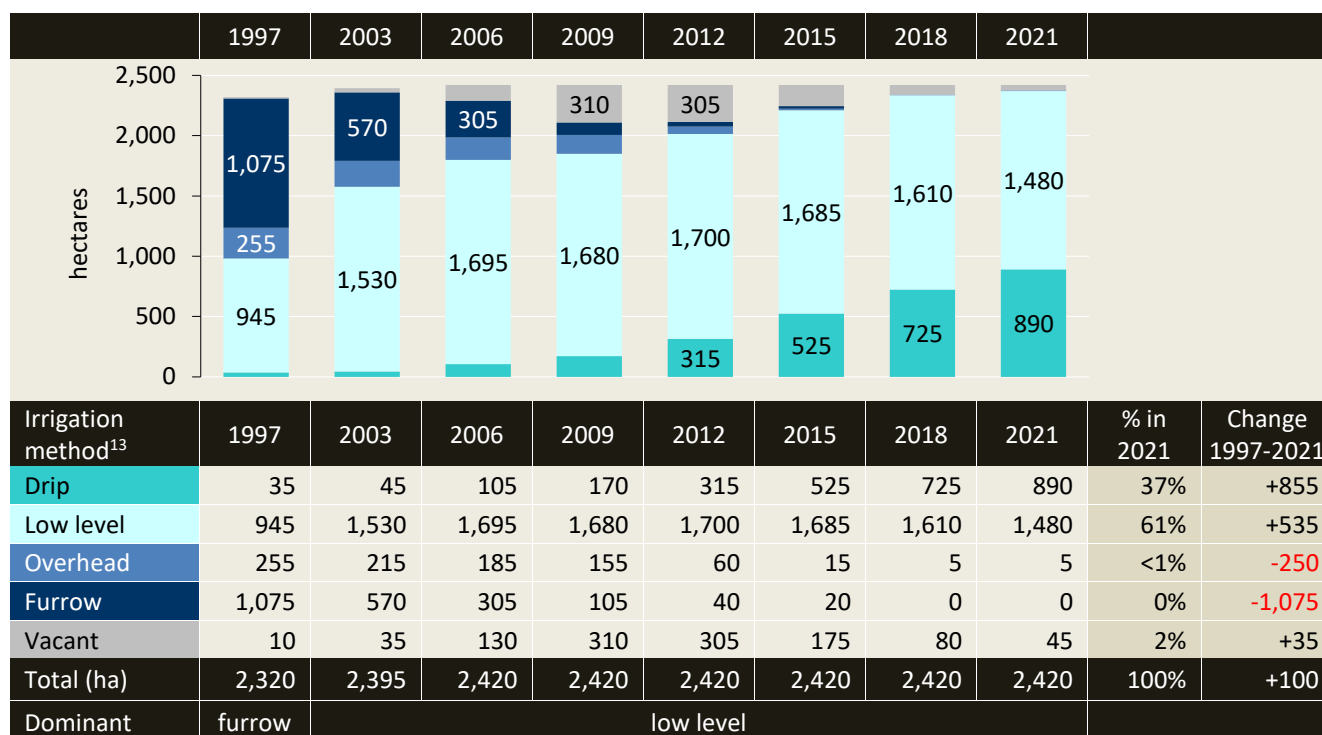


Figure 32: Robinvale irrigation district - irrigation methods from 1997 to 2021

¹³ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

2.3.7 Robinvale irrigation district - salinity impact zones

Figure 33 summarises river salinity impact zones of irrigated areas in the Robinvale irrigation district from 1997 to 2021. The Robinvale district is in low salinity impact zones L2 and L3. No irrigable areas are in the high salinity impact zone.

In 2021, the irrigable area of 2,420 ha comprised:

- 99% (2,395 ha) in the second lowest salinity impact zone L2; and
- 1% (25 ha) in L3.

From 1997 to 2021, the area irrigated in:

- L2 increased by 70 ha, a 3% increase from 2,290 to 2,360 ha; and
- L3 decreased by 5 ha, a 25% decrease from 20 to 15 ha.

From 1997 to 2021, the irrigable area in:

- L2 increased by 95 ha, a 4% increase from 2,300 to 2,395 ha; and
- L3 increased by 5 ha, a 25% increase from 20 to 25 ha.

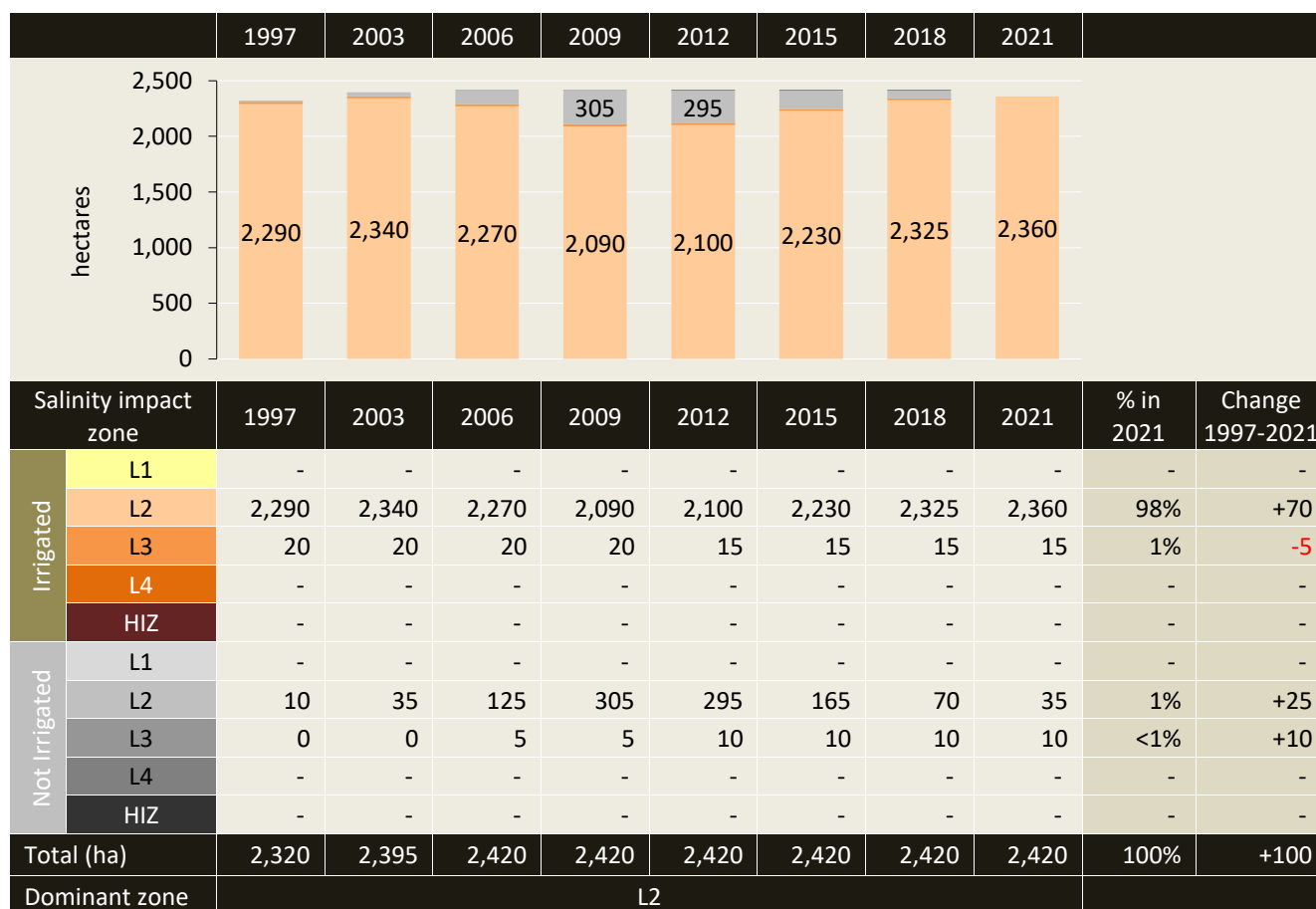


Figure 33: Robinvale irrigation district - irrigable area in each salinity impact zone from 1997 to 2021

2.3.8 Robinvale irrigation district - property change

Figure 34 provides estimates of property numbers and average property size (irrigable area) in the Robinvale irrigation district from 1997 to 2021.

In 2021:

- there were approximately 96 irrigation properties; and
- most properties (81%) had an irrigable area less than 40 ha.

From 1997 to 2021:

- the number of properties decreased by 73, a 43% decrease from 169 to 96 properties;
- properties with an irrigable area less than 40 ha decreased by 86, while the number over 40 ha increased by 13; and
- average property size (irrigable area) increased from 14 to 25 ha.

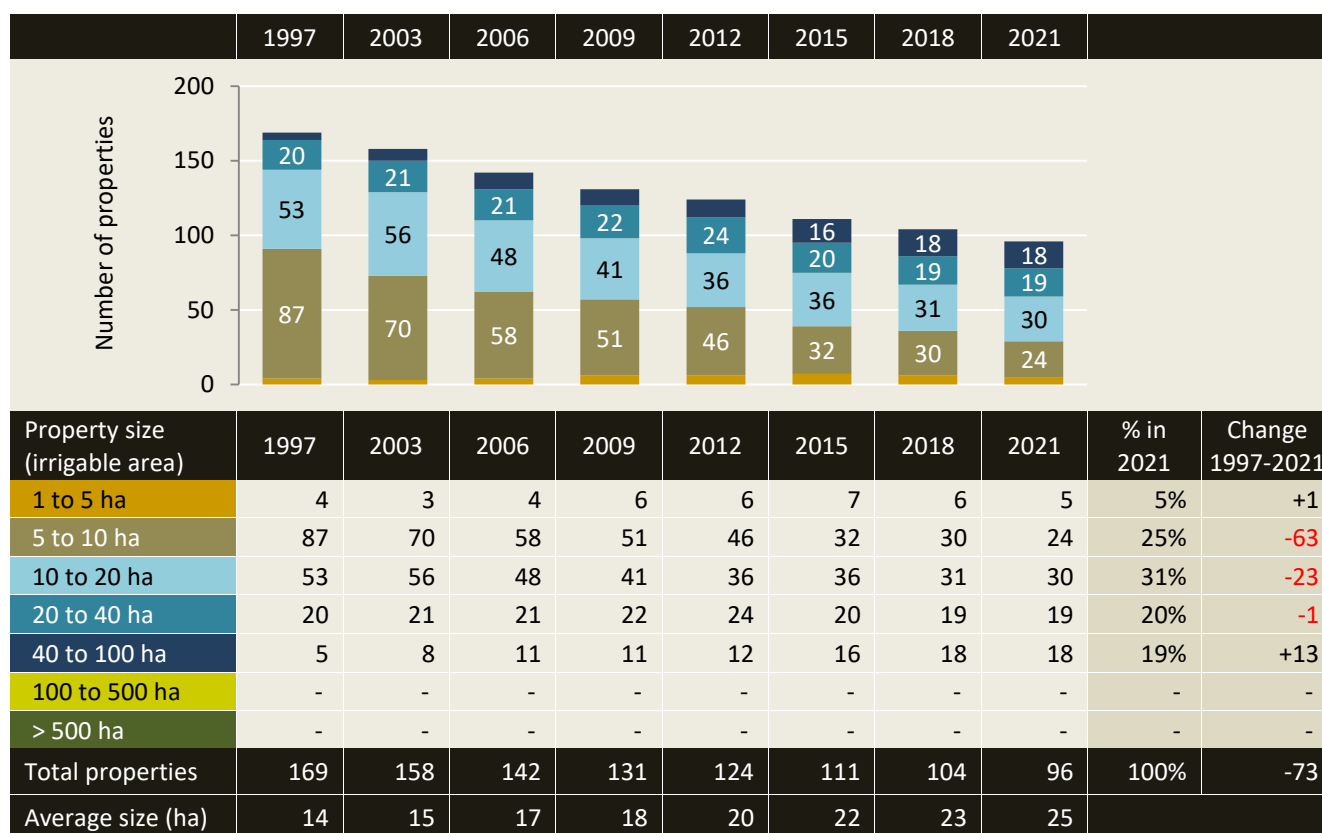


Figure 34: Robinvale irrigation district - property numbers and sizes from 1997 to 2021

2.4 Red Cliffs irrigation district

In summary for the Red Cliffs irrigation district

Crop types in 2021

In 2021, table grapes replaced wine grapes as the dominant crop. The main plantings in 2021 were:

1. table grapes, 1,185 ha (27% of the irrigable area);
2. wine grapes, 1,020 ha (23% of the irrigable area);
3. vegetables other than carrots and potatoes, 285 ha (7% of the irrigable area); and
4. dried grapes, 280 ha (6% of the irrigable area).

Crop types 1997 to 2021

The main crop type changes from 1997 to 2021 were:

- dried grape plantings decreased by 1,095 ha, an 80% decrease from 1,375 ha to 280 ha;
- wine grape plantings decreased by 930 ha, a 48% decrease from 1,950 ha to 1,020 ha; and
- table grape plantings increased by 710 ha, a 149% increase from 475 ha to 1,185 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 515 ha (18%) of permanent crops were planted or redeveloped in the previous three years. The 515 ha was the highest area of development activity since 2009. The new plantings were:

1. table grapes (345 ha);
2. wine grapes (50 ha);
3. citrus (40 ha);
4. dried grapes (35 ha);
5. almonds and walnuts (a total of 20 ha); and
6. fruit trees and nurseries (a total of 25 ha).

From 1997 to 2021, the area of new or redeveloped permanent plantings was at its lowest in 2015 with 305 ha (11%) planted in the previous three years and highest in 1997 with 1,080 ha (26%) planted in the previous three years.

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 4,380 ha comprised:

- 67% (2,930 ha) irrigated permanent plantings;
- 9% (415 ha) irrigated seasonal crops;
- 20% (860 ha) vacant, previously an irrigated permanent planting; and
- 4% (175 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings decreased from 92% to 67% of the irrigable area;
- seasonal crops increased from 5% to 9% of the irrigable area; and
- vacant, not irrigated areas increased from 3% to 24% of the irrigable area.

In summary for the Red Cliffs irrigation district

Irrigation development - new and retired areas

In the Red Cliffs irrigation district, the irrigable area decreased by 70 ha, a 2% decrease from 4,450 ha in 1997 to 4,380 ha in 2021.

The net decrease of 70 ha was the balance of 170 ha retired from irrigation and 100 ha of expansion.

Irrigation methods

The dominant irrigation method in the Red Cliffs irrigation district was furrow irrigation in 1997. Overhead irrigation replaced furrows as the dominant method from 2003 to 2006, followed by drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 4,380 ha comprised:

- 51% (2,225 ha) drip irrigation;
- 14% (620 ha) low level irrigation;
- 11% (480 ha) overhead sprinklers;
- <1% (20 ha) furrow irrigation; and
- 24% (1,035 ha) not irrigated.

Salinity impact zones

The Red Cliffs irrigation district is in salinity zones L1, L4 and HIZ.

In 2021, the irrigable area of 4,380 ha comprised:

- 34% (1,470 ha) in the lowest salinity impact zone, L1;
- 24% (1,030 ha) in L4; and
- 43% (1,880 ha) in HIZ.

From 1997 to 2021 the irrigable area in:

- L1 decreased by 5 ha, a <1% decrease from 1,475 to 1,470 ha;
- L4 increased by 10 ha, a 1% increase from 1,020 to 1,030 ha; and
- HIZ decreased by 75 ha, a 4% decrease from 1,955 to 1,880 ha in 2021. The net decrease in the HIZ was mainly areas retired from irrigation for housing developments.

Irrigation properties

In 2021, there were approximately 390 irrigation properties in the Red Cliffs district and the average property size (irrigable area) was 11 ha.

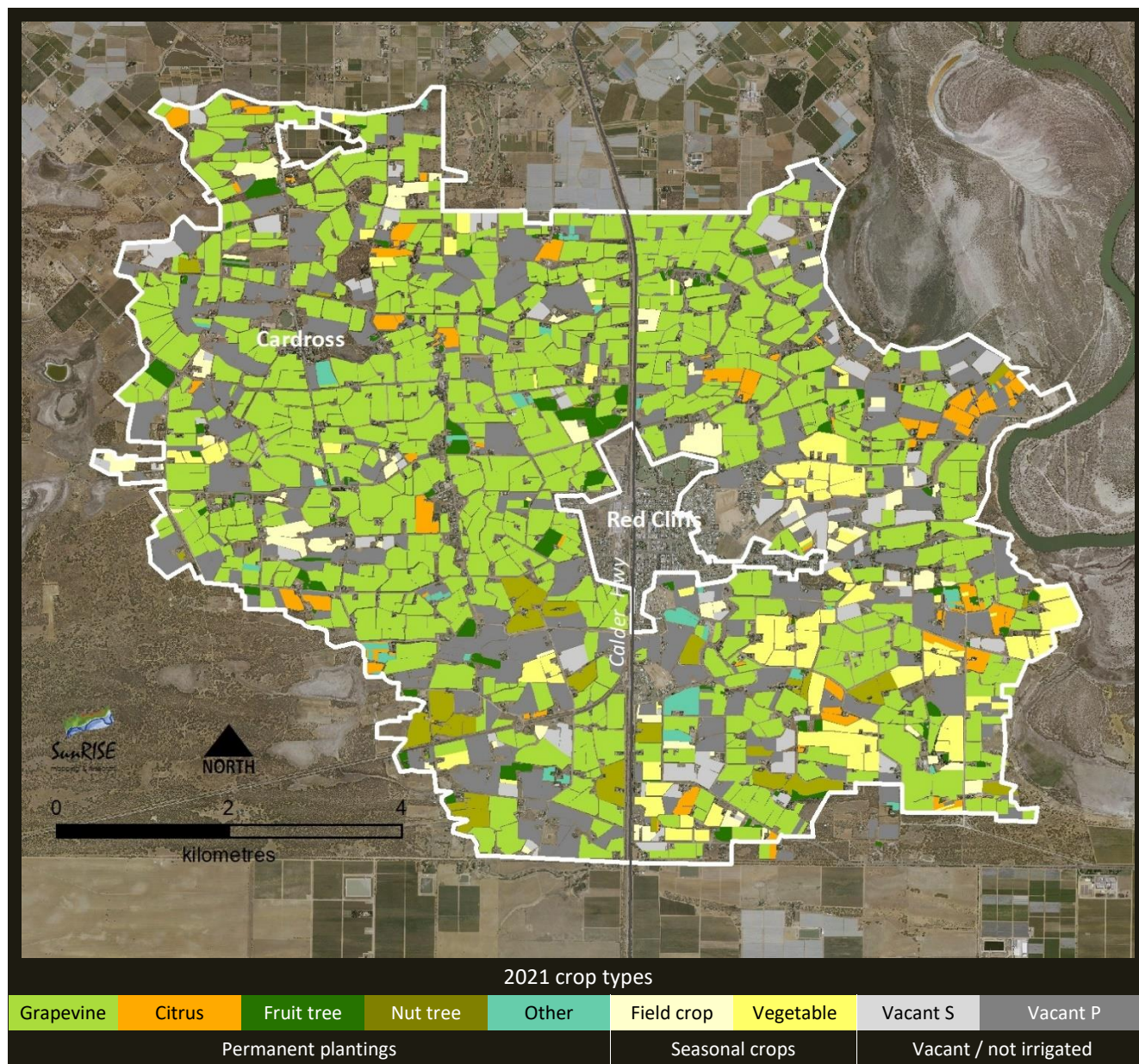
From 1997 to 2021:

- the number of properties decreased by 123, a 24% decrease from 513 to 390 properties;
- properties with an irrigable area less than 20 ha decreased by 154, while the number over 20 ha increased by 31; and
- average property size (irrigable area) increased from 9 to 11 ha.

2.4.1 Red Cliffs irrigation district - crop types in 2021

Map 6 shows the Red Cliffs irrigation district and crop types in 2021.

The aerial photography was flown in February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 6: Red Cliffs irrigation district showing 2021 crop types

2.4.2 Red Cliffs irrigation district - crop types from 1997 to 2021

Figure 35 summarises crop types in the Red Cliffs irrigation district from 1997 to 2021.

In 2021, table grapes replaced wine grapes as the dominant crop type. The main plantings in 2021 were:

1. table grapes, 1,185 ha (27% of the irrigable area);
2. wine grapes, 1,020 ha (23% of the irrigable area);
3. vegetables other than carrots and potatoes, 285 ha (7% of the irrigable area); and
4. dried grapes, 280 ha (6% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- dried grapes decreased by 1,095 ha, an 80% decrease from 1,375 to 280 ha;
- wine grapes decreased by 930 ha, a 48% decrease from 1,950 to 1,020 ha; and
- table grapes increased by 710 ha, a 149% increase from 475 to 1,185 ha.

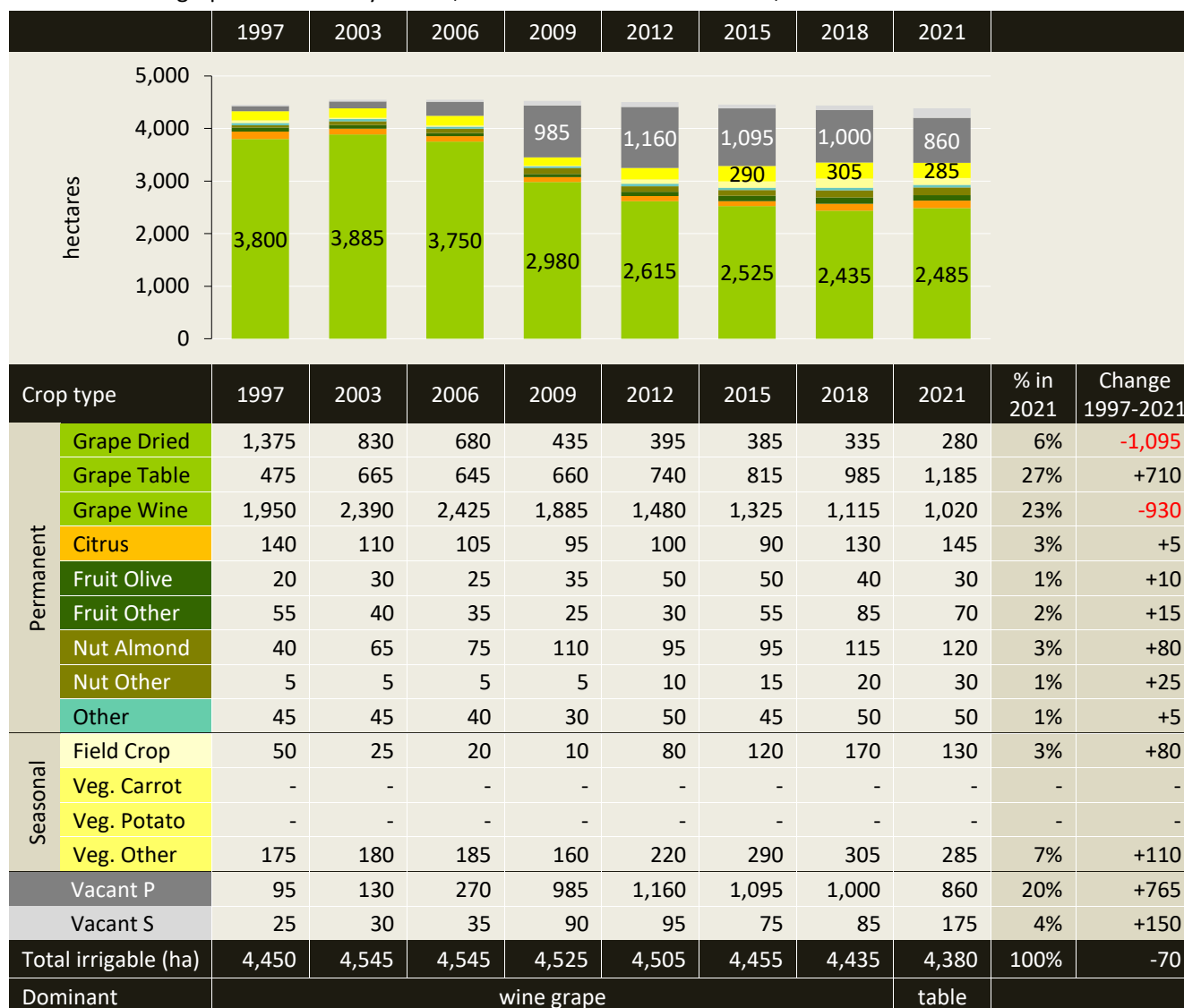


Figure 35: Red Cliffs irrigation district - crop types from 1997 to 2021

2.4.3 Red Cliffs irrigation district - development of permanent crops

Figure 36 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Red Cliffs irrigation district from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 515 ha (18%) of permanent crops were planted or redeveloped within the previous three years.
- The 515 ha was the highest area of development activity since 2009.
- The new plantings were:
 1. table grapes (345 ha);
 2. wine grapes (50 ha);
 3. citrus (40 ha);
 4. dried grapes (35 ha);
 5. almonds and walnuts (a total of 20 ha);
 6. fruit trees (15 ha); and
 7. nurseries (10 ha).

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was at its lowest in 2015 with 305 ha (11%) planted in the previous three years and highest in 1997 with 1,080 ha (26%) planted in the previous three years.

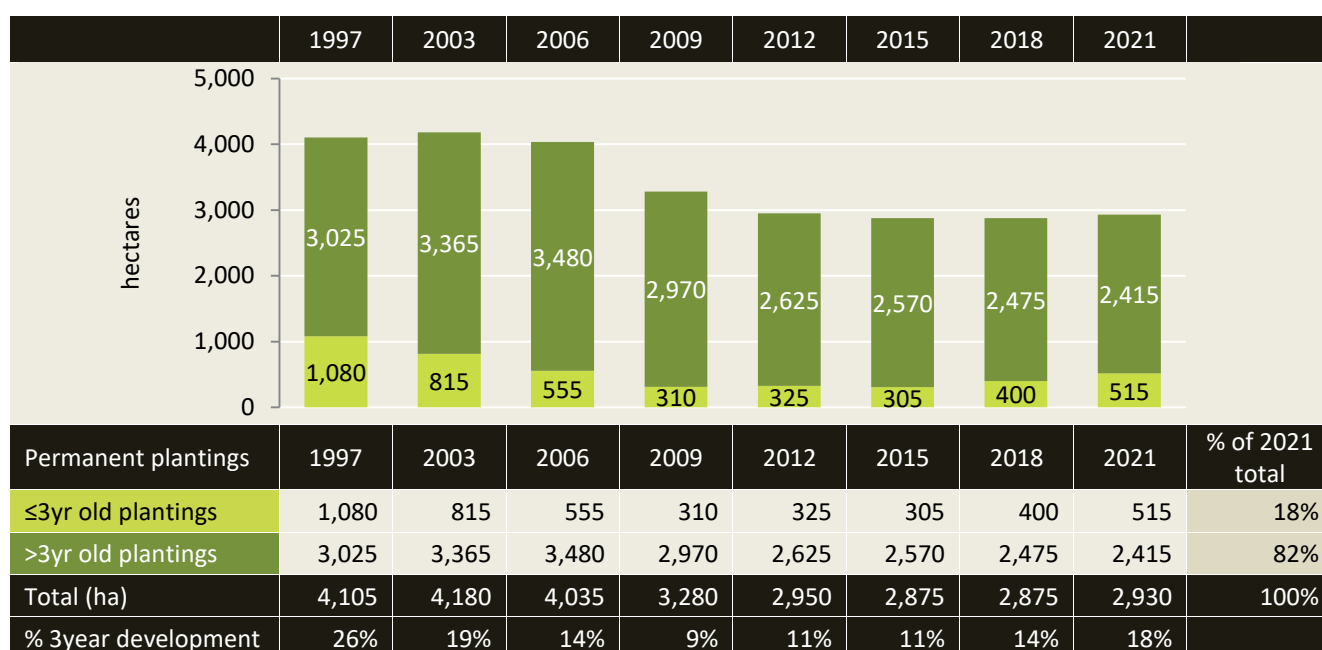


Figure 36: Red Cliffs irrigation district - development of permanent crops from 1997 to 2021

2.4.4 Red Cliffs irrigation district - planting trends

Figure 37 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Red Cliffs irrigation district from 1997 to 2021.

In 2021, the irrigable area of 4,380 ha comprised:

- 67% (2,930 ha) irrigated permanent plantings;
- 9% (415 ha) irrigated seasonal crops;
- 20% (860 ha) vacant, previously an irrigated permanent planting; and
- 4% (175 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 92% permanent, 5% seasonal and 3% vacant in 1997; to
- 67% permanent, 9% seasonal and 24% vacant in 2021.

The area vacant was at its highest in 2012 with 28% of the irrigable area not irrigated.

From 1997 to 2021:

- irrigated permanent crops decreased by 1,175 ha, from 4,105 to 2,930 ha;
- irrigated seasonal crops increased by 190 ha, from 225 to 415 ha;
- vacant areas, previously irrigated permanent plantings increased by 765 ha, from 95 to 860 ha; and
- vacant areas, previously irrigated seasonal crops decreased by 150 ha, from 25 to 175 ha.

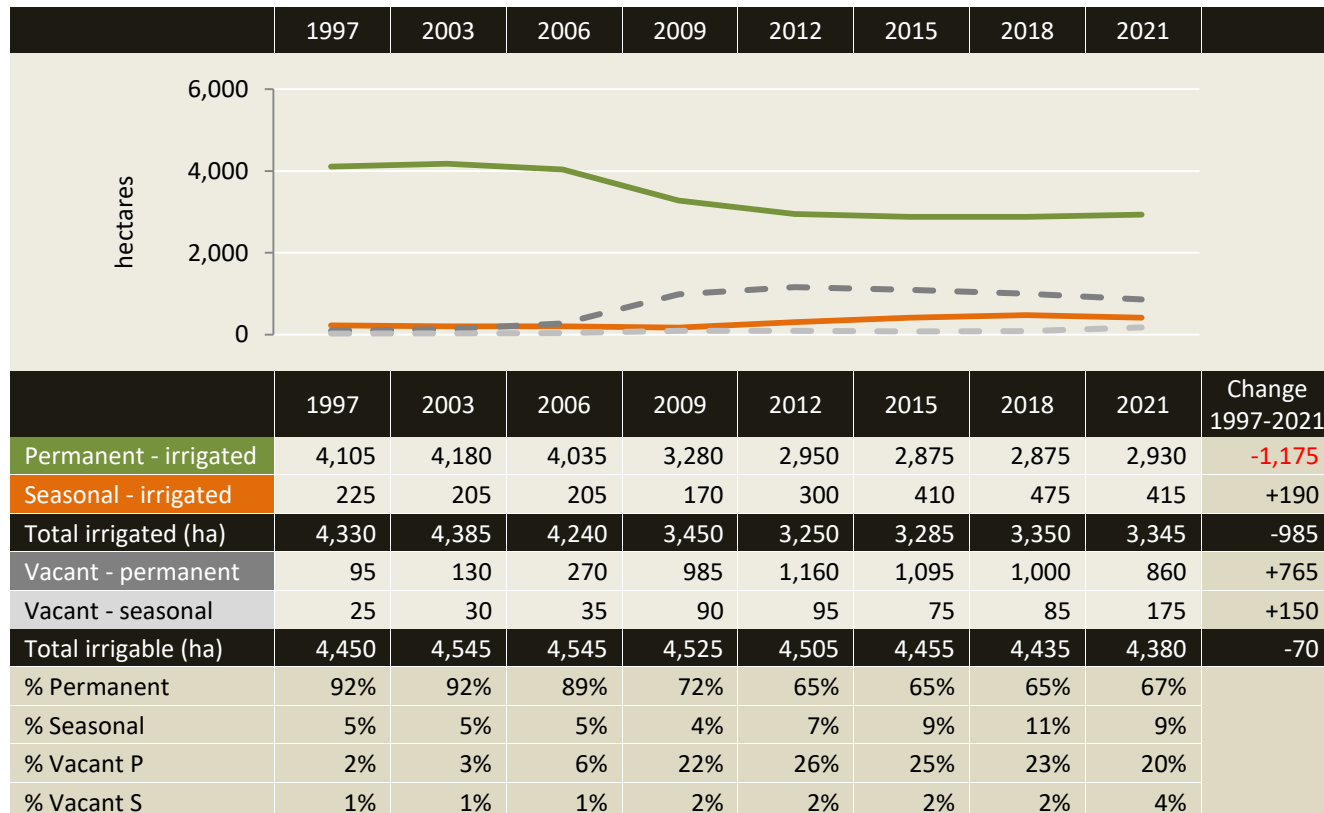
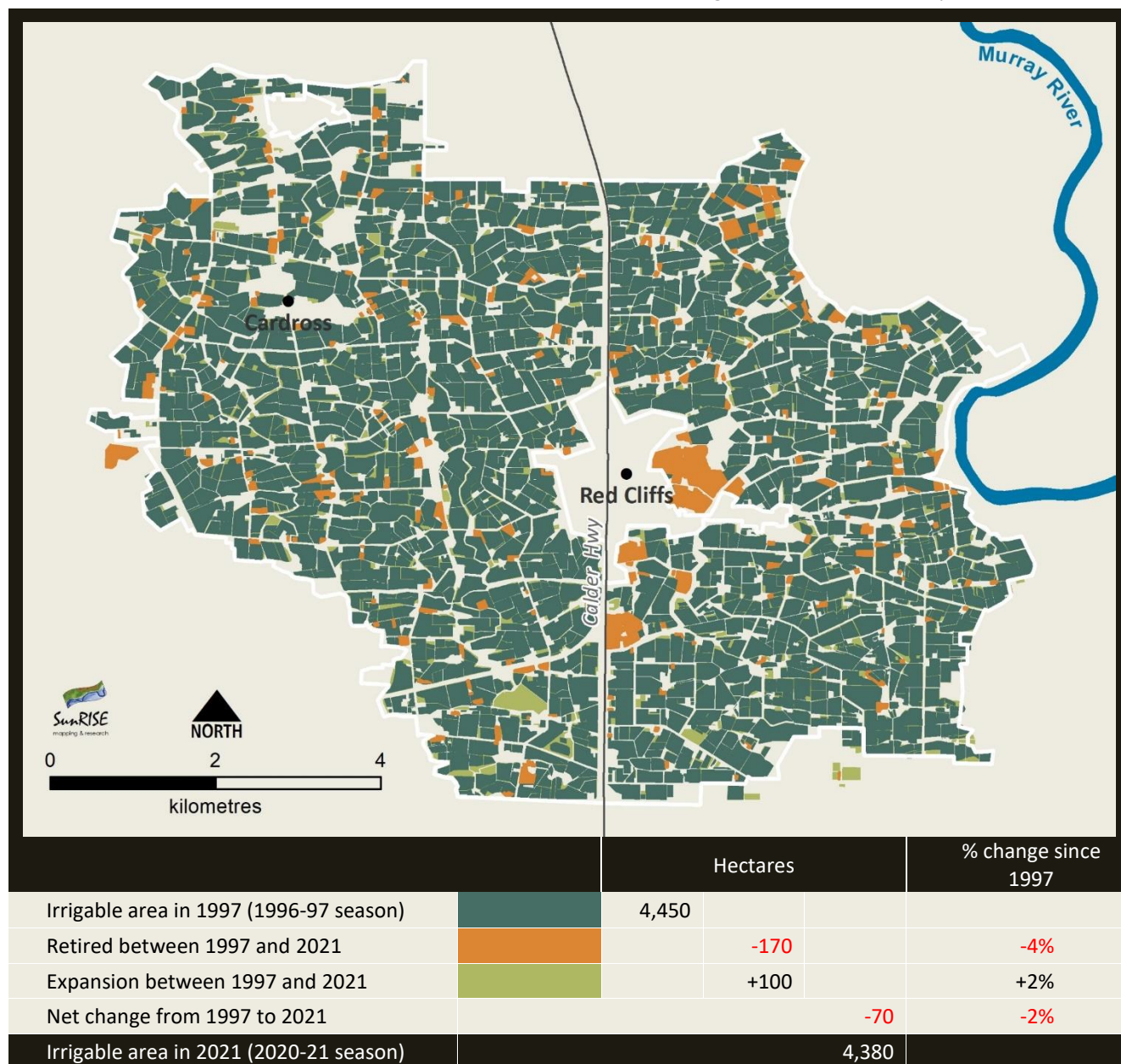


Figure 37: Red Cliffs irrigation district - planting trends from 1997 to 2021

2.4.5 Red Cliffs irrigation district - irrigation development

Map 7 shows irrigation development from 1997 to 2021 in the Red Cliffs irrigation district with respect to new development (expansion) and areas retired¹⁴ from irrigation.

- The irrigable area decreased by 70 ha, a 2% decrease from 4,450 ha in 1997 to 4,380 ha in 2021.
- The net decrease of 70 ha was the balance of 170 ha retired from irrigation and 100 ha of expansion.



Map 7: Red Cliffs irrigation district - irrigation development from 1997 to 2021

¹⁴ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

2.4.6 Red Cliffs irrigation district - irrigation methods

Figure 38 summarises irrigation methods in the Red Cliffs irrigation district from 1997 to 2021.

The dominant irrigation method in the Red Cliffs irrigation district was furrow irrigation in 1997. Overhead irrigation replaced furrows as the dominant method from 2003 to 2006, followed by drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 4,380 ha comprised:

- 51% (2,225 ha) drip irrigation;
- 14% (620 ha) low level irrigation;
- 11% (480 ha) overhead sprinklers;
- <1% (20 ha) furrow irrigation; and
- 24% (1,035 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 1,860 ha, a 510% increase from 365 to 2,225 ha;
- low level irrigation increased by 140 ha, a 29% increase from 480 to 620 ha;
- overhead irrigation decreased by 1,030 ha, a 68% decrease from 1,510 to 480 ha; and
- furrow irrigation decreased by 1,955 ha, a 99% decrease from 1,975 to 20 ha.

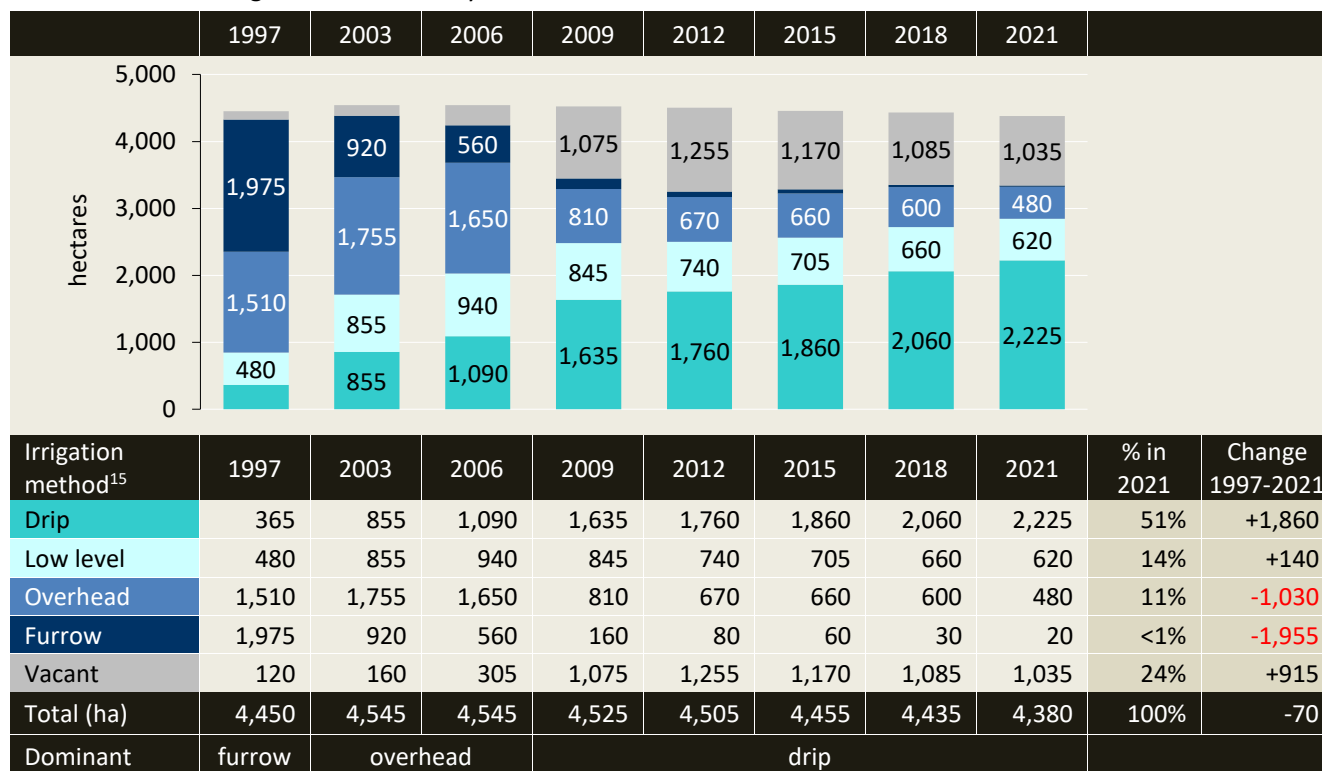


Figure 38: Red Cliffs irrigation district - irrigation methods from 1997 to 2021

¹⁵ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

2.4.7 Red Cliffs irrigation district - salinity impact zones

Figure 39 summarises river salinity impact zones of irrigated areas in the Red Cliffs irrigation district from 1997 to 2021. The Red Cliffs district is in low salinity impact zones L1 and L4, and in the high salinity impact zone, HIZ.

In 2021, the irrigable area of 4,380 ha comprised:

- 34% (1,470 ha) in the lowest salinity impact zone, L1;
- 24% (1,030 ha) in L4; and
- 43% (1,880 ha) in HIZ.

From 1997 to 2021, the area irrigated in:

- L1 decreased by 325 ha, a 23% decrease from 1,430 to 1,105 ha;
- L4 decreased by 215 ha, a 22% decrease from 995 to 780 ha; and
- HIZ decreased by 445 ha, a 23% decrease from 1,905 to 1,460 ha.

From 1997 to 2021, the irrigable area in:

- L1 decreased by 5 ha, a <1% decrease from 1,475 to 1,470 ha;
- L4 increased by 10 ha, a 1% increase from 1,020 to 1,030 ha; and
- HIZ decreased by 75 ha, a 4% decrease from 1,955 to 1,880 ha. The net decrease in the HIZ was mainly areas retired from irrigation for housing developments.

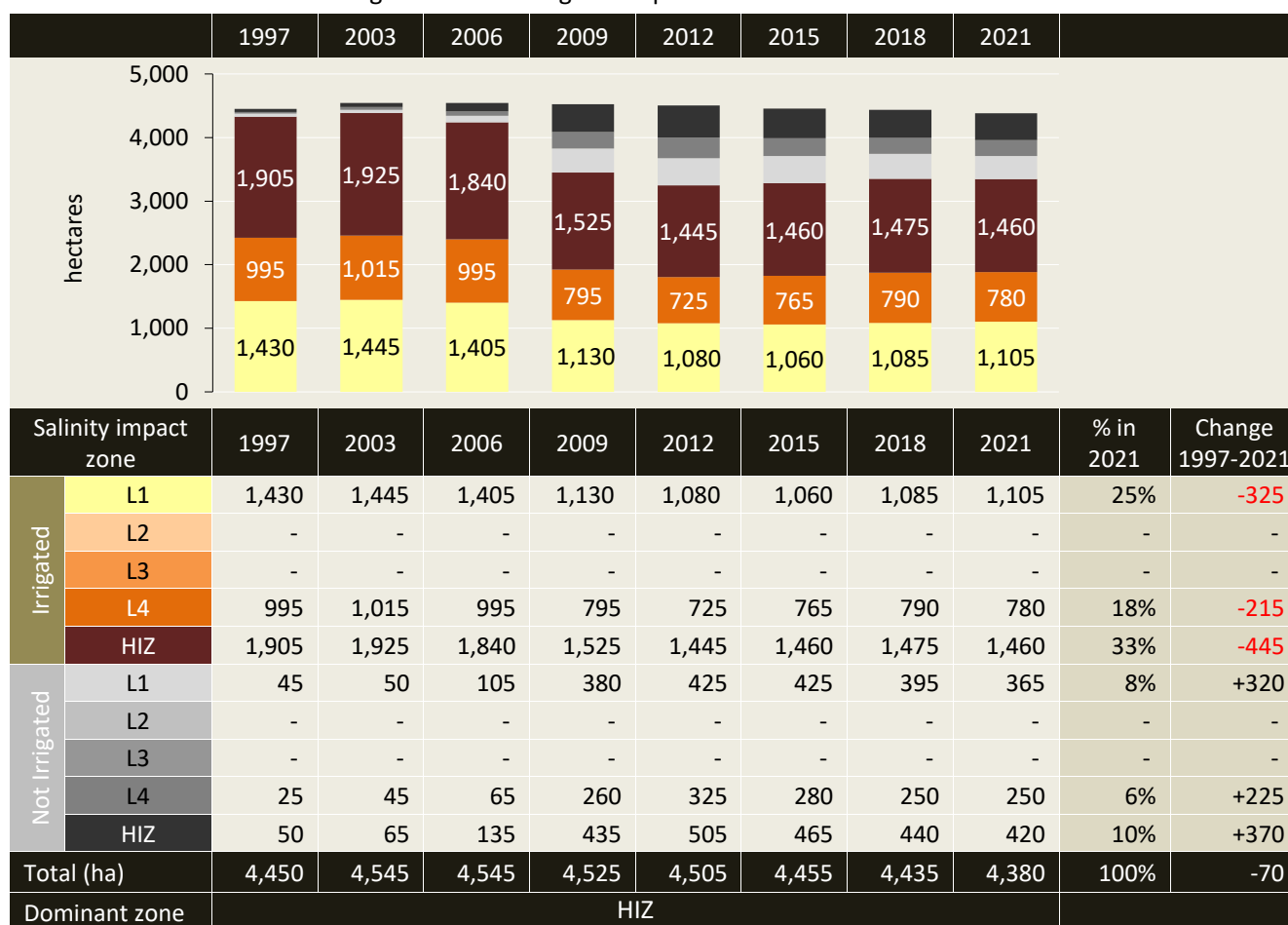


Figure 39: Red Cliffs irrigation district - irrigable area in each salinity impact zone from 1997 to 2021

2.4.8 Red Cliffs irrigation district - property change

Figure 40 provides estimates of property numbers and average property size (irrigable area) in the Red Cliffs irrigation district from 1997 to 2021.

In 2021:

- there were approximately 390 irrigation properties; and
- most properties (87%) had an irrigable area less than 20 ha.

From 1997 to 2021:

- the number of properties decreased by 123, a 24% decrease from 513 to 390;
- properties with an irrigable area less than 20 ha decreased by 154, while the number over 20 ha increased by 31; and
- average property size (irrigable area) increased from 9 to 11 ha.

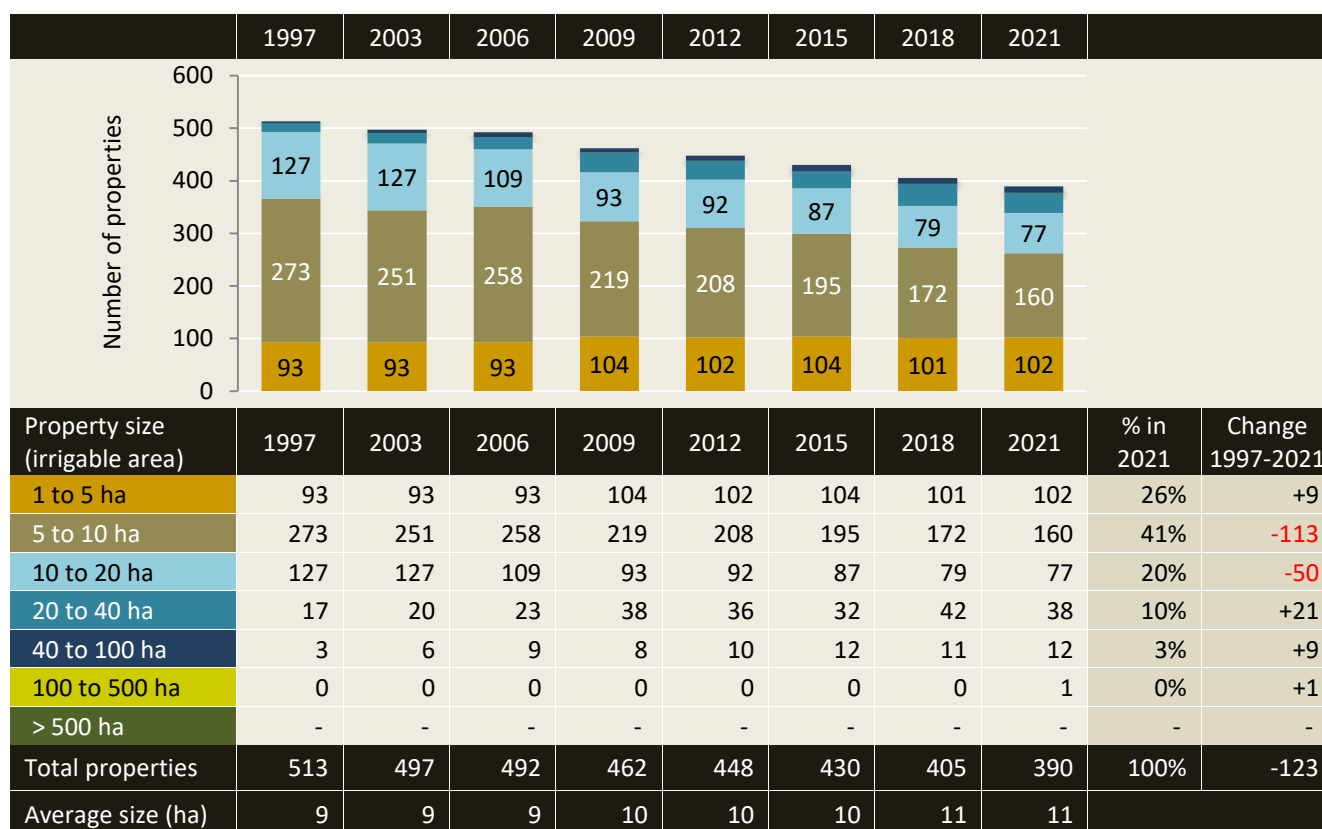


Figure 40: Red Cliffs irrigation district - property numbers and sizes from 1997 to 2021

2.5 Mildura irrigation district

In summary for the Mildura irrigation district

Crop types in 2021

The main plantings in the Mildura irrigation district in 2021 were:

1. table grapes, 2,275 ha (40% of the irrigable area);
2. wine grapes, 870 ha (15% of the irrigable area); and
3. dried grapes, 525 ha (9% of the irrigable area).

Crop types 1997 to 2021

The dominant crop type changed from dried grapes in 1997 to wine grapes from 2003 to 2009, then table grapes from 2012 to 2021.

The main crop type changes from 1997 to 2021 were:

- dried grape plantings decreased by 1,805 ha, a 77% decrease from 2,330 to 525 ha;
- wine grape plantings decreased by 1,370 ha, a 61% decrease from 2,240 to 870 ha; and
- table grape plantings increased by 1,290 ha, a 131% increase from 985 to 2,275 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 820 ha (20%) of permanent crops were planted or redeveloped in the previous three years.

The 820 ha was the highest area of development activity since 2006.

The new plantings were:

1. table grapes (600 ha);
2. citrus (95 ha);
3. dried grapes (50 ha);
4. wine grapes (45 ha);
5. almonds (15 ha); and
6. fruit trees and nurseries (a total of 15 ha).

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 5,715 ha comprised:

- 70% (4,020 ha) irrigated permanent plantings;
- 4% (245 ha) irrigated seasonal crops;
- 20% (1,130 ha) vacant, previously an irrigated permanent planting; and
- 6% (320 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings decreased from 92% to 70% of the irrigable area;
- seasonal crops decreased from 6% to 4% of the irrigable area; and
- vacant, not irrigated areas increased from 2% to 26% of the irrigable area.

In summary for the Mildura irrigation district

Irrigation development - new and retired areas

In the Mildura irrigation district, the irrigable area decreased by 730 ha, an 11% decrease from 6,445 ha in 1997 to 5,715 ha in 2021.

The net decrease of 730 ha was the balance of 990 ha retired from irrigation and 260 ha of expansion.

Irrigation methods

The dominant irrigation method in the Mildura irrigation district was furrow irrigation in 1997. Furrows were replaced by overhead sprinklers as the dominant method by 2006, followed by low level sprinklers in 2009 and drippers from 2012 to 2021.

In 2021, the irrigable area of 5,715 ha comprised:

- 45% (2,545 ha) drip irrigation;
- 21% (1,190 ha) low level irrigation;
- 6% (365 ha) overhead sprinklers;
- 3% (165 ha) furrow irrigation; and
- 26% (1,450 ha) not irrigated.

Salinity impact zones

The Mildura irrigation district is in the lowest salinity impact zone, L1 and in the high impact zone, HIZ.

In 2021, the irrigable area of 5,715 ha comprised:

- 37% (2,105 ha) in L1; and
- 63% (3,610 ha) in the HIZ.

From 1997 to 2021 the irrigable area in:

- L1 increased by 85 ha, a 4% increase from 2,020 to 2,105 ha; and
- HIZ decreased by 815 ha, an 18% decrease from 4,425 to 3,610 ha. The decrease was predominantly areas retired from irrigation for urban development.

The area irrigated in HIZ continued to decrease from 1997 to 2015, but increased by 105 ha between 2015 and 2018. The increase was largely due to vacant areas in HIZ being brought back into production.

Irrigation properties

In 2021, there were approximately 577 irrigation properties in the Mildura irrigation district and the average property size (irrigable area) was 10 ha.

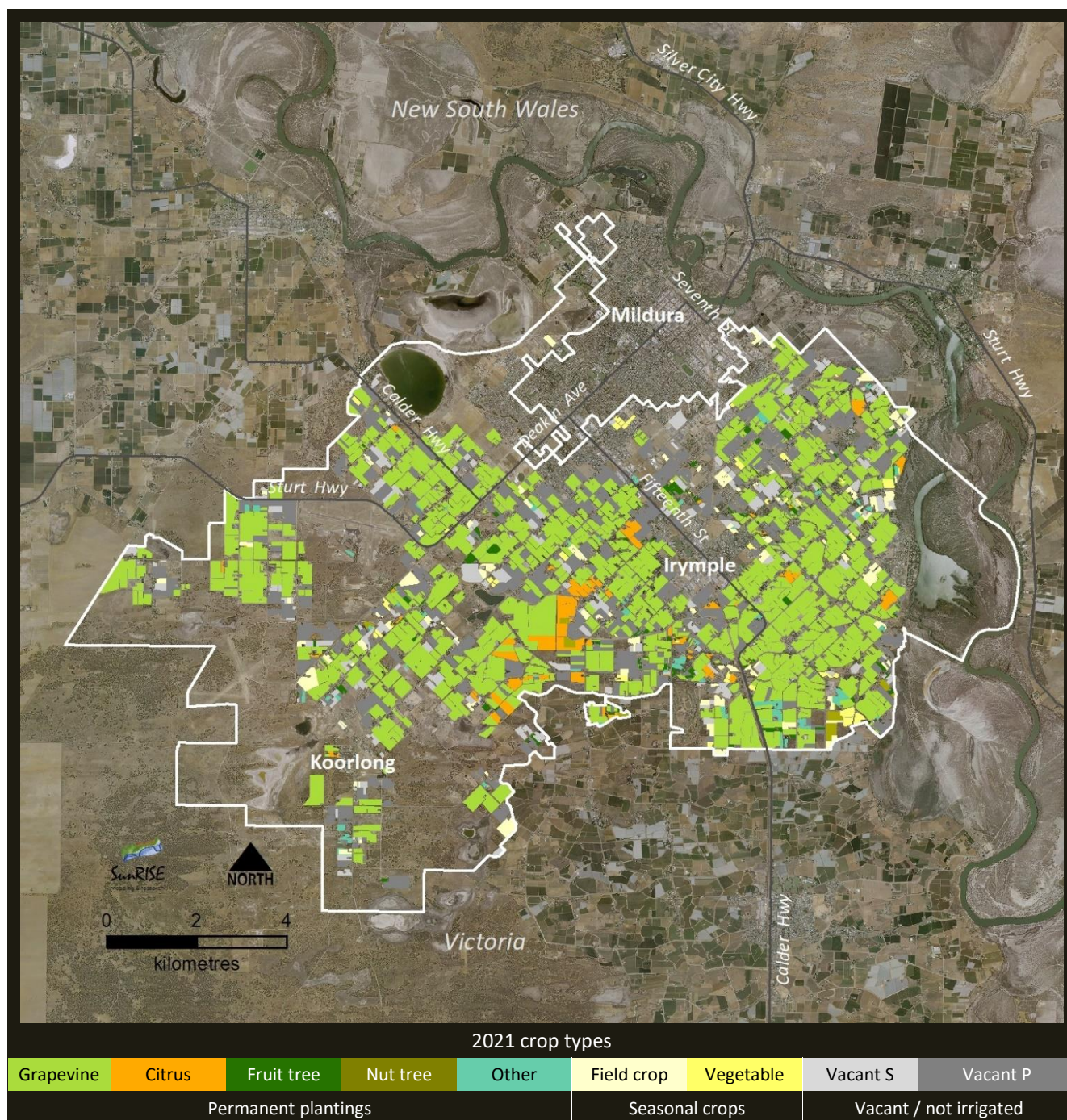
From 1997 to 2021:

- the number of properties decreased by 258, a 31% decrease from 835 to 577 properties;
- properties with an irrigable area less than 40 ha decreased by 277, while the number over 40 ha increased by 19; and
- average property size (irrigable area) increased from 8 to 10 ha.

2.5.1 Mildura irrigation district - crop types in 2021

Map 8 shows the Mildura irrigation district and crop types in 2021.

The aerial photography was flown in February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 8: Mildura irrigation district showing 2021 crop types

2.5.2 Mildura irrigation district - crop types from 1997 to 2021

Figure 41 summarises crop types in the Mildura irrigation district from 1997 to 2021. The dominant crop type changed from dried grapes in 1997 to wine grapes from 2003 to 2009, then table grapes from 2012 to 2021.

In 2021, the main plantings were:

1. table grapes, 2,275 ha (40% of the irrigable area);
2. wine grapes, 870 ha (15% of the irrigable area); and
3. dried grapes, 525 ha (9% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- dried grapes decreased by 1,805 ha, a 77% decrease from 2,330 to 525 ha;
- wine grapes decreased by 1,370 ha, a 61% decrease from 2,240 to 870 ha; and
- table grapes increased by 1,290 ha, a 131% increase from 985 to 2,275 ha.

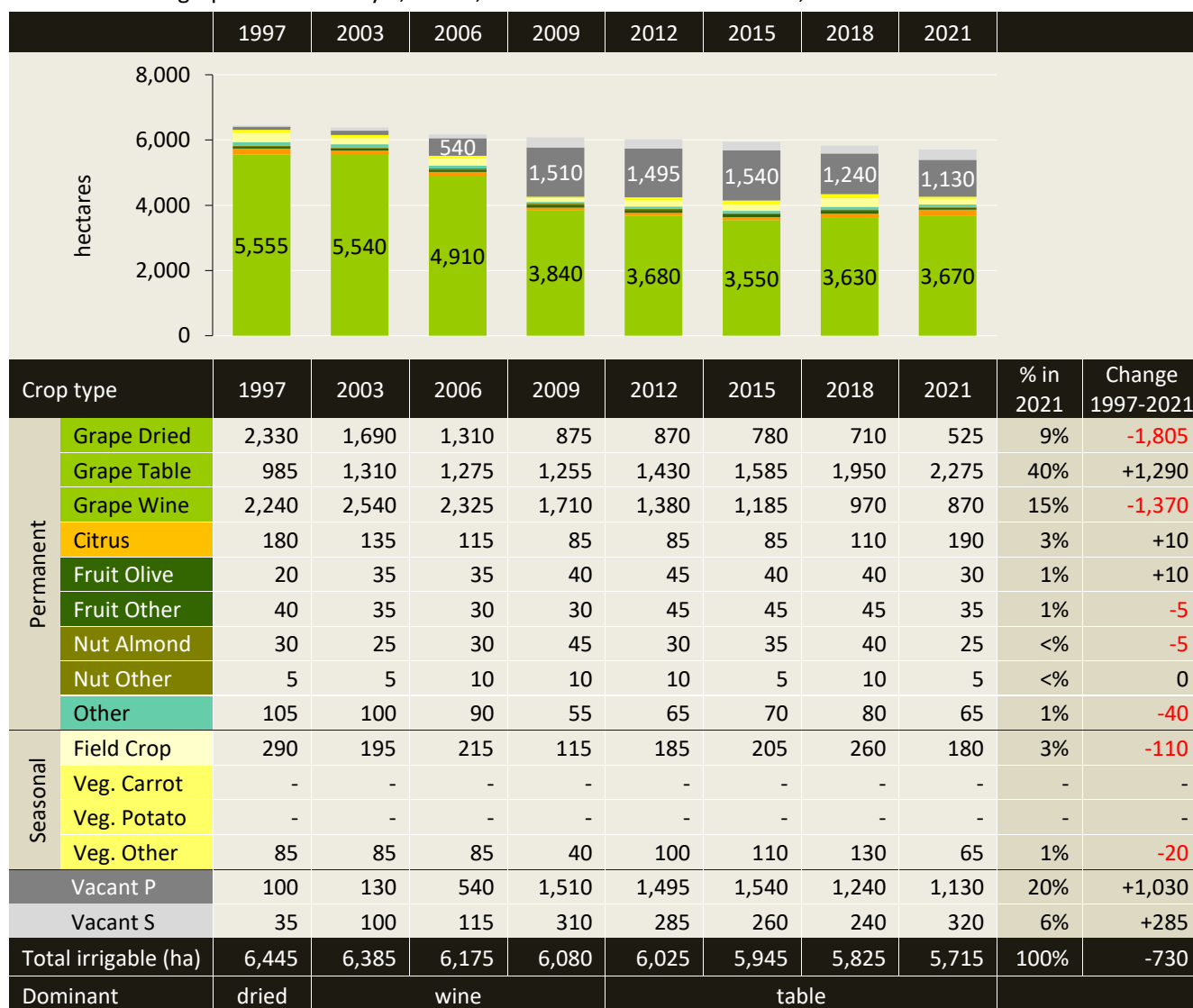


Figure 41: Mildura irrigation district - crop types from 1997 to 2021

2.5.3 Mildura irrigation district - development of permanent crops

Figure 42 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Mildura irrigation district from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 820 ha (20%) of permanent crops were planted or redeveloped within the previous three years.
- The 820 ha was the highest area of development activity since 2006.
- The new plantings were:
 1. table grapes (600 ha);
 2. citrus (95 ha);
 3. dried grapes (50 ha);
 4. wine grapes (45 ha);
 5. almonds (15 ha); and
 6. fruit trees and nurseries (a total of 15 ha).

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was at its lowest in 2009 with 380 ha (9%) planted in the previous three years and highest in 1997 with 970 ha (16%) planted in the previous three years.

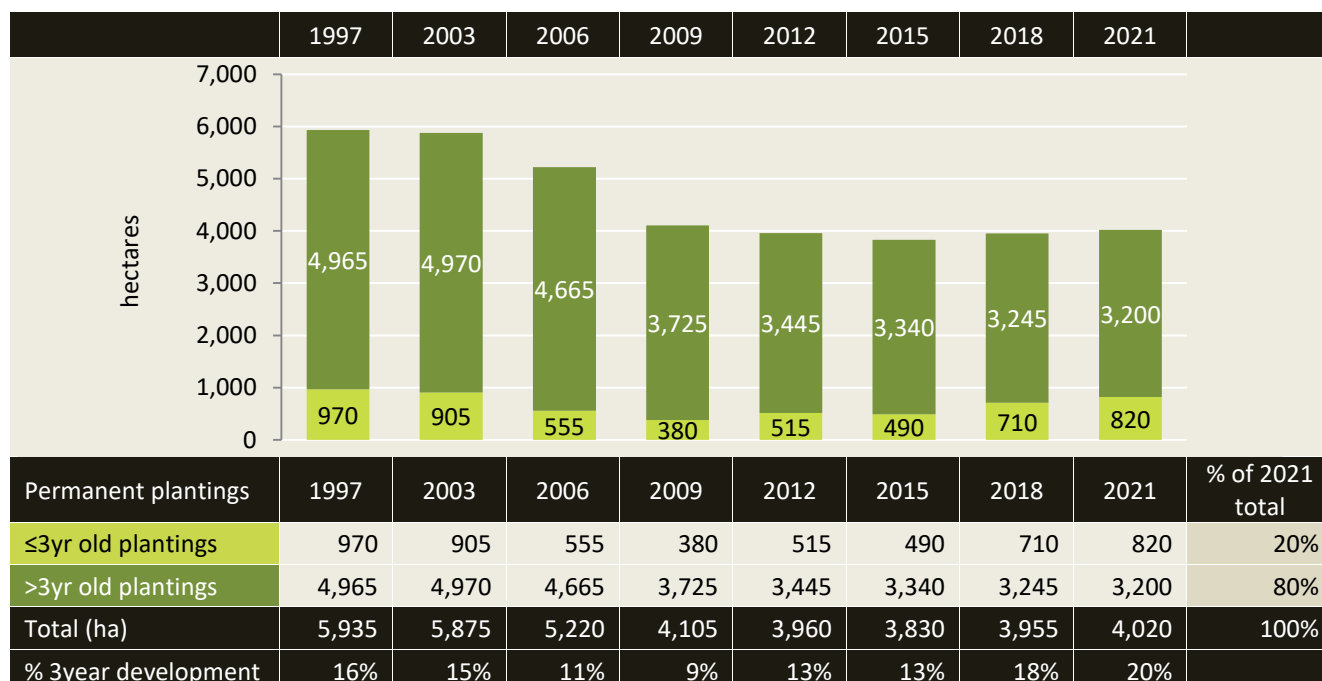


Figure 42: Mildura irrigation district - development of permanent crops from 1997 to 2021

2.5.4 Mildura irrigation district - planting trends

Figure 43 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Mildura irrigation district from 1997 to 2021.

In 2021, the irrigable area of 5,715 ha comprised:

- 70% (4,020 ha) irrigated permanent plantings;
- 4% (245 ha) irrigated seasonal crops;
- 20% (1,130 ha) vacant, previously an irrigated permanent planting; and
- 6% (320 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 92% permanent, 6% seasonal and 2% vacant in 1997; to
- 70% permanent, 4% seasonal and 26% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops decreased by 1,915 ha, from 5,935 to 4,020 ha;
- irrigated seasonal crops decreased by 130 ha, from 375 to 245 ha;
- vacant areas, previously irrigated permanent plantings increased by 1,030 ha, from 100 to 1,130 ha; and
- vacant areas, previously irrigated seasonal crops increased by 285 ha, from 35 to 320 ha.

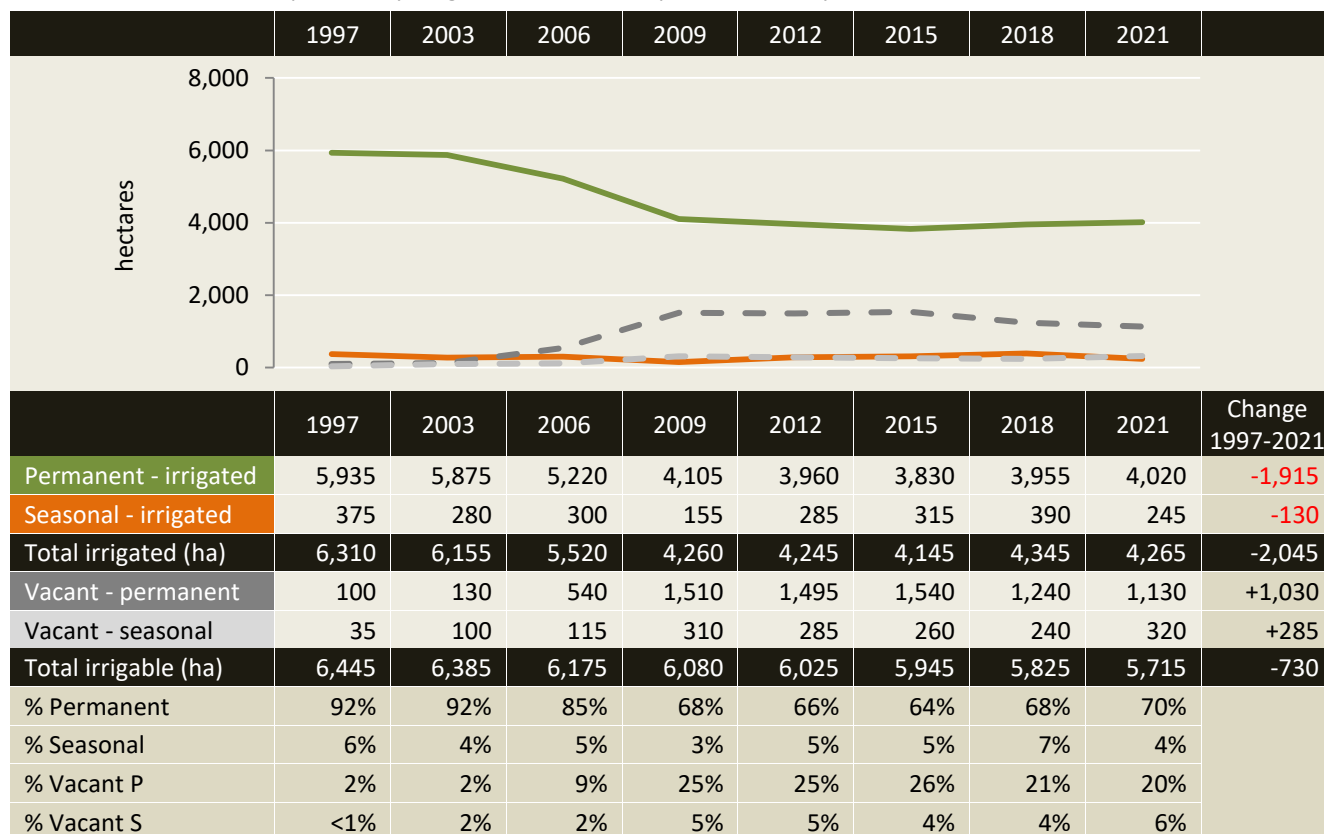
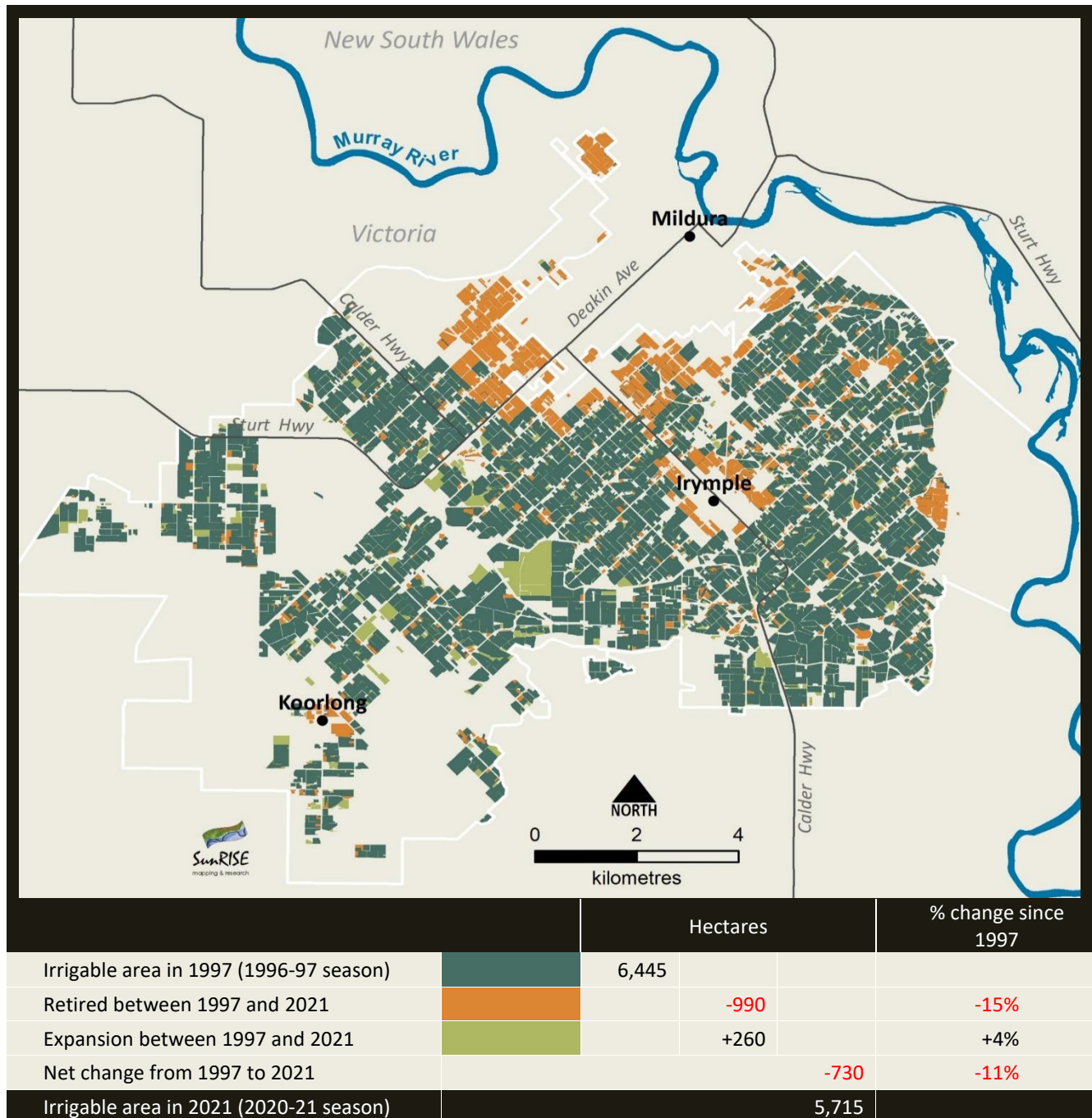


Figure 43: Mildura irrigation district - planting trends from 1997 to 2021

2.5.5 Mildura irrigation district - irrigation development

Map 9 shows irrigation development from 1997 to 2021 in the Mildura irrigation district with respect to new development (expansion) and areas retired¹⁶ from irrigation.

- The irrigable area decreased by 730 ha, an 11% decrease from 6,445 ha in 1997 to 5,715 ha in 2021.
- The net decrease of 730 ha was the balance of 990 ha retired from irrigation and 260 ha of expansion.



Map 9: Mildura irrigation district - irrigation development from 1997 to 2021

¹⁶ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

2.5.6 Mildura irrigation district - irrigation methods

Figure 44 summarises irrigation methods in the Mildura irrigation district from 1997 to 2021.

The dominant irrigation method in the Mildura irrigation district was furrow irrigation in 1997. Furrows were replaced by overhead sprinklers as the dominant method by 2006, followed by low level sprinklers in 2009 and drippers from 2012 to 2021.

In 2021, the irrigable area of 5,715 ha comprised:

- 45% (2,545 ha) drip irrigation;
- 21% (1,190 ha) low level irrigation;
- 6% (365 ha) overhead sprinklers;
- 3% (165 ha) furrow irrigation; and
- 25% (1,450 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 2,350 ha, a 1,205% increase from 195 to 2,545 ha;
- low level irrigation increased by 425 ha, a 56% increase from 765 to 1,190 ha;
- overhead irrigation decreased by 1,500 ha, an 80% decrease from 1,865 to 365 ha; and
- furrow irrigation decreased by 3,320 ha, a 95% decrease from 3,485 to 165 ha.

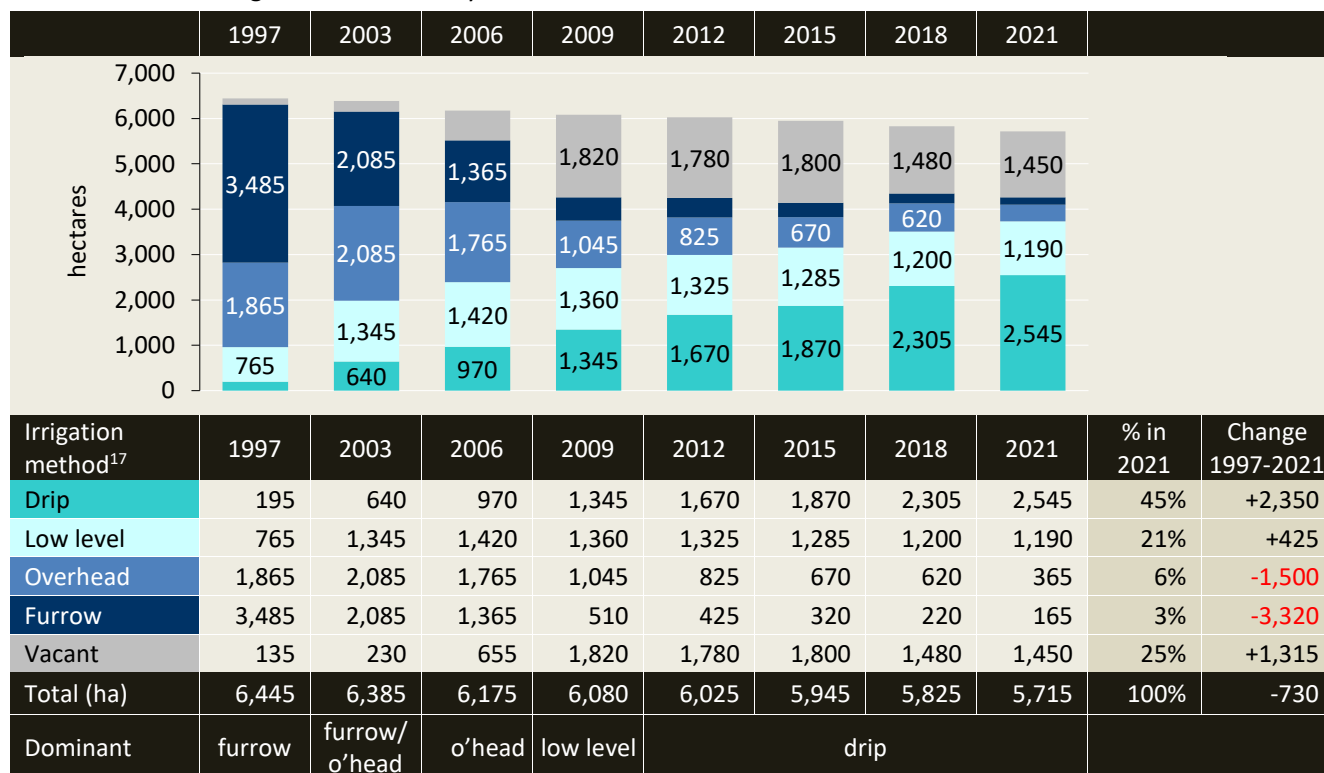


Figure 44: Mildura irrigation district - irrigation methods from 1997 to 2021

¹⁷ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

2.5.7 Mildura irrigation district - salinity impact zones

Figure 45 summarises river salinity impact zones of irrigated areas in the Mildura irrigation district from 1997 to 2021. The Mildura district is in the lowest salinity impact zone, L1 and in the high salinity impact zone, HIZ.

In 2021, the irrigable area of 5,715 ha comprised:

- 37% (2,105 ha) in L1; and
- 63% (3,610 ha) in the HIZ.

From 1997 to 2021, the area irrigated in:

- L1 decreased by 445 ha, a 23% decrease from 1,965 to 1,520 ha; and
- HIZ decreased by 1,600 ha, a 37% decrease from 4,345 to 2,745 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 85 ha, a 4% increase from 2,020 to 2,105 ha; and
- HIZ decreased by 815 ha, an 18% decrease from 4,425 to 3,610 ha. The decrease of irrigable area in the HIZ was mainly areas retired from irrigation for urban development.



Figure 45: Mildura irrigation district - irrigable area in each salinity impact zone from 1997 to 2021

2.5.8 Mildura irrigation district - property change

Figure 46 provides estimates of property numbers and average property size (irrigable area) in the Mildura irrigation district from 1997 to 2021.

In 2021:

- there were approximately 577 irrigation properties; and
- most properties (90%) had an irrigable area less than 20 ha.

From 1997 to 2021:

- the number of properties decreased by 258, a 31% decrease from 835 to 577 properties;
- properties with an irrigable area less than 40 ha decreased by 277, while the number over 40 ha increased by 19; and
- average property size (irrigable area) increased from 8 to 10 ha.

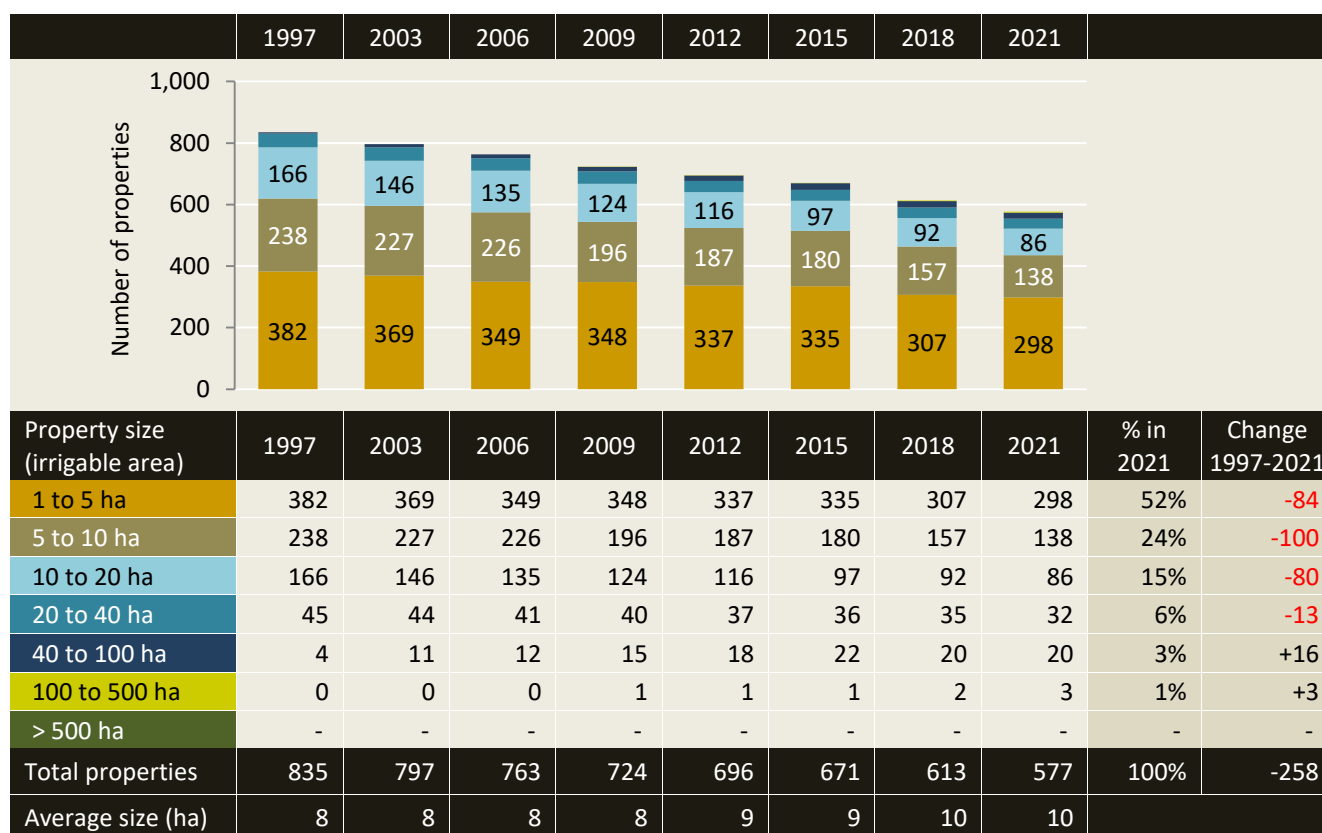


Figure 46: Mildura irrigation district - property numbers and sizes from 1997 to 2021

2.6 Merbein irrigation district

In summary for the Merbein irrigation district

Crop types in 2021

The main plantings in the Merbein irrigation district in 2021 were:

1. table grapes, 770 ha (26% of the irrigable area);
2. dried grapes, 385 ha (13% of the irrigable area); and
3. wine grapes, 250 ha (9% of the irrigable area).

Crop types 1997 to 2021

Table grape plantings replaced dried grapes as the dominant crop in 2021. Dried grapes were dominant from 1997 to 2018, except in 2009 when wine grapes were temporarily dominant. The main crop type changes from 1997 to 2021 were:

- dried grape plantings decreased by 1,255 ha, a 77% decrease from 1,640 to 385 ha;
- wine grape plantings decreased by 665 ha, a 73% decrease from 915 to 250 ha; and
- table grape plantings increased by 620 ha, a 413% increase from 150 to 770 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 430 ha (26%) of permanent crops were planted or redeveloped in the previous three years.

The 430 ha was the highest area of development activity since 2003.

The new plantings were:

1. table grapes (315 ha);
2. dried grapes (35 ha);
3. citrus (30 ha);
4. wine grapes (20 ha);
5. pistachios (15 ha); and
6. fruit trees and nurseries (a total of 15 ha).

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 2,915 ha comprised:

- 57% (1,670 ha) irrigated permanent plantings;
- 7% (195 ha) irrigated seasonal crops;
- 31% (910 ha) vacant, previously an irrigated permanent planting; and
- 5% (140 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings decreased from 97% to 57% of the irrigable area;
- seasonal crops increased from 2% to 7% of the irrigable area; and
- vacant, not irrigated areas increased from 1% to 36% of the irrigable area.

In summary for the Merbein irrigation district

Irrigation development - new and retired areas

In the Merbein irrigation district, the irrigable area decreased by 230 ha, a 7% decrease from 3,145 ha in 1997 to 2,915 ha in 2021.

The net decrease of 230 ha was the balance of 245 ha retired from irrigation and 15 ha of expansion. Areas retired were mainly for urban development.

Irrigation methods

The dominant irrigation method in the Merbein district was furrow irrigation from 1997 to 2006, followed by drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 2,915 ha comprised:

- 38% (1,115 ha) drip irrigation;
- 16% (470 ha) low level irrigation;
- 7% (190 ha) overhead sprinklers;
- 3% (90 ha) furrow irrigation; and
- 36% (1,050 ha) not irrigated.

Salinity impact zones

The Merbein district is in the lowest salinity impact zone, L1 and in the high salinity impact zone, HIZ.

In 2021, the irrigable area of 2,915 ha comprised:

- 35% (1,010 ha) in L1; and
- 65% (1,905 ha) in HIZ.

From 1997 to 2021 the irrigable area in:

- L1 decreased by 20 ha, a 2% decrease from 1,030 to 1,010 ha; and
- HIZ decreased by 210 ha, a 10% decrease from 2,115 to 1,905 ha, predominantly areas retired from irrigation for urban development.

Irrigation properties

In 2021, there were approximately 251 irrigation properties and the average property size (irrigable area) was 12 ha.

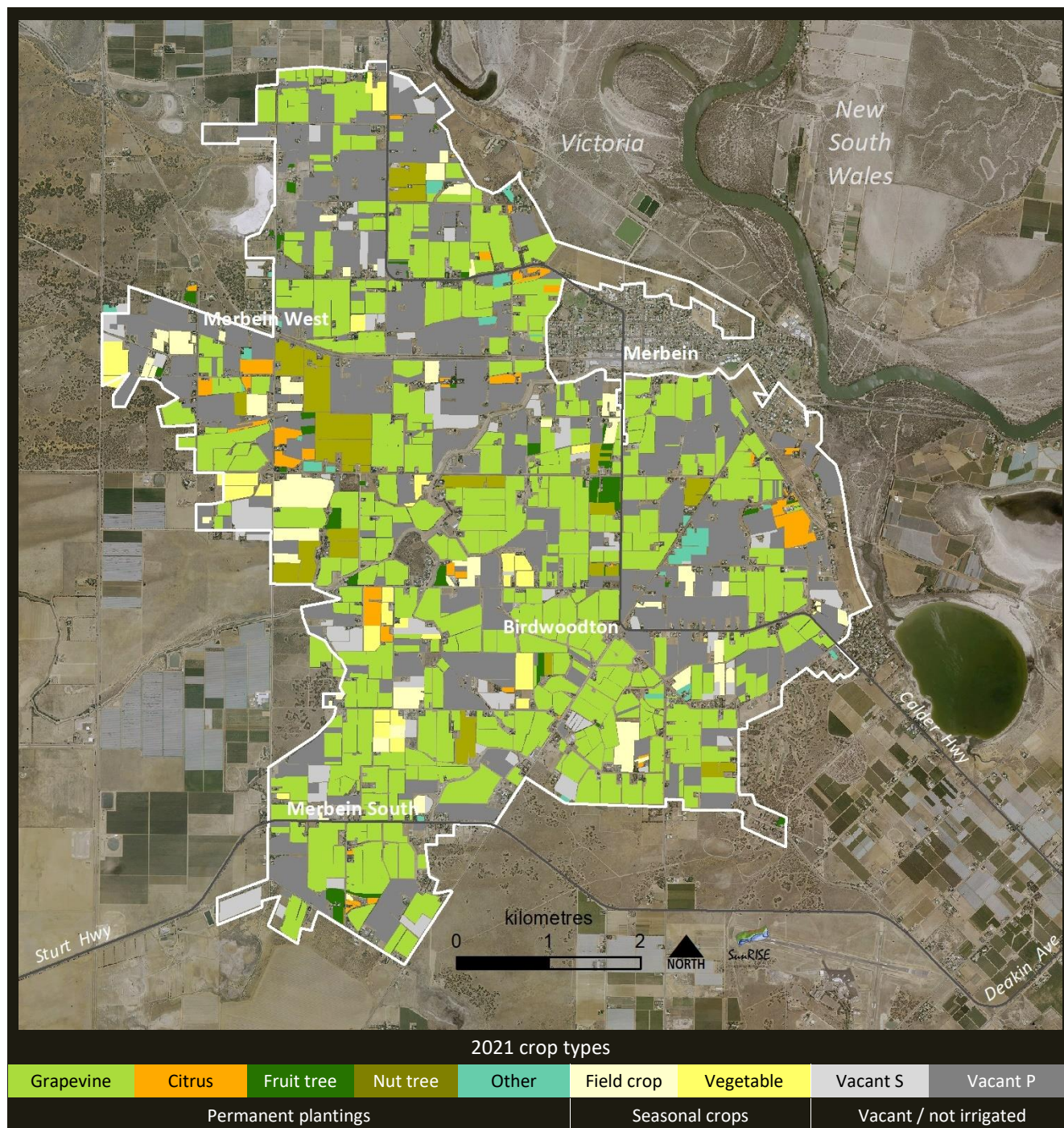
From 1997 to 2021:

- the number of properties decreased by 79, a 24% decrease from 330 to 251 properties;
- properties with an irrigable area less than 40 ha decreased by 93, while the number over 40 ha increased by 14; and
- average property size (irrigable area) increased from 10 to 12 ha.

2.6.1 Merbein irrigation district - crop types in 2021

Map 10 shows the Merbein irrigation district and crop types in 2021.

The aerial photography was flown in February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 10: Merbein irrigation district showing 2021 crop types

2.6.2 Merbein irrigation district - crop types from 1997 to 2021

Figure 47 summarises crop types in the Merbein irrigation district from 1997 to 2021. Dried grape plantings were the dominant crop type from 1997 to 2018, except in 2009 when wine grapes were temporarily dominant. Table grapes replaced dried grapes in 2021 as the dominant crop.

In 2021, the main plantings were:

1. table grapes, 770 ha (26% of the irrigable area);
2. dried grapes, 385 ha (13% of the irrigable area); and
3. wine grapes, 250 ha (9% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- dried grapes decreased by 1,255 ha, a 77% decrease from 1,640 to 385 ha;
- wine grapes decreased by 665 ha, a 73% decrease from 915 to 250 ha; and
- table grapes increased by 620 ha, a 413% increase from 150 to 770 ha.

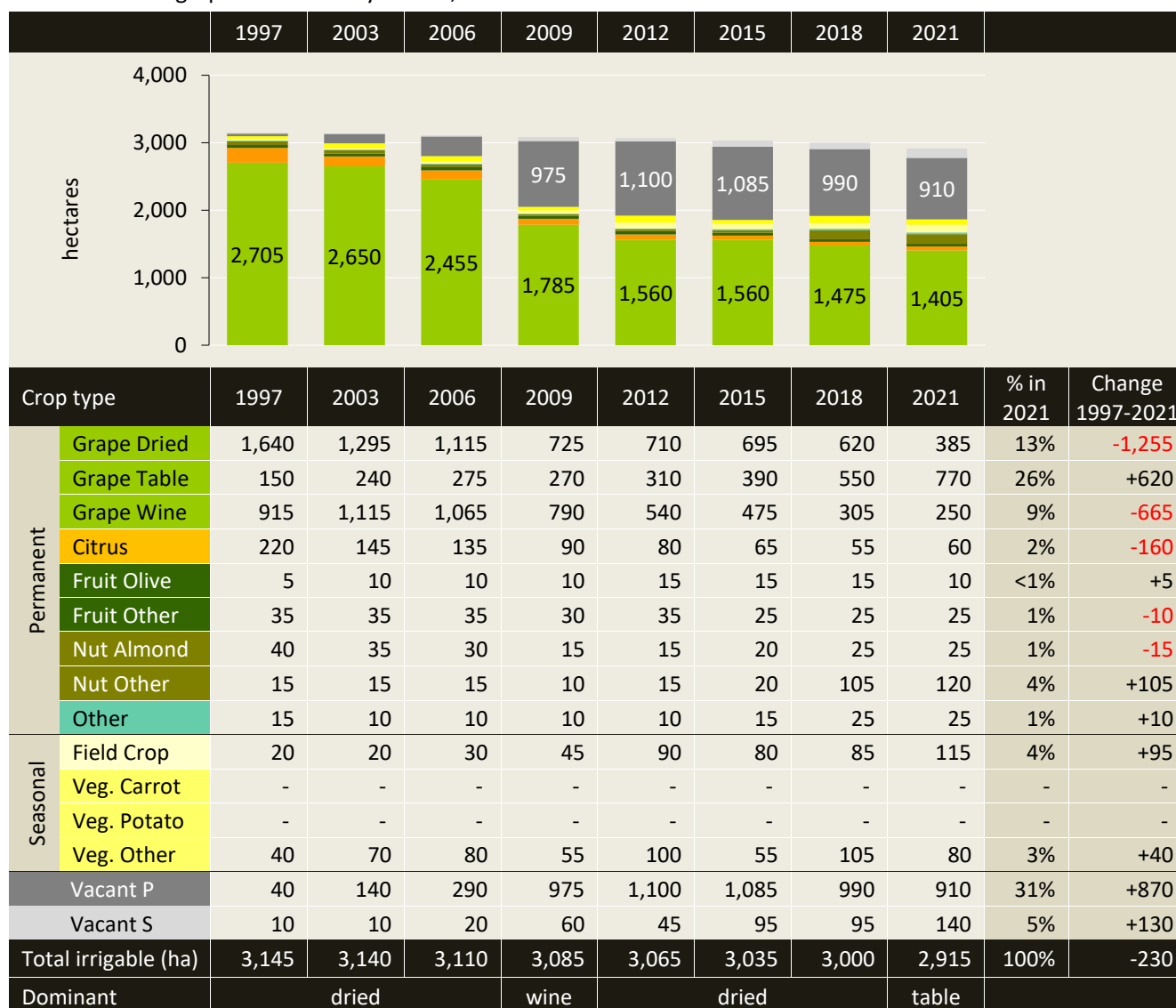


Figure 47: Merbein irrigation district - crop types from 1997 to 2021

2.6.3 Merbein irrigation district - development of permanent crops

Figure 48 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Merbein irrigation district from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 430 ha (26%) of permanent crops were planted or redeveloped within the previous three years.
- The 430 ha was the highest area of development activity since 2003.
- The new plantings were:
 1. table grapes (315 ha);
 2. dried grapes (35 ha);
 3. citrus (30 ha);
 4. wine grapes (20 ha);
 5. pistachios (15 ha); and
 6. fruit trees and nurseries (a total of 15 ha).

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was at its lowest in 2009 with 135 ha (7%) planted in the previous three years and highest in 1997 with 500 ha (16%) planted in the previous three years.

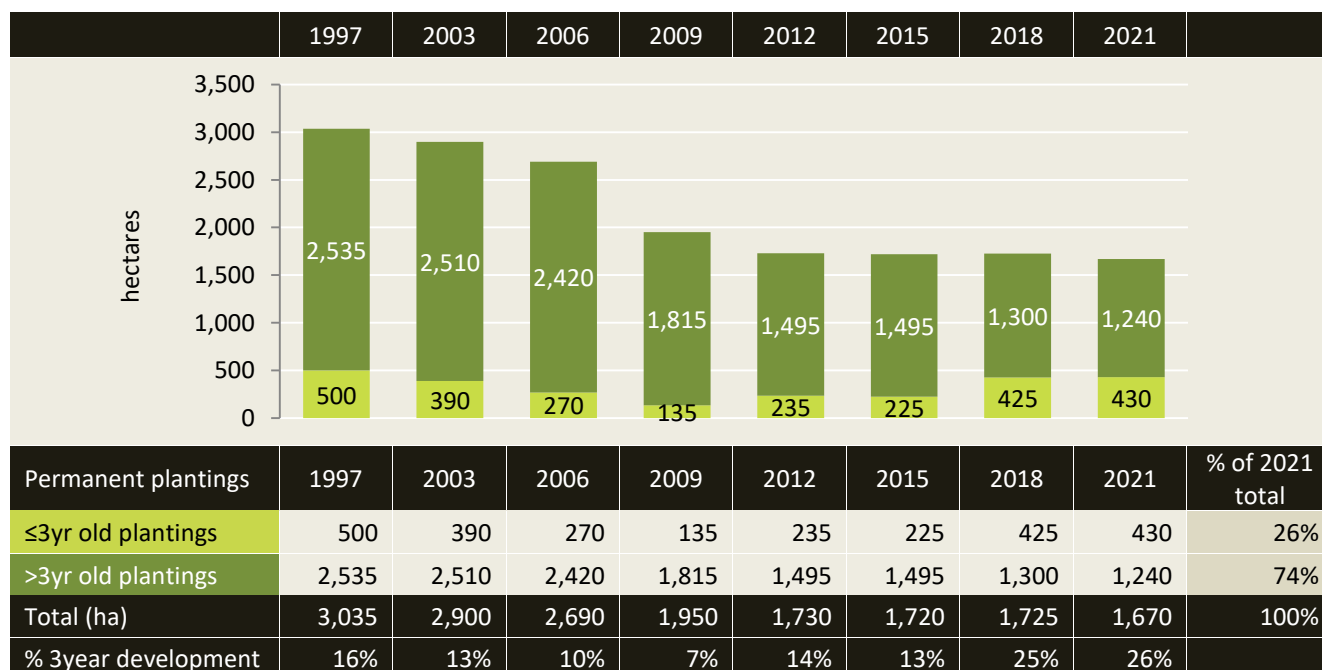


Figure 48: Merbein irrigation district - development of permanent crops from 1997 to 2021

2.6.4 Merbein irrigation district - planting trends

Figure 49 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Merbein irrigation district from 1997 to 2021.

In 2021, the irrigable area of 2,915 ha comprised:

- 57% (1,670 ha) irrigated permanent plantings;
- 7% (195 ha) irrigated seasonal crops;
- 31% (910 ha) vacant, previously an irrigated permanent planting; and
- 5% (140 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 97% permanent, 2% seasonal and 1% vacant in 1997; to
- 57% permanent, 7% seasonal and 36% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops decreased by 1,365 ha, from 3,035 to 1,670 ha;
- irrigated seasonal crops increased by 135 ha, from 60 to 195 ha;
- vacant areas, previously irrigated permanent plantings increased by 870 ha, from 40 to 910 ha; and
- vacant areas, previously irrigated seasonal crops increased by 130 ha, from 10 to 140 ha.

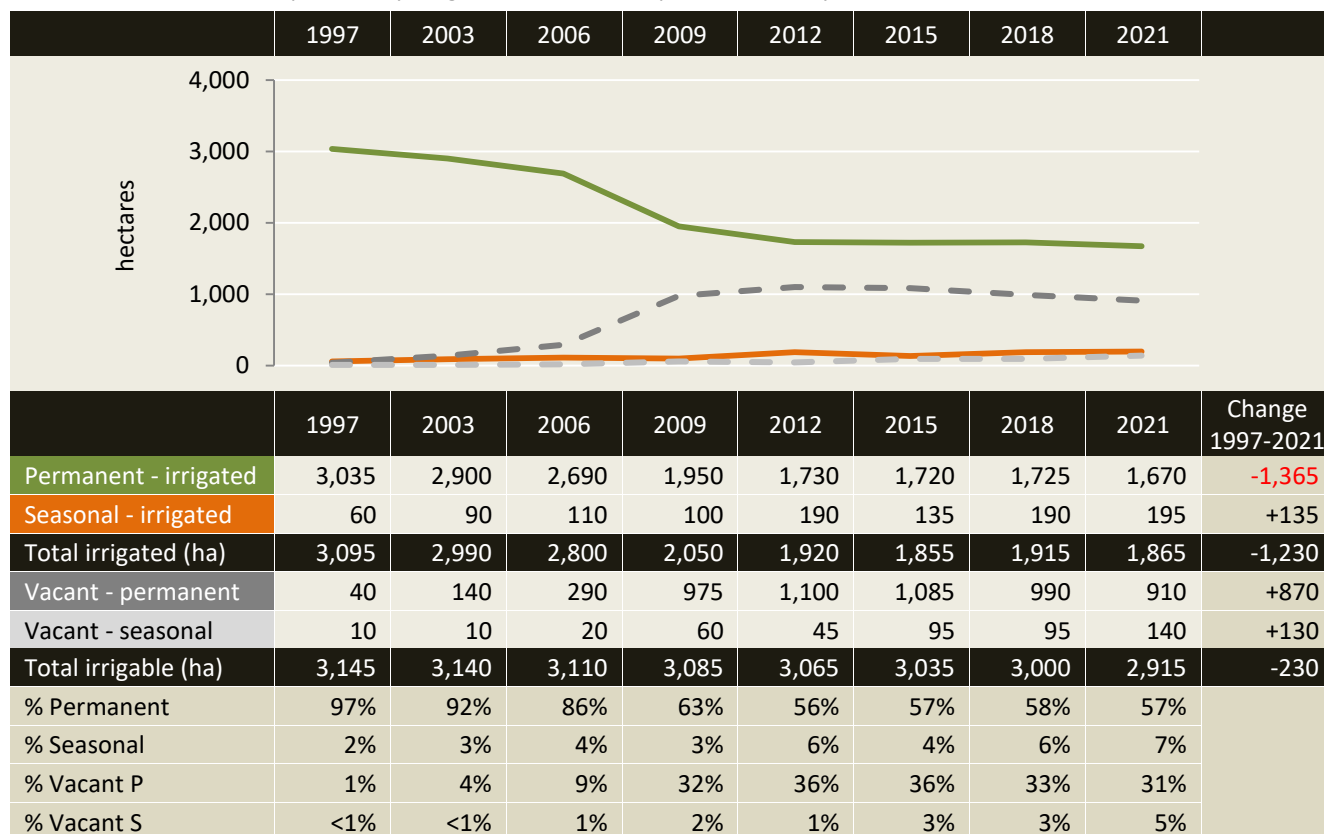
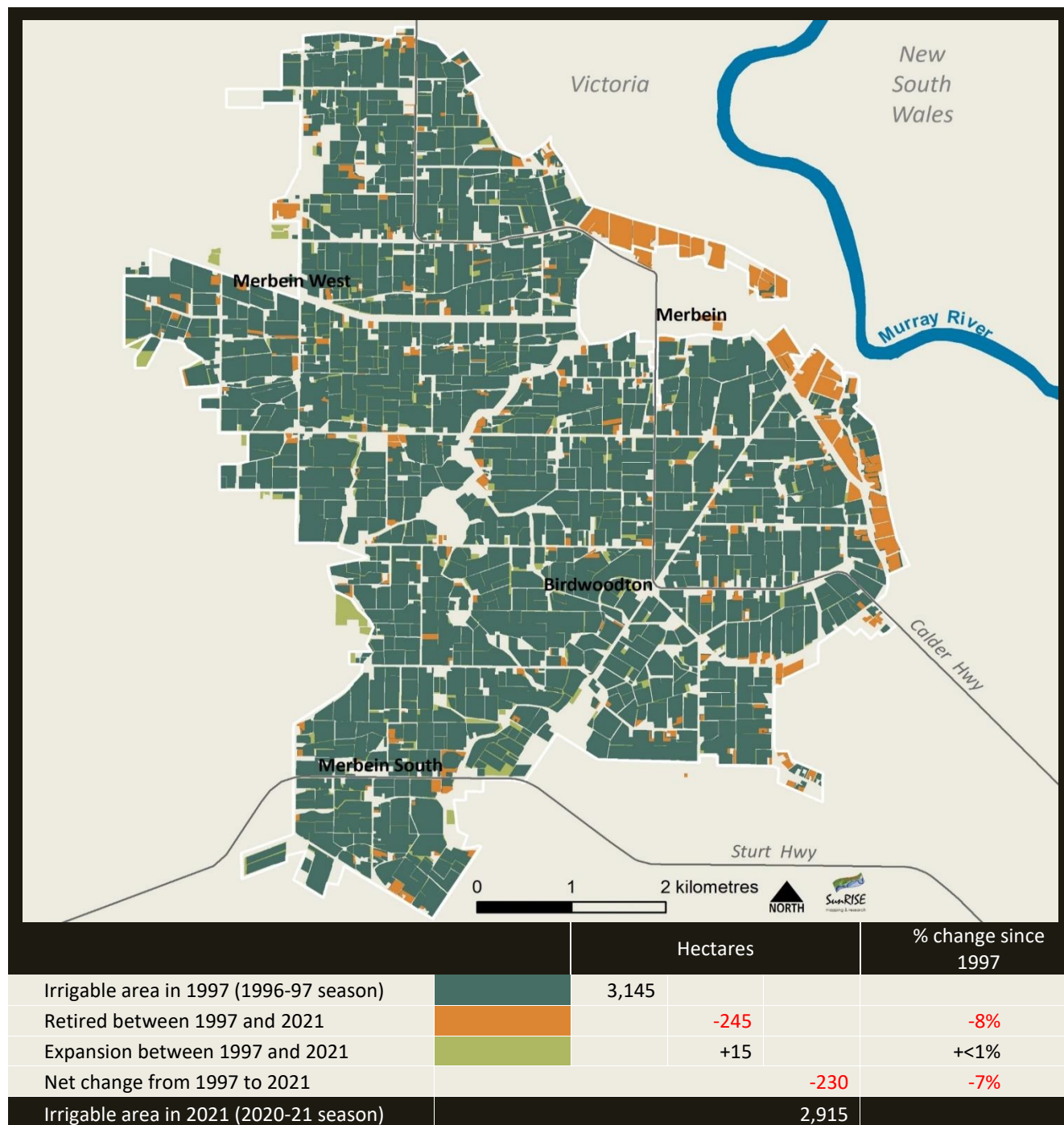


Figure 49: Merbein irrigation district - planting trends from 1997 to 2021

2.6.5 Merbein irrigation district - irrigation development

Map 11 shows irrigation development from 1997 to 2021 in the Merbein irrigation district with respect to new development (expansion) and areas retired¹⁸ from irrigation.

- The irrigable area decreased by 230 ha, a 7% decrease from 3,145 ha in 1997 to 2,915 ha in 2021.
- The net decrease of 230 ha was the balance of 245 ha retired from irrigation and 15 ha of expansion.



Map 11: Merbein irrigation district - irrigation development from 1997 to 2021

¹⁸ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

2.6.6 Merbein irrigation district - irrigation methods

Figure 50 summarises irrigation methods in the Merbein irrigation district from 1997 to 2021.

The dominant irrigation method in the Merbein district was furrow irrigation from 1997 to 2006, followed by drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 2,915 ha comprised:

- 38% (1,115 ha) drip irrigation;
- 16% (470 ha) low level irrigation;
- 7% (190 ha) overhead sprinklers;
- 3% (90 ha) furrow irrigation; and
- 36% (1,050 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 1,030 ha, a 1,212% increase from 85 to 1,115 ha;
- low level irrigation increased by 65 ha, a 16% increase from 405 to 470 ha;
- overhead irrigation decreased by 265 ha, a 58% decrease from 455 to 190 ha; and
- furrow irrigation decreased by 2,060 ha, a 96% decrease from 2,150 to 90 ha.

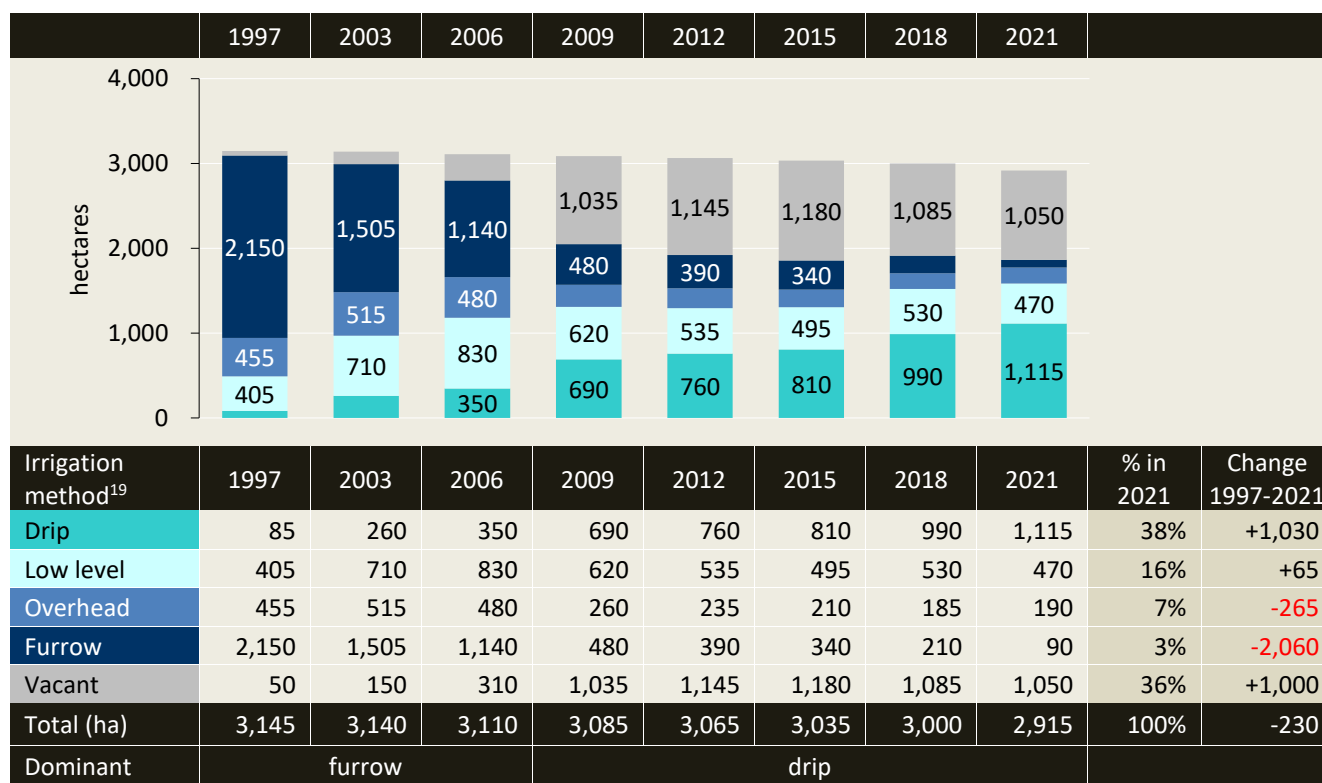


Figure 50: Merbein irrigation district - irrigation methods from 1997 to 2021

¹⁹ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

2.6.7 Merbein irrigation district - salinity impact zones

Figure 51 summarises river salinity impact zones of irrigated areas in the Merbein irrigation district from 1997 to 2021. The Merbein district is in the lowest salinity impact zone, L1 and the high salinity impact zone, HIZ.

In 2021, the irrigable area of 2,915 ha comprised:

- 35% (1,010 ha) in L1; and
- 65% (1,905 ha) in the HIZ.

From 1997 to 2021, the area irrigated in:

- L1 decreased by 275 ha, a 27% decrease from 1,015 to 740 ha; and
- HIZ decreased by 955 ha, a 46% decrease from 2,080 to 1,125 ha.

From 1997 to 2021, the irrigable area in:

- L1 decreased by 20 ha, a 2% decrease from 1,030 to 1,010 ha; and
- HIZ decreased by 210 ha, a 10% decrease from 2,115 to 1,905 ha.



Figure 51: Merbein irrigation district - irrigable area in each salinity impact zone from 1997 to 2021

2.6.8 Merbein irrigation district - property change

Figure 52 provides estimates of property numbers and average property size (irrigable area) in the Merbein irrigation district from 1997 to 2021.

In 2021:

- there were approximately 251 irrigation properties; and
- most properties (88%) had an irrigable area less than 20 ha.

From 1997 to 2021:

- the number of properties decreased by 79, a 24% decrease from 330 to 251 properties;
- properties with an irrigable area less than 40 ha decreased by 93, while the number over 40 ha increased by 14; and
- average property size (irrigable area) increased from 10 to 12 ha.

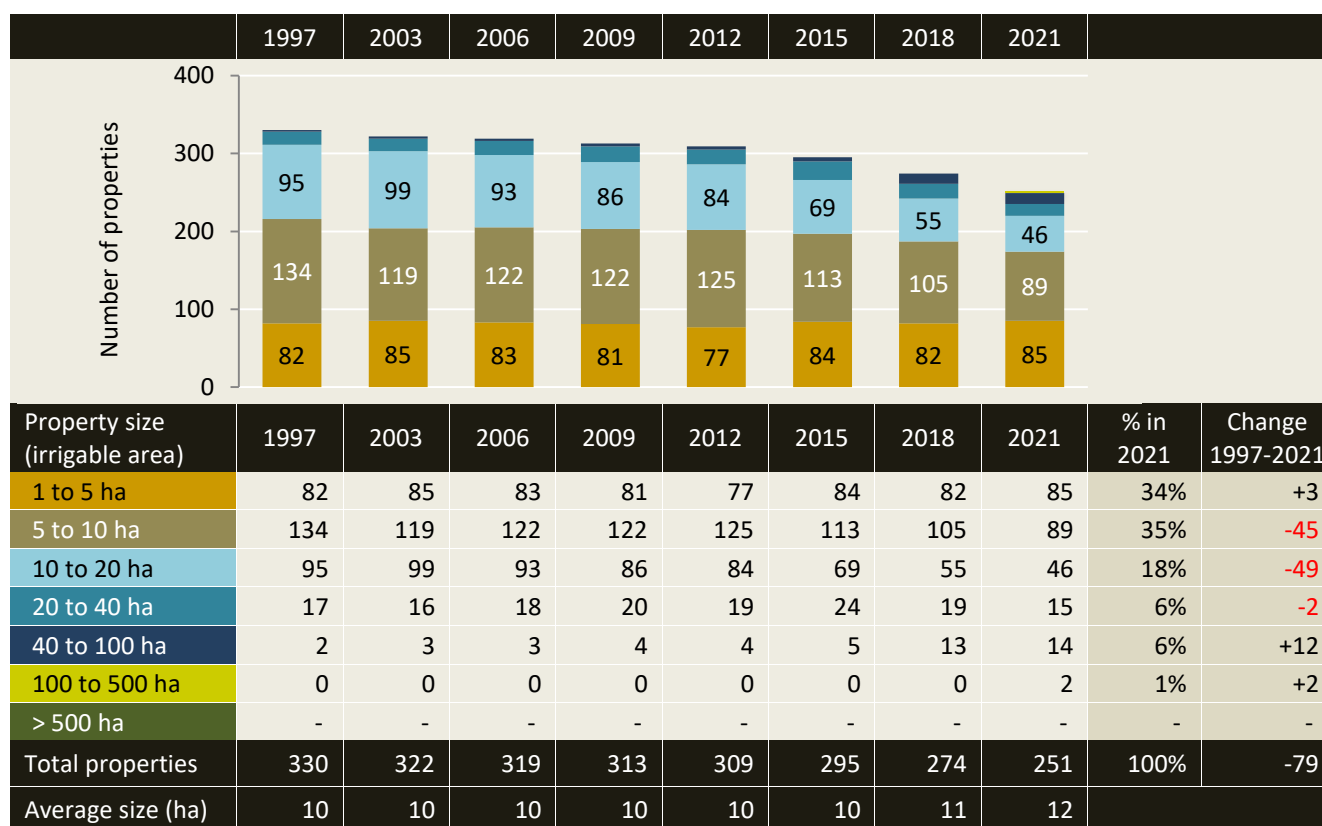


Figure 52: Merbein irrigation district - property numbers and sizes from 1997 to 2021

3. Private diverters

3.1 Private diverters summary

In summary for private diverters, Nyah to South Australia

Crop types in 2021

The main plantings in the private diverter river reaches in 2021 were:

1. almonds, 26,235 ha (41% of the irrigable area);
2. wine grapes, 5,440 ha (8% of the irrigable area);
3. field crops, 4,720 ha (7% of the irrigable area);
4. citrus, 4,195 ha (7% of the irrigable area);
5. table grapes, 4,080 ha (6% of the irrigable area); and
6. olives, 3,640 ha (6% of the irrigable area).

Crop types 1997 to 2021

The dominant crop type changed from field crops in 1997 to wine grapes from 2003 to 2006 then almonds from 2009 to 2021.

The main crop type changes from 1997 to 2021 were:

- almonds increased by 24,605 ha, a 1,510% increase from 1,630 to 26,235 ha;
- olives increased by 3,575 ha, a 5,500% increase from 65 to 3,640 ha;
- table grape plantings increased by 2,970 ha, a 268% increase from 1,110 to 4,080 ha;
- wine grape plantings increased by 1,350 ha, a 33% increase from 4,090 to 5,440 ha;
- field crops decreased by 1,245 ha, a 21% decrease from 5,965 to 4,720 ha; and
- fruit trees other than olives, mainly stone fruit and avocados, increased by 1,075 ha, a 187% increase from 575 to 1,650 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 5,640 ha (12%) of permanent crops in the private diverter river reaches were planted or redeveloped within the previous three years. These new plantings were predominantly almonds and table grapes:

1. almonds (2,130 ha);
2. table grapes (1,165 ha);
3. wine grapes (735 ha);
4. citrus (685 ha);
5. fruit trees (450 ha, mainly stone fruit and avocados);
6. pistachios (265 ha);
7. dried grapes (165 ha); and
8. miscellaneous (45 ha).

The proportion of these new plantings in each river reach was; 32% in Colignan, 25% Wemen, 16% Nyah, 15% Boundary Bend, 8% Lock 10 to SA and 4% Mildura private diverters.

In summary for private diverters, Nyah to South Australia

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 64,385 ha comprised:

- 74% (47,440 ha) irrigated permanent plantings;
- 13% (8,305 ha) irrigated seasonal crops;
- 4% (2,570 ha) vacant, previously an irrigated permanent planting; and
- 9% (6,070 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- permanent plantings increased from 53% to 74% of the irrigable area;
- seasonal crops decreased from 43% to 13% of the irrigable area; and
- vacant, not irrigated areas increased from 4% to 13% of the irrigable area.

Irrigation development - expansion and retired areas

Across the private diverter river reaches, the irrigable area increased by 42,130 ha, a 189% increase from 22,255 ha in 1997 to 64,385 ha in 2021.

The net increase of 42,130 ha was the balance of 1,005 ha retired from irrigation and 43,135 ha of expansion. Since 2018 the irrigable area increased from 61,350ha to 64,385 ha an increase of 3,035ha.

Expansion occurred in all of the six river reaches between 1997 and 2021. The largest growth areas were:

- the Boundary Bend river reach with a net increase in irrigable area of 16,415 ha (+320%); and
- the Wemen river reach with a net increase in the irrigable area of 11,675 ha (+543%).

Irrigation methods

The dominant irrigation method in the private diverter river reaches changed from overhead sprinklers in 1997 to drip irrigation from 2003 to 2021.

In 2021, the irrigable area of 64,385 ha comprised:

- 68% (43,730 ha) drip irrigation;
- 6% (3,990 ha) low level irrigation;
- 10% (6,175 ha) overhead sprinklers;
- 3% (1,850 ha) furrow irrigation; and
- 13% (8,640 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 40,570 ha, a 1,284% increase from 3,160 to 43,730 ha;
- low level irrigation increased by 775 ha, a 24% increase from 3,215 to 3,990 ha;
- overhead irrigation decreased by 2,980 ha, a 33% decrease from 9,155 to 6,175 ha; and
- furrow irrigation decreased by 4,000 ha, a 68% decrease from 5,850 to 1,850 ha.

In summary for private diverters, Nyah to South Australia

Salinity impact zones

The dominant salinity impact zone across irrigable areas in the private diverter river reaches changed from L2 in 1997 to L1 from 2003 to 2021.

In 2021, the irrigable area of 64,385 ha comprised:

- 58% (37,145 ha) in the lowest salinity impact zone, L1;
- 20% (13,065 ha) in L2;
- 4% (2,490 ha) in L3;
- 14% (8,825 ha) in L4; and
- 4% (2,860 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021 the irrigable area in:

- L1 to L4 increased by 42,205 ha, a 218% increase from 19,320 ha to 61,525 ha;
- HIZ decreased by 75 ha, a 3% decrease from 2,935 ha to 2,860 ha.

Irrigation properties

In 2021, there were approximately 404 irrigation properties and the average property size (irrigable area) was 159 ha.

From 1997 to 2021:

- the number of properties decreased by 96, a 19% decrease from 500 to 404 properties;
- properties with an irrigable area less than 100 ha decreased by 144, while the number over 100 ha increased by 48; and
- average property size (irrigable area) increased from 45 to 159 ha.

3.1.1 Private diverters summary - crop types in 2021

Table 8 lists irrigated crop types in the private diverter river reaches in 2021.

The main crop types in 2021 were:

1. almonds, 26,235 ha (41% of the irrigable area);
2. wine grapes, 5,440 ha (8% of the irrigable area);
3. field crops (winter and summer), 4,720 ha (7% of the irrigable area);
4. citrus, 4,195 ha (7% of the irrigable area);
5. table grapes, 4,080 ha (6% of the irrigable area); and
6. olives, 3,640 ha (6% of the irrigable area).

Table 8: Private diverters - irrigated crop types in 2021

Crop type		2021 (ha)	2021 %	Description
Permanent plantings	Grapevine	Dried	1,175	2%
		Table	4,080	6%
		Wine	5,440	8%
	Citrus		4,195	7%
	Fruit tree	Olive	3,640	6%
		Other	1,650	3%
	Nut tree	Almond	26,235	41%
		Other	645	1%
	Other	Miscellaneous	380	1%
Permanent crops (sub-total)		47,440	74%	
Seasonal crops	Field crop	Summer	790	1%
		Winter	3,930	6%
	Vegetable	Carrot	670	1%
		Potato	1,435	2%
		Other	1,480	2%
	Seasonal crops (sub-total)		8,305	13%
Vac.	Vacant P		2,570	4%
	Vacant S		6,070	9%
Total all crop areas		64,385	100%	

3.1.2 Private diverters summary - crop types from 1997 to 2021

Figure 53 summarises crop types across the six private diverter river reaches from 1997 to 2021.

The dominant crop changed from field crops in 1997 to wine grapes from 2003 to 2006 then almonds from 2009 to 2021.

From 1997 to 2021, the main planting changes were:

- almond trees increased by 24,605 ha, a 1,510% increase from 1,630 to 26,235 ha;
- olive trees increased by 3,575 ha, a 5,500% increase from 65 to 3,640 ha;
- table grape plantings increased by 2,970 ha, a 268% increase from 1,110 to 4,080 ha;
- wine grape plantings increased by 1,350 ha, a 33% increase from 4,090 to 5,440 ha;
- field crops decreased by 1,245 ha, a 21% decrease from 5,965 to 4,720 ha; and
- other fruit trees (mainly stone fruit and avocados) increased by 1,075 ha, a 187% increase from 575 to 1,650 ha.

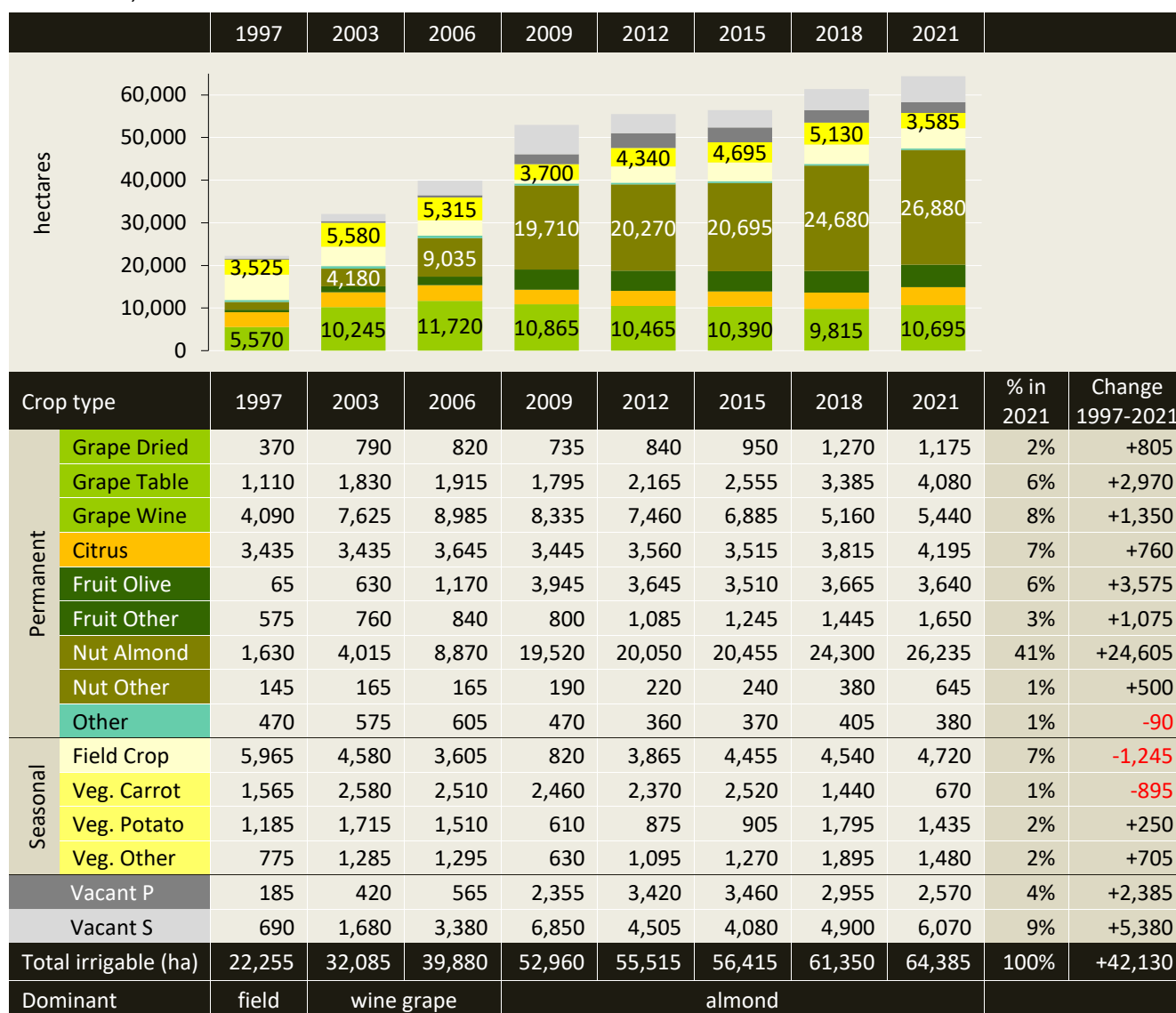


Figure 53: Private diverters - crop types from 1997 to 2021

3.1.3 Private diverters summary - development of permanent crops

Figure 54 summarises development activity of permanent crops planted or redeveloped by private diverters in the previous three years from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 5,640 ha (12%) of permanent crops were planted or top-worked within the previous three years.
- These new plantings were:
 1. almonds (2,130 ha);
 2. table grapes (1,165 ha);
 3. wine grapes (735 ha);
 4. citrus (685 ha);
 5. fruit trees (450 ha, mainly stone fruit and avocados);
 6. pistachios (265 ha);
 7. dried grapes (165 ha); and
 8. miscellaneous (45 ha).
- Three-year development of permanent plantings by river reach was; Nyah 915 ha, Boundary Bend 870 ha, Wemen 1,410 ha, Colignan 1,775 ha, Mildura 205 ha and Lock 10 to SA 465 ha.

From 1997 to 2021:

- The area of new or redeveloped permanent plantings was highest in 2009 with 15,035 ha (38%) planted in the previous three years and at its lowest in 1997 with 2,835 ha planted in the previous three years.



Figure 54: Private diverters - development of permanent crops from 1997 to 2021

3.1.4 Private diverters summary - planting trends

Figure 55 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the private diverter river reaches from 1997 to 2021.

In 2021, the irrigable area of 64,385 ha comprised:

- 74% (47,440 ha) irrigated permanent plantings;
- 13% (8,305 ha) irrigated seasonal crops;
- 4% (2,570 ha) vacant, previously an irrigated permanent planting; and
- 9% (6,070 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 53% permanent, 43% seasonal and 4% vacant in 1997; to
- 74% permanent, 13% seasonal and 13% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 35,550 ha, from 11,890 to 47,440 ha;
- irrigated seasonal crops decreased by 1,185 ha, from 9,490 to 8,305 ha;
- vacant areas, previously irrigated permanent plantings increased by 2,385 ha, from 185 to 2,570 ha; and
- vacant areas, previously irrigated seasonal crops increased by 5,380 ha, from 690 to 6,070 ha.

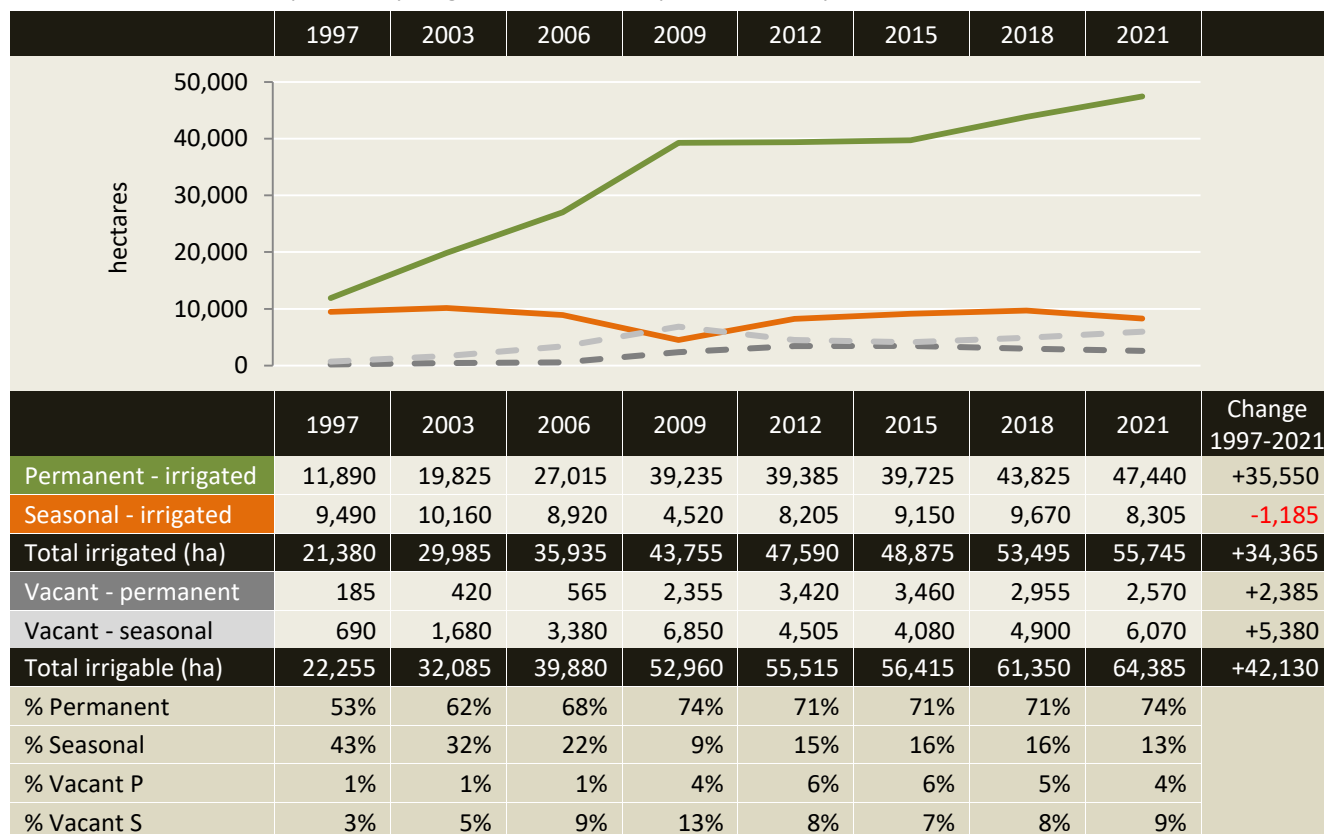


Figure 55: Private diverters - planting trends from 1997 to 2021

3.1.5 Private diverters summary - irrigation development

Figure 56 summarises irrigation development with respect to new development (expansion) and areas retired²⁰ from irrigation in the private diverter river reaches from 1997 to 2021.

- The irrigable area increased by 42,130 ha, a 189% increase from 22,255 ha in 1997 to 64,385 ha in 2021.
- The net increase of 42,130 ha was the balance of 1,005 ha retired from irrigation and 43,135 ha of expansion.
- Expansion occurred in all six river reaches. The largest growth areas from 1997 to 2021 were:
 - the Boundary Bend river reach with a net increase in irrigable area of 16,415 ha; and
 - the Wemen river reach with a net increase in irrigable area of 11,675 ha.

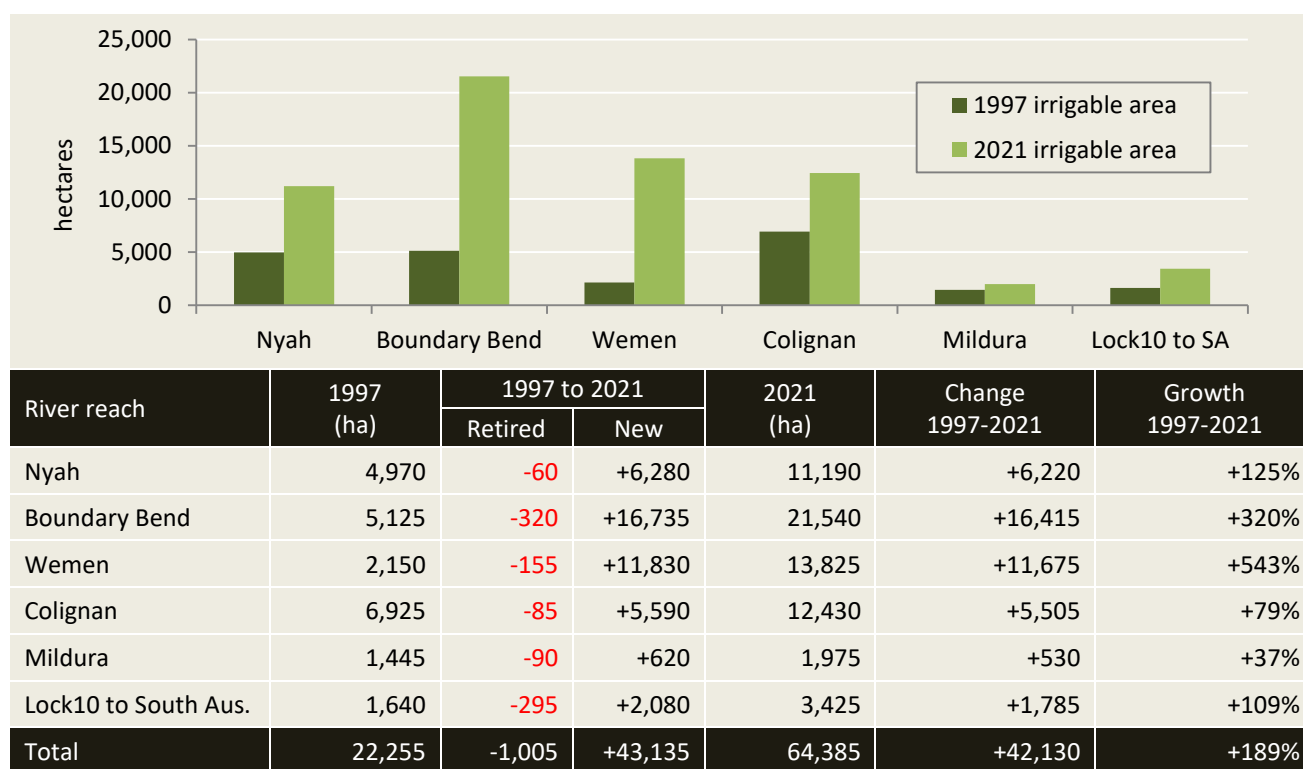


Figure 56: Private diverters - irrigation development from 1997 to 2021

²⁰ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.1.6 Private diverters summary - irrigation methods

Figure 57 summarises irrigation methods for Murray River private diverters in the Mallee catchment from 1997 to 2021.

The dominant irrigation method of private diverters in the Mallee catchment changed from overhead in 1997 to drip irrigation from 2003 to 2021.

In 2021, the irrigable area of 64,385 ha comprised:

- 68% (43,730 ha) drip irrigation;
- 6% (3,990 ha) low level irrigation;
- 10% (6,175 ha) overhead sprinklers;
- 3% (1,850 ha) furrow irrigation; and
- 13% (8,640 ha) vacant, not irrigated.

From 1997 to 2021:

- drip irrigation increased by 40,570 ha, a 1,284% increase from 3,160 to 43,730 ha;
- low level irrigation increased by 775 ha, a 24% increase from 3,215 to 3,990 ha;
- overhead irrigation decreased by 2,980 ha, a 33% decrease from 9,155 to 6,175 ha; and
- furrow irrigation decreased by 4,000 ha, a 68% decrease from 5,850 to 1,850 ha.

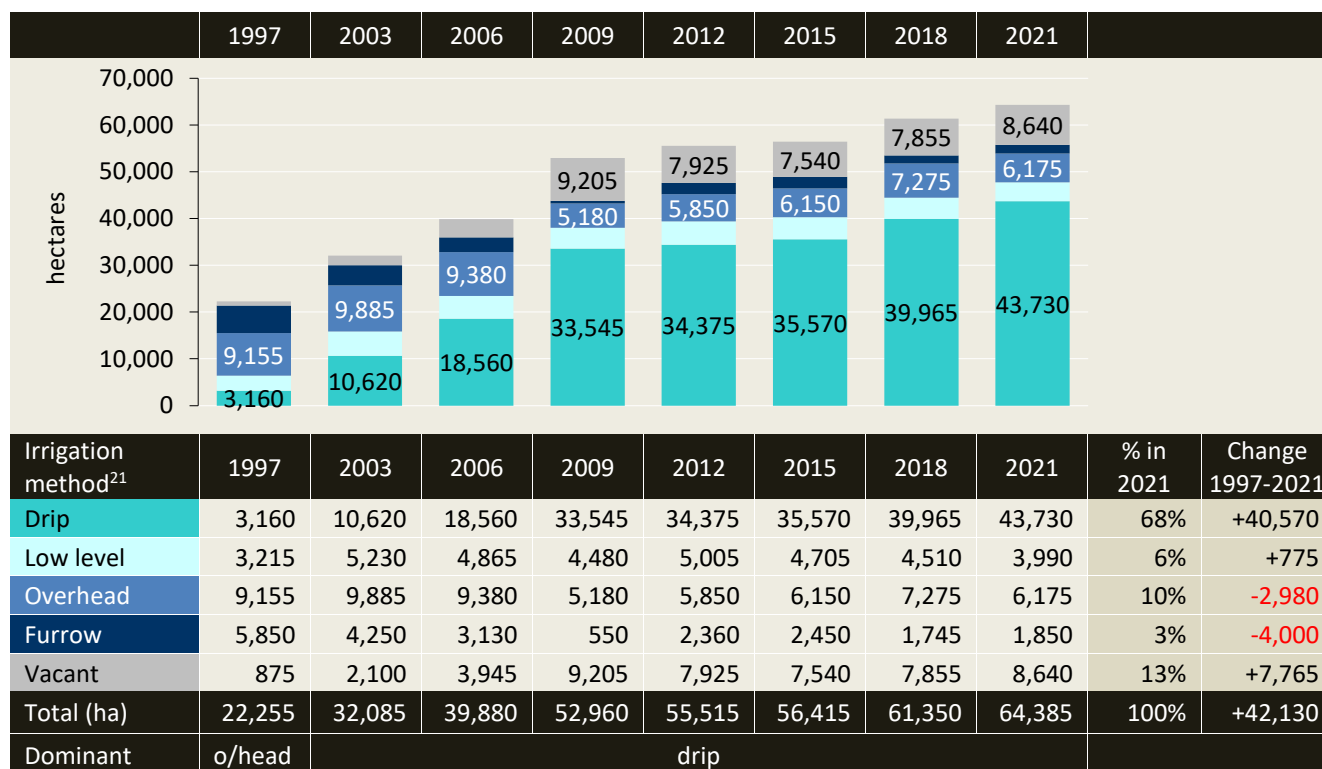


Figure 57: Private diverters - irrigation methods from 1997 to 2021

²¹ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

Irrigation methods in the private diverter areas

Figure 58 compares irrigation methods in each of the private diverter river reaches in 2021.

Drip irrigation was the dominant method in each of the private diverter river reaches in 2021.

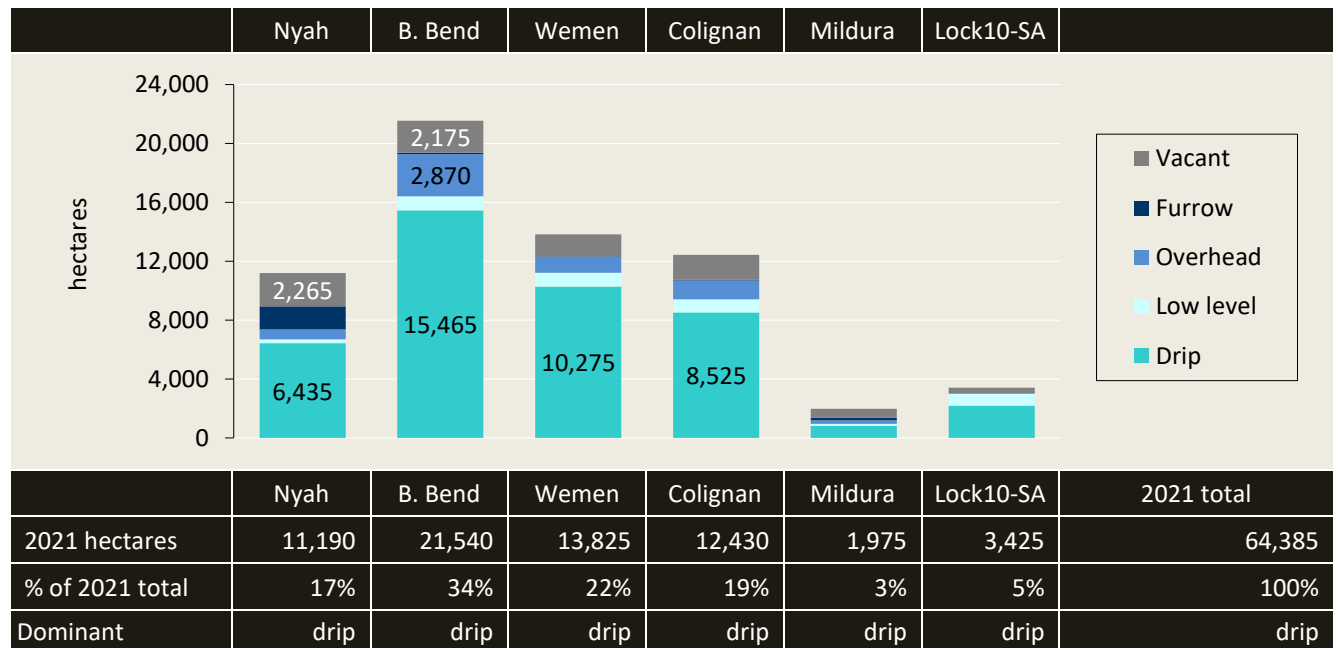


Figure 58: Private diverters - irrigation methods in each river reach in 2021

3.1.7 Private diverters summary - salinity impact zones

Figure 59 summarises river salinity impact zones of irrigated areas in the private diverter river reaches from 1997 to 2021. Irrigation development was predominantly in the lowest salinity impact zone, L1, from 2003 to 2021. The dominant zone changed from L2 to L1 between 1997 and 2003.

In 2021, the irrigable area of 64,385 ha comprised:

- 58% (37,145 ha) in the lowest salinity impact zone, L1;
- 20% (13,065 ha) in L2;
- 4% (2,490 ha) in L3;
- 14% (8,825 ha) in L4; and
- 4% (2,860 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021, the area irrigated in:

- L1 to L4 increased by 35,135 ha, a 186% increase from 18,875 to 54,010 ha; and
- HIZ decreased by 770 ha, a 31% decrease from 2,505 to 1,735 ha.

From 1997 to 2021, the irrigable area in:

- L1 to L4 increased by 42,205 ha, a 218% increase from 19,320 to 61,525 ha; and
- HIZ decreased by 75 ha, a 3% decrease from 2,935 to 2,860 ha.

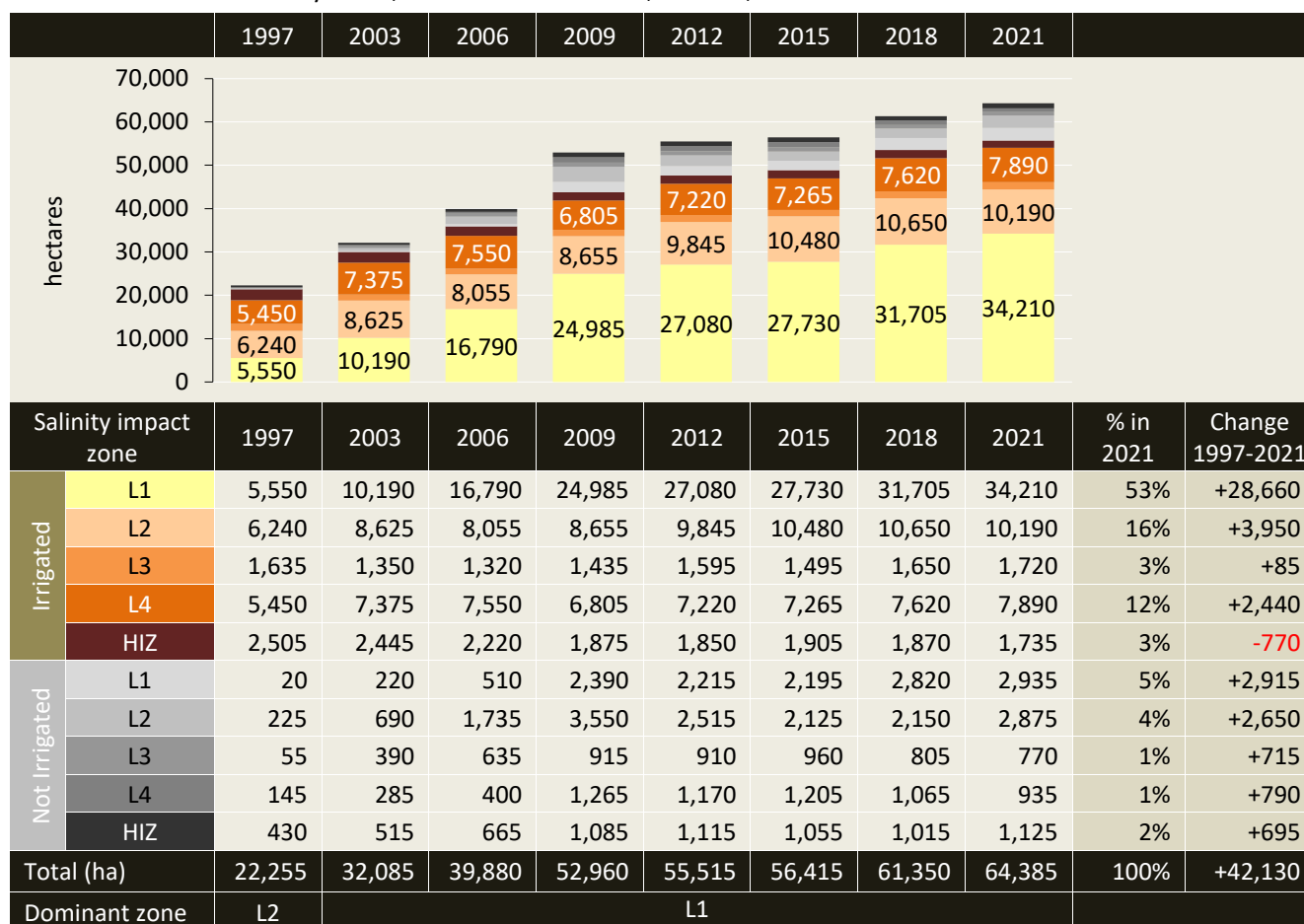


Figure 59: Private diverters - irrigable area in each salinity impact zone from 1997 to 2021

Salinity zones in each of the private diverter river reaches

Figure 60 compares salinity impact zones in each of the private diverter river reaches in 2021.

Three of the six river reaches have irrigation areas in high salinity impact zones; Colignan, Mildura and the Lock 10 to SA river reach.

The dominant zone across irrigable areas in the Nyah, Boundary Bend and Lock 10 to SA river reaches was the lowest salinity impact zone, L1. In the Colignan river reach it was L4 and in the Mildura river reach it was the high impact zone, HIZ.

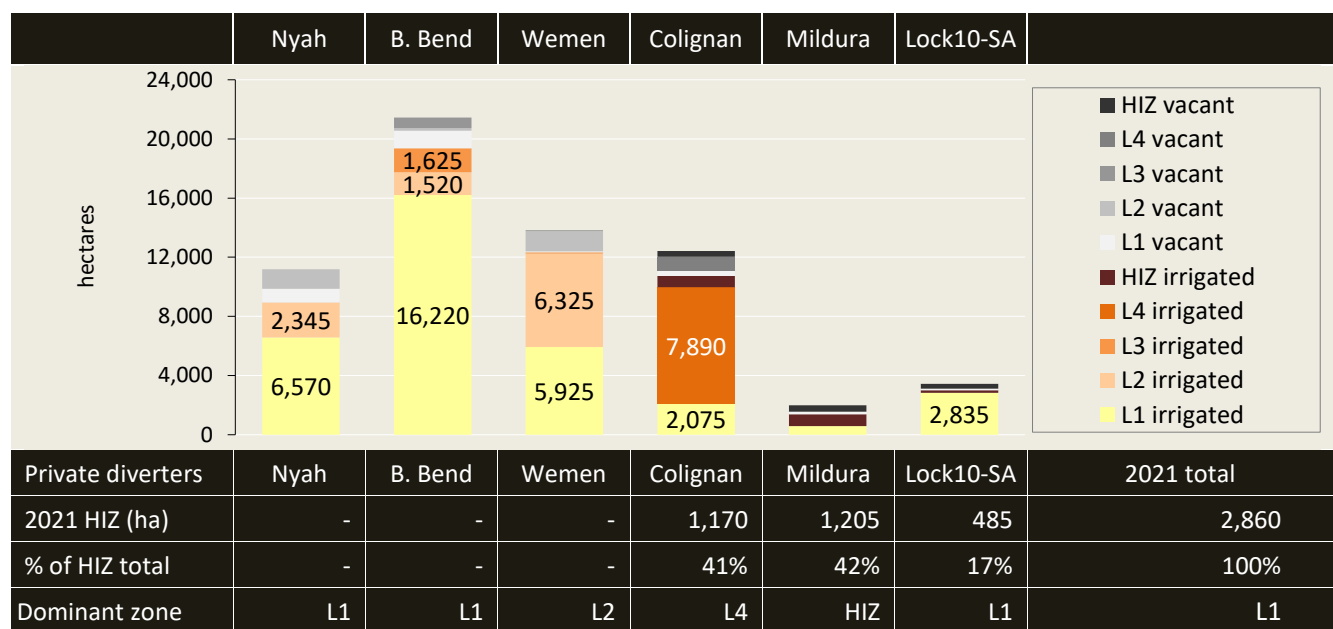


Figure 60: Private diverters - salinity impact zones in each river reach in 2021

3.1.8 Private diverters summary - property change

Figure 61 provides an estimate of property numbers and average property size (irrigable area) in the private diverter river reaches from 1997 to 2021.

In 2021:

- there were approximately 404 irrigation properties; and
- 57% of properties had an irrigable area over 20 ha.

From 1997 to 2021:

- the number of properties decreased by 96, a 19% decrease from 500 to 404 properties;
- properties with an irrigable area less than 100 ha decreased by 144, while the number over 100 ha increased by 48; and
- average property size (irrigable area) increased from 45 to 159 ha.

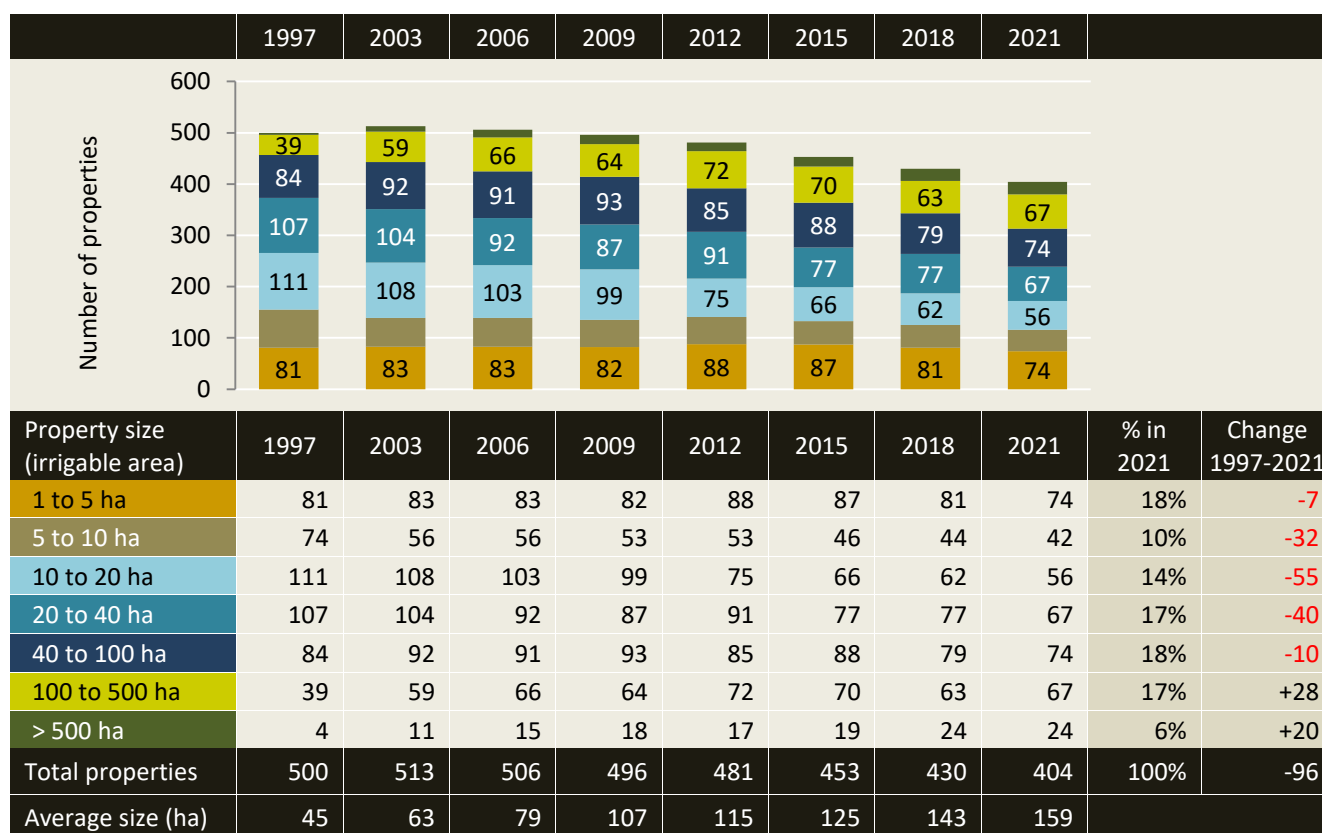


Figure 61: Private diverters - property numbers and sizes from 1997 to 2021

Irrigation properties in each of the private diverter areas

Figure 62 provides an estimate of property numbers and average property size (irrigable area) in each of the private diverter river reaches in 2021.

In 2021:

- the Colignan river reach had the highest number of private diverters (130 properties);
- the Wemen river reach had the highest average property size (irrigable area of 343 ha); and
- Boundary Bend, Wemen and Lock 10 to South Australia river reaches had average property sizes greater than the Mallee average for private diverters of 150 ha.

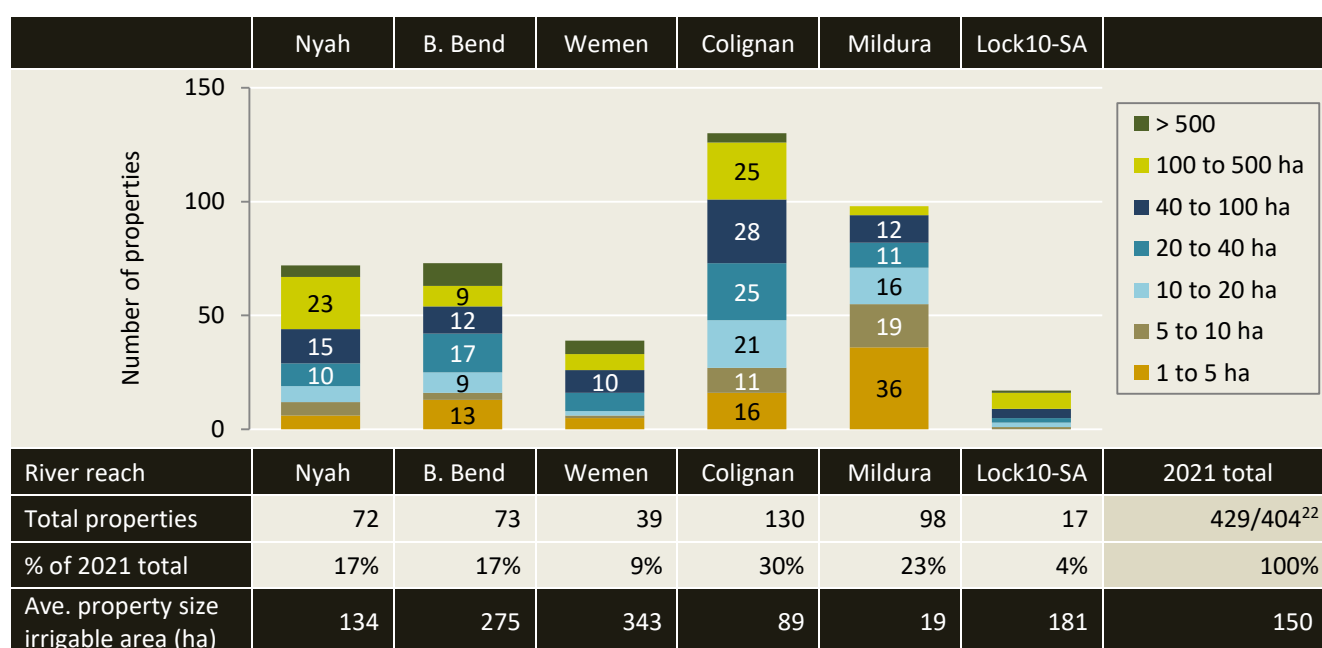


Figure 62: Private diverters - property numbers and average size in each river reach in 2021

²² The total number of private diverters in each river reach (429 properties, Figure 62) is greater than the total across the private diverter areas (404 properties, Figure 61) as some properties irrigate in more than one river reach.

3.2 Nyah river reach (Woorinen South to the Wakool junction)

In summary for the Nyah river reach²³

Crop types in 2021

The main plantings in the Nyah river reach in 2021 were:

1. almond trees, 3,825 ha (34% of the irrigable area);
2. field crops, 2,350 ha (21% of the irrigable area); and
3. wine grapes, 1,085 ha (10% of the irrigable area).

Crop types 1997 to 2021

Almonds were the dominant crop from 2009 to 2021. They replaced field crops which were dominant from 1997 to 2006. The main crop type changes from 1997 to 2021 were:

- almonds increased by 3,825 ha, from no plantings in 1997 to 3,825 ha in 2021;
- field crops decreased by 1,335 ha, a 36% decrease from 3,685 to 2,350 ha;
- wine grape plantings increased by 960 ha, a 768% increase from 125 to 1,085 ha; and
- fruit trees, mostly stone fruit, increased by 715 ha, a 433% increase from 165 to 880 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 915 ha (15%) of permanent crops were planted or redeveloped in the previous three years. These new plantings were:

1. stone fruit (275 ha);
2. almonds (220 ha);
3. wine grapes (210 ha);
4. pistachios (155 ha); and
5. table grapes, avocados, citrus and nurseries (a total of 55 ha).

From 1997 to 2021, the area of new and redeveloped permanent plantings was at its lowest in 1997 with 130 ha (22%) planted in the previous three years and highest in 2009 with 2,810 ha (61%) planted in the previous three years.

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 11,190 ha comprised:

- 56% (6,290 ha) irrigated permanent plantings;
- 24% (2,635 ha) irrigated seasonal crops; and
- 20% (2,265 ha) vacant, not irrigated areas.

From 1997 to 2021:

- permanent plantings increased from 12% to 56% of the irrigable area;
- seasonal crops decreased from 85% to 24% of the irrigable area; and
- vacant, not irrigated areas increased from 3% to 20% of the irrigable area.

²³ The boundary between the Nyah and Boundary Bend river reaches was adjusted in 2021 based on water use licence extents. Areas for the Nyah river reach are greater in this 2021 report than in earlier reports.

In summary for the Nyah river reach

Irrigation development - new and retired areas

The irrigable area in the Nyah river reach increased by 6,220 ha, a 125% increase from 4,970 ha in 1997 to 11,190 ha in 2021.

The net increase of 6,220 ha was the balance of 60 ha retired from irrigation and 6,280 ha of expansion.

Irrigation methods

The dominant irrigation method in the Nyah river reach was furrow irrigation from 1997 to 2006, then drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 11,190 ha comprised:

- 58% (6,435 ha) drip irrigation;
- 2% (260 ha) low level irrigation;
- 6% (675 ha) overhead sprinklers;
- 14% (1,555 ha) furrow irrigation; and
- 20% (2,265 ha) not irrigated.

Salinity impact zones

The Nyah river reach is in low salinity impact zones; L1, L2 and L3.

In 2021, the irrigable area of 11,190 ha comprised:

- 67% (7,505 ha) in the lowest salinity impact zone, L1;
- 33% (3,675 ha) in L2; and
- <1% (10 ha) in L3.

From 1997 to 2021 the irrigable area in:

- L1 increased by 5,650 ha, a 305% increase from 1,855 ha to 7,505 ha;
- L2 increased by 570 ha, an 18% increase from 3,105 ha to 3,675 ha; and
- L3 was 10 ha in 1997 and 2021.

Irrigation properties

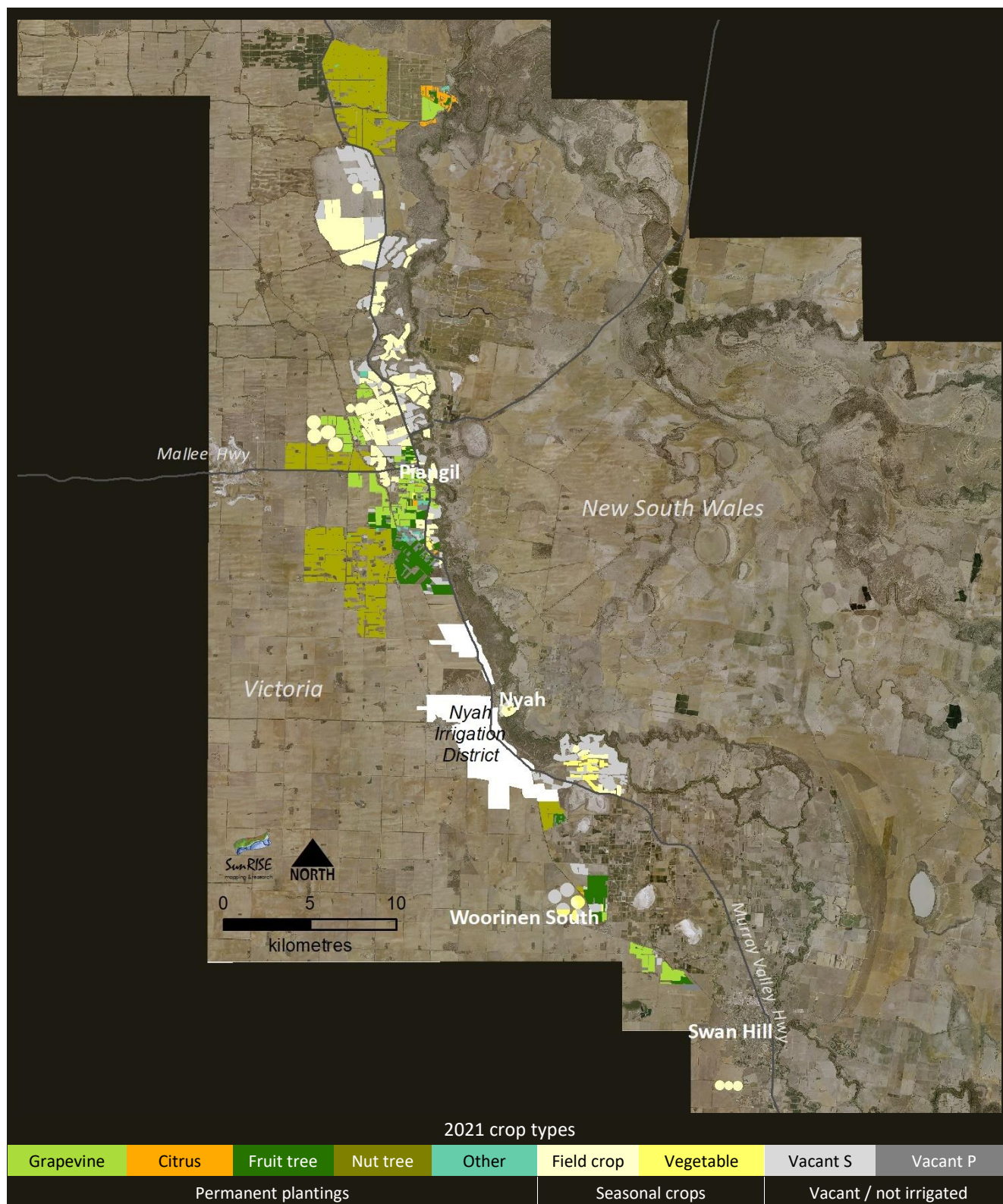
In 2021, there were approximately 72 irrigation properties and the average property size (irrigable area) was 155 ha.

From 1997 to 2021:

- the number of properties decreased by 13, a 15% decrease from 85 to 72 properties;
- properties with an irrigable area less than 100 ha decreased by 31, while the number over 100 ha increased by 18; and
- average property size (irrigable area) increased from 58 to 155 ha.

3.2.1 Nyah river reach - crop types in 2021

Map 12 shows the Nyah river reach and crop types in 2021. The aerial photography was flown in January 2021 (source: Coordinated Imagery Program, DELWP Victoria).



Map 12: Nyah river reach showing 2021 crop types

3.2.2 Nyah river reach - crop types from 1997 to 2021

Figure 63 summarises crop types in the Nyah river reach from 1997 to 2021. The dominant crop type was field crops from 1997 to 2006, then almonds from 2009 to 2021.

In 2021, the main plantings were:

1. almond trees, 3,825 ha (34% of the irrigable area);
2. field crops, 2,350 ha (21% of the irrigable area); and
3. wine grapes, 1,085 ha (10% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- almonds increased by 3,825 ha, from no plantings in 1997 to 3,825 ha in 2021;
- field crops decreased by 1,335 ha, a 36% decrease from 3,685 to 2,350 ha;
- wine grapes increased by 960 ha, a 768% increase from 125 to 1,085 ha; and
- fruit trees, mostly stone fruit, increased by 715 ha; a 433% increase from 165 to 880 ha.

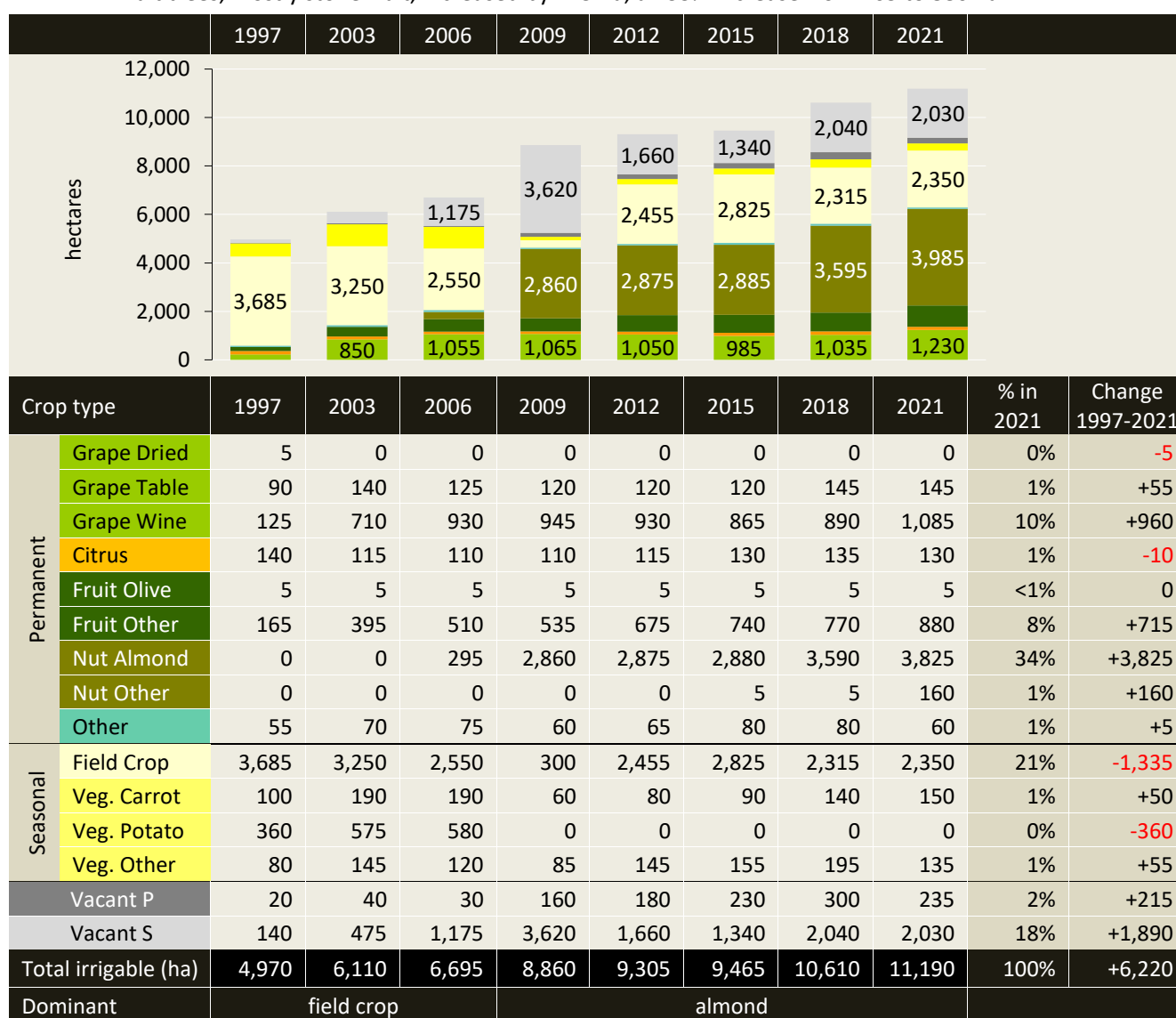


Figure 63: Nyah river reach - crop types from 1997 to 2021

3.2.3 Nyah river reach - development of permanent crops

Figure 64 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Nyah river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 915 ha (15%) of permanent crops were planted or redeveloped within the previous three years.
- These new plantings were:
 1. stone fruit (275 ha);
 2. almonds (220 ha);
 3. wine grapes (210 ha);
 4. pistachios (155 ha); and
 5. table grapes, avocados, citrus and nurseries (a total of 55 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 1997 with 130 ha (22%) planted in the previous three years and highest in 2009 with 2,810 ha (61%) planted in the previous three years.

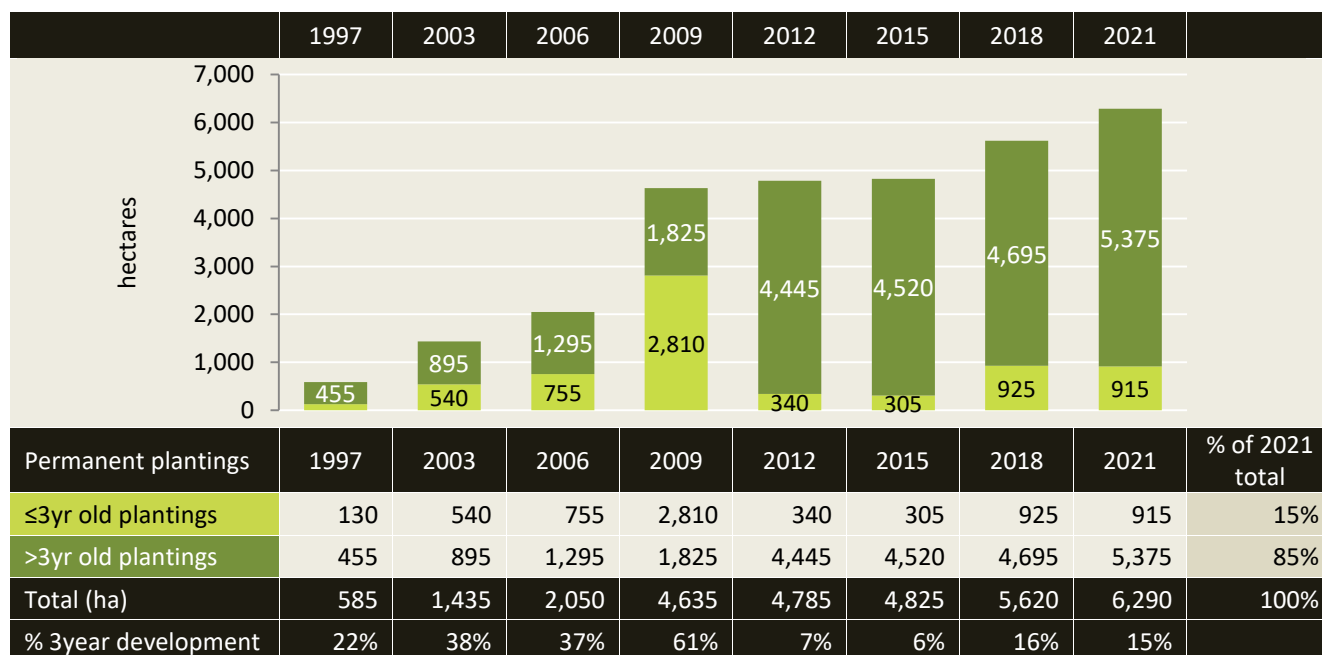


Figure 64: Nyah river reach - development of permanent crops from 1997 to 2021

3.2.4 Nyah river reach - planting trends

Figure 65 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Nyah river reach from 1997 to 2021.

In 2021, the irrigable area of 11,190 ha comprised:

- 56% (6,290 ha) irrigated permanent plantings;
- 24% (2,635 ha) irrigated seasonal crops;
- 2% (235 ha) vacant, previously an irrigated permanent planting; and
- 18% (2,030 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 12% permanent, 85% seasonal and 3% vacant in 1997; to
- 56% permanent, 24% seasonal and 20% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 5,705 ha, from 585 to 6,290 ha;
- irrigated seasonal crops decreased by 1,590 ha, from 4,225 to 2,635 ha;
- vacant areas, previously irrigated permanent plantings increased by 215 ha, from 20 to 235 ha; and
- vacant areas, previously irrigated seasonal crops increased by 1,890 ha, from 140 to 2,030 ha.

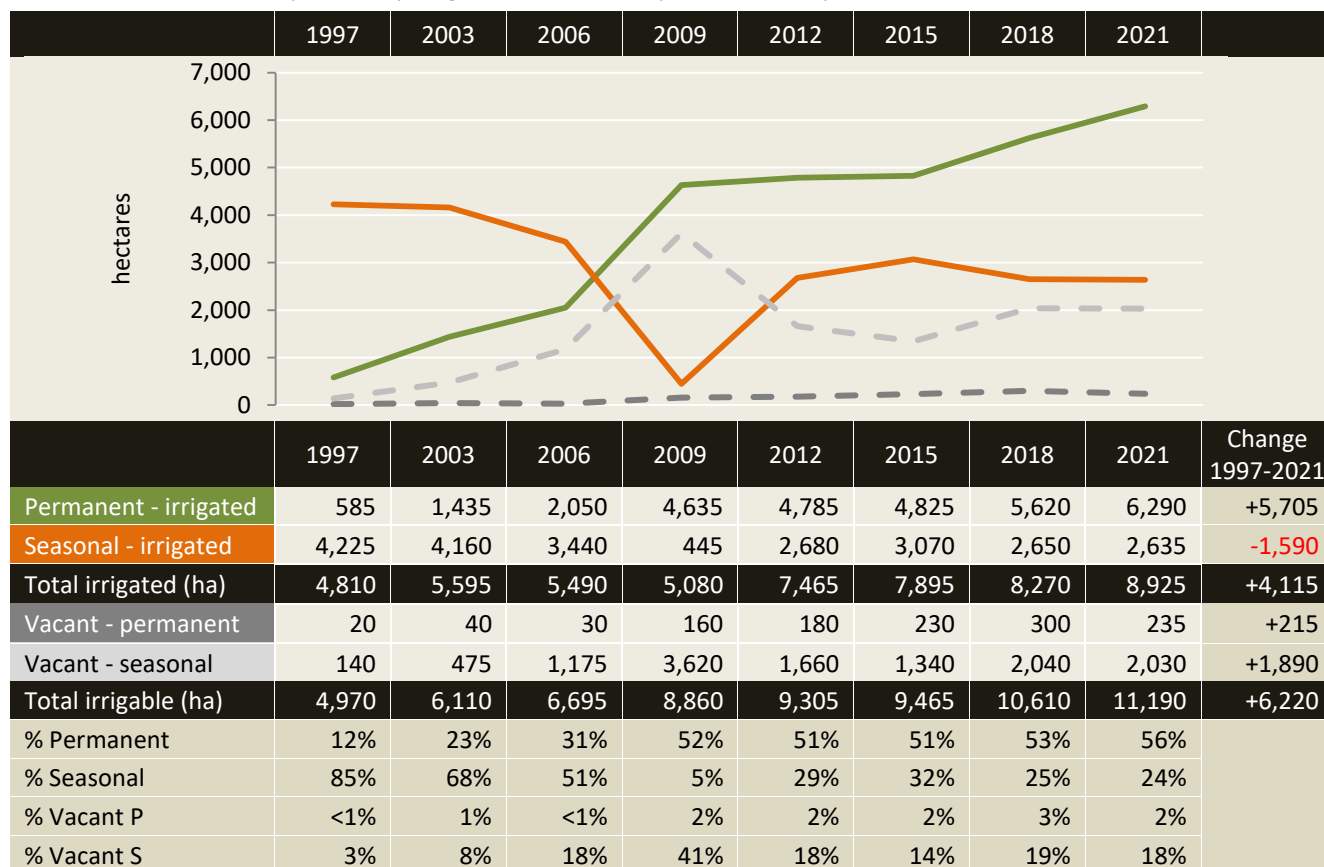
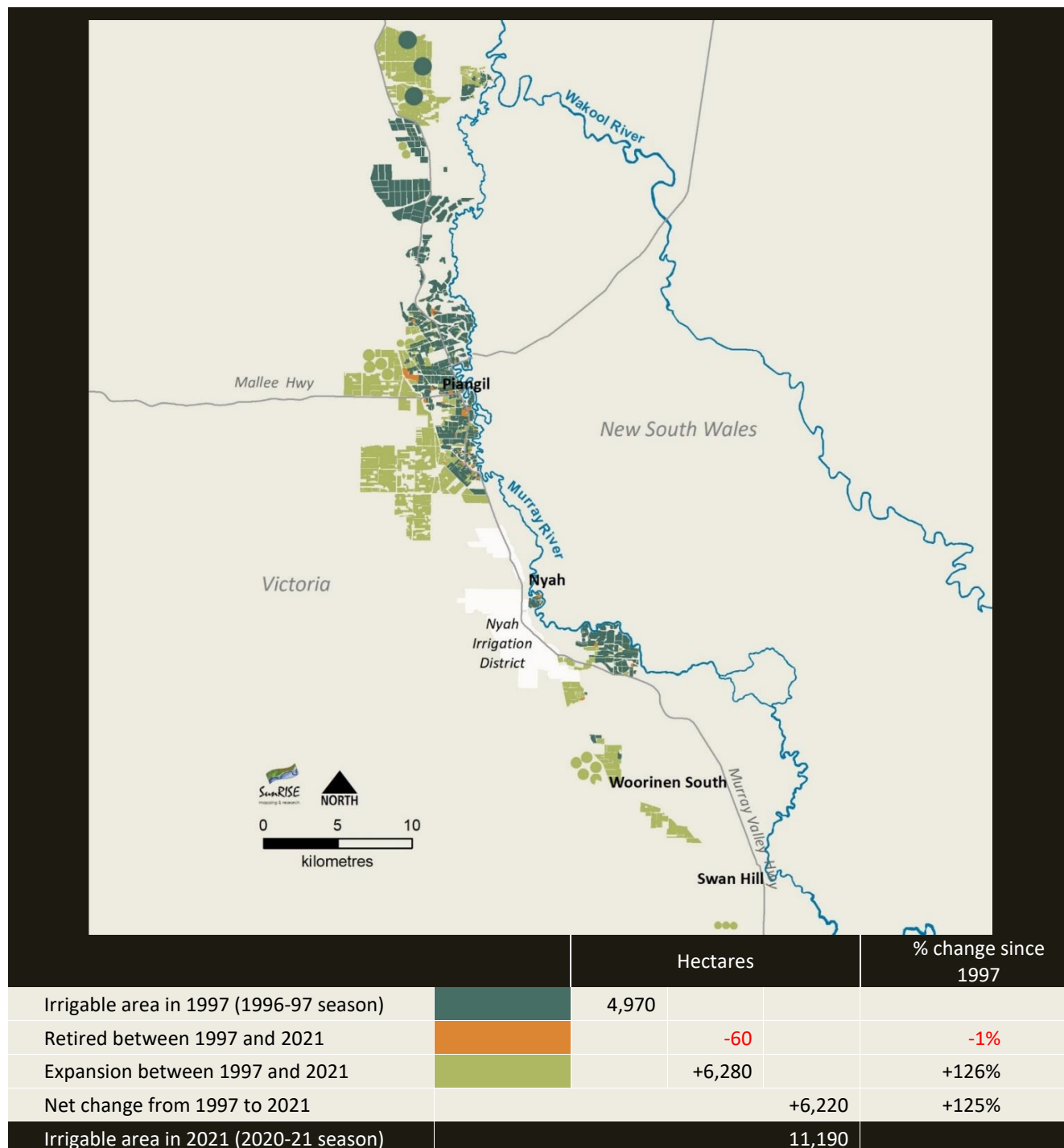


Figure 65: Nyah river reach - planting trends from 1997 to 2021

3.2.5 Nyah river reach - irrigation development

Map 13 shows irrigation development, from 1997 to 2021, in the Nyah river reach with respect to new development (expansion) and areas retired²⁴ from irrigation.

- The irrigable area increased by 6,220 ha, a 125% increase from 4,970 ha in 1997 to 11,190 ha in 2021.
- The net increase of 6,220 ha was the balance of 60 ha retired from irrigation and 6,280 ha of expansion.



Map 13: Nyah river reach - irrigation development from 1997 to 2021

²⁴ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.2.6 Nyah river reach - irrigation methods

Figure 66 summarises irrigation methods in the Nyah river reach from 1997 to 2021.

The dominant irrigation method in the Nyah river reach was furrow irrigation from 1997 to 2006, then drip irrigation from 2009 to 2021.

In 2021, the irrigable area of 11,190 ha comprised:

- 58% (6,435 ha) drip irrigation;
- 2% (260 ha) low level irrigation;
- 6% (675 ha) overhead sprinklers;
- 14% (1,555 ha) furrow irrigation; and
- 20% (2,265 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 6,370 ha, a 9,800% increase from 65 to 6,435 ha;
- low level irrigation increased by 95 ha, a 58% increase from 165 to 260 ha;
- overhead irrigation decreased by 165 ha, a 20% decrease from 840 to 675 ha; and
- furrow irrigation decreased by 2,185 ha, a 58% decrease from 3,740 to 1,555 ha.

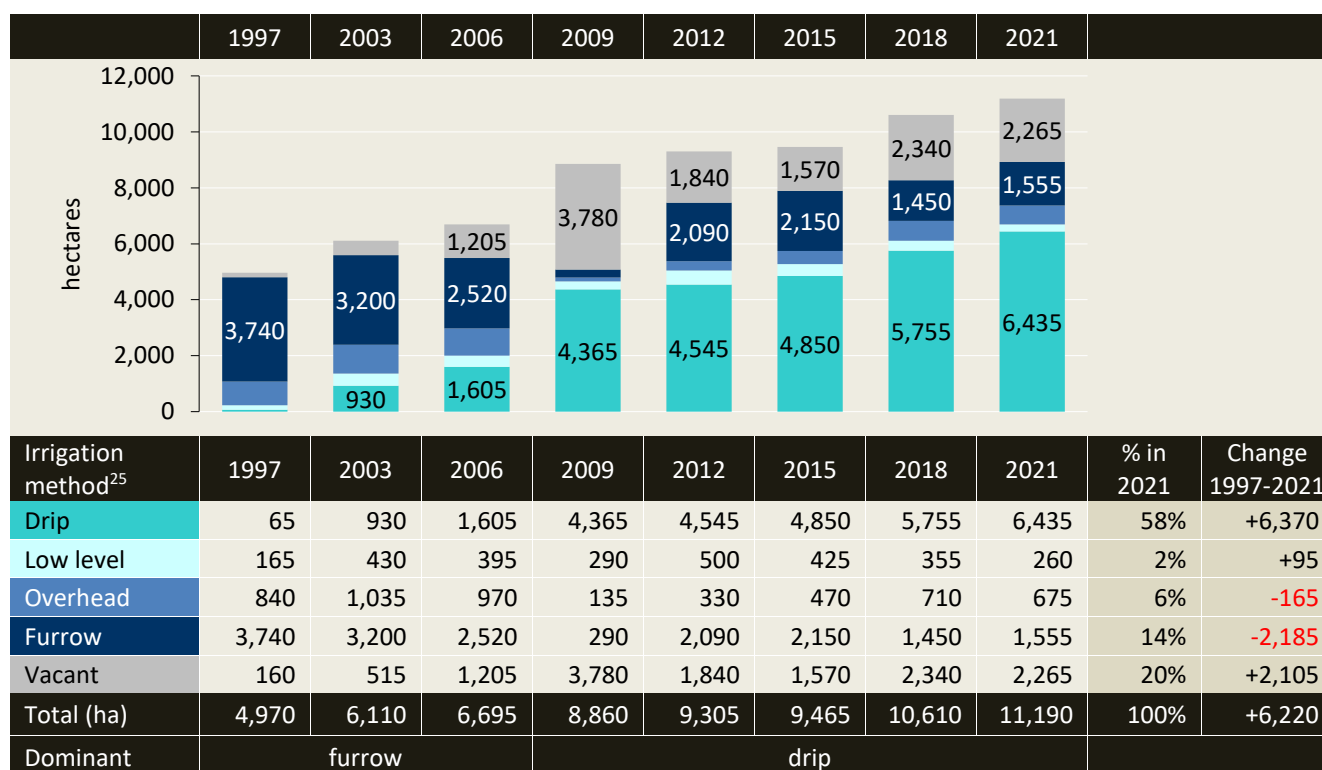


Figure 66: Nyah river reach - irrigation methods from 1997 to 2021

²⁵ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4)

3.2.7 Nyah river reach - salinity impact zones

Figure 67 summarises river salinity impact zones of irrigated areas in the Nyah river reach from 1997 to 2021. Nyah private diverters are in low salinity impact zones L1, L2 and L3. There are no high salinity impact zones. Irrigation development from 1997 to 2021 occurred predominantly in L1.

In 2021, the irrigable area of 11,190 ha comprised:

- 67% (7,505 ha) in the lowest salinity impact zone, L1;
- 33% (3,675 ha) in L2; and
- <1% (10 ha) in L3.

From 1997 to 2021, the area irrigated in:

- L1 increased by 4,720 ha, a 255% increase from 1,850 to 6,570 ha;
- L2 decreased by 605 ha, a 21% decrease from 2,950 to 2,345 ha; and
- L3 was 10 ha in 1997 and 2021.

From 1997 to 2021, the irrigable area in:

- L1 increased by 5,650 ha, a 305% increase from 1,855 to 7,505 ha;
- L2 increased by 570 ha, an 18% increase from 3,105 to 3,675 ha; and
- L3 was 10 ha in 1997 and 2021.

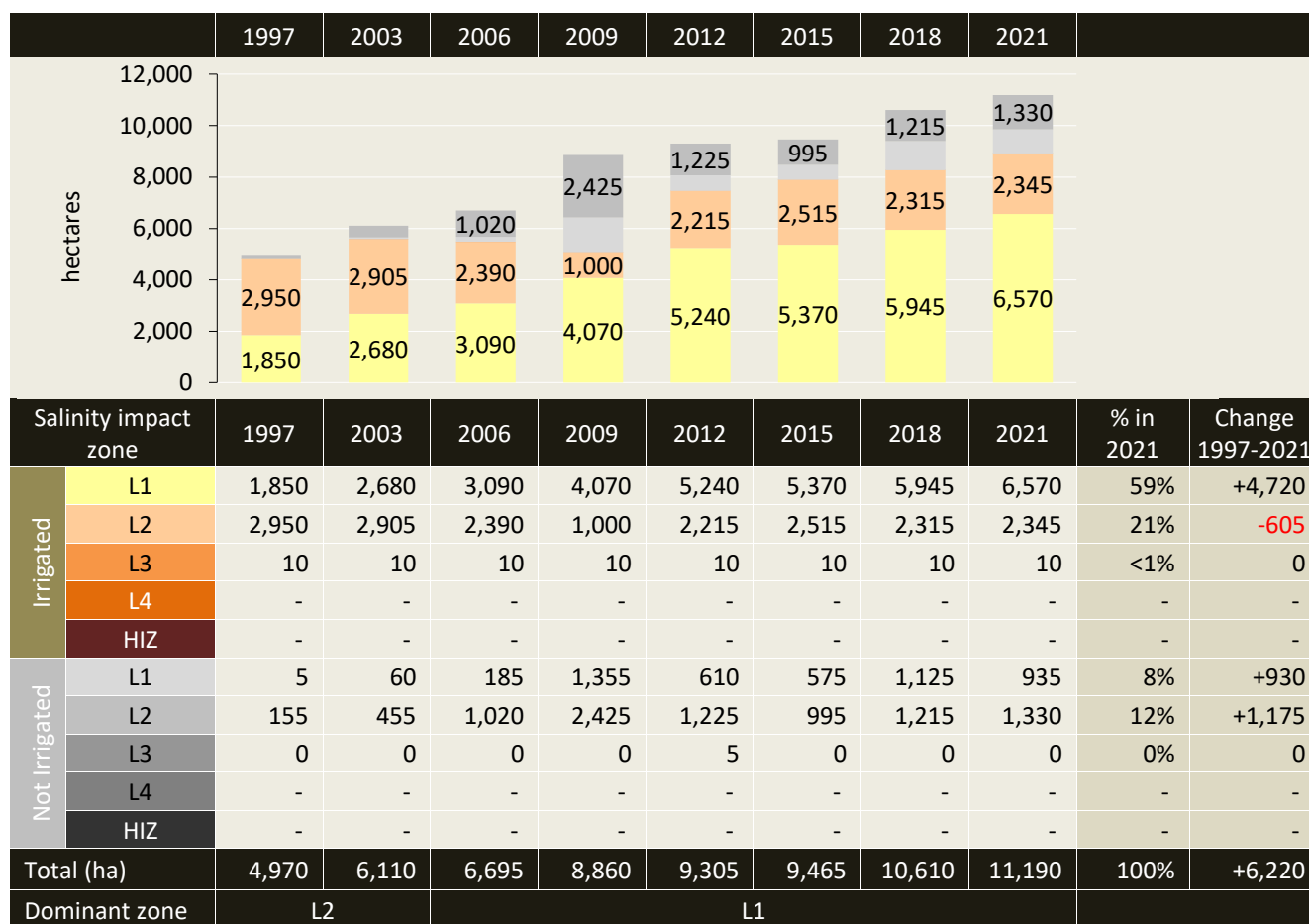


Figure 67: Nyah river reach - irrigable area in each salinity impact zone from 1997 to 2021

3.2.8 Nyah river reach - property change

Figure 68 provides estimates of property numbers and average property size (irrigable area) in the Nyah river reach from 1997 to 2021.

In 2021:

- there were approximately 72 irrigation properties; and
- 60% of properties had an irrigable area over 40 ha.

From 1997 to 2021:

- the number of properties decreased by 13, a 15% decrease from 85 to 72 properties;
- properties with an irrigable area less than 100 ha decreased by 31, while the number over 100 ha increased by 18; and
- average property size (irrigable area) increased from 58 to 155 ha.

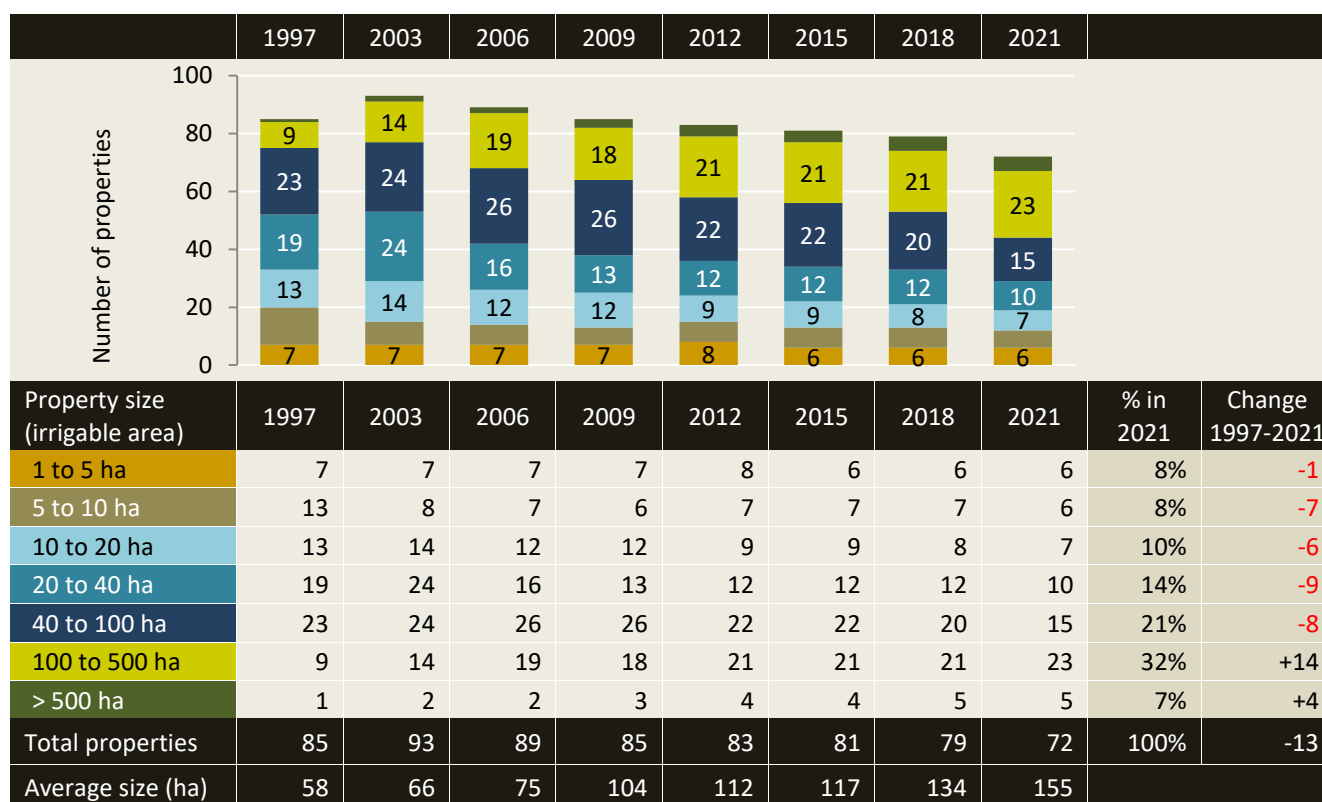


Figure 68: Nyah river reach - property numbers and sizes from 1997 to 2021

3.3 Boundary Bend river reach (*Wakool to Euston weir*)

In summary for the Boundary Bend river reach²⁶

Crop types in 2021

The main plantings in the Boundary Bend river reach in 2021 were:

1. almond trees, 10,525 ha (49% of the irrigable area);
2. olive trees, 2,765 ha (13% of the irrigable area);
3. table grapes, 1,810 ha (8% of the irrigable area); and
4. potatoes, 1,435 ha (7% of the irrigable area).

Crop types 1997 to 2021

The dominant crop changed from field crops in 1997 to potatoes in 2003 then almonds from 2006 to 2021.

The main crop type changes from 1997 to 2021 were:

- almonds increased by 9,900 ha, a 1,584% increase from 625 to 10,525 ha;
- olives increased by 2,715 ha, a 5430% increase from 50 to 2,765 ha;
- table grape plantings increased by 1,265 ha, a 232% increase from 545 to 1,810 ha; and
- potatoes increased by 610 ha, a 74% increase from 825 to 1,435 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 870 ha (5%) of permanent crops were planted or redeveloped within the previous three years.

The 870 ha was the lowest area of development activity since 2003.

The new plantings were:

1. table grapes (310 ha);
2. almonds (275 ha);
3. citrus (135 ha);
4. avocados (80 ha); and
5. pistachios (70 ha).

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 21,540 ha comprised:

- 77% (16,495 ha) irrigated permanent plantings;
- 13% (2,870 ha) irrigated seasonal crops; and
- 10% (2,175 ha) vacant, not irrigated areas.

From 1997 to 2021:

- permanent plantings increased from 47% to 77% of the irrigable area;
- seasonal crops decreased from 51% to 13% of the irrigable area; and
- vacant, not irrigated areas increased from 2% to 10% of the irrigable area.

²⁶ The boundary between the Nyah and Boundary Bend river reaches was adjusted in 2021 based on water use licence extents. Areas for the Boundary Bend river reach in this 2021 report are less than in earlier reports.

In summary for the Boundary Bend river reach

Irrigation development - new and retired areas

The irrigable area in the Boundary Bend river reach increased by 16,415 ha, a 320% increase from 5,125 ha in 1997 to 21,540 ha in 2021.

The net increase of 16,415 ha was the balance of 320 ha retired from irrigation and 16,735 ha of expansion.

Irrigation methods

The dominant irrigation method in the Boundary Bend river reach was overhead irrigation from 1997 to 2003, followed by drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 21,540 ha comprised:

- 72% (15,465 ha) drip irrigation;
- 4% (945 ha) low level irrigation;
- 13% (2,870 ha) overhead sprinklers;
- < 1% (85 ha) furrow irrigation; and
- 10% (2,175 ha) not irrigated.

Salinity impact zones

The Boundary Bend river reach is in low salinity impact zones: L1, L2 and L3. Irrigation development from 1997 to 2021 occurred predominantly in L1.

In 2021, the irrigable area of 21,540 ha comprised:

- 81% (17,505 ha) in the lowest salinity impact zone, L1;
- 8% (1,705 ha) in L2; and
- 11% (2,330 ha) in L3.

From 1997 to 2021 the irrigable area in:

- L1 increased by 15,445 ha, a 750% increase from 2,060 to 17,505 ha;
- L2 increased by 200 ha, a 13% increase from 1,505 to 1,705 ha; and
- L3 increased by 770 ha, a 49% increase from 1,560 to 2,330 ha.

Irrigation properties

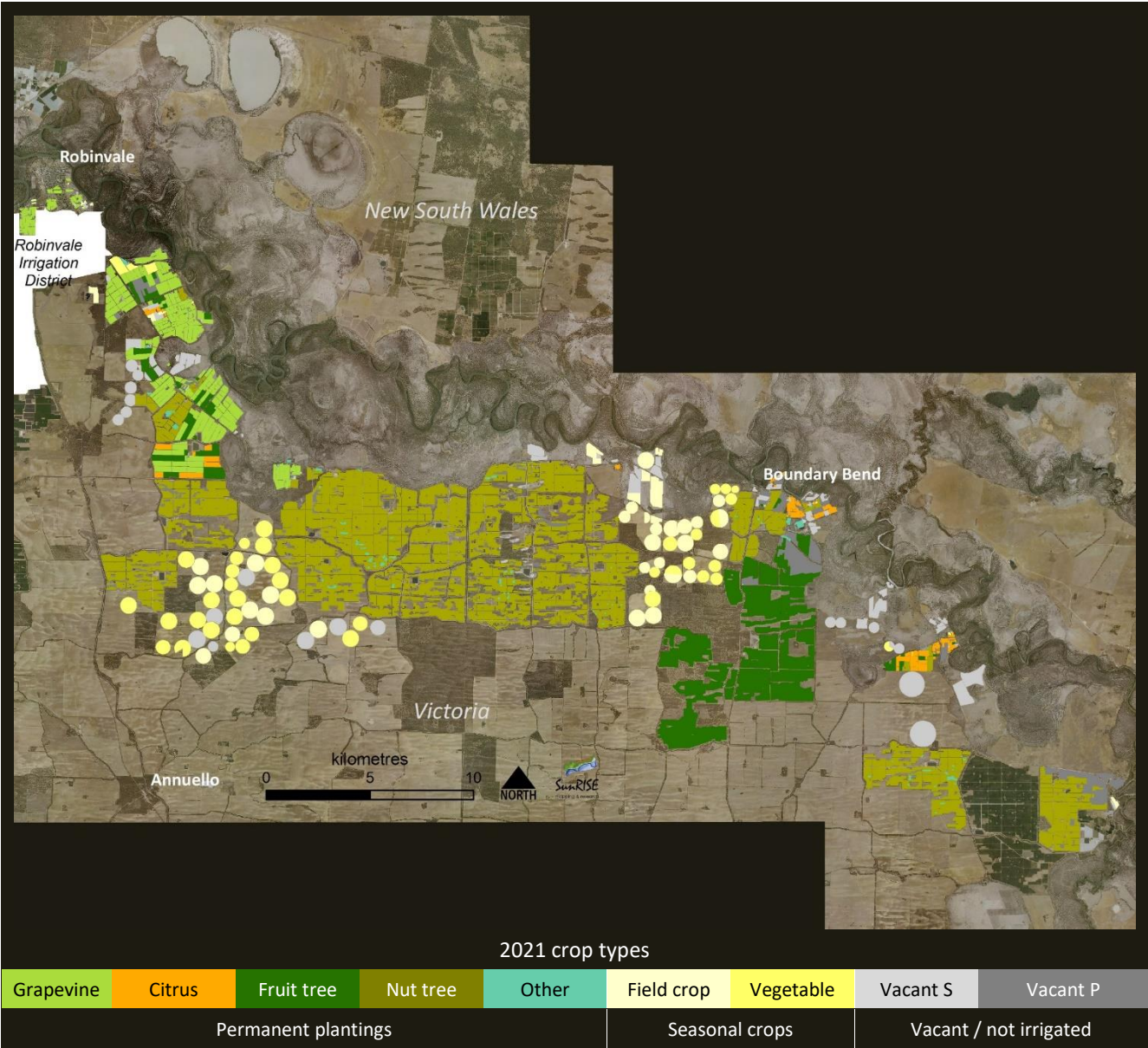
In 2021, there were approximately 73 irrigation properties and the average property size (irrigable area) was 295 ha.

From 1997 to 2021:

- the number of properties decreased by 38, a 34% decrease from 111 to 73 properties;
- properties with an irrigable area less than 40 ha decreased by 50, and the number over 40 ha increased by 12; and
- average property size (irrigable area) increased from 46 to 295 ha.

3.3.1 Boundary Bend river reach - crop types in 2021

Map 14 shows the Boundary Bend river reach and crop types in 2021.
The aerial photography was flown in January 2021 (source: Coordinated Imagery Program, DELWP Victoria).



Map 14: Boundary Bend river reach showing 2021 crop types

3.3.2 Boundary Bend river reach - crop types from 1997 to 2021

Figure 69 summarises crop types in the Boundary Bend river reach from 1997 to 2021. The dominant crop type changed from field crops in 1997 to potatoes in 2003 then almonds from 2006 to 2021.

In 2021, the main plantings were:

1. almond trees, 10,525 ha (49% of the irrigable area);
2. olive trees, 2,765 ha (13% of the irrigable area);
3. table grapes, 1,810 ha (8% of the irrigable area); and
4. potatoes, 1,435 ha (7% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- almond trees increased by 9,900 ha, a 1,584% increase from 625 to 10,525 ha;
- olive trees increased by 2,715 ha, a 5,430% increase from 50 to 2,765 ha; and
- table grapes increased by 1,265 ha, a 232% increase from 545 to 1,810 ha.

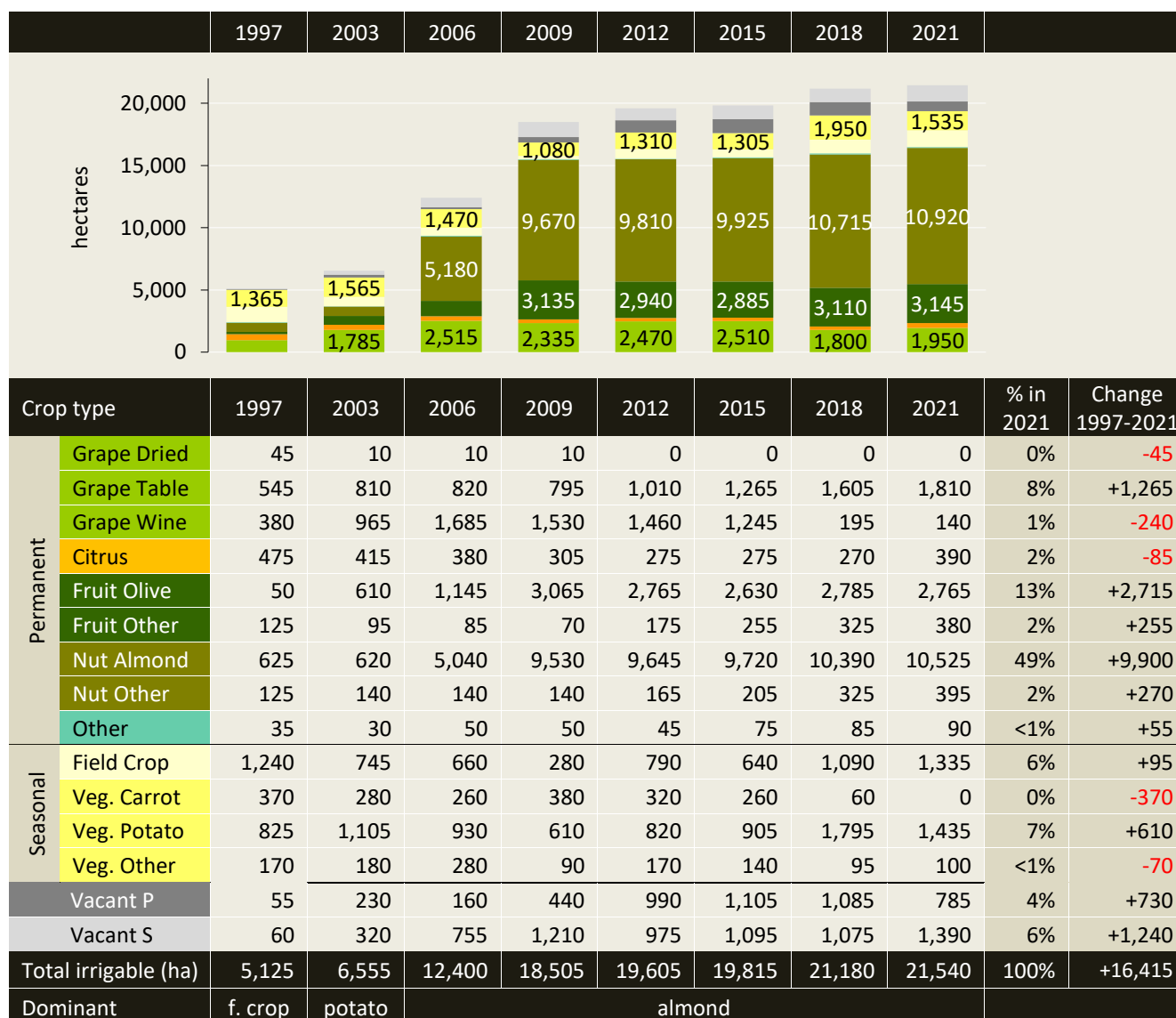


Figure 69: Boundary Bend river reach - crop types from 1997 to 2021

3.3.3 Boundary Bend river reach - development of permanent crops

Figure 70 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Boundary Bend river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 870 ha (5%) of permanent crops were planted or redeveloped within the previous three years.
- The 870 ha was the lowest area of development activity since 2003.
- The new plantings were:
 1. table grapes (310 ha);
 2. almonds (275 ha);
 3. citrus (135 ha);
 4. avocados (80 ha); and
 5. pistachios (70 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 1997 with 250 ha (10%) planted in the previous three years and highest in 2009 with 6,605 ha (43%) planted in the previous three years.



Figure 70: Boundary Bend river reach - development of permanent crops from 1997 to 2021

3.3.4 Boundary Bend river reach - planting trends

Figure 71 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Boundary Bend river reach from 1997 to 2021.

In 2021, the irrigable area of 21,540 ha comprised:

- 77% (16,495 ha) irrigated permanent plantings;
- 13% (2,870 ha) irrigated seasonal crops;
- 4% (785 ha) vacant, previously an irrigated permanent planting; and
- 6% (1,390 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 47% permanent, 51% seasonal and 2% vacant in 1997; to
- 77% permanent, 13% seasonal and 10% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 14,090 ha, from 2,405 to 16,495 ha;
- irrigated seasonal crops increased by 265 ha from 2,605 to 2,870 ha;
- vacant areas, previously irrigated permanent plantings increased by 730 ha, from 55 to 785 ha; and
- vacant areas, previously irrigated seasonal crops increased by 1,330 ha, from 60 to 1,390 ha.

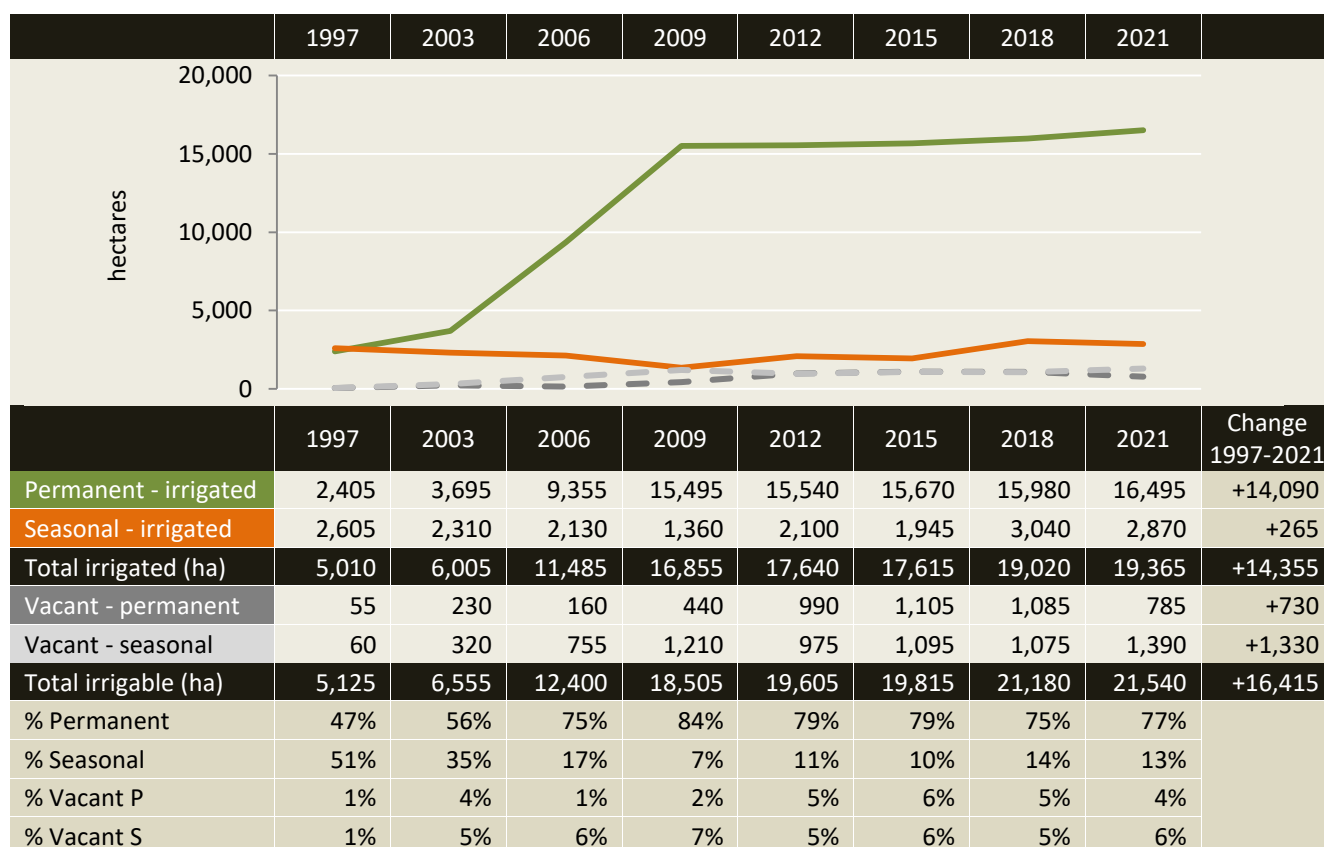
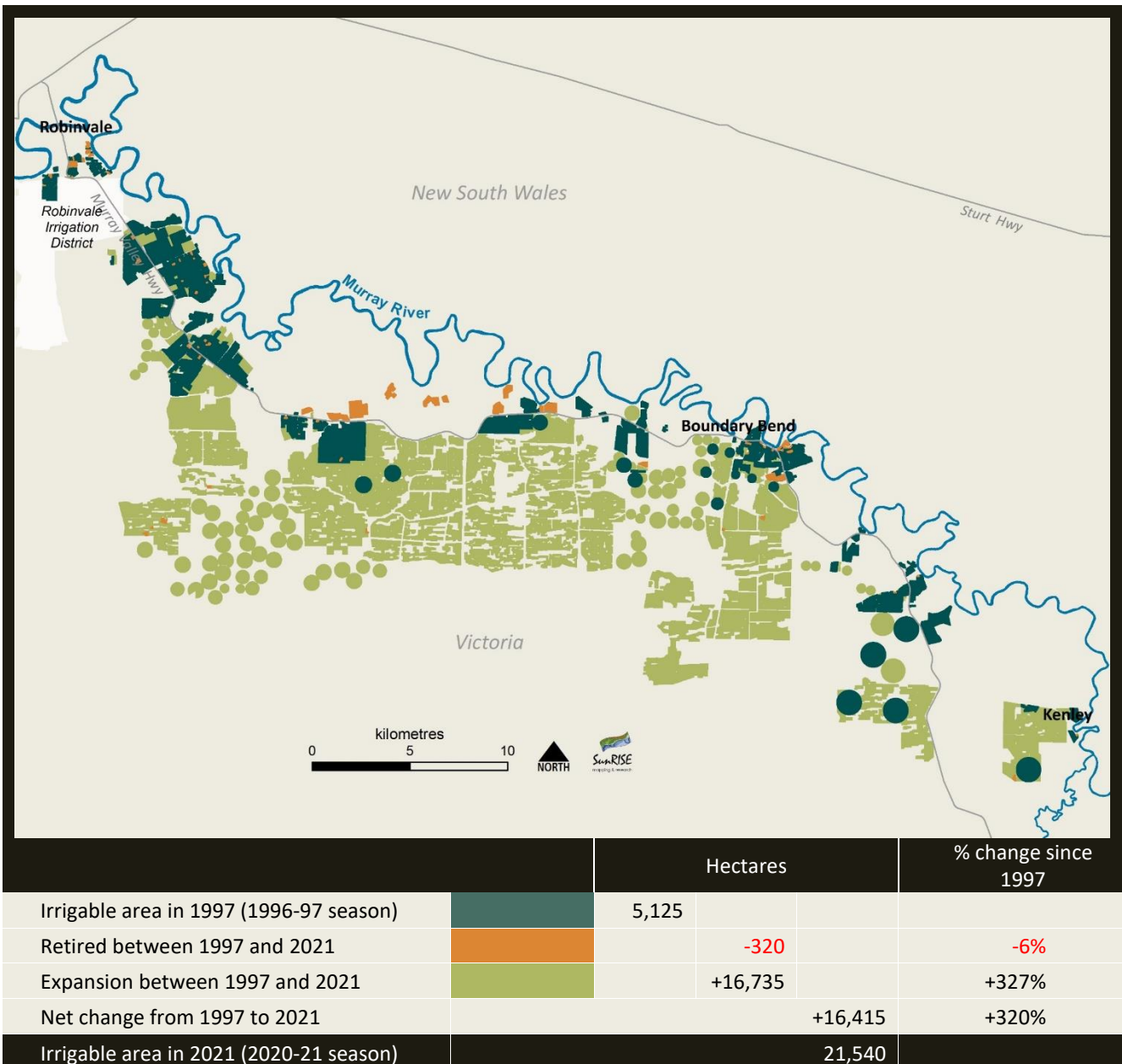


Figure 71: Boundary Bend river reach - planting trends from 1997 to 2021

3.3.5 Boundary Bend river reach - irrigation development

Map 15 shows irrigation development from 1997 to 2021 in the Boundary Bend river reach with respect to new development (expansion) and areas retired²⁷ from irrigation.

- The irrigable area increased by 16,415 ha, a 320% increase from 5,125 ha in 1997 to 21,540 ha in 2021.
- The net increase of 16,415 ha was the balance of 320 ha retired from irrigation and 16,735 ha of expansion.



Map 15: Boundary Bend river reach - irrigation development from 1997 to 2021

²⁷ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.3.6 Boundary Bend river reach - irrigation methods

Figure 72 summarises irrigation methods in the Boundary Bend river reach from 1997 to 2021.

The dominant irrigation method in the Boundary Bend river reach was overhead irrigation from 1997 to 2003, followed by drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 21,540 ha comprised:

- 72% (15,465 ha) drip irrigation;
- 4% (945 ha) low level irrigation;
- 13% (2,870 ha) overhead sprinklers;
- < 1% (85 ha) furrow irrigation; and
- 10% (2,175 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 14,740 ha, a 2,033% increase from 725 to 15,465 ha;
- low level irrigation increased by 65 ha, a 7% increase from 880 to 945 ha;
- overhead irrigation increased by 405 ha, a 16% increase from 2,465 to 2,870 ha; and
- furrow irrigation decreased by 855 ha, a 91% decrease from 940 to 85 ha.



Figure 72: Boundary Bend river reach - irrigation methods from 1997 to 2021

²⁸ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

3.3.7 Boundary Bend river reach - salinity impact zones

Figure 73 summarises river salinity impact zones of irrigated areas in the Boundary Bend river reach from 1997 to 2021. Boundary Bend private diverters are in low salinity impact zones L1, L2 and L3. Irrigation development from 1997 to 2021 occurred predominantly in L1.

In 2021, the irrigable area of 21,540 ha comprised:

- 81% (17,505 ha) in the lowest salinity impact zone, L1;
- 8% (1,705 ha) in L2; and
- 11% (2,330 ha) in L3.

From 1997 to 2021, the area irrigated in:

- L1 increased by 14,165 ha, a 689% increase from 2,055 to 16,220 ha;
- L2 increased by 85 ha, a 6% increase from 1,435 to 1,520 ha; and
- L3 increased by 105 ha, a 7% increase from 1,520 to 1,625 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 15,445 ha, a 750% increase from 2,060 to 17,505 ha;
- L2 increased by 200 ha, a 13% increase from 1,505 to 1,705 ha; and
- L3 increased by 770 ha, a 49% increase from 1,560 to 2,330 ha.

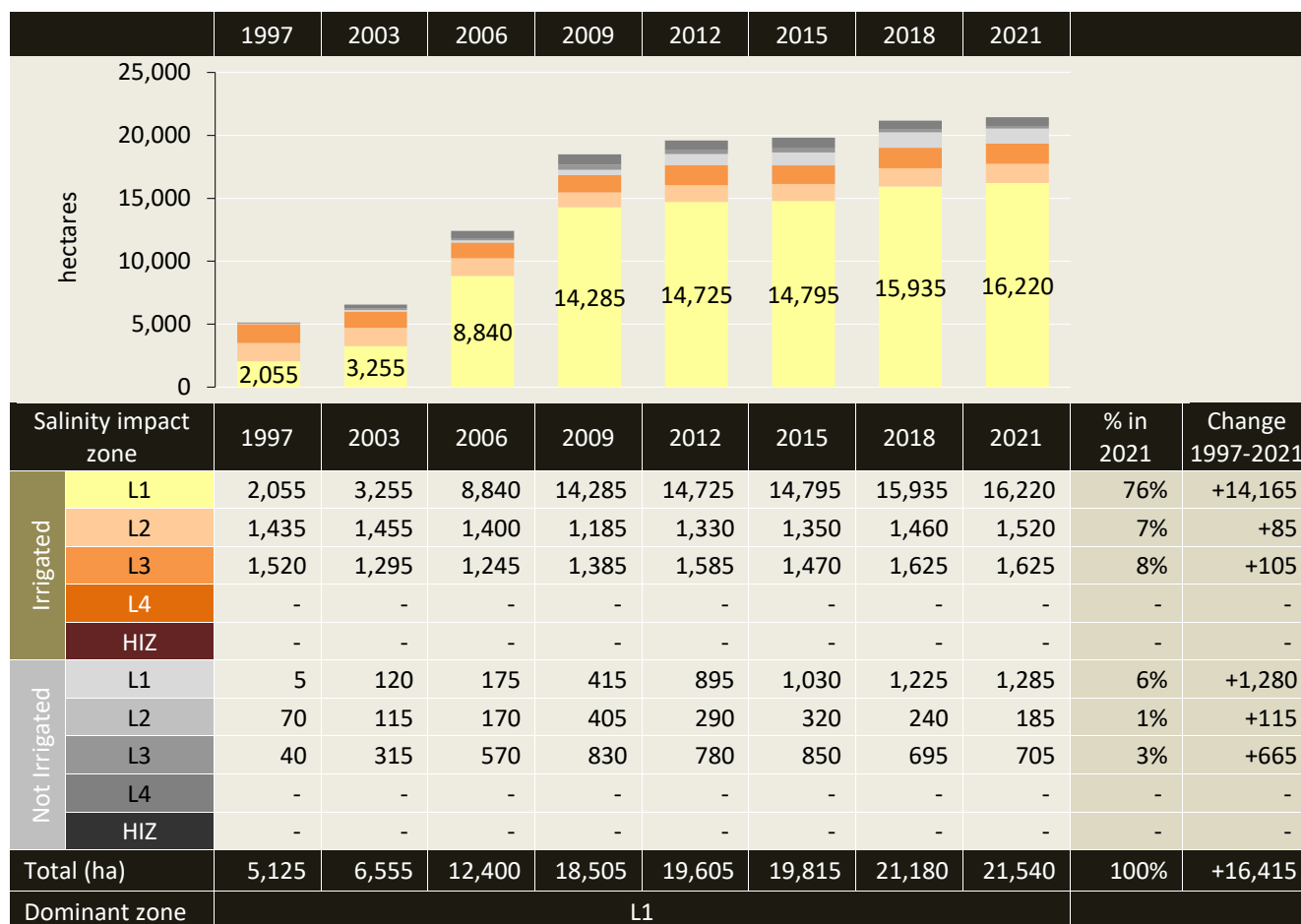


Figure 73: Boundary Bend river reach - irrigable area in each salinity impact zone, 1997 to 2021

3.3.8 Boundary Bend - property change

Figure 74 provides estimates of property numbers and average property size (irrigable area) in the Boundary Bend river reach from 1997 to 2021.

In 2021:

- there were approximately 73 irrigation properties; and
- 66% of properties had an irrigable area over 20 ha.

From 1997 to 2021:

- the number of properties decreased by 38, a 34% decrease from 111 to 73 properties;
- properties with an irrigable area less than 40 ha decreased by 50, and the number over 40 ha increased by 12; and
- average property size (irrigable area) increased from 46 to 295 ha.

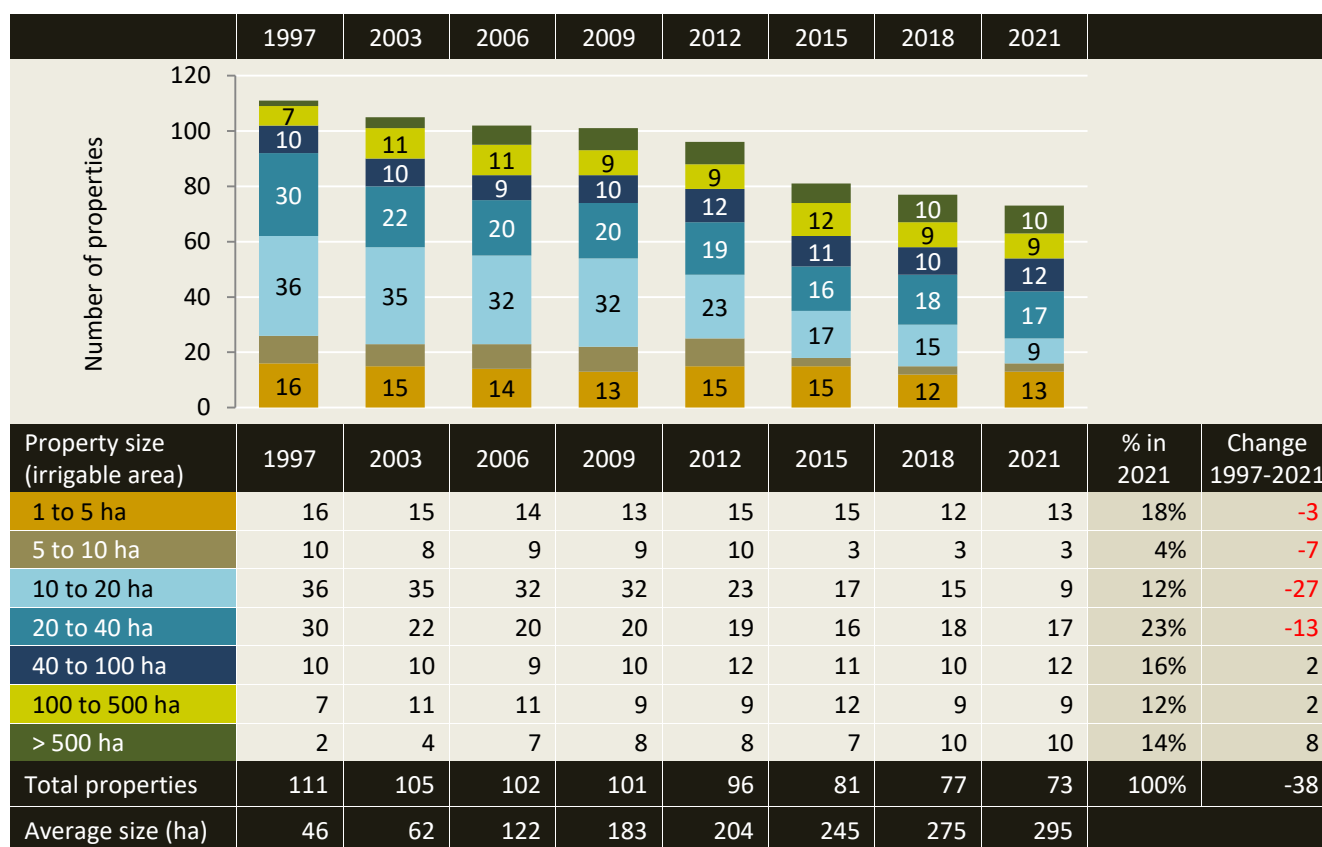


Figure 74: Boundary Bend river reach - property numbers and sizes from 1997 to 2021

3.4 Wemen river reach (Euston weir to Liparoo)

In summary for the Wemen river reach

Crop types in 2021

The main plantings in the Wemen river reach in 2021 were:

1. almond trees, 8,445 ha (61% of the irrigable area);
2. olives, 855 ha (6% of the irrigable area);
3. vegetables other than carrots and potatoes, 815 ha (6% of the irrigable area); and
4. table grapes, 630 ha (5% of the irrigable area).

Crop types 1997 to 2021

The dominant crop in the Wemen river reach changed from carrots in 1997 to almonds from 2003 to 2021.

The main crop type changes from 1997 to 2021 were:

- almond trees increased by 8,275 ha, a 4,868% increase from 170 to 8,445 ha;
- olive trees increased by 855 ha, from no plantings in 1997 to 855 ha in 2021; and
- vegetables other than carrots and potatoes increased by 560 ha, a 220% increase from 255 to 815 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 1,410 ha (13%) of permanent crops were planted or redeveloped in the previous three years. These new plantings were predominantly (89%) almonds and table grapes:

1. almonds (945 ha);
2. table grapes (315 ha);
3. pistachios (40 ha);
4. citrus (35 ha);
5. dried grapes (25 ha);
6. avocados and mangos (a total of 25 ha); and
7. wine grapes and miscellaneous (a total of 25 ha).

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 13,825 ha comprised:

- 77% (10,700 ha) irrigated permanent plantings;
- 12% (1,635 ha) irrigated seasonal crops;
- 1% (160 ha) vacant, previously an irrigated permanent planting; and
- 10% (1,330 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- irrigated permanent crops increased by 9,860 ha, from 840 to 10,700 ha;
- irrigated seasonal crops increased by 345 ha, from 1,290 to 1,635 ha;
- vacant areas, previously irrigated permanent plantings increased by 155 ha, from 5 to 160 ha; and
- vacant areas, previously irrigated seasonal crops increased by 1,315 ha, from 15 to 1,330 ha.

In summary for the Wemen river reach

Irrigation development - new and retired areas

The irrigable area in the Wemen river reach increased by 11,675 ha, a 543% increase from 2,150 ha in 1997 to 13,825 ha in 2021.

The net increase of 11,675 ha was the balance of 155 ha retired from irrigation and 11,830 ha of expansion.

Irrigation methods

The dominant irrigation method in the Wemen river reach changed from overheads in 1997 to drip irrigation from 2003 to 2021.

In 2021, the irrigable area of 13,825 ha comprised:

- 74% (10,275 ha) drip irrigation;
- 7% (950 ha) low level irrigation;
- 8% (1,105 ha) overhead sprinklers;
- < 1% (5 ha) furrow irrigation; and
- 11% (1,490 ha) not irrigated.

Salinity impact zones

The Wemen river reach is in the low salinity impact zones: L1, L2 and L3. Irrigation development from 1997 to 2021 occurred predominantly in L1 and L2.

In 2021, the irrigable area of 13,825 ha comprised:

- 43% (5,990 ha) in the lowest salinity impact zone, L1;
- 56% (7,685 ha) in L2; and
- 1% (150 ha) in L3.

From 1997 to 2021 the irrigable area in:

- L1 increased by 5,815 ha, a 3,323% increase from 175 to 5,990 ha;
- L2 increased by 5,830 ha, a 314% increase from 1,855 to 7,685 ha; and
- L3 increased by 30 ha, a 25% increase from 120 to 150 ha.

Irrigation properties

In 2021, there were approximately 39 irrigation properties and the average property size (irrigable area) was 354 ha.

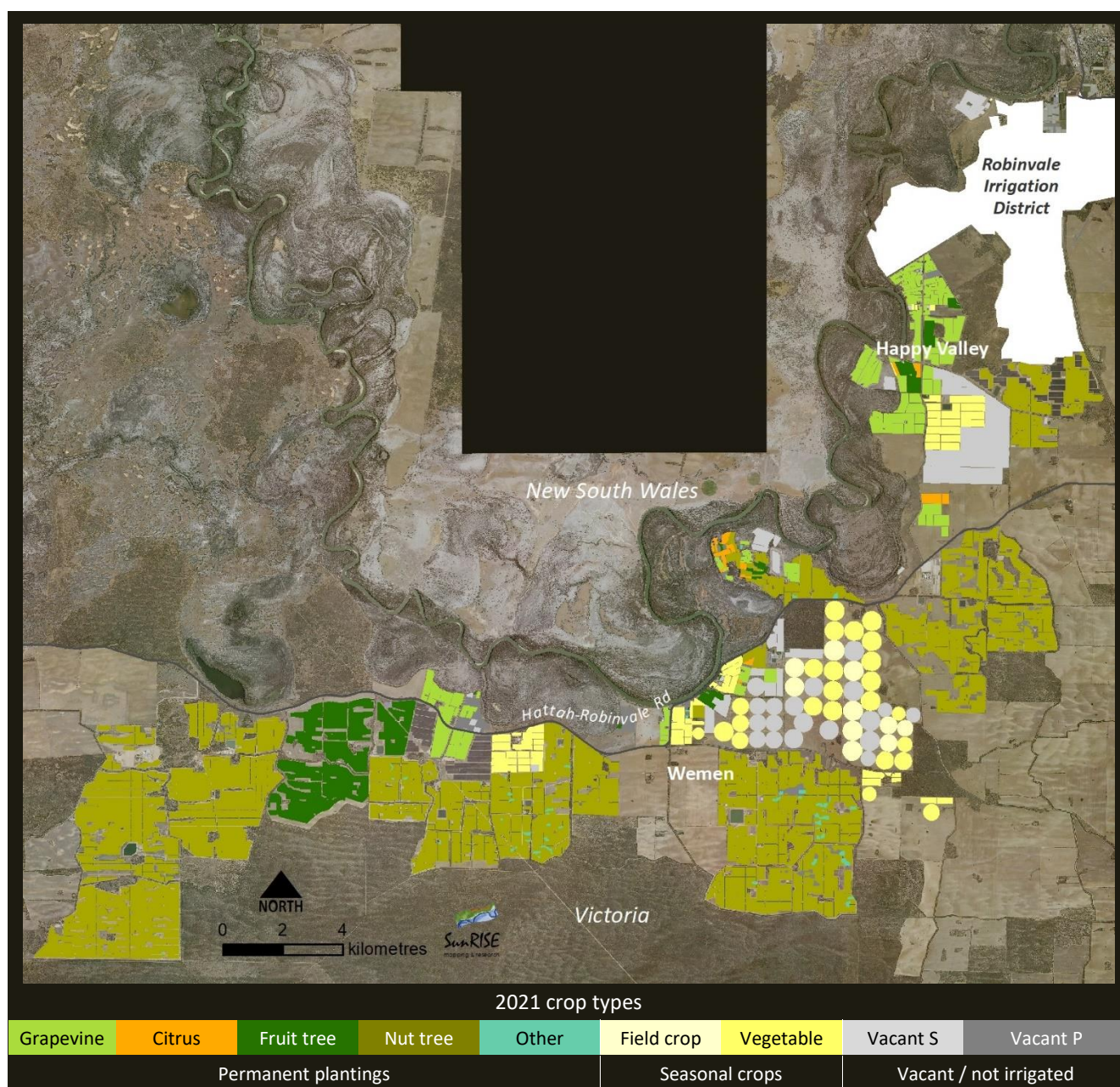
From 1997 to 2021:

- the number of properties decreased by 1, a 3% decrease from 40 to 39 properties;
- properties with an irrigable area less than 20 ha decreased by 11, while the number over 20 ha increased by 10; and
- average property size (irrigable area) increased from 54 to 354 ha.

3.4.1 Wemen river reach - crop types in 2021

Map 16 shows the Wemen river reach with crop types in 2021.

The aerial photography was flown January - February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 16: Wemen river reach showing 2021 crop types

3.4.2 Wemen river reach - crop types from 1997 to 2021

Figure 75 summarises crop types in the Wemen river reach from 1997 to 2021. The dominant crop type changed from carrots in 1997 to almonds from 2003 to 2021.

In 2021, the main plantings were:

1. almond trees, 8,445 ha (61% of the irrigable area);
2. olives, 855 ha (6% of the irrigable area);
3. vegetables other than carrots and potatoes, 815 ha (6% of the irrigable area); and
4. table grapes, 630 ha (5% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- almond trees increased by 8,275 ha, a 4,868% increase from 170 to 8,445 ha;
- olive trees increased by 855 ha, from no plantings in 1997 to 855 ha in 2021; and
- vegetables other than carrots and potatoes increased by 560 ha, a 220% increase from 255 to 815 ha.

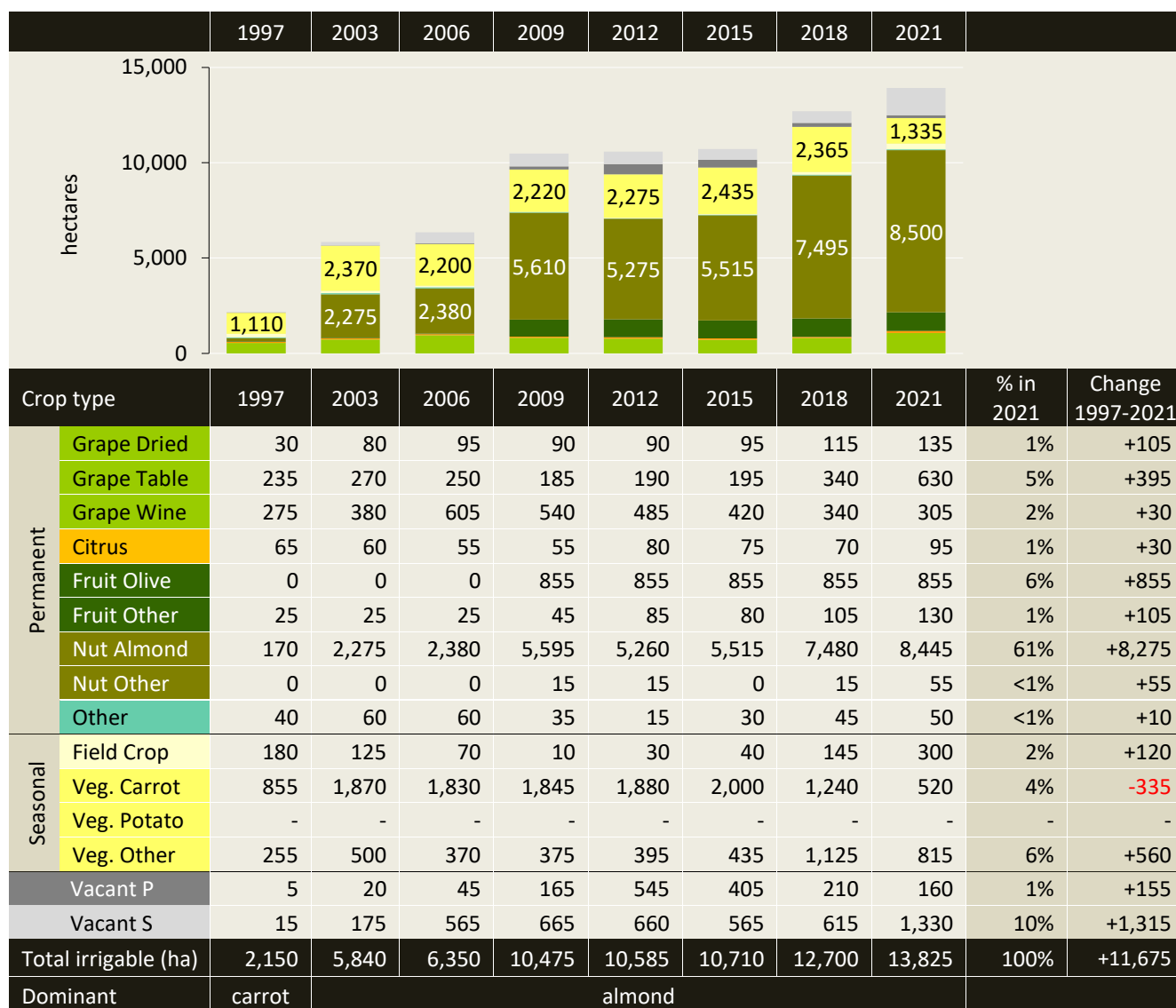


Figure 75: Wemen river reach - crop types from 1997 to 2021

3.4.3 Wemen river reach - development of permanent crops

Figure 76 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Wemen river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 1,410 ha (13%) of permanent crops were planted or redeveloped within the previous three years.
- These new plantings were:
 1. almonds (945 ha);
 2. table grapes (315 ha);
 3. pistachios (40 ha);
 4. citrus (35 ha);
 5. dried grapes (25 ha);
 6. avocados and mangos (a total of 25 ha); and
 7. wine grapes and miscellaneous (a total of 25 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 1997 with 75 ha (9%) planted in the previous three years and highest in 2009 with 4,145 ha (56%) planted in the previous three years.

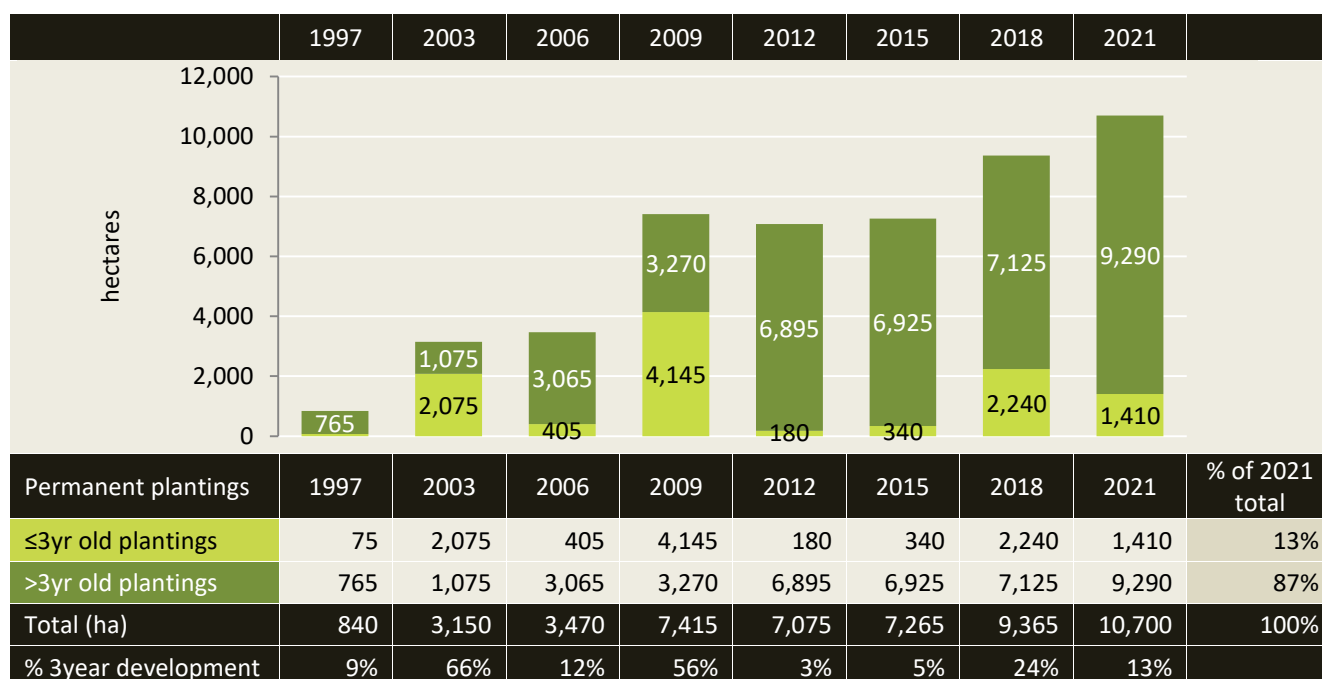


Figure 76: Wemen river reach - development of permanent crops from 1997 to 2021

3.4.4 Wemen river reach - planting trends

Figure 77 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Wemen river reach from 1997 to 2021.

In 2021, the irrigable area of 13,825 ha comprised:

- 77% (10,700 ha) irrigated permanent plantings;
- 12% (1,635 ha) irrigated seasonal crops;
- 1% (160 ha) vacant, previously an irrigated permanent planting; and
- 10% (1,330 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 39% permanent, 60% seasonal and 1% vacant in 1997; to
- 77% permanent, 12% seasonal and 11% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 9,860 ha, from 840 to 10,700 ha;
- irrigated seasonal crops increased by 345 ha, from 1,290 to 1,635 ha;
- vacant areas, previously irrigated permanent plantings increased by 155 ha, from 5 to 160 ha; and
- vacant areas, previously irrigated seasonal crops increased by 1,315 ha, from 15 to 1,330 ha.

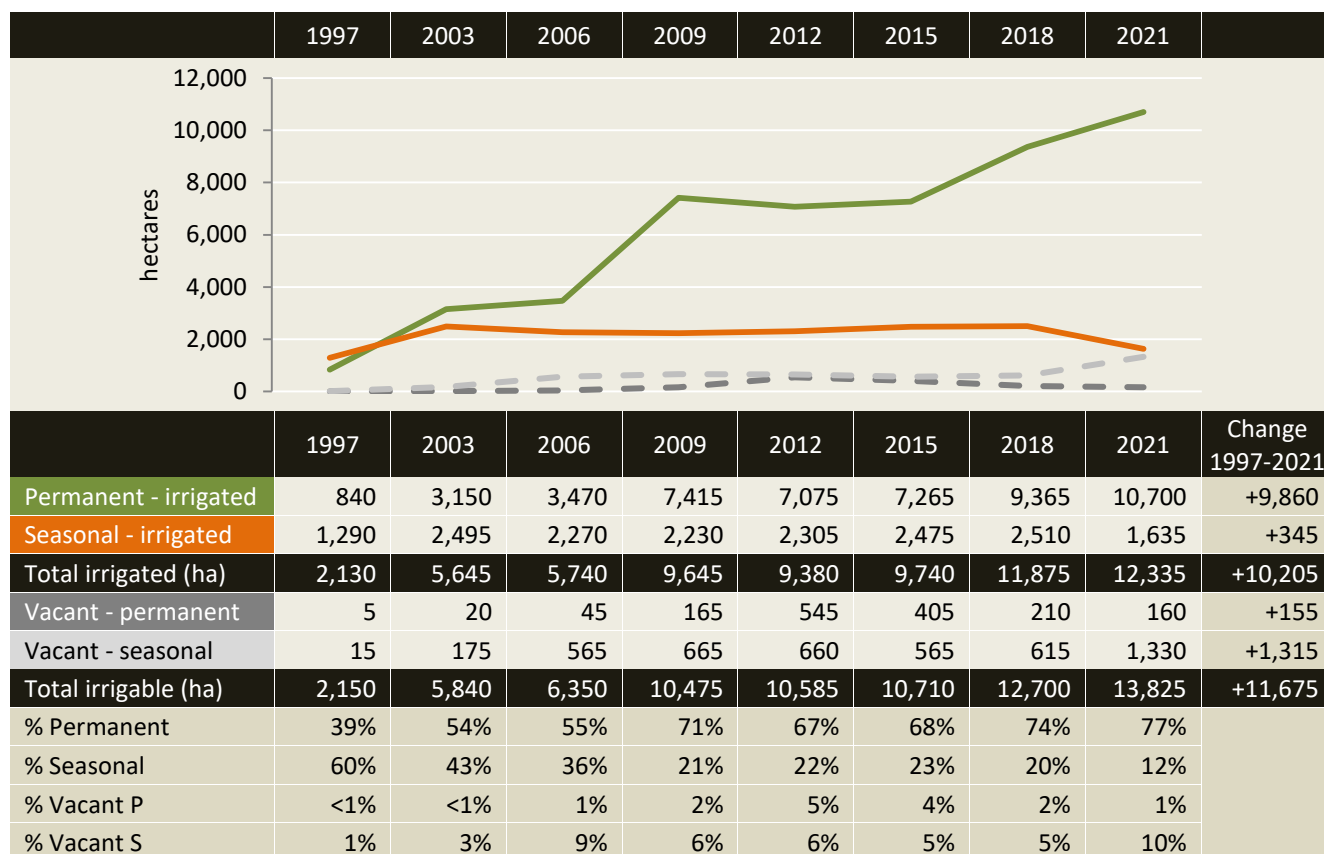
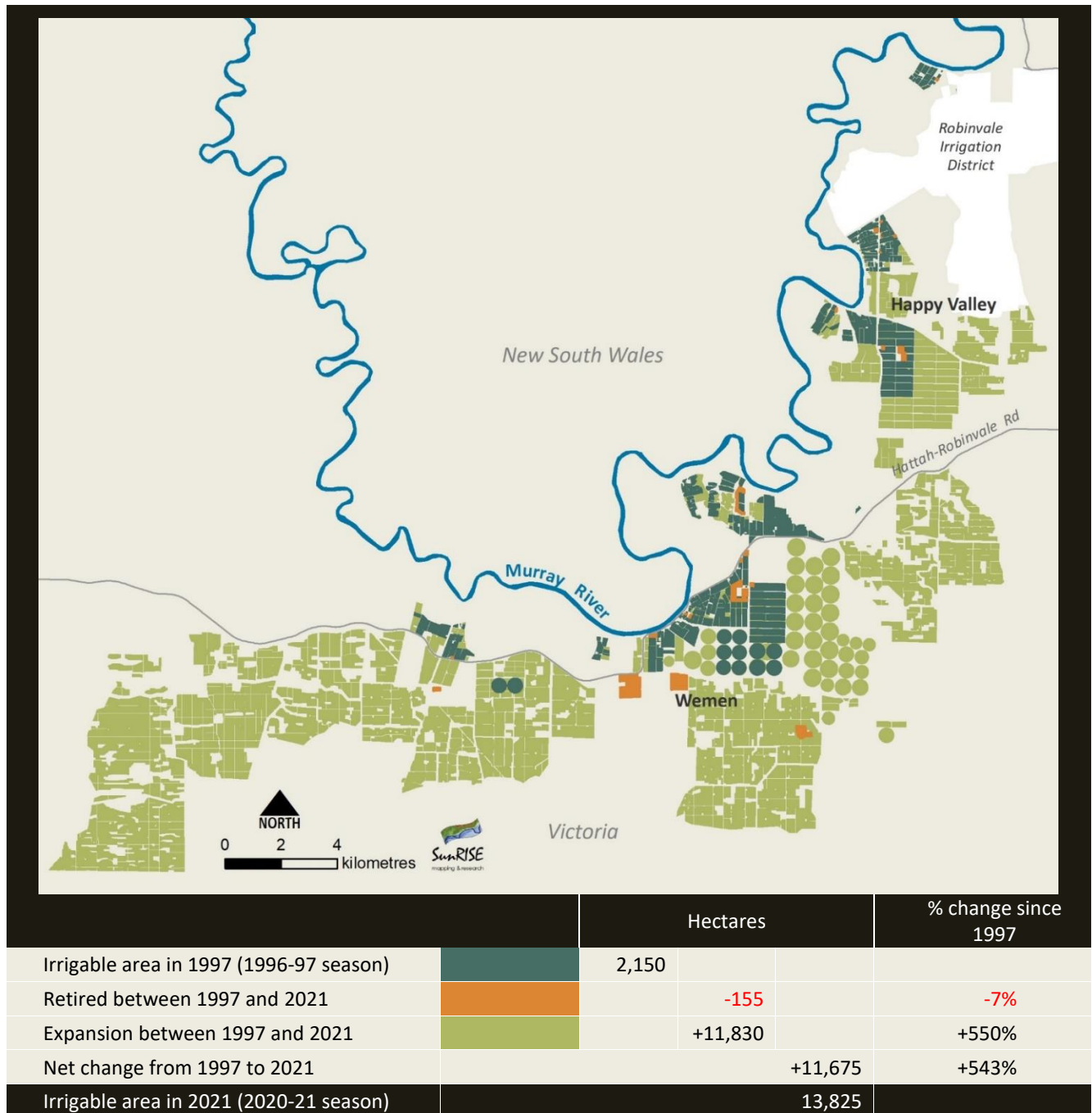


Figure 77: Wemen river reach - planting trends from 1997 to 2021

3.4.5 Wemen river reach - irrigation development

Map 17 shows irrigation development from 1997 to 2021 in the Wemen river reach with respect to new development (expansion) and areas retired²⁹ from irrigation.

- The irrigable area increased by 11,675 ha, a 543% increase from 2,150 ha in 1997 to 13,825 ha in 2021.
- The net increase of 11,675 ha was the balance of 155 ha retired from irrigation and 11,830 ha of expansion.



Map 17: Wemen river reach - irrigation development from 1997 to 2021

²⁹ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.4.6 Wemen river reach - irrigation methods

Figure 78 summarises irrigation methods in the Wemen river reach from 1997 to 2021.

The dominant irrigation method in the Wemen river reach changed from overheads in 1997 to drip irrigation from 2003 to 2021.

In 2021, the irrigable area of 13,825 ha comprised:

- 74% (10,275 ha) drip irrigation;
- 7% (950 ha) low level irrigation;
- 8% (1,105 ha) overhead sprinklers;
- < 1% (5 ha) furrow irrigation; and
- 11% (1,490 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 10,045 ha, a 4,367% increase from 230 to 10,275 ha;
- low level irrigation increased by 230 ha, a 32% increase from 720 to 950 ha;
- overhead irrigation increased by 100 ha, a 10% increase from 1,005 to 1,105 ha; and
- furrow irrigation decreased by 170 ha, a 97% decrease from 175 to 5 ha.

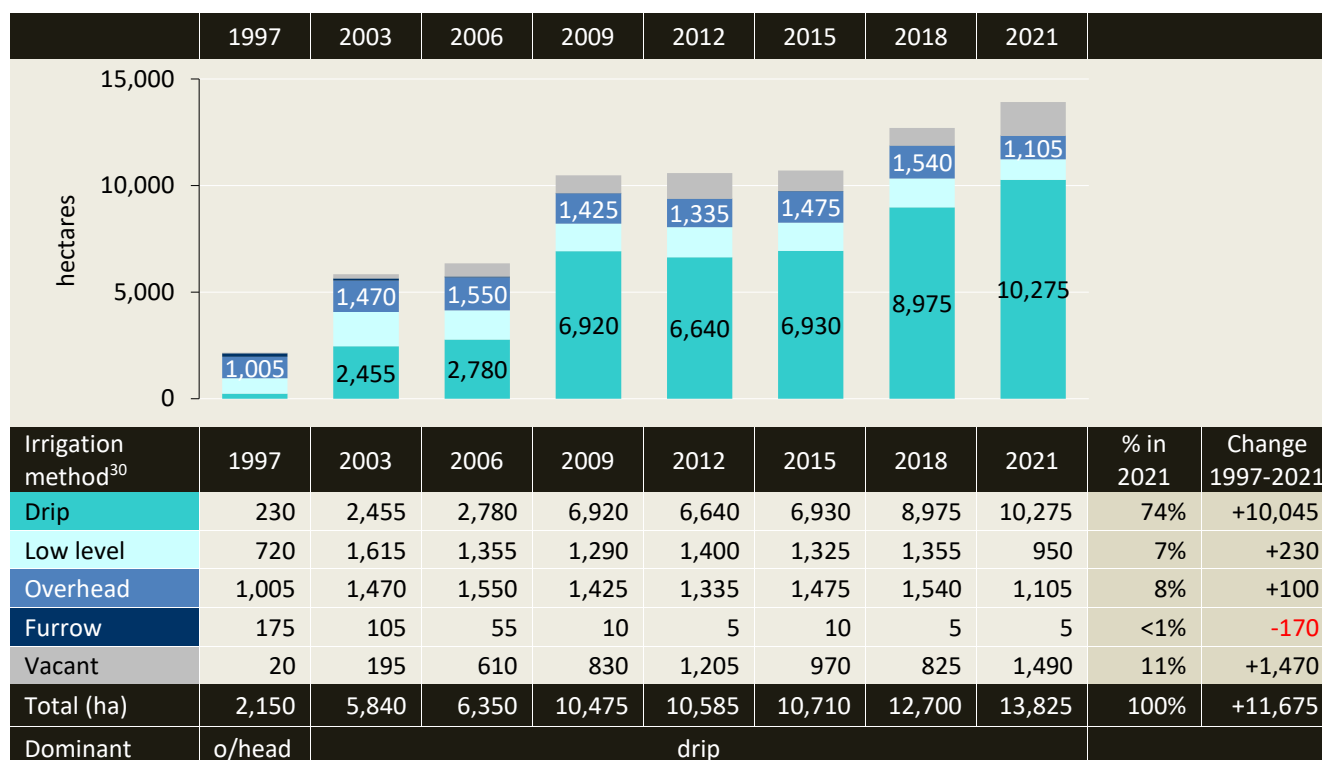


Figure 78: Wemen river reach - irrigation methods from 1997 to 2021

³⁰ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

3.4.7 Wemen river reach - salinity impact zones

Figure 79 summarises river salinity impact zones of irrigated areas in the Wemen river reach from 1997 to 2021. Wemen private diverters are in low salinity impact zones L1, L2 and L3. There are no high salinity impact zones. Irrigation development from 1997 to 2021 occurred predominantly in L1 and L2.

In 2021, the irrigable area of 13,825 ha comprised:

- 43% (5,990 ha) in the lowest salinity impact zone, L1;
- 56% (7,685 ha) in L2; and
- 1% (150 ha) in L3.

From 1997 to 2021, the area irrigated in:

- L1 increased by 5,755 ha, a 3,385% increase from 170 to 5,925 ha;
- L2 increased by 4,470 ha, a 241% increase from 1,855 to 6,325 ha; and
- L3 decreased by 20 ha, a 19% decrease from 105 to 85 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 5,815 ha, a 3,323% increase from 175 to 5,990 ha;
- L2 increased by 5,830 ha, a 314% increase from 1,855 to 7,685 ha; and
- L3 increased by 30 ha, a 25% increase from 120 to 150 ha.

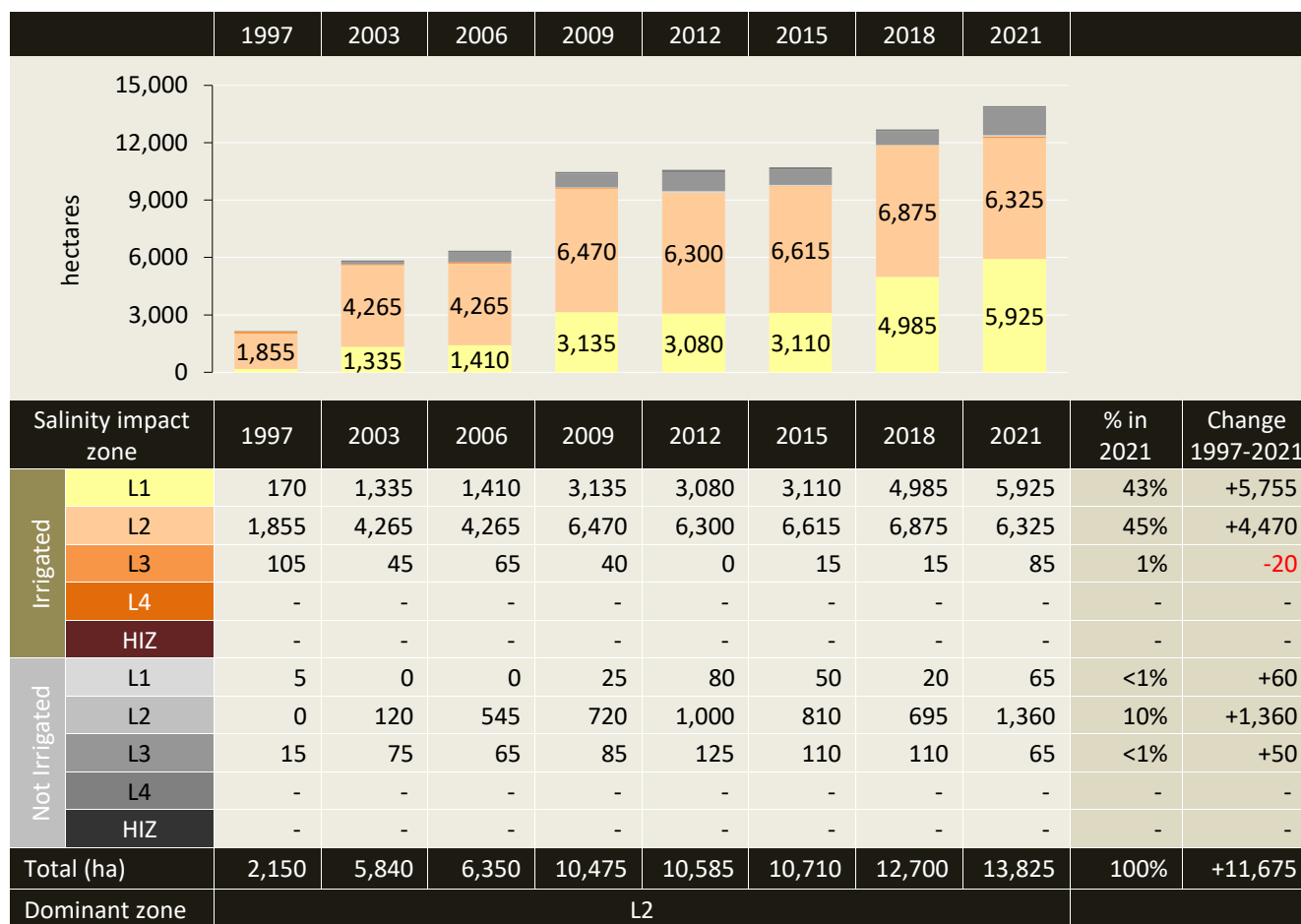


Figure 79: Wemen river reach - irrigable area in each salinity impact zone from 1997 to 2021

3.4.8 Wemen river reach - property change

Figure 80 provides estimates of property numbers and average property size (irrigable area) in the Wemen river reach from 1997 to 2021.

In 2021:

- there were approximately 39 irrigation properties; and
- 79% of properties had an irrigable area over 20 ha.

From 1997 to 2021:

- the number of properties decreased by 1, a 3% decrease from 40 to 39 properties;
- properties with an irrigable area less than 20 ha decreased by 11, while the number over 20 ha increased by 10; and
- average property size (irrigable area) increased from 54 to 354 ha.

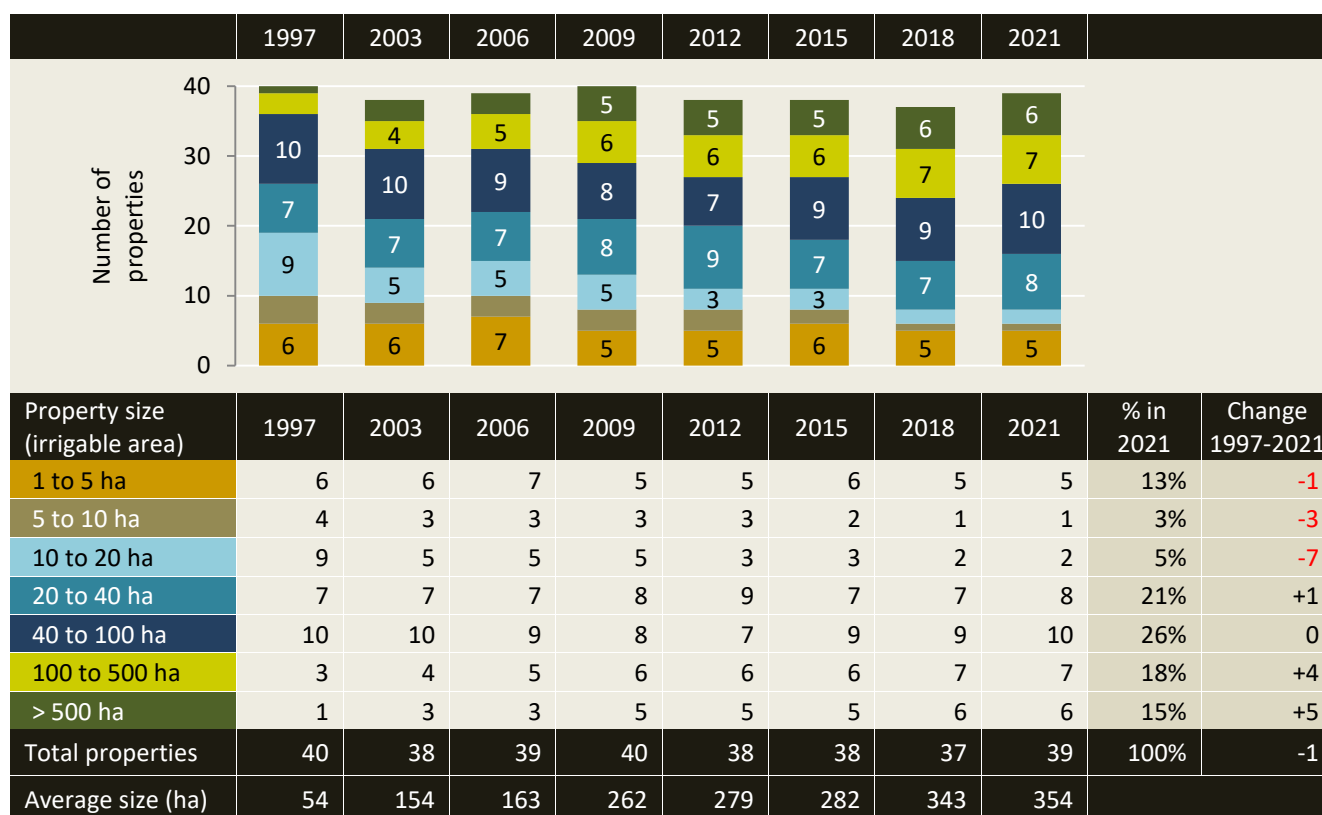


Figure 80: Wemen river reach - property numbers and sizes from 1997 to 2021

3.5 Colignan river reach (*Colignan to Yatpool*)

In summary for the Colignan to Yatpool river reach

Crop types in 2021

The main plantings in the Colignan to Yatpool river reach in 2021 were:

1. citrus, 3,330 ha (27% of the irrigable area);
2. wine grapes, 2,795 ha (22% of the irrigable area);
3. almonds, 1,470 ha (12% of the irrigable area);
4. table grapes, 990 ha (8% of the irrigable area); and
5. dried grapes, 970 ha (8% of the irrigable area).

Crop types 1997 to 2021

The dominant crop type in the Colignan to Yatpool river reach was wine grapes from 1997 to 2015, followed by citrus from 2018 to 2021.

The main crop type changes from 1997 to 2021 were:

- almonds increased by 1,285 ha, a 695% increase from 185 to 1,470 ha;
- dried grapes increased by 925 ha, a 2,056% increase from 45 to 970 ha;
- table grapes increased by 815 ha, a 466% increase from 175 to 990 ha; and
- citrus increased by 795 ha, a 31% increase from 2,535 to 3,330 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, at least 1,775 ha (18%) of permanent crops were planted or redeveloped in the previous three years. The 1,775 ha was the highest area of development activity since 2006.

The new plantings were:

1. almonds (510 ha);
2. citrus (465 ha);
3. table grapes (355 ha);
4. wine grapes (255 ha);
5. dried grapes (140 ha); and
6. other (50 ha of stone fruit, avocados and nurseries).

From 1997 to 2021, the area of new and redeveloped permanent plantings was at its lowest in 2015 with 600 ha (7%) planted in the previous three years and highest in 2003 with 2,005 ha (23%) planted in the previous three years. The 2003 development was predominantly wine grapes.

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 12,430 ha comprised:

- 80% (9,915 ha) irrigated permanent plantings;
- 6% (825 ha) irrigated seasonal crops;
- 8% (955 ha) vacant, previously an irrigated permanent planting; and
- 6% (735 ha) vacant, previously an irrigated seasonal crop.

In summary for the Colignan to Yatpool river reach

From 1997 to 2021:

- irrigated permanent crops increased by 3,890 ha, from 6,025 to 9,915 ha;
- irrigated seasonal crops increased by 125 ha, from 700 to 825 ha;
- vacant areas, previously irrigated permanent plantings increased by 860 ha, from 95 to 955 ha; and
- vacant areas, previously irrigated seasonal crops increased by 630 ha, from 105 to 735 ha.

Irrigation development - new and retired areas

The irrigable area in the Colignan river reach increased by 5,505 ha, a 79% increase from 6,925 ha in 1997 to 12,430 ha in 2021.

The net increase of 5,505 ha was the balance of 85 ha retired from irrigation and 5,590 ha of expansion.

Irrigation methods

The dominant irrigation method in the Colignan river reach changed from overheads in 1997 to drip irrigation from 2003 to 2021. In 2021, the irrigable area of 12,430 ha comprised:

- 69% (8,525 ha) drip irrigation;
- 7% (885 ha) low level irrigation;
- 10% (1,295 ha) overhead sprinklers;
- < 1% (35 ha) furrow irrigation; and
- 14% (1,690 ha) vacant, not irrigated.

Salinity impact zones

The Colignan river reach is in low salinity impact zones L1 and L4 and in the high impact zone, HIZ. Irrigation development from 1997 to 2021 occurred mainly in L4.

In 2021, the irrigable area of 12,430 ha comprised:

- 20% (2,435 ha) in the lowest salinity impact zone, L1;
- 71% (8,825 ha) in L4; and
- 9% (1,170 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021 the irrigable area in:

- L1 increased by 2,140 ha, a 725% increase from 295 to 2,435 ha;
- L4 increased by 3,230 ha, a 58% increase from 5,595 to 8,825 ha; and
- HIZ increased by 135 ha, a 13% increase from 1,035 to 1,170 ha.

Irrigation properties

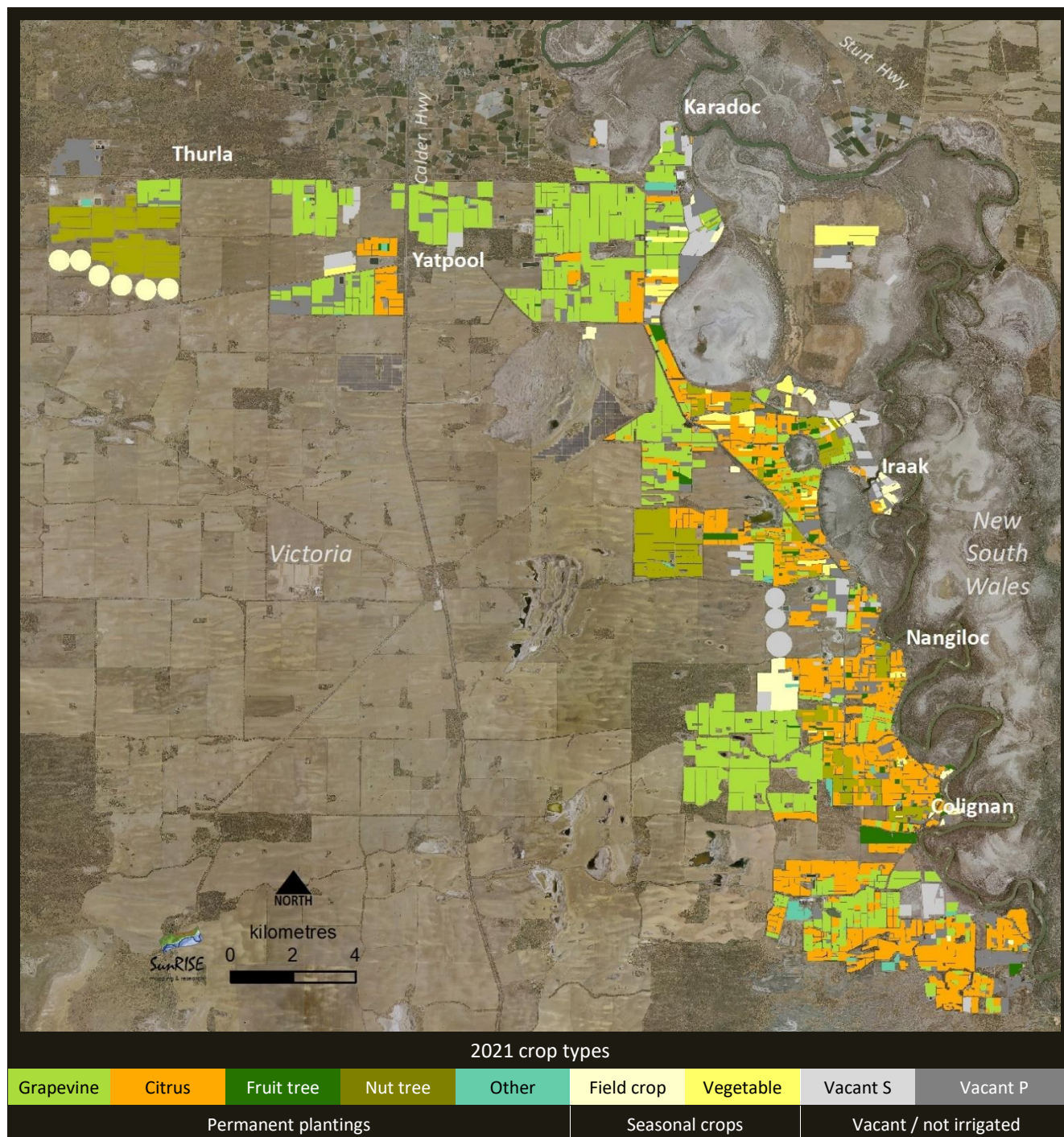
In 2021, there were approximately 130 irrigation properties and the average property size (irrigable area) was 96 ha. From 1997 to 2021:

- the number of properties decreased by 15, a 10% decrease from 145 to 130 properties;
- properties with an irrigable area less than 100 ha decreased by 26, while the number over 100 ha increased by 11; and
- average property size (irrigable area) increased from 48 to 96 ha.

3.5.1 Colignan river reach - crop types in 2021

Map 18 shows the Colignan river reach with crop types in 2021.

The aerial photography was flown in February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 18: Colignan river reach showing 2021 crop types

3.5.2 Colignan river reach - crop types from 1997 to 2021

Figure 81 summarises crop types in the Colignan river reach from 1997 to 2021. The dominant crop type was wine grapes from 1997 to 2015, followed by citrus from 2018 to 2021.

In 2021, the main plantings were:

1. citrus, 3,330 ha (27% of the irrigable area);
2. wine grapes, 2,795 ha (22% of the irrigable area);
3. almonds, 1,470 ha (12% of the irrigable area);
4. table grapes, 990 ha (8% of the irrigable area); and
5. dried grapes, 970 ha (8% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- almonds increased by 1,285 ha, a 695% increase from 185 to 1,470 ha;
- dried grapes increased by 925 ha, a 2,056% increase from 45 to 970 ha;
- table grapes increased by 815 ha, a 466% increase from 175 to 990 ha; and
- citrus increased by 795 ha, a 31% increase from 2,535 to 3,330 ha.

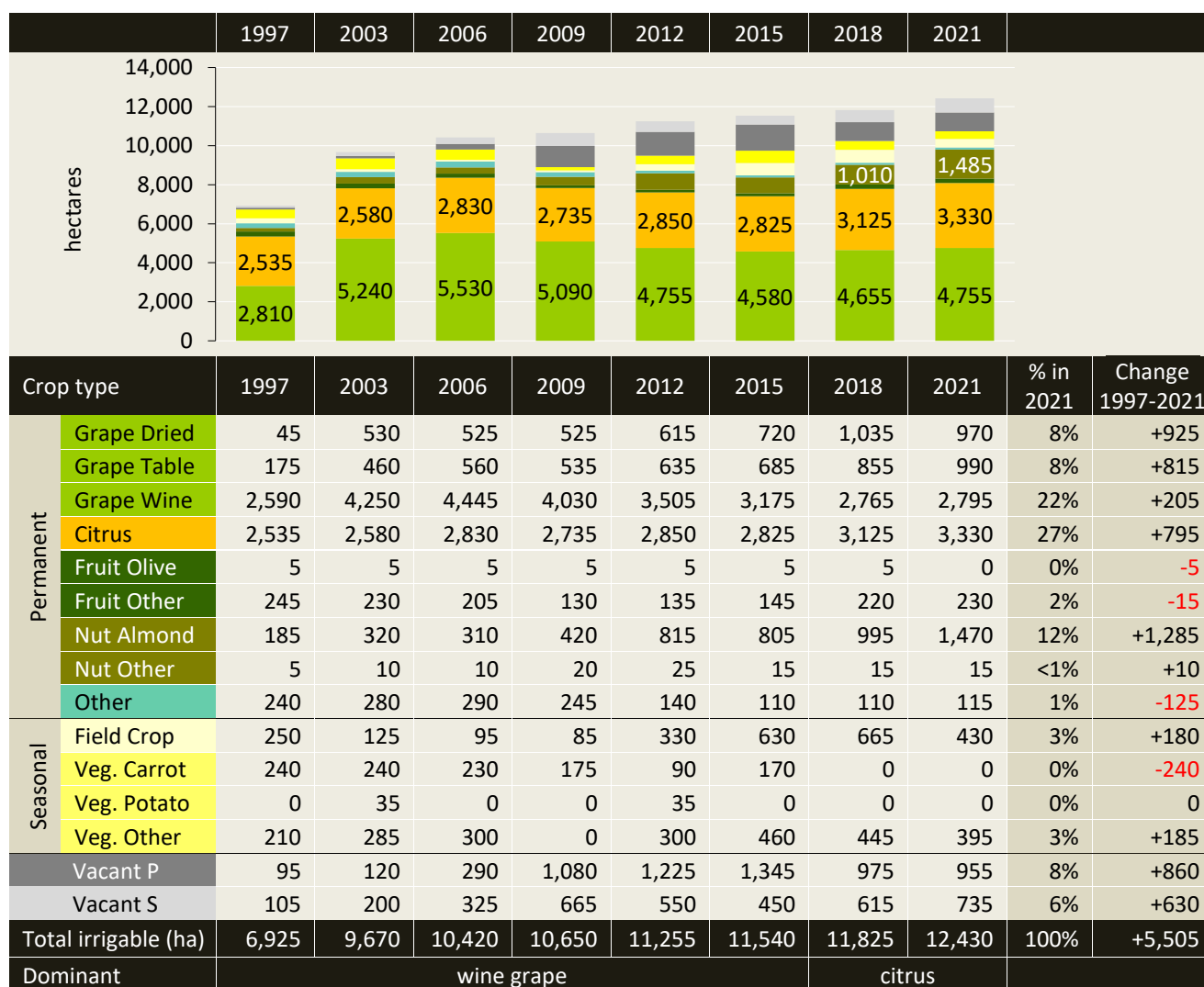


Figure 81: Colignan river reach - crop types from 1997 to 2021

3.5.3 Colignan river reach - development of permanent crops

Figure 82 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Colignan river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 1,775 ha (18%) of permanent crops were planted or redeveloped within the previous three years.
- The 1,775 ha was the highest area of development activity since 2006.
- The new plantings were:
 1. almonds (510 ha);
 2. citrus (465 ha);
 3. table grapes (355 ha);
 4. wine grapes (255 ha);
 5. dried grapes (140 ha); and
 6. other (50 ha of stone fruit, avocados and nurseries).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 2015 with 600 ha (7%) planted in the previous three years and highest in 2003 with 2,005 ha (23%) planted in the previous three years. The 2003 development was predominantly wine grapes.

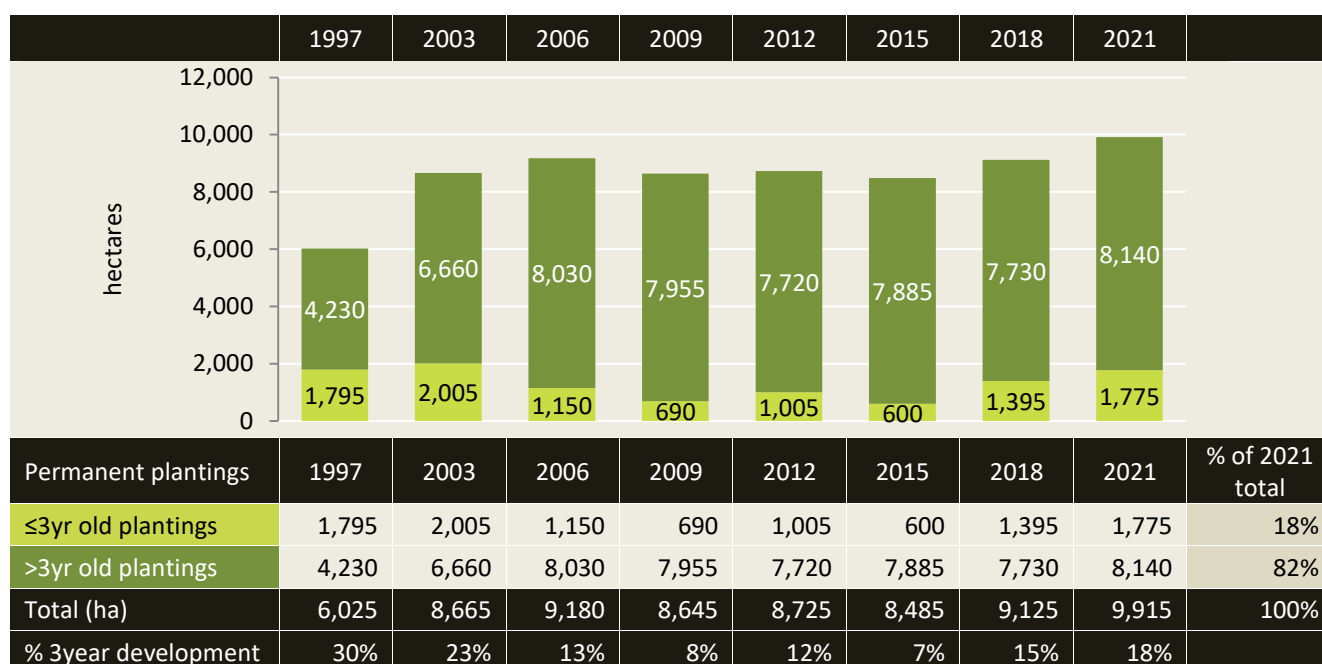


Figure 82: Colignan river reach - development of permanent crops from 1997 to 2021

3.5.4 Colignan river reach - planting trends

Figure 83 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Colignan river reach from 1997 to 2021.

In 2021, the irrigable area of 12,430 ha comprised:

- 80% (9,915 ha) irrigated permanent plantings;
- 6% (825 ha) irrigated seasonal crops;
- 8% (955 ha) vacant, previously an irrigated permanent planting; and
- 6% (735 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 87% permanent, 10% seasonal and 3% vacant in 1997; to
- 80% permanent, 6% seasonal and 14% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 3,890 ha, from 6,025 to 9,915 ha;
- irrigated seasonal crops increased by 125 ha, from 700 to 825 ha;
- vacant areas, previously irrigated permanent plantings increased by 860 ha, from 95 to 955 ha; and
- vacant areas, previously irrigated seasonal crops increased by 630 ha, from 105 to 735 ha.

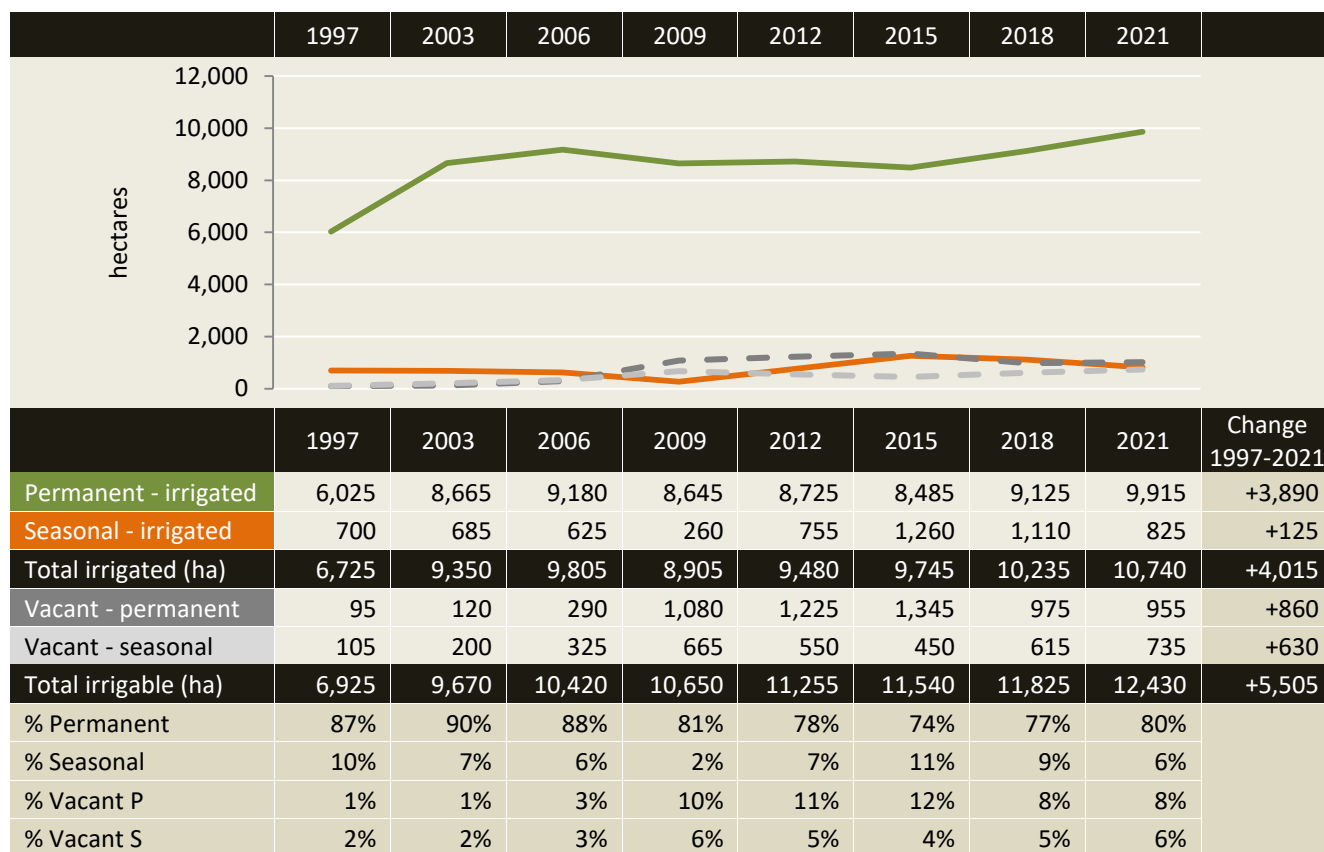
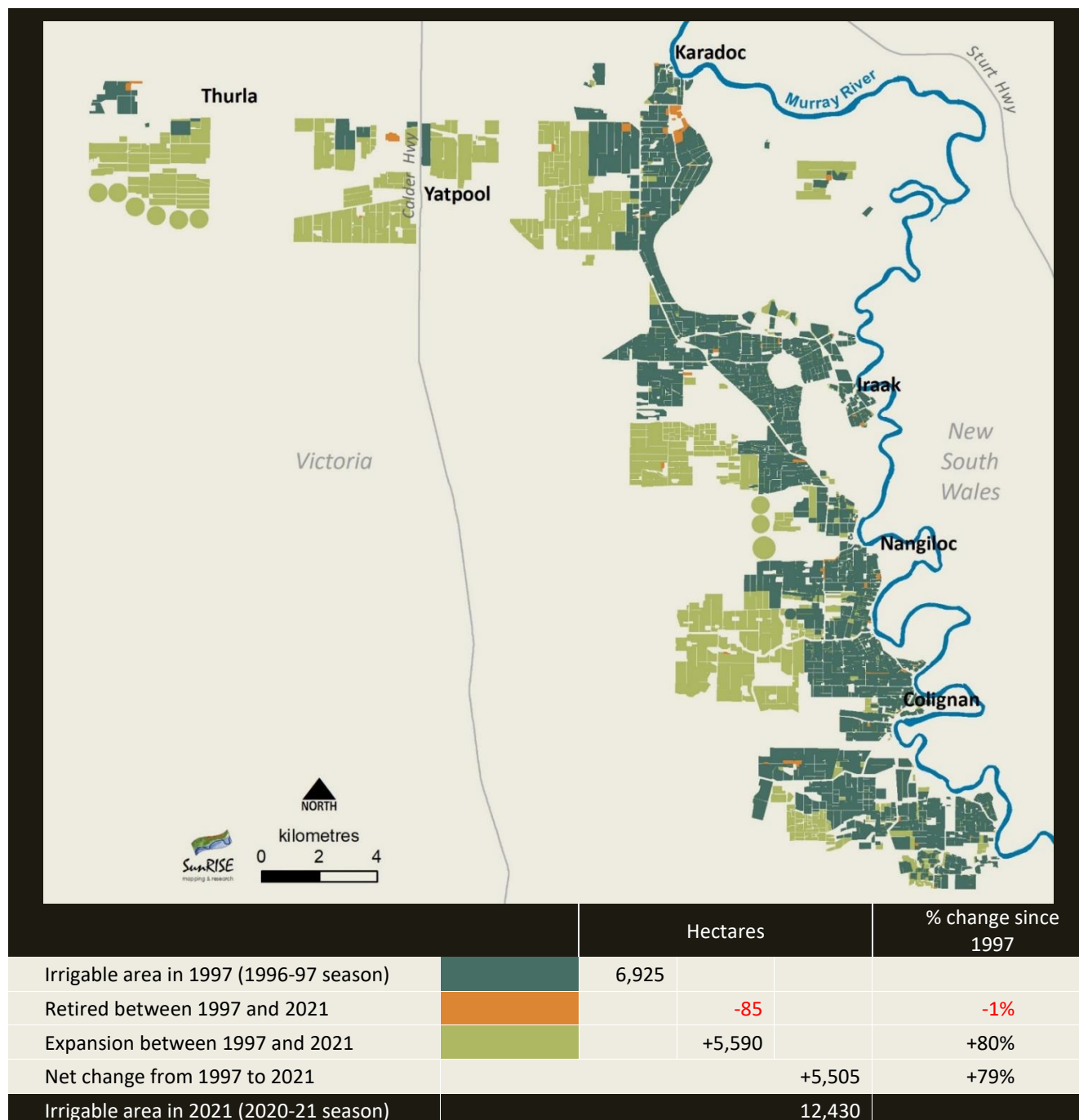


Figure 83: Colignan river reach - planting trends from 1997 to 2021

3.5.5 Colignan river reach - irrigation development

Map 19 shows irrigation development from 1997 to 2021 in the Colignan river reach with respect to new development (expansion) and areas retired³¹ from irrigation.

- The irrigable area increased by 5,505 ha, a 79% increase from 6,925 ha in 1997 to 12,430 ha in 2021.
- The net increase of 5,505 ha was the balance of 85 ha retired from irrigation and 5,590 ha of expansion.



Map 19: Colignan river reach - irrigation development from 1997 to 2021

³¹ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.5.6 Colignan river reach - irrigation methods

Figure 84 summarises irrigation methods in the Colignan river reach from 1997 to 2021.

The dominant irrigation method in the Colignan river reach changed from overheads in 1997 to drip irrigation from 2003 to 2021.

In 2021, the irrigable area of 12,430 ha comprised:

- 69% (8,525 ha) drip irrigation;
- 7% (885 ha) low level irrigation;
- 10% (1,295 ha) overhead sprinklers;
- < 1% (35 ha) furrow irrigation; and
- 14% (1,690 ha) vacant, not irrigated.

From 1997 to 2021:

- drip irrigation increased by 6,895 ha, a 423% increase from 1,630 to 8,525 ha;
- low level irrigation increased by 370 ha, a 72% increase from 515 to 885 ha;
- overhead irrigation decreased by 3,110 ha, a 71% decrease from 4,405 to 1,295 ha; and
- furrow irrigation decreased by 140 ha, an 80% decrease from 175 to 35 ha.



Figure 84: Colignan river reach - irrigation methods from 1997 to 2021

³² Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

3.5.7 Colignan river reach - salinity impact zones

Figure 85 summarises river salinity impact zones of irrigated areas in the Colignan river reach from 1997 to 2021. Colignan private diverters are in low salinity impact zones L1 and L4, and the high salinity impact zone, HIZ. Irrigation development from 1997 to 2021 predominantly occurred in L4.

In 2021, the irrigable area of 12,430 ha comprised:

- 20% (2,435 ha) in the lowest salinity impact zone, L1;
- 71% (8,825 ha) in L4; and
- 9% (1,170 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021, the area irrigated in:

- L1 increased by 1,780 ha, a 603% increase from 295 to 2,075 ha;
- L4 increased by 2,440 ha, a 45% increase from 5,450 to 7,890 ha; and
- HIZ decreased by 205 ha, a 21% decrease from 980 to 775 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 2,140 ha, a 725% increase from 295 to 2,435 ha;
- L4 increased by 3,230 ha, a 58% increase from 5,595 to 8,825 ha; and
- HIZ increased by 135 ha, a 13% increase from 1,035 to 1,170 ha.

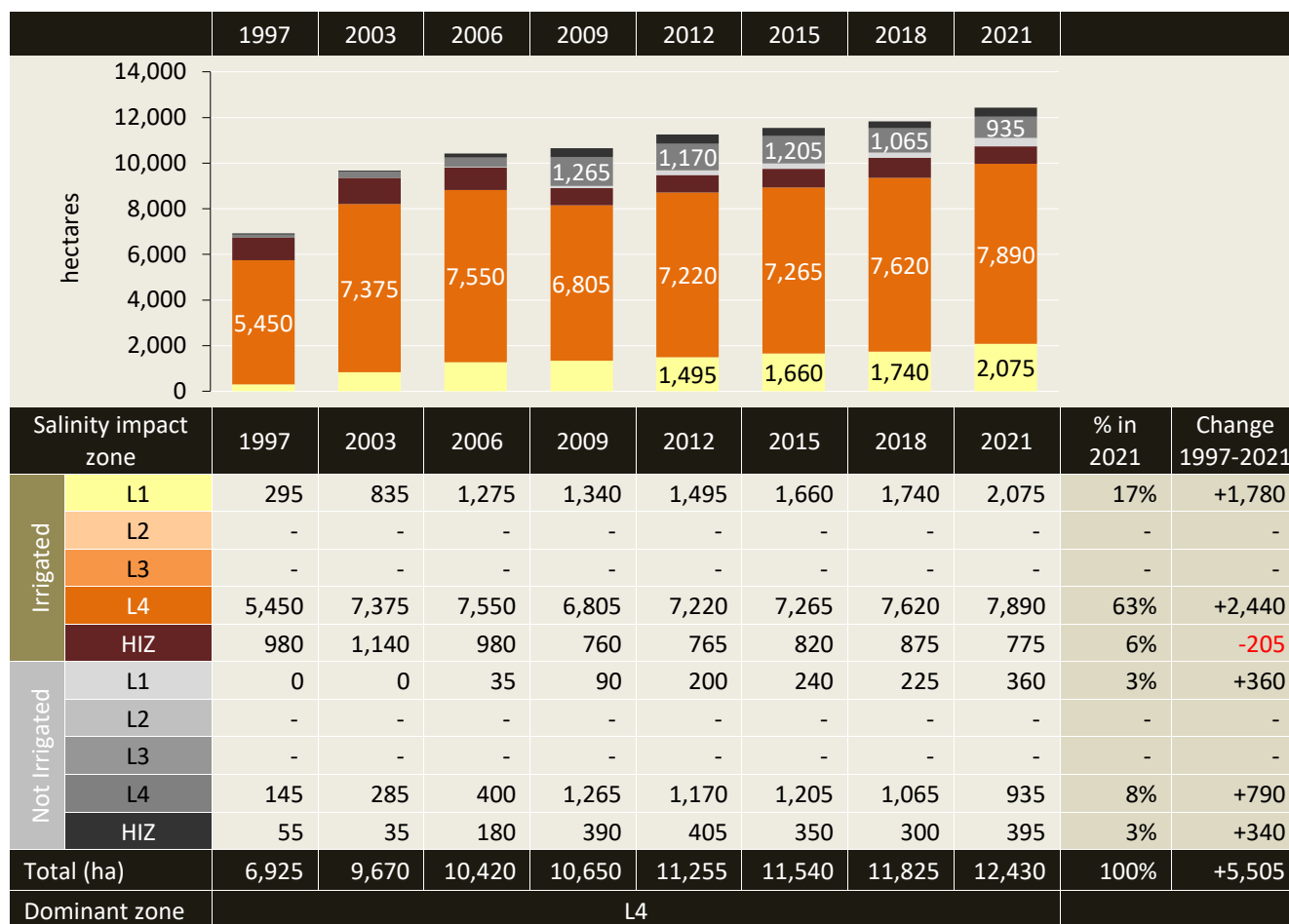


Figure 85: Colignan river reach - irrigable area in each salinity impact zone from 1997 to 2021

3.5.8 Colignan river reach - property change

Figure 86 provides estimates of property numbers and average property size (irrigable area) in the Colignan river reach from 1997 to 2021.

In 2021:

- there were approximately 130 irrigation properties; and
- 63% of properties had an irrigable area over 20 ha.

From 1997 to 2021:

- the number of properties decreased by 15, a 10% decrease from 145 to 130 properties;
- properties with an irrigable area less than 100 ha decreased by 26, while the number over 100 ha increased by 11; and
- average property size (irrigable area) increased from 48 to 96 ha.

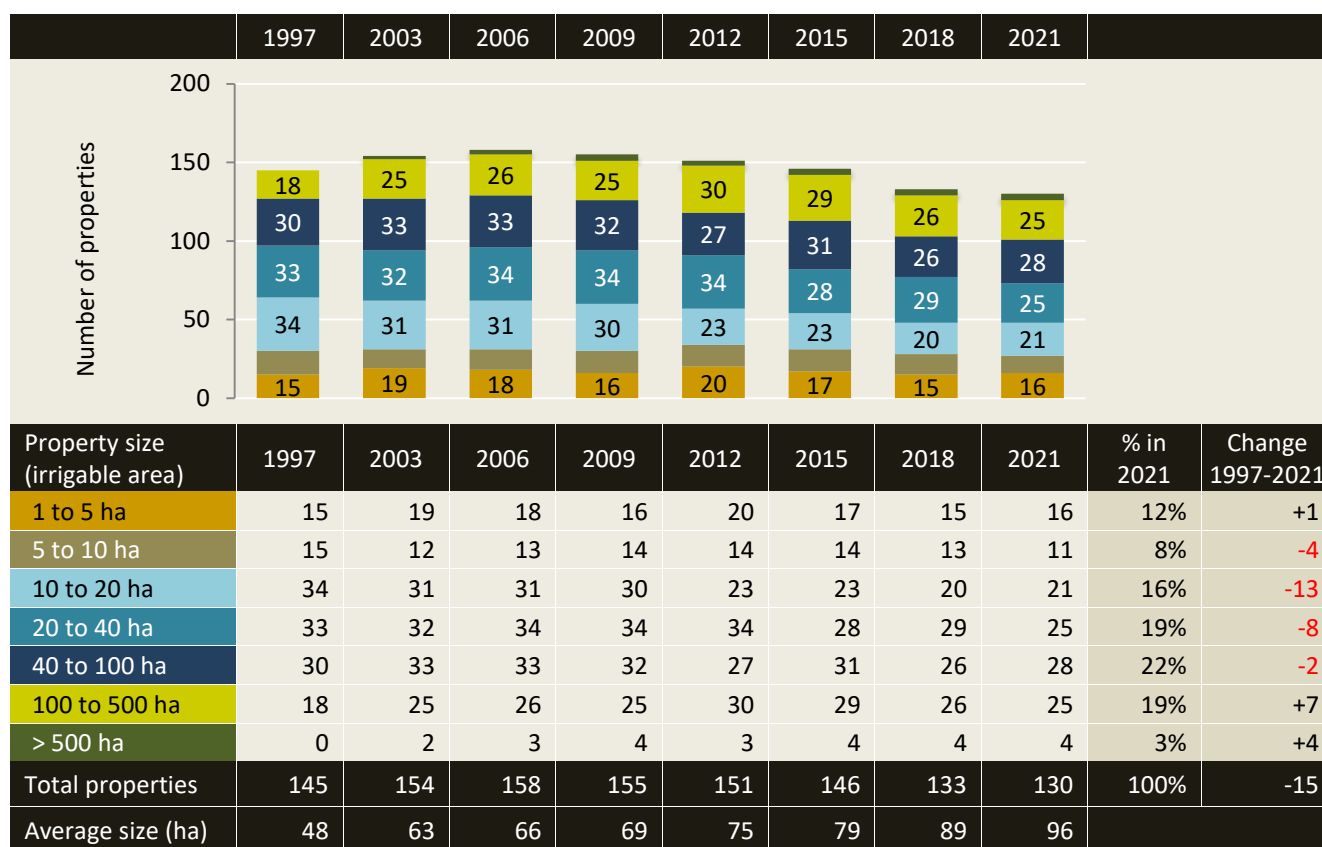


Figure 86: Colignan river reach - property numbers and sizes from 1997 to 2021

3.6 Mildura river reach (*Mildura to Lock 10*)

In summary for the Mildura river reach

Crop types in 2021

Dominant plantings in the Mildura river reach in 2021 were:

1. table grapes, 450 ha (23% of the irrigable area);
2. field crops, 305 ha (15% of the irrigable area);
3. wine grapes, 290 ha (15% of the irrigable area); and
4. citrus, 105 ha (5% of the irrigable area).

Crop types 1997 to 2021

The dominant crop type was wine grapes from 1997 to 2015, followed by table grapes from 2018 to 2021.

The main crop type changes from 1997 to 2021 were:

- table grapes increased by 385 ha, a 592% increase from 65 to 450 ha;
- dried grapes decreased by 170 ha, a 71% decrease from 240 to 70 ha; and
- wine grapes decreased by 140 ha, a 33% decrease from 430 to 290 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, over 205 ha (20%) of permanent crops were planted or redeveloped in the previous three years. These new plantings were:

1. table grapes (110 ha);
2. wine grapes (45 ha);
3. citrus (25 ha); and
4. fruit trees (25 ha).

From 1997 to 2021, the area of new and redeveloped permanent plantings was at its lowest in 2009 with 90 ha (10%) planted in the previous three years and highest in 2018 with 255 ha (24%) planted in the previous three years.

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 1,975 ha comprised:

- 53% (1,040 ha) irrigated permanent plantings;
- 17% (330 ha) irrigated seasonal crops;
- 14% (290 ha) vacant, previously an irrigated permanent planting; and
- 16% (315 ha) vacant, previously an irrigated seasonal crop.

From 1997 to 2021:

- irrigated permanent crops increased by 85 ha, from 955 to 1,040 ha;
- irrigated seasonal crops decreased by 100 ha, from 430 to 330 ha;
- vacant areas, previously irrigated permanent plantings increased by 280 ha, from 10 to 290 ha; and
- vacant areas, previously irrigated seasonal crops increased by 265 ha, from 50 to 315 ha.

In summary for the Mildura river reach

Irrigation development - new and retired areas

The irrigable area in the Mildura river reach increased by 530 ha, a 37% increase from 1,445 ha in 1997 to 1,975 ha in 2021.

The net increase of 530 ha was the balance of 90 ha retired from irrigation and 620 ha of expansion.

Irrigation methods

The dominant irrigation method in the Mildura river reach changed from furrows in 1997 to overhead sprinklers in 2003, then drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 1,975 ha comprised:

- 42% (835 ha) drip irrigation;
- 7% (135 ha) low level irrigation;
- 12% (230 ha) overhead sprinklers;
- 9% (170 ha) furrow irrigation; and
- 30% (605 ha) vacant, not irrigated.

Salinity impact zones

The Mildura river reach is in the lowest salinity impact zone, L1 and the high impact zone, HIZ. Irrigation development from 1997 to 2021 occurred predominantly in L1.

In 2021, the irrigable area of 1,975 ha comprised:

- 39% (770 ha) in the lowest salinity impact zone, L1; and
- 61% (1,205 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021 the irrigable area in:

- L1 increased by 590 ha, a 328% increase from 180 to 770 ha; and
- HIZ decreased by 60 ha, a 5% decrease from 1,265 to 1,205 ha. The decrease was mainly areas retired from irrigation for urban development.

Irrigation properties

In 2021, there were approximately 98 irrigation properties and the average property size (irrigable area) was 20 ha.

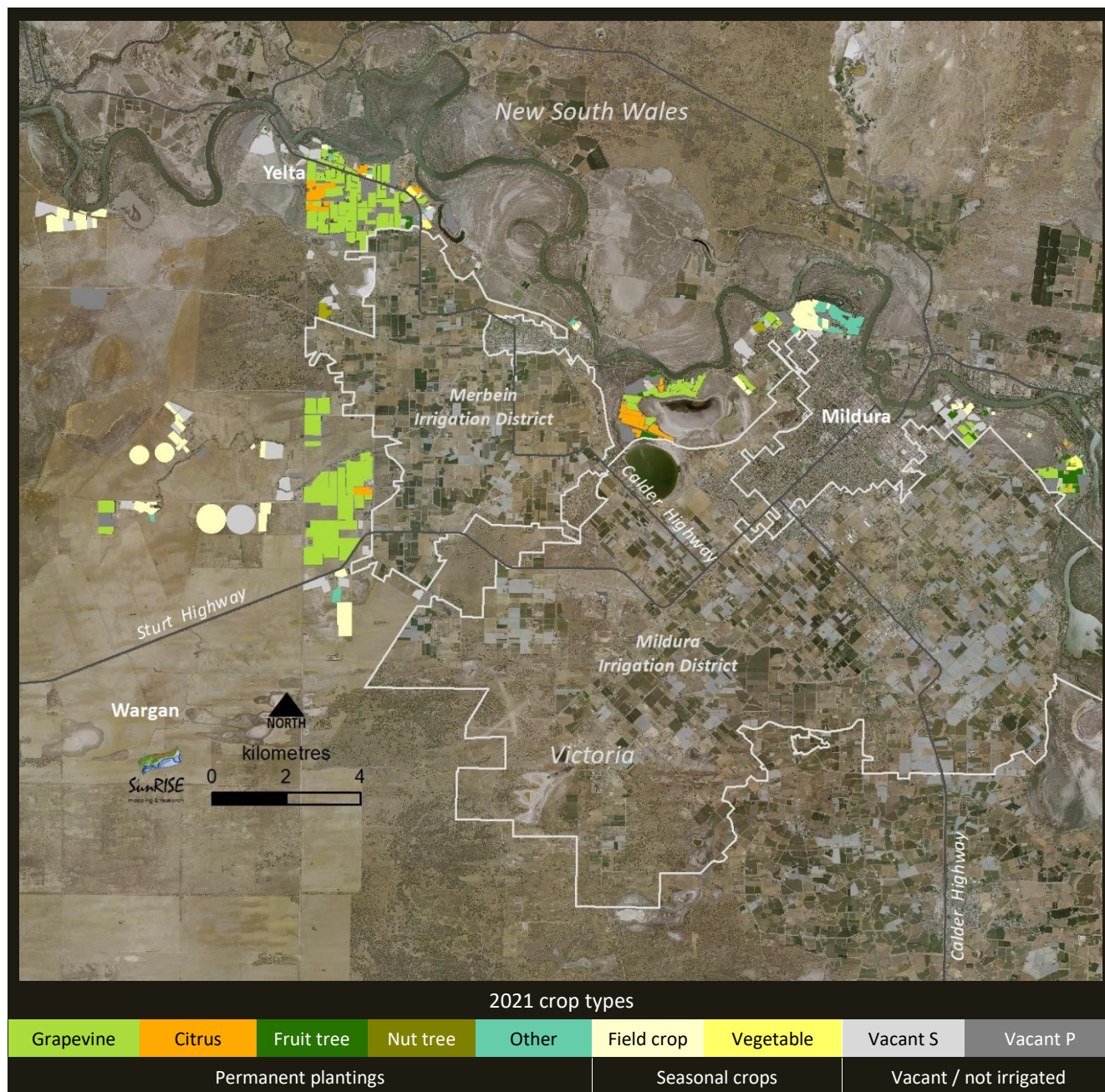
From 1997 to 2021:

- the number of properties decreased by 14, a 13% decrease from 112 to 98;
- properties with an irrigable area less than 40 ha decreased by 21, while the number over 40 ha increased by 7; and
- average property size (irrigable area) increased from 13 to 20 ha.

3.6.1 Mildura river reach - crop types in 2021

Map 20 shows the Mildura river reach with crop types in in 2021.

The aerial photography was flown in February 2021 (*source: Coordinated Imagery Program, DELWP Victoria*).



Map 20: Mildura river reach showing 2021 crop types

3.6.2 Mildura river reach - crop types from 1997 to 2021

Figure 87 summarises crop types in the Mildura river reach from 1997 to 2021. The dominant crop type was wine grapes from 1997 to 2015, followed by table grapes from 2018 to 2021.

In 2021, the main plantings were:

1. table grapes, 450 ha (23% of the irrigable area);
2. field crops, 305 ha (15% of the irrigable area);
3. wine grapes, 290 ha (15% of the irrigable area); and
4. citrus, 105 ha (5% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- table grapes increased by 385 ha, a 592% increase from 65 to 450 ha;
- dried grapes decreased by 170 ha, a 71% decrease from 240 to 70 ha; and
- wine grapes decreased by 140 ha, a 33% decrease from 430 to 290 ha.

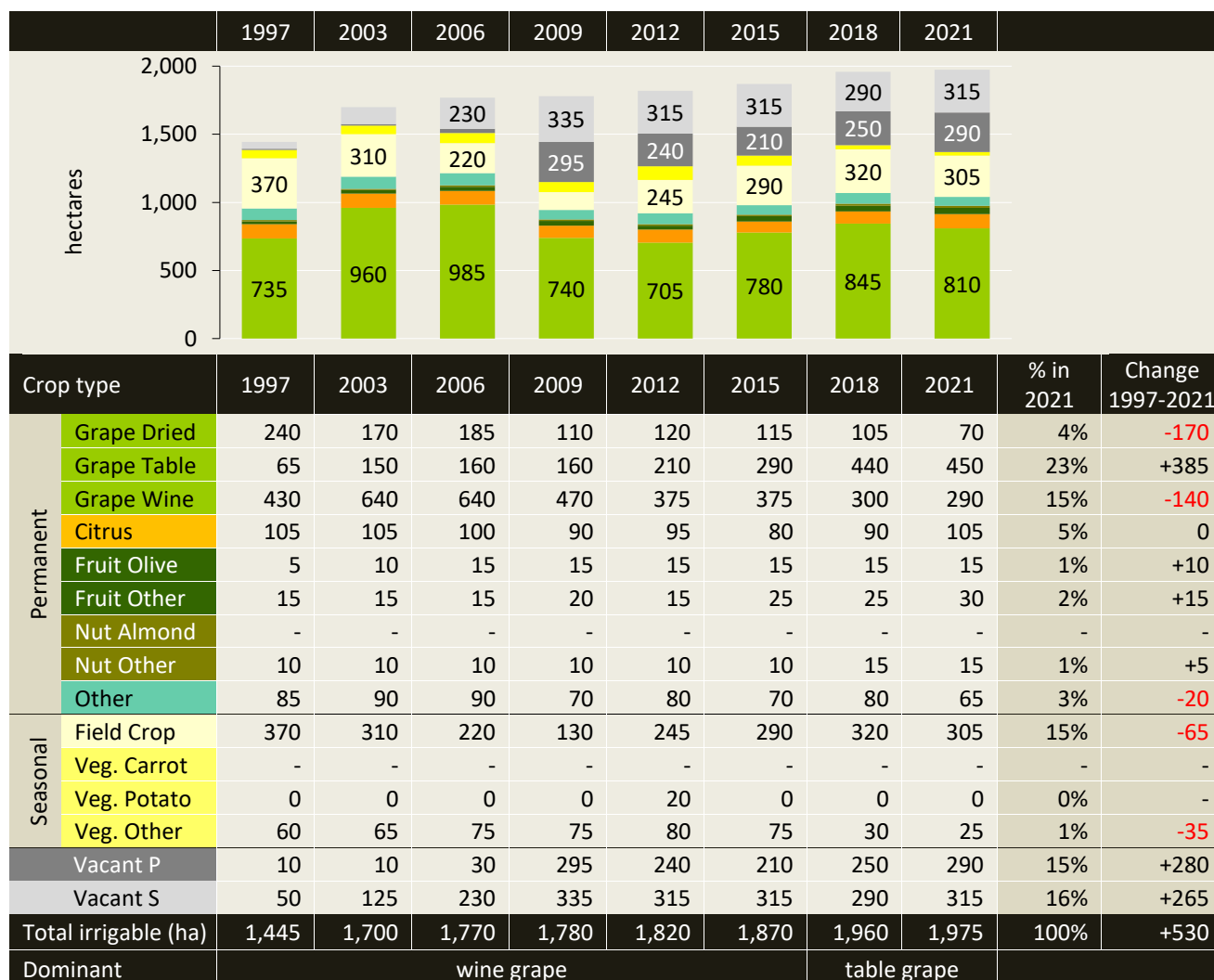


Figure 87: Mildura river reach - crop types from 1997 to 2021

3.6.3 Mildura river reach - development of permanent crops

Figure 88 shows the proportion of permanent crops planted or redeveloped in the previous three years in the Mildura river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 205 ha (20%) of permanent crops were planted or redeveloped within the previous three years.
- These new plantings were:
 1. table grapes (110 ha);
 2. wine grapes (45 ha);
 3. citrus (25 ha); and
 4. fruit trees (25 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 2009 with 90 ha (10%) planted in the previous three years and highest in 2018 with 255 ha (24%) planted in the previous three years.

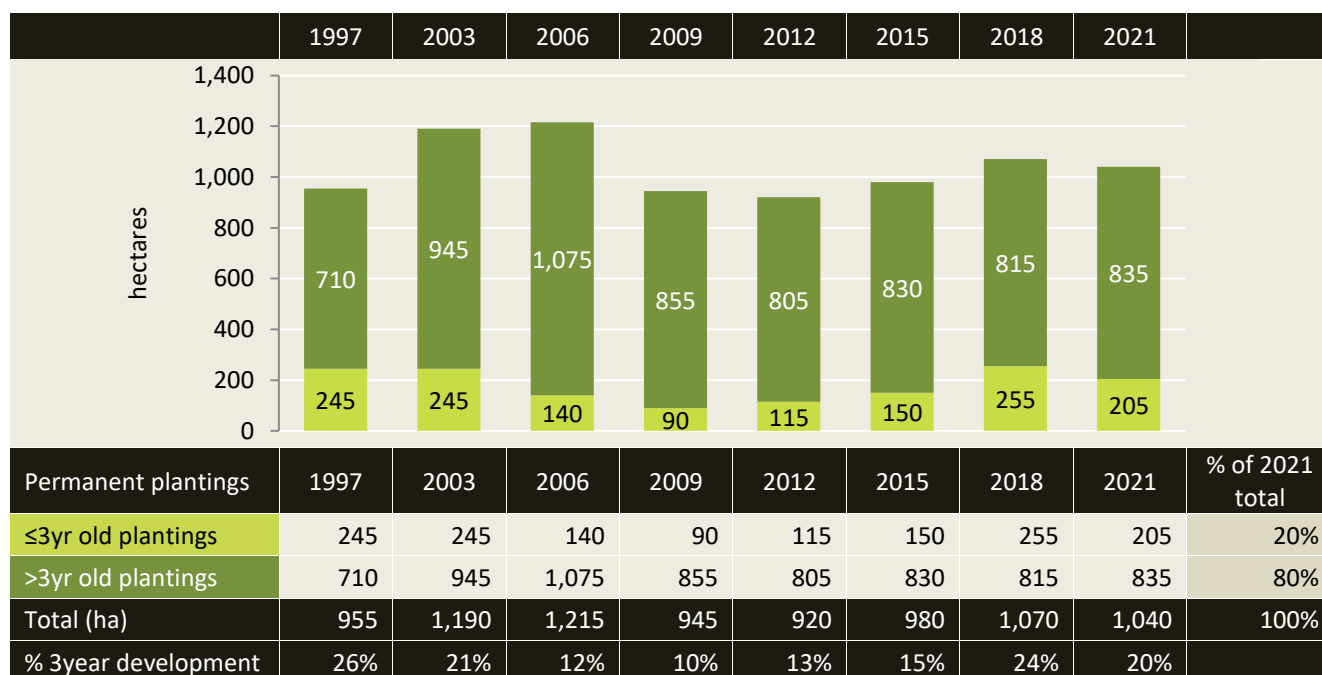


Figure 88: Mildura river reach - development of permanent crops from 1997 to 2021

3.6.4 Mildura river reach - planting trends

Figure 89 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Mildura river reach from 1997 to 2021.

In 2021, the irrigable area of 1,975 ha comprised:

- 53% (1,040 ha) irrigated permanent plantings;
- 17% (330 ha) irrigated seasonal crops;
- 14% (290 ha) vacant, previously an irrigated permanent planting; and
- 16% (315 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 66% permanent, 30% seasonal and 4% vacant in 1997; to
- 53% permanent, 17% seasonal and 30% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 85 ha, from 955 to 1,040 ha;
- irrigated seasonal crops decreased by 100 ha, from 430 to 330 ha;
- vacant areas, previously irrigated permanent plantings increased by 280 ha, from 10 to 290 ha; and
- vacant areas, previously irrigated seasonal crops increased by 265 ha, from 50 to 315 ha.

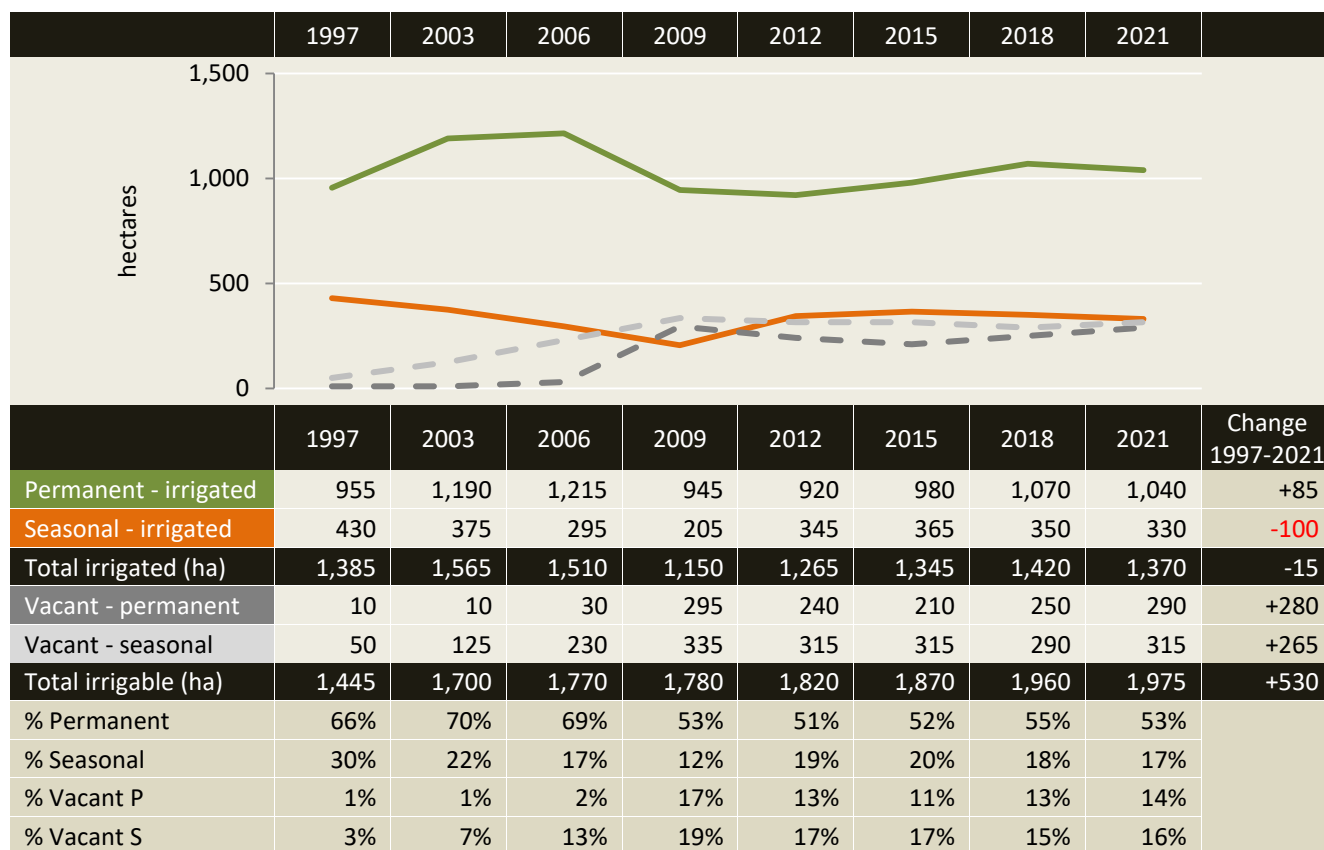
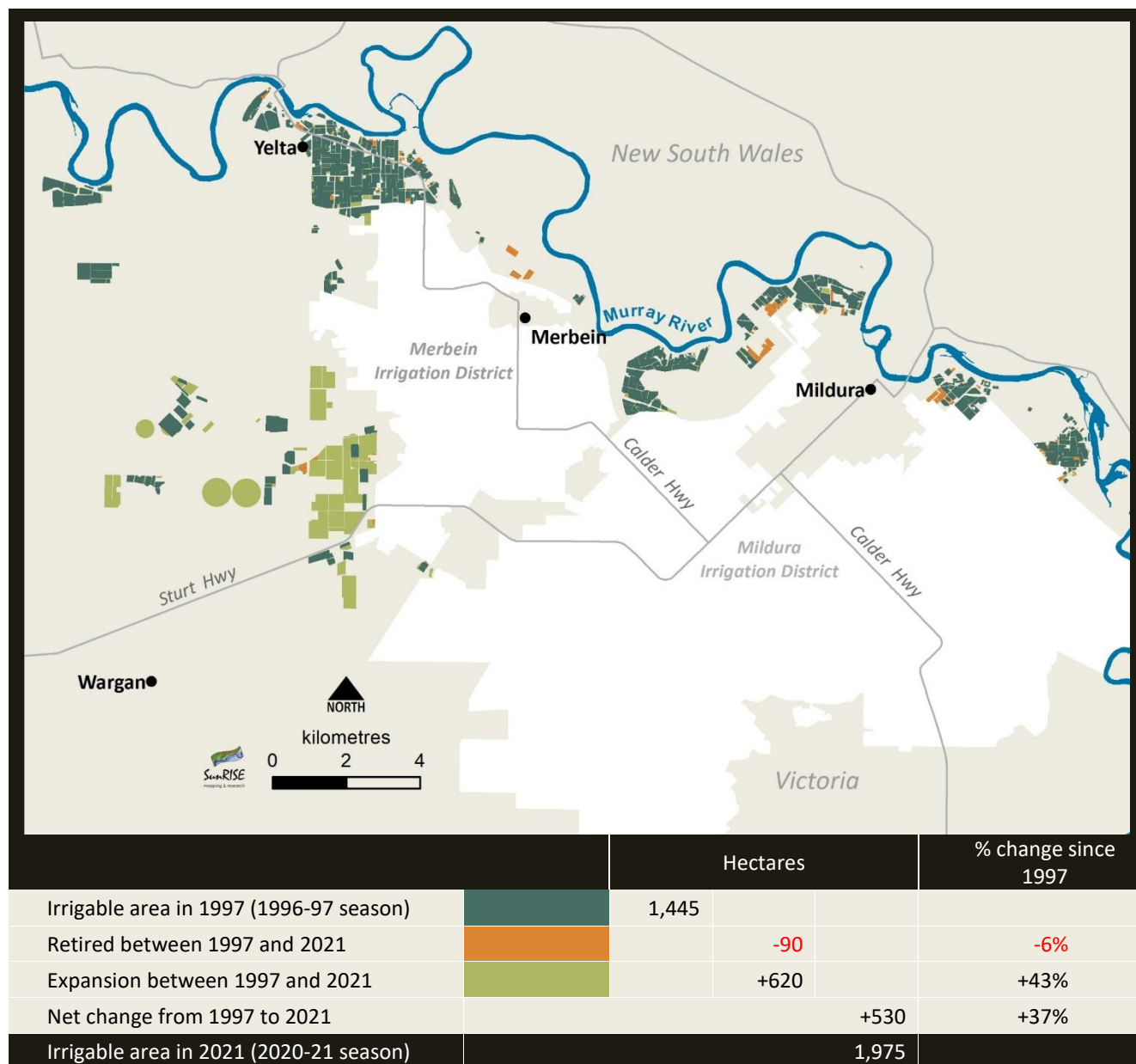


Figure 89: Mildura river reach - planting trends from 1997 to 2021

3.6.5 Mildura river reach - irrigation development

Map 21 shows irrigation development from 1997 to 2021 in the Mildura river reach with respect to new development (expansion) and areas retired³³ from irrigation.

- The irrigable area increased by 530 ha, a 37% increase from 1,445 ha in 1997 to 1,975 ha in 2021.
- The net increase of 530 ha was the balance of 90 ha retired from irrigation and 620 ha of expansion.



Map 21: Mildura river reach - irrigation development from 1997 to 2021

³³ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.6.6 Mildura river reach - irrigation methods

Figure 90 summarises irrigation methods in the Mildura river reach from 1997 to 2021.

The dominant irrigation method in the Mildura river reach changed from furrows in 1997 to overhead sprinklers in 2003, then drip irrigation from 2006 to 2021.

In 2021, the irrigable area of 1,975 ha comprised:

- 42% (835 ha) drip irrigation;
- 7% (135 ha) low level irrigation;
- 12% (230 ha) overhead sprinklers;
- 9% (170 ha) furrow irrigation; and
- 30% (605 ha) vacant, not irrigated.

From 1997 to 2021:

- drip irrigation increased by 615 ha, a 280% increase from 220 to 835 ha;
- low level irrigation decreased by 15 ha, a 10% decrease from 150 to 135 ha;
- overhead irrigation decreased by 195 ha, a 46% decrease from 425 to 230 ha; and
- furrow irrigation decreased by 420 ha, a 71% decrease from 590 to 170 ha.

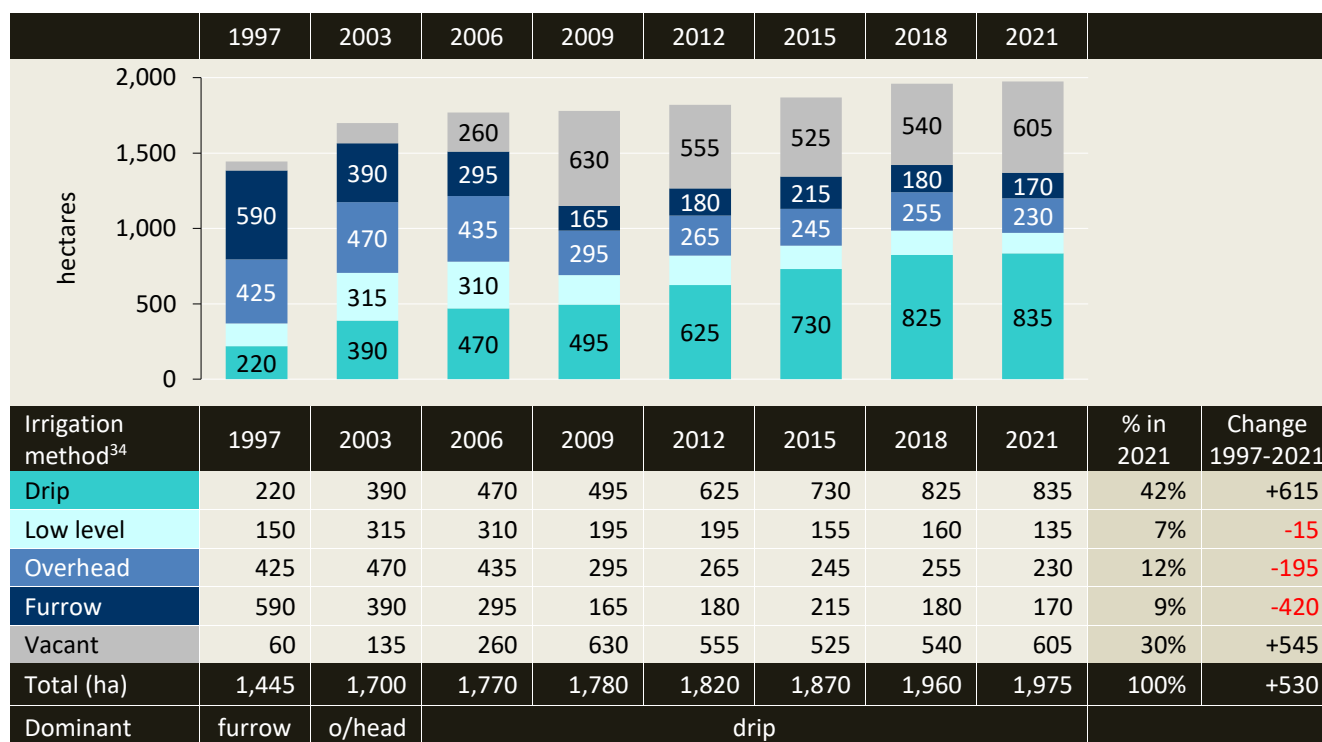


Figure 90: Mildura river reach - irrigation methods from 1997 to 2021

³⁴ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

3.6.7 Mildura river reach - salinity impact zones

Figure 91 summarises river salinity impact zones of irrigated areas in the Mildura river reach from 1997 to 2021. Mildura private diverters are in the lowest salinity impact zone, L1 and the high salinity impact zone, HIZ. Irrigation development from 1997 to 2021 predominantly occurred in L1.

In 2021, the irrigable area of 1,975 ha comprised:

- 39% (770 ha) in the lowest salinity impact zone, L1; and
- 61% (1,205 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021, the area irrigated in:

- L1 increased by 410 ha, a 234% increase from 175 to 585 ha; and
- HIZ decreased by 425 ha, a 35% decrease from 1,210 to 785 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 590 ha, a 328% increase from 180 to 770 ha; and
- HIZ decreased by 60 ha, a 5% decrease from 1,265 to 1,205 ha. The decrease was mainly areas retired from irrigation for urban development.

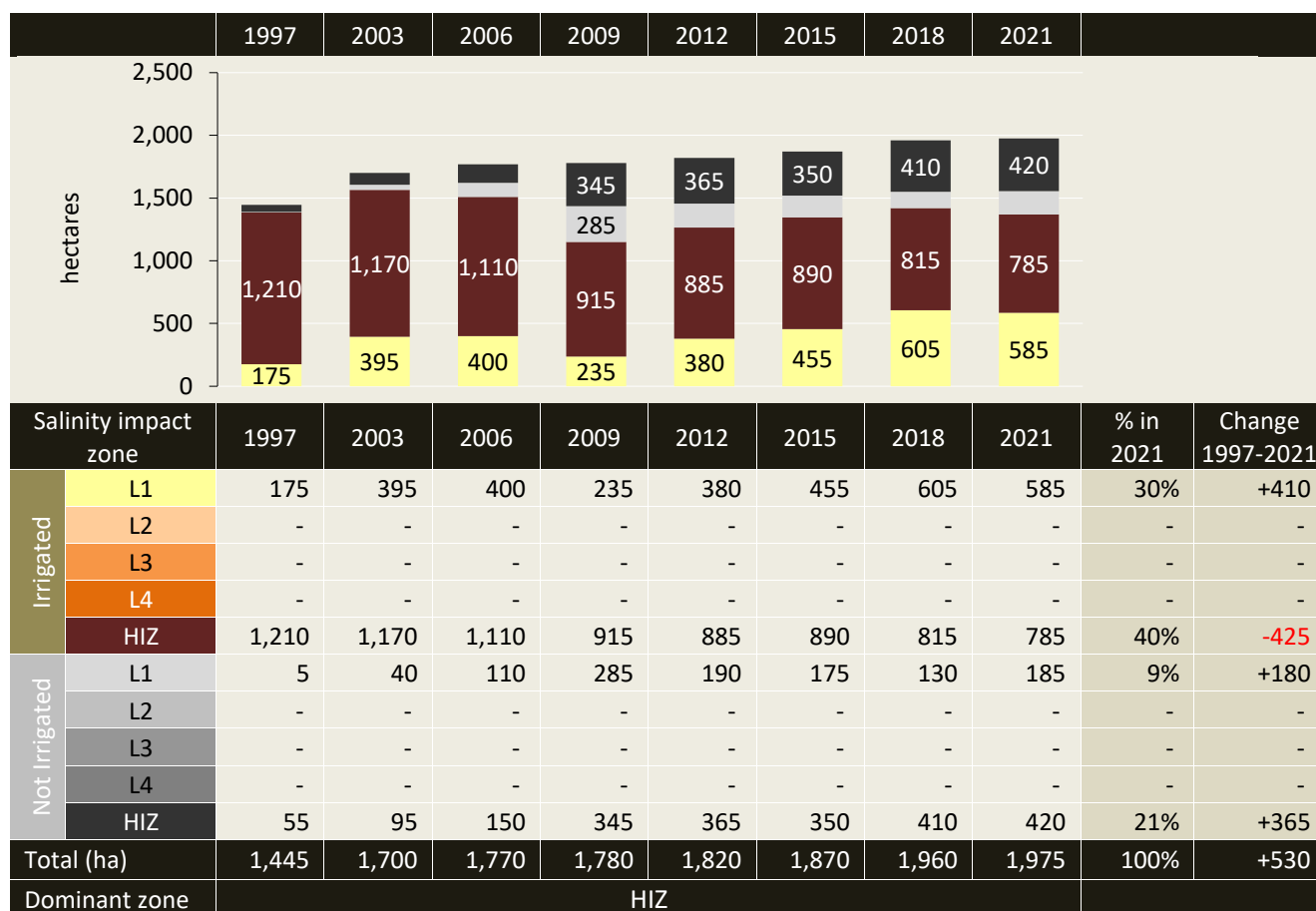


Figure 91: Mildura river reach - irrigable area in each salinity impact zone from 1997 to 2021

3.6.8 Mildura river reach - property change

Figure 92 provides estimates of property numbers and average property size (irrigable area) in the Mildura river reach from 1997 to 2021.

In 2021:

- there were approximately 98 irrigation properties; and
- 84% of properties had an irrigable area less than 40 ha.

From 1997 to 2021:

- the number of properties decreased by 14, a 13% decrease from 112 to 98 properties;
- properties with an irrigable area less than 40 ha decreased by 21, while the number over 40 ha increased by 7; and
- average property size (irrigable area) increased from 13 to 20 ha.

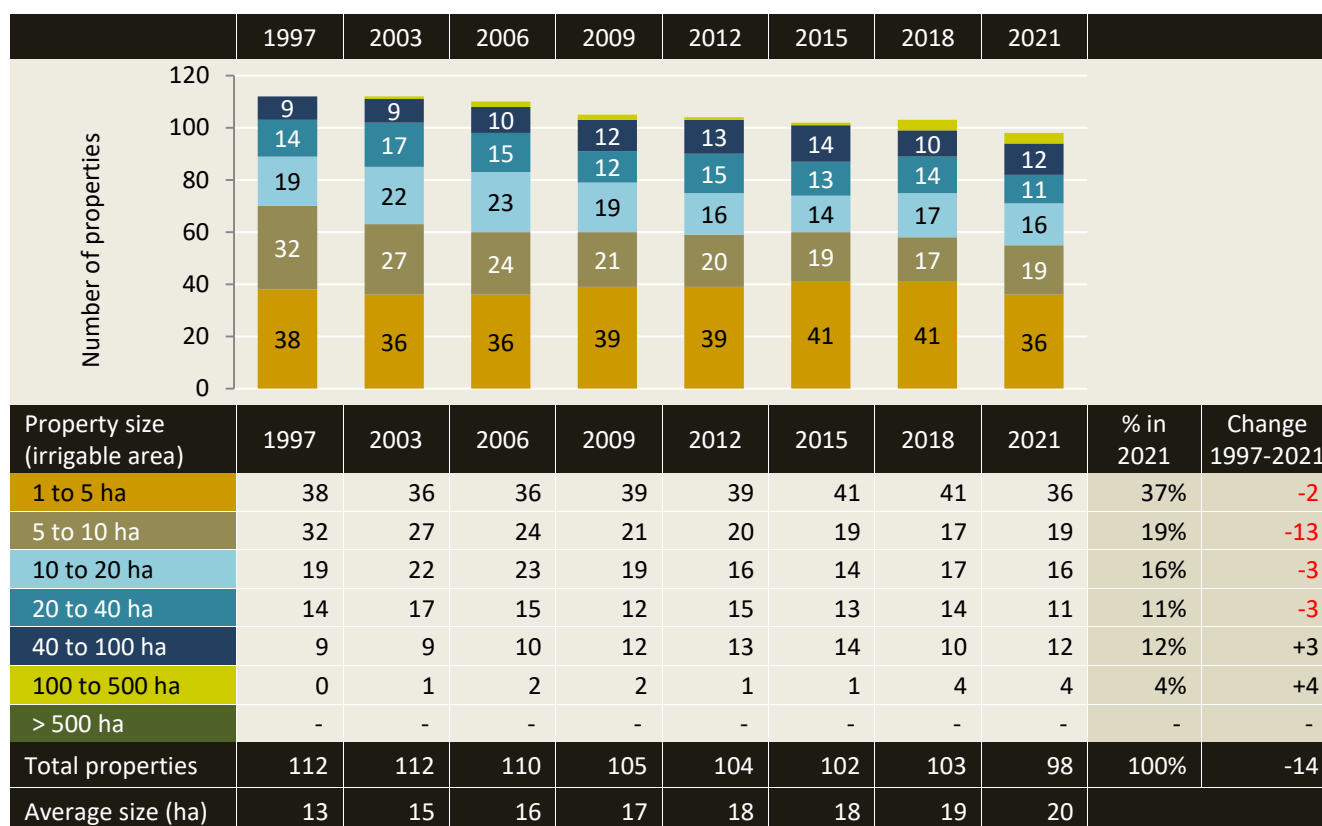


Figure 92: Mildura river reach - property numbers and sizes from 1997 to 2021

3.7 Lock 10 to the South Australian Border

In summary for the Lock 10 to South Australia river reach

Crop types in 2021

Dominant plantings in the Lock 10 to SA river reach in 2021 were:

1. almond trees, 1,970 ha (58% of the irrigable area);
2. wine grapes, 825 ha (24% of the irrigable area); and
3. citrus, 145 ha (4% of the irrigable area).

Crop types 1997 to 2021

Almonds were the dominant crop from 1997 to 2021.

The main crop type changes from 1997 to 2021 were:

- almonds increased by 1,320 ha, a 203% increase from 650 to 1,970 ha;
- wine grapes increased by 535 ha, a 184% increase from 290 to 825 ha; and
- field crops decreased by 240 ha, a 100% decrease from 240 to 0 ha.

Development of permanent plantings (new or redeveloped in the previous three years)

In 2021, at least 465 ha (16%) of permanent crops were planted or redeveloped in the previous three years. These new plantings were:

1. wine grapes (210 ha);
2. almonds (180 ha);
3. table grapes (55 ha); and
4. citrus (20 ha).

From 1997 to 2021, the area of new and redeveloped permanent plantings was at its lowest in 2006 with 165 ha (9%) planted in the previous three years and highest in 2009 with 695 ha (33%) planted in the previous three years.

Planting trends - permanent plantings, seasonal crops and vacant areas

In 2021, the irrigable area of 3,425 ha comprised:

- 88% (3,000 ha) irrigated permanent plantings;
- <1% (10 ha) irrigated seasonal crops; and
- 12% (415 ha) vacant, not irrigated areas.

From 1997 to 2021:

- permanent plantings increased from 66% to 88% of the irrigable area;
- seasonal crops decreased from 15% to <1% of the irrigable area; and
- vacant, not irrigated areas decreased from 19% to 12% of the irrigable area.

In summary for the Lock 10 to South Australia river reach

Irrigation development - new and retired areas

The irrigable area in the Lock 10 to SA river reach increased by 1,785 ha, a 109% increase from 1,640 ha in 1997 to 3,425 ha in 2021.

The net increase of 1,785 ha was the balance of 295 ha retired from irrigation and 2,080 ha of expansion.

Irrigation methods

The dominant irrigation method in the Lock 10 to South Australia river reach was low level sprinklers from 1997 to 2003 followed by drippers from 2009 to 2021.

In 2021, the irrigable area of 3,425 ha comprised:

- 64% (2,195 ha) drip irrigation;
- 24% (815 ha) low level irrigation;
- 0% (0 ha) overhead sprinklers; and
- 12% (415 ha) not irrigated.

Salinity impact zones

The Lock 10 to South Australia river reach is in the lowest salinity impact zone, L1 and in the high salinity impact zone, HIZ. Irrigation development from 1997 to 2021 predominantly occurred in L1.

In 2021, the irrigable area of 3,425 ha comprised:

- 86% (2,940 ha) in the lowest salinity impact zone, L1; and
- 14% (485 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021 the irrigable area in:

- L1 increased by 1,935 ha, a 193% increase from 1,005 to 2,940 ha; and
- HIZ decreased by 150 ha, a 24% decrease from 635 to 485 ha.

Irrigation properties

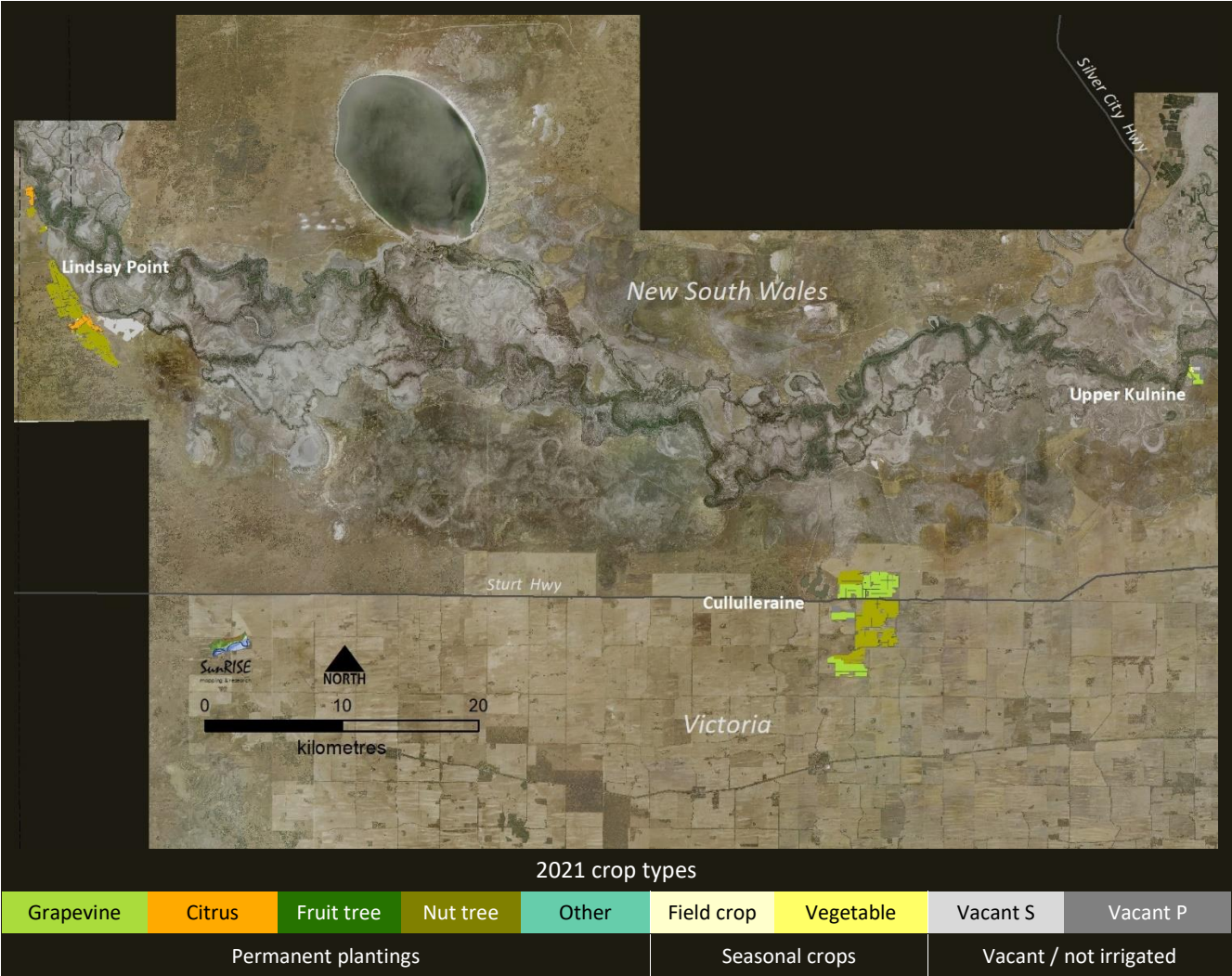
In 2021, there were approximately 17 irrigation properties and the average property size (irrigable area) was 201 ha.

From 1997 to 2021:

- there were 17 properties in 1997 and 2021;
- properties with an irrigable area of less than 40 ha decreased by 4 and the number over 40 ha increased by 4; and
- average property size (irrigable area) increased from 96 to 201 ha.

3.7.1 Lock 10 to South Australia - crop types in 2021

Map 22 shows the Lock 10 to South Australia river reach with crop types in in 2021.
The aerial photography was flown in February 2021 (source: Coordinated Imagery Program, DELWP Victoria).



Map 22: Lock 10 to South Australia showing 2021 crop types

3.7.2 Lock 10 to South Australia - crop types from 1997 to 2021

Figure 93 summarises crop types in the Lock 10 to South Australia river reach from 1997 to 2021. The dominant crop type from 1997 to 2021 was almonds.

In 2021, the main plantings were:

1. almond trees, 1,970 ha (58% of the irrigable area);
2. wine grapes, 825 ha (24% of the irrigable area); and
3. citrus, 145 ha (4% of the irrigable area).

From 1997 to 2021, the main planting changes were:

- almonds increased by 1,320 ha, a 203% increase from 650 to 1,970 ha;
- wine grapes increased by 535 ha, a 184% increase from 290 to 825 ha; and
- table grapes increased by 55 ha, from 0 to 55 ha.

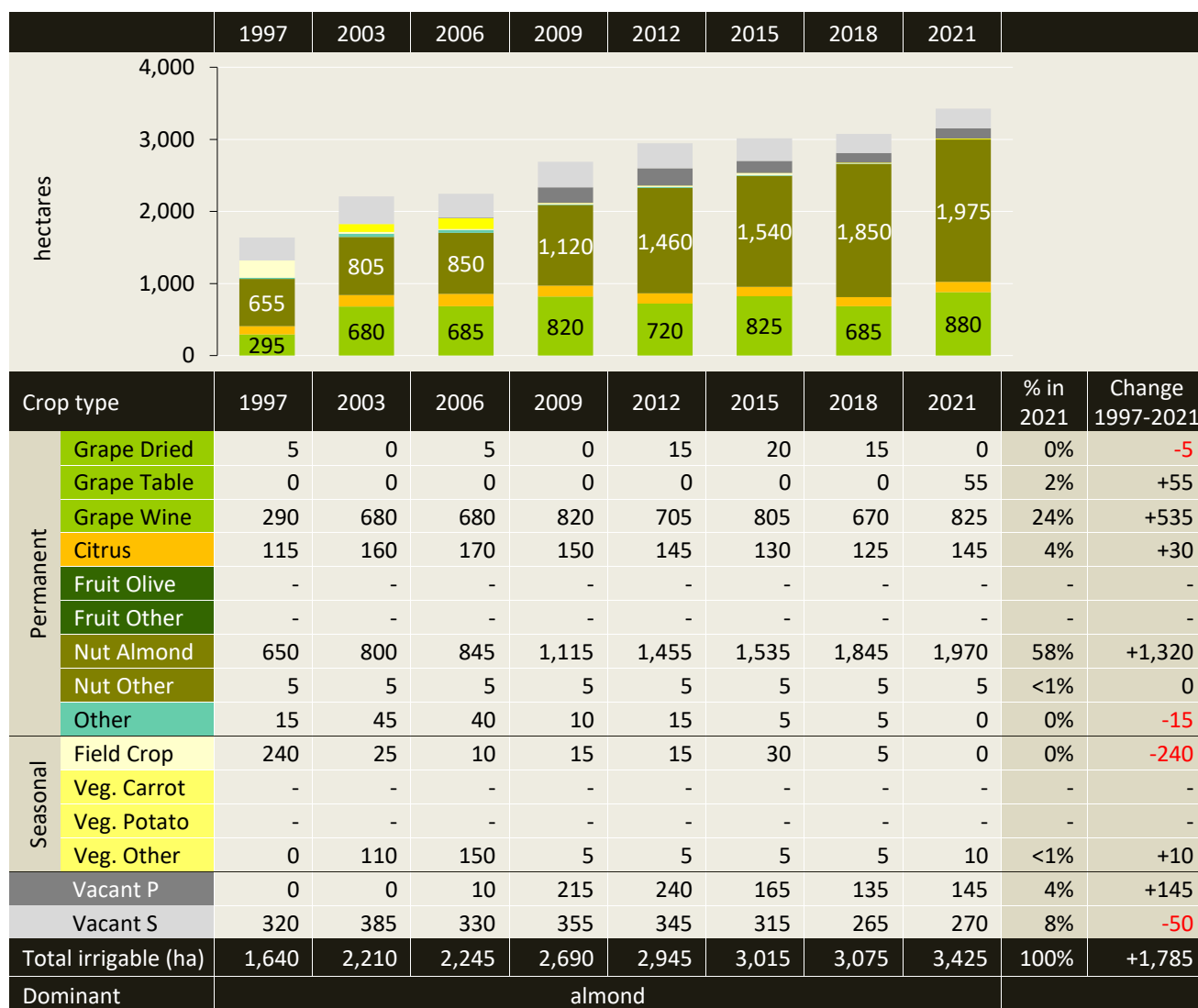


Figure 93: Lock 10 to South Australia - crop types from 1997 to 2021

3.7.3 Lock 10 to South Australia - development of permanent crops

Figure 94 shows the proportion of permanent crops planted or redeveloped, in the previous three years, in the Lock 10 to South Australia river reach from 1997 to 2021.

The information provides an indication of development activity that doesn't necessarily involve a change in area or crop type as it includes replanting or top working to different varieties. The figures are conservative, as top worked plantings can be difficult to interpret from the three-yearly aerial imagery, particularly for grapevines.

In 2021:

- 465 ha (16%) of permanent crops were planted or redeveloped within the previous three years.
- These new plantings were:
 1. wine grapes (210 ha);
 2. almonds (180 ha);
 3. table grapes (55 ha); and
 4. citrus (20 ha).

From 1997 to 2021:

- The area of new and redeveloped permanent plantings was at its lowest in 2006 with 165 ha (9%) planted in the previous three years and highest in 2009 with 695 ha (33%) planted in the previous three years.

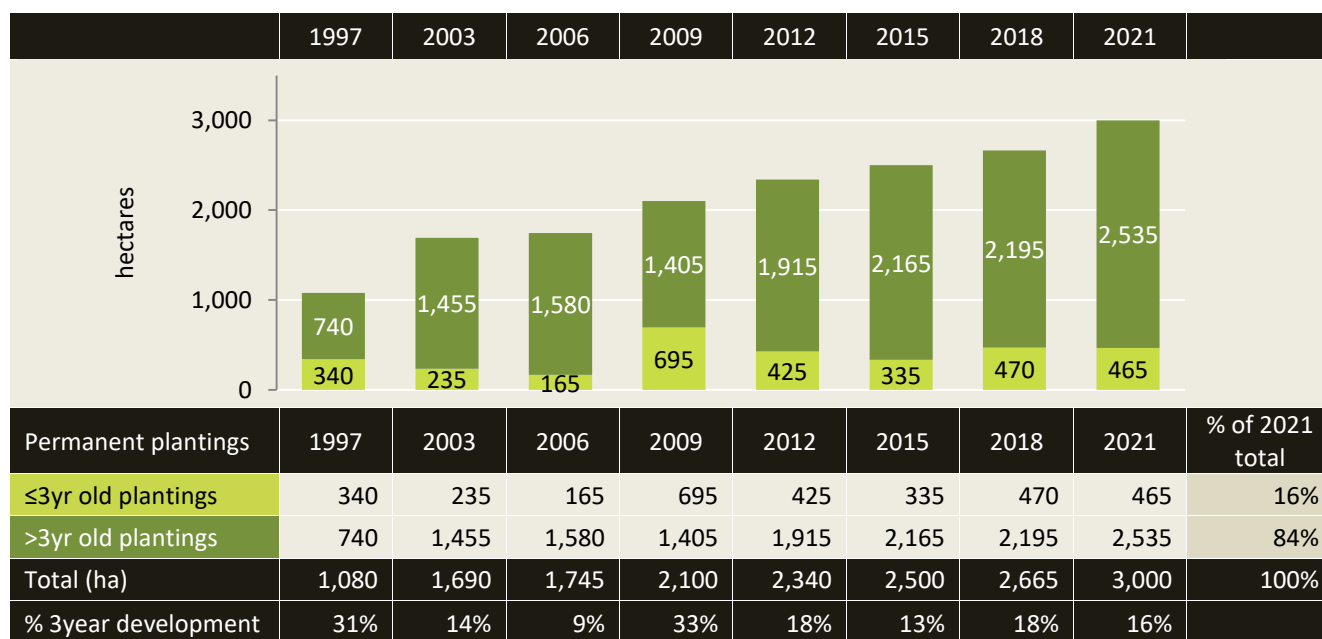


Figure 94: Lock 10 to South Australia river reach - development of permanent crops 1997 to 2021

3.7.4 Lock 10 to South Australia - planting trends

Figure 95 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Lock 10 to South Australia river reach from 1997 to 2021.

In 2021, the irrigable area of 3,425 ha comprised:

- 88% (3,000 ha) irrigated permanent plantings;
- <1% (10 ha) irrigated seasonal crops;
- 4% (145 ha) vacant, previously an irrigated permanent planting; and
- 8% (270 ha) vacant, previously an irrigated seasonal crop.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 66% permanent, 15% seasonal and 19% vacant in 1997; to
- 88% permanent, <1% seasonal and 12% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 1,920 ha, from 1,080 to 3,000 ha;
- irrigated seasonal crops decreased by 230 ha, from 240 to 10 ha;
- vacant areas, previously irrigated permanent plantings increased by 145 ha, from 0 to 145 ha; and
- vacant areas, previously irrigated seasonal crops decreased by 50 ha, from 320 to 270 ha.

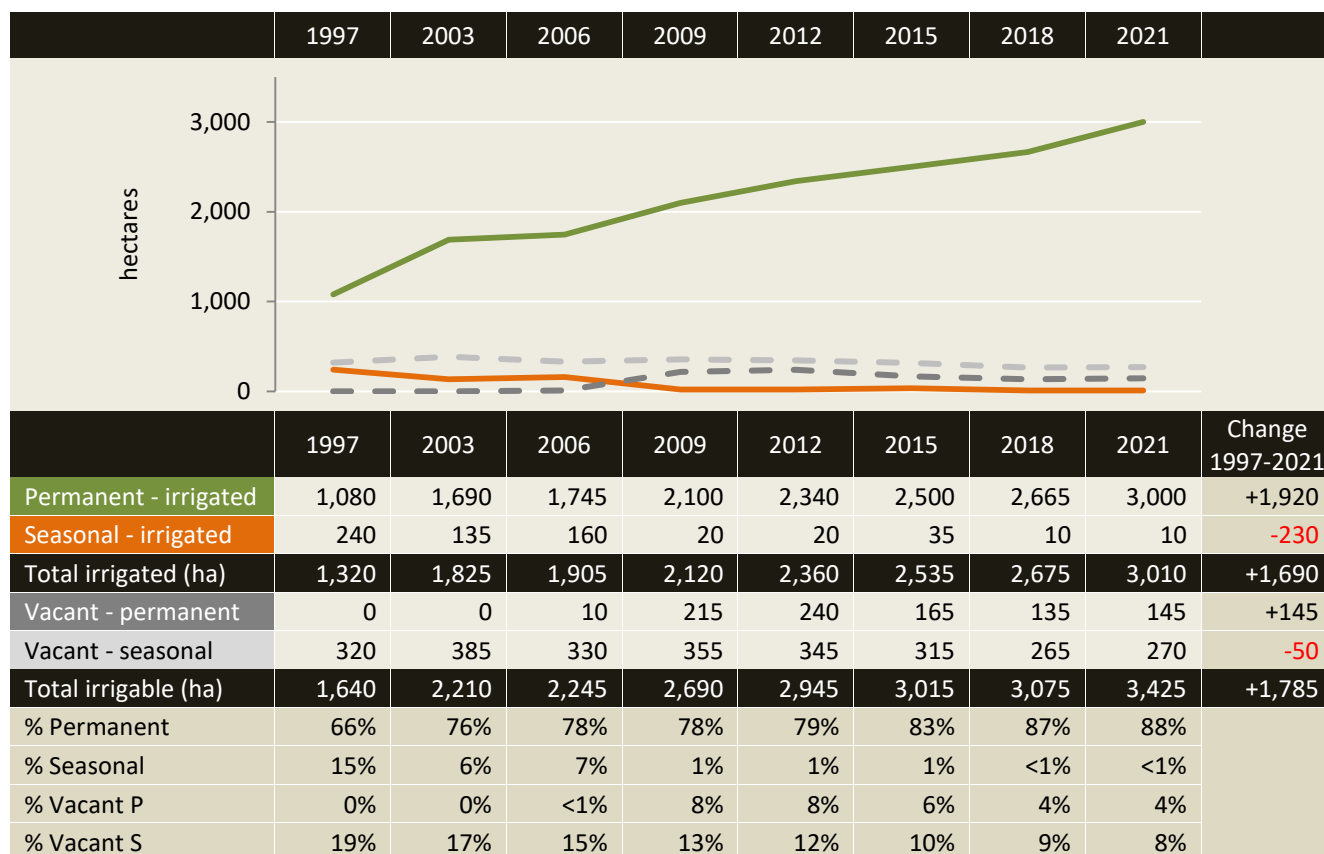
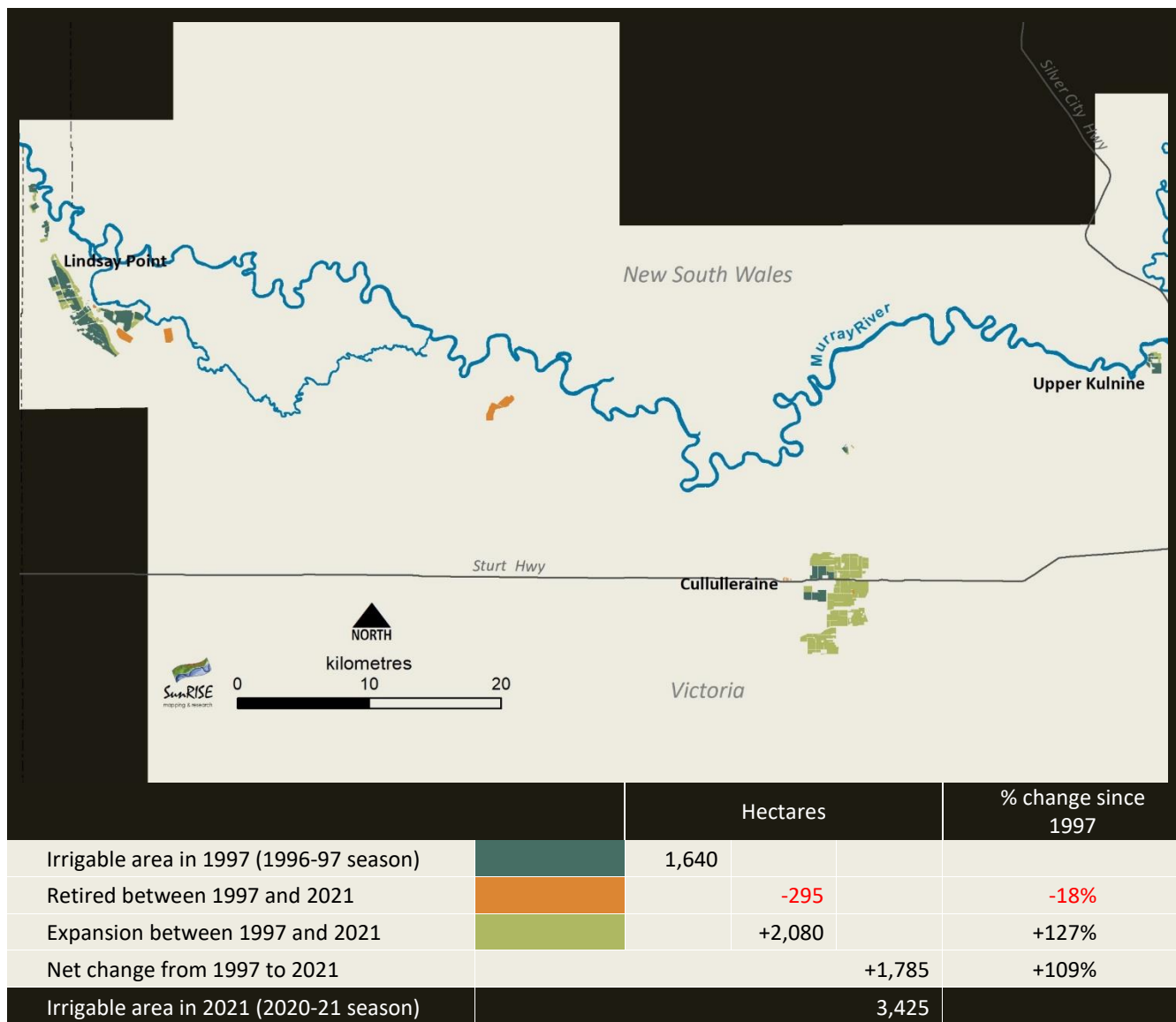


Figure 95: Lock 10 to South Australia river reach - planting trends from 1997 to 2021

3.7.5 Lock 10 to South Australia - irrigation development

Map 23 shows irrigation development in the Lock 10 to South Australia river reach with respect to new development (expansion) and areas retired³⁵ from irrigation from 1997 to 2021.

- The irrigable area increased by 1,785 ha, a 109% increase from 1,640 ha in 1997 to 3,425 ha in 2021.
- The net increase of 1,785 ha was the balance of 295 ha retired from irrigation and 2,080 ha of expansion.



Map 23: Lock 10 to South Australia - irrigation development from 1997 to 2021

³⁵ Retired areas were previously irrigated but have undergone a change in land use and no longer have irrigation infrastructure e.g. urban development, sheds, dams, land set aside for conservation or returned to dryland agriculture.

3.7.6 Lock 10 to South Australia - irrigation methods

Figure 96 summarises irrigation methods in the Lock 10 to South Australia river reach from 1997 to 2021.

The dominant irrigation method in the Lock 10 to South Australia river reach was low level sprinklers from 1997 to 2003 followed by drippers from 2009 to 2021.

In 2021, the irrigable area of 3,425 ha comprised:

- 64% (2,195 ha) drip irrigation;
- 24% (815 ha) low level irrigation;
- 0% (0 ha) overhead sprinklers; and
- 12% (415 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 1,905 ha, a 657% increase from 290 to 2,195 ha;
- low level irrigation increased by 30 ha, a 4% increase from 785 to 815 ha;
- overhead irrigation decreased by 15 ha, a 100% decrease from 15 to 0 ha; and
- furrow irrigation decreased by 230 ha, a 100% decrease from 230 to 0 ha.

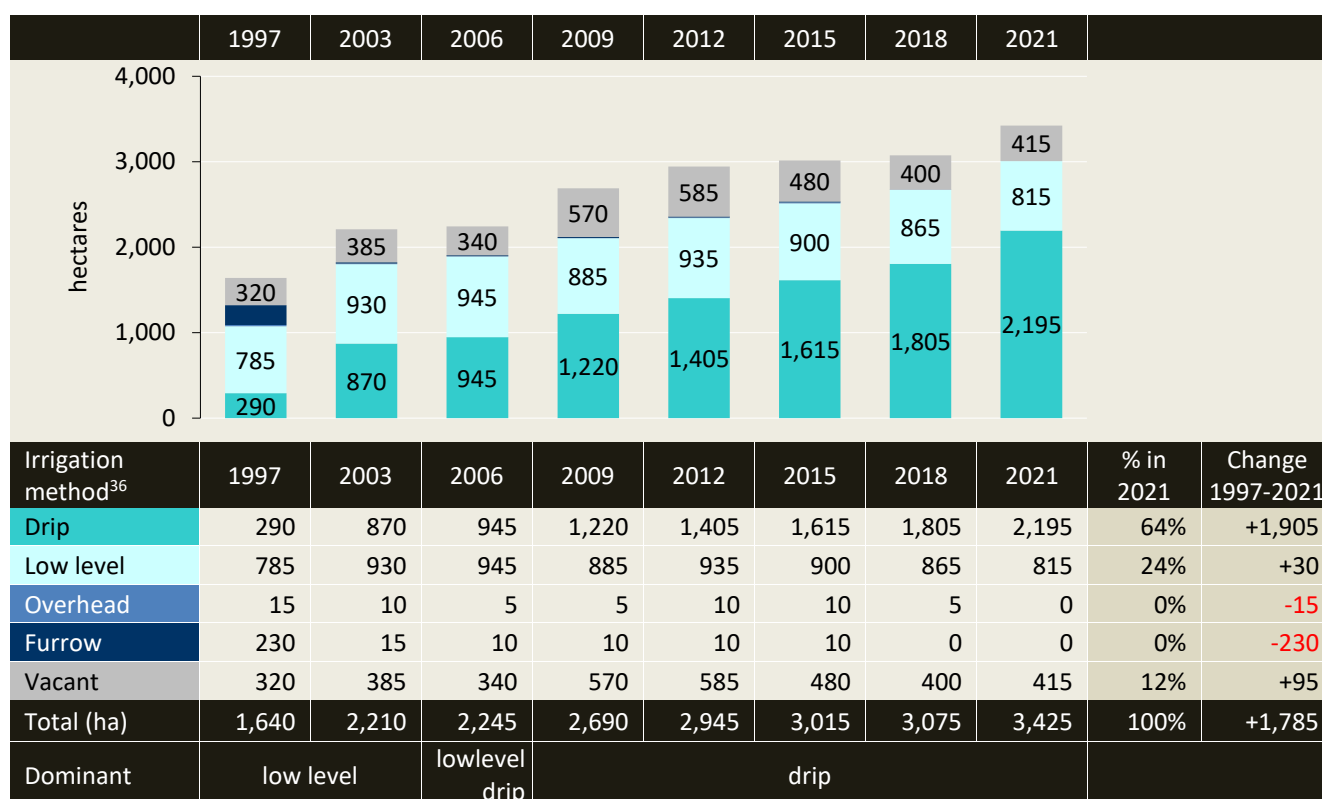


Figure 96: Lock 10 to South Australia - irrigation methods from 1997 to 2021

³⁶ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

3.7.7 Lock 10 to South Australia - salinity impact zones

Figure 97 summarises river salinity impact zones of irrigated areas in the Lock 10 to South Australia river reach from 1997 to 2021. Lock 10 to SA private diverters are in the lowest salinity impact zone, L1 and the high salinity impact zone, HIZ. Irrigation development from 1997 to 2021 predominantly occurred in L1.

In 2021, the irrigable area of 3,425 ha comprised:

- 86% (2,940 ha) in the lowest salinity impact zone, L1; and
- 14% (485 ha) in the high salinity impact zone, HIZ.

From 1997 to 2021, the area irrigated in:

- L1 increased by 1,830 ha, a 182% increase from 1,005 to 2,835 ha; and
- HIZ decreased by 140 ha, a 44% decrease from 315 to 175 ha.

From 1997 to 2021, the irrigable area in:

- L1 increased by 1,935 ha, a 193% increase from 1,005 to 2,940 ha; and
- HIZ decreased by 150 ha, a 24% decrease from 635 to 485 ha.

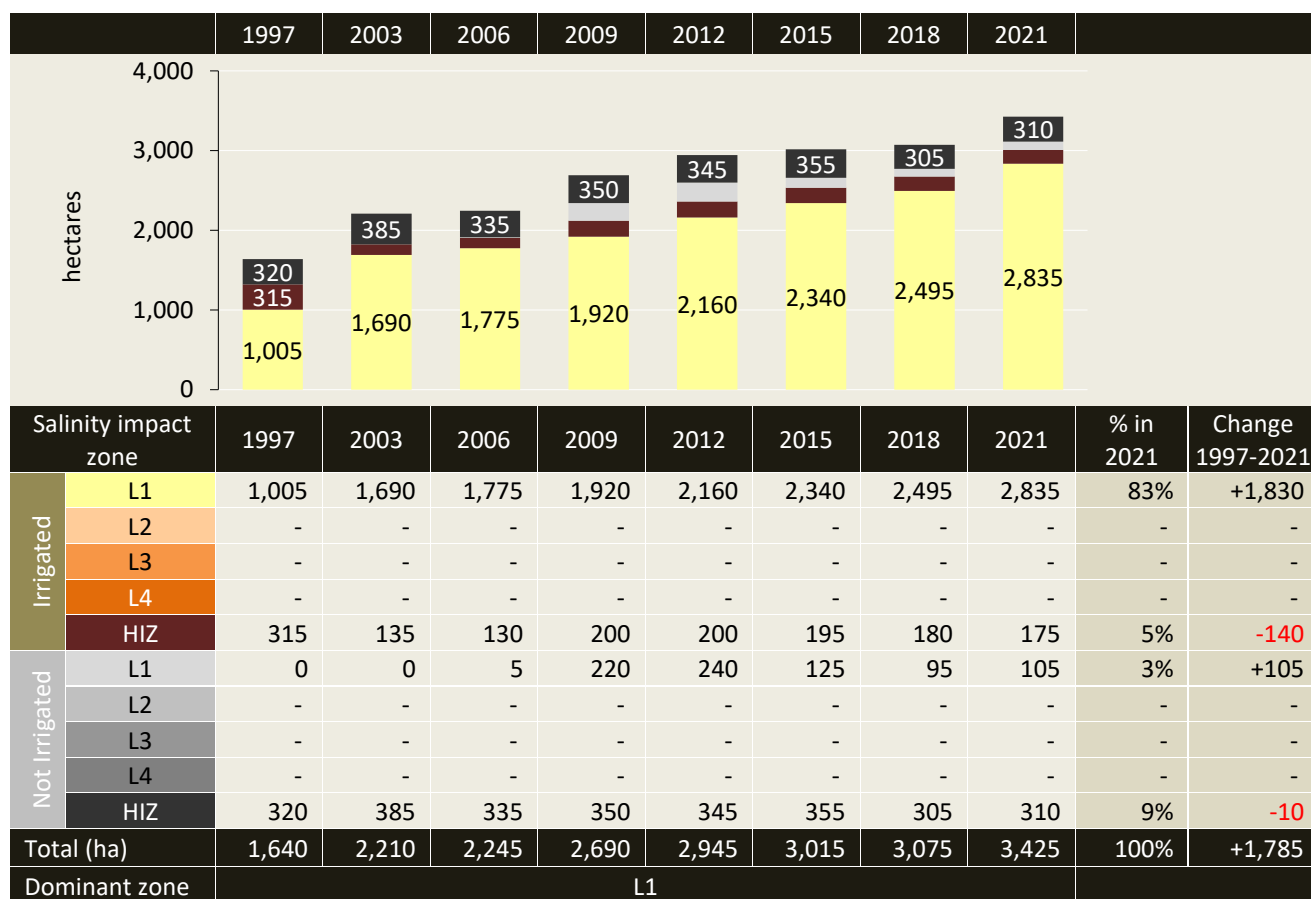


Figure 97: Lock 10 to South Australia - irrigable area in each salinity impact zone from 1997 to 2021

3.7.8 Lock 10 to South Australia - property change

Figure 98 provides estimates of property numbers and average property size (irrigable area) in the Lock 10 to South Australia river reach from 1997 to 2021.

In 2021:

- there were approximately 17 irrigation properties; and
- 71% of properties had an irrigable area over 40 ha.

From 1997 to 2021:

- there were 17 properties in 1997 and 2021;
- properties with an irrigable area of less than 40 ha decreased by 4 and the number over 40 ha increased by 4; and
- average property size (irrigable area) increased from 96 to 201 ha.

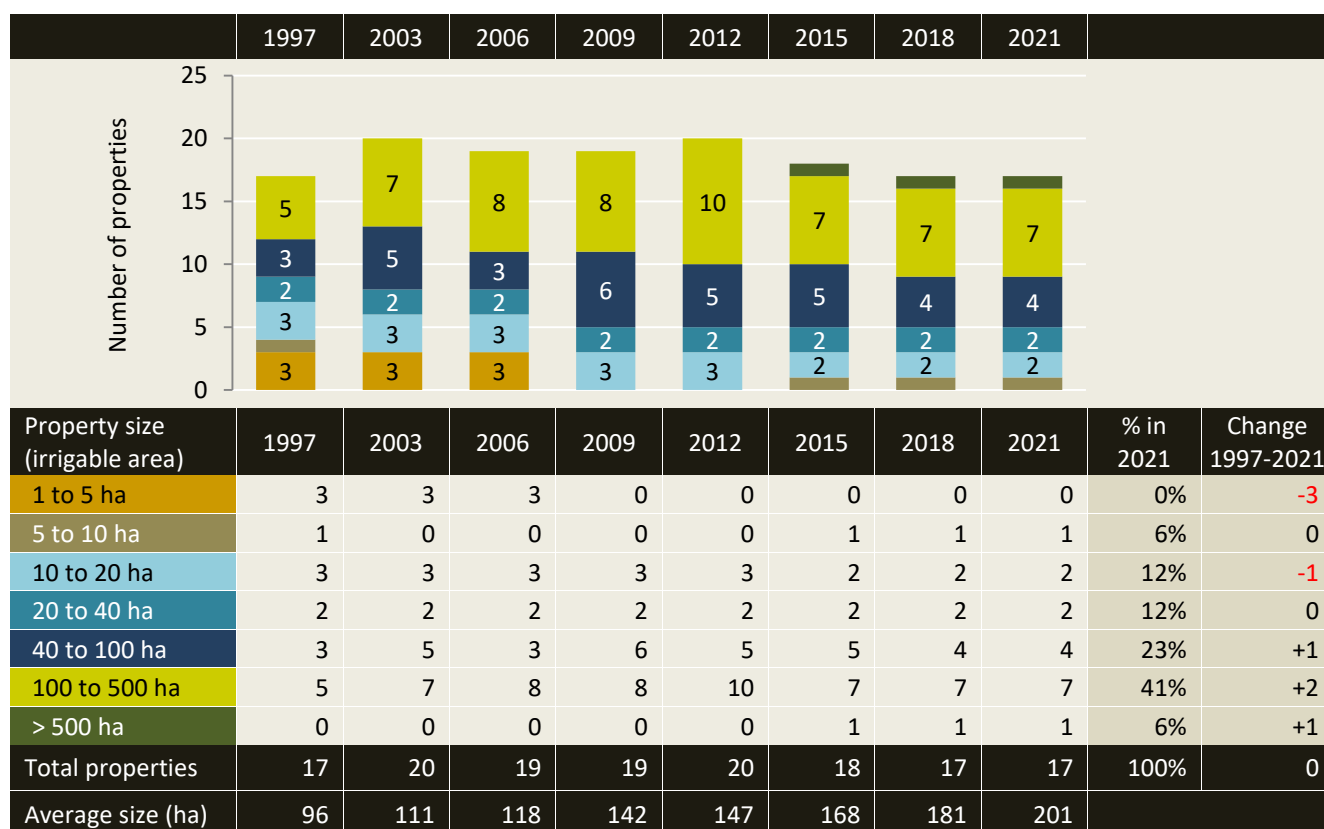


Figure 98: Lock 10 to South Australia - property numbers and sizes from 1997 to 2021

4. Murrayville GMA

In summary for the Murrayville Groundwater Management Area

Limitations of the information

Irrigated crops in the Murrayville GMA were mapped from a limited series of aerial imagery and information in this section should be treated as estimates only.

Unlike permanent plantings, it is difficult to accurately determine irrigation activity for seasonal crops, and to distinguish vegetables from field crops, such as potatoes and cereal crops, from limited imagery of the season. As 99% of irrigated areas in the Murrayville Groundwater Management Area (GMA) were seasonal, accuracy of the information is limited.

No imagery was available for 1997, however, information from the *Murrayville Area Groundwater Management Plan 2001* assisted with estimates.

Crop types

Potatoes were the dominant irrigated crop in the Murrayville GMA from 1997 to 2021.

Plantings in 2021 were:

- potatoes: 1,180 ha (17% of the irrigable area);
- field crops: 990 ha (15% of the irrigable area); and
- olive trees: 45 ha (1% of the irrigable area).

Changes in crop types from 1997 to 2021 were:

- potato crops increased by 560 ha, a 90% increase from 620 to 1,180 ha;
- field crops increased by 765 ha, a 340% increase from 225 to 990 ha; and
- olive trees increased by 15 ha, a 50% increase from 30 to 45 ha.

Irrigation methods

The dominant irrigation method in the Murrayville GMA was pivot irrigation from 1997 to 2021.

In 2021, the irrigable area of 6,785 ha comprised:

- 1% (45 ha) drip irrigation;
- 32% (2,170 ha) pivot (overhead) irrigation; and
- 67% (4,570 ha) not irrigated.

Irrigation properties

In 2021, there were approximately 18 irrigation properties and the average property size (irrigable area) was 377 ha.

Estimates from 1997 to 2021:

- the number of properties with irrigation increased by 8, an 80% increase from 10 to 18;
- properties with an irrigable area less than 100 ha remained at 8, while the number over 100 ha increased by 8; and
- average property size (irrigable area) increased from 121 to 377 ha.

4.1.1 Murrayville GMA - crop types in 2021

Map 24 shows the Murrayville Groundwater Management Area (GMA) with crop types in in 2021.



Map 24: Murrayville GMA showing 2021 crop types

4.1.2 Murrayville GMA - crop types from 1997 to 2021

Figure 99 summarises crop types in the Murrayville GMA from 1997 to 2021.

Potatoes were the dominant crop from 1997 to 2021.

Plantings in 2021 were:

- potatoes, 1,180 ha (17% of the irrigable area);
- field crops, 990 ha (15% of the irrigable area); and
- olive trees, 45 ha (1% of the irrigable area).

From 1997 to 2021, planting changes were:

- potato crops increased by 560 ha, a 90% increase from 620 to 1,180 ha;
- field crops increased by 765 ha, a 340% increase from 225 to 990 ha; and
- olive trees increased by 15 ha, a 50% increase from 30 to 45 ha.

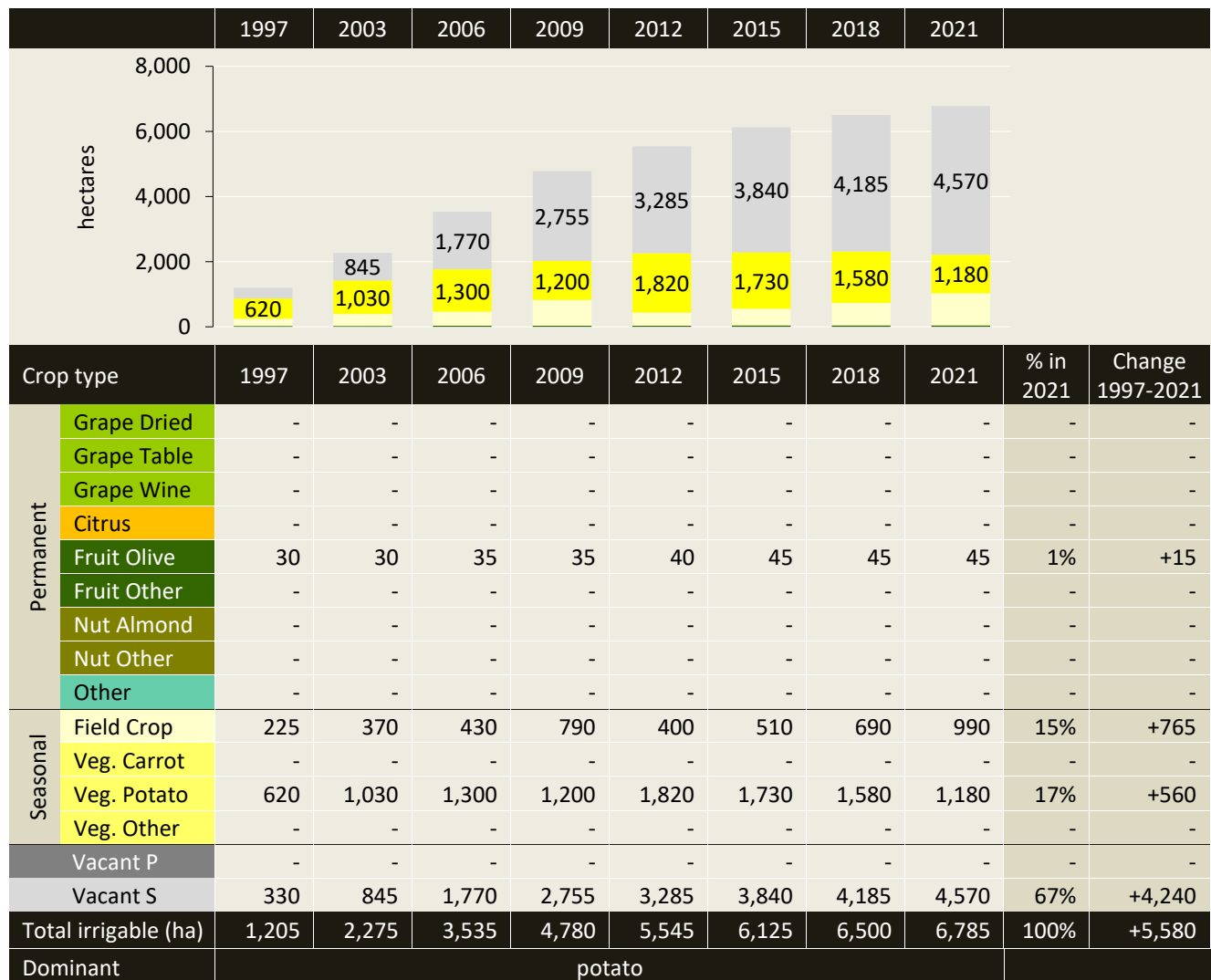


Figure 99: Murrayville GMA - crop types from 1997 to 2021

4.1.3 Murrayville GMA – planting trends

Figure 100 summarises planting trends with respect to permanent crops, seasonal crops and vacant areas in the Murrayville GMA from 1997 to 2021.

In 2021, the irrigable area of 6,785 ha comprised:

- 1% (45 ha) irrigated permanent plantings (olives);
- 32% (2,170 ha) irrigated seasonal crops; and
- 67% (4,570 ha) vacant, previously irrigated seasonal crops.

The proportion of permanent plantings, seasonal cropping and vacant areas changed from:

- 2% permanent, 70% seasonal and 27% vacant in 1997; to
- 1% permanent, 32% seasonal and 67% vacant in 2021.

From 1997 to 2021:

- irrigated permanent crops increased by 15 ha, from 30 to 45 ha;
- irrigated seasonal crops increased by 1,325 ha, from 845 to 2,170 ha; and
- vacant areas, previously irrigated seasonal crops increased by 4,240 ha, from 330 to 4,570 ha.

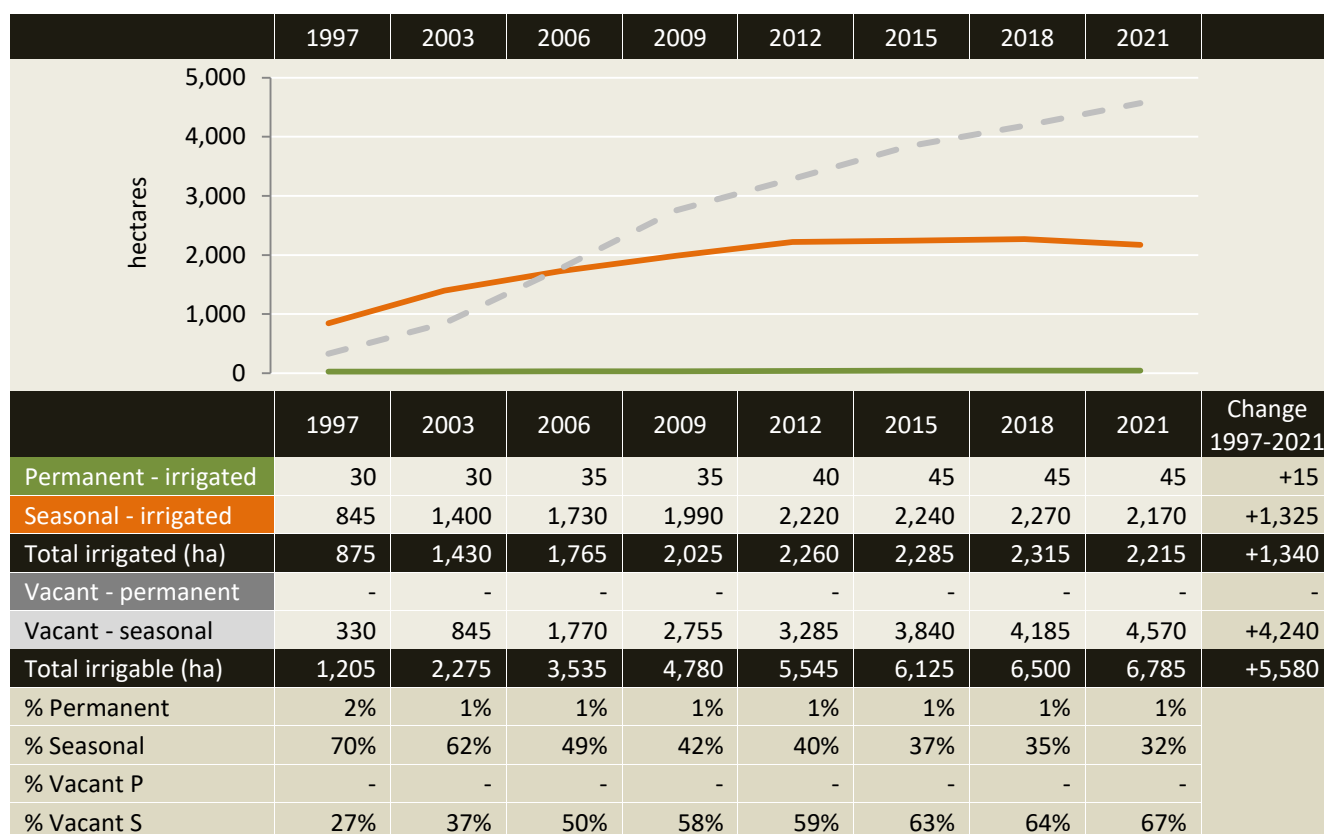


Figure 100: Murrayville GMA – planting trends from 1997 to 2021

4.1.4 Murrayville GMA - irrigation methods

Figure 101 summarises irrigation methods in the Murrayville GMA from 1997 to 2021.

The dominant irrigation method in the Murrayville GMA was pivot irrigation from 1997 to 2021.

In 2021, the irrigable area of 6,785 ha comprised:

- 1% (45 ha) drip irrigation;
- 32% (2,170 ha) pivot (overhead) irrigation; and
- 67% (4,570 ha) not irrigated.

From 1997 to 2021:

- drip irrigation increased by 15 ha, a 50% increase from 30 to 45 ha;
- pivot irrigation increased by 1,360 ha, a 168% increase from 810 to 2,170 ha; and
- furrow irrigation ceased by 2003.

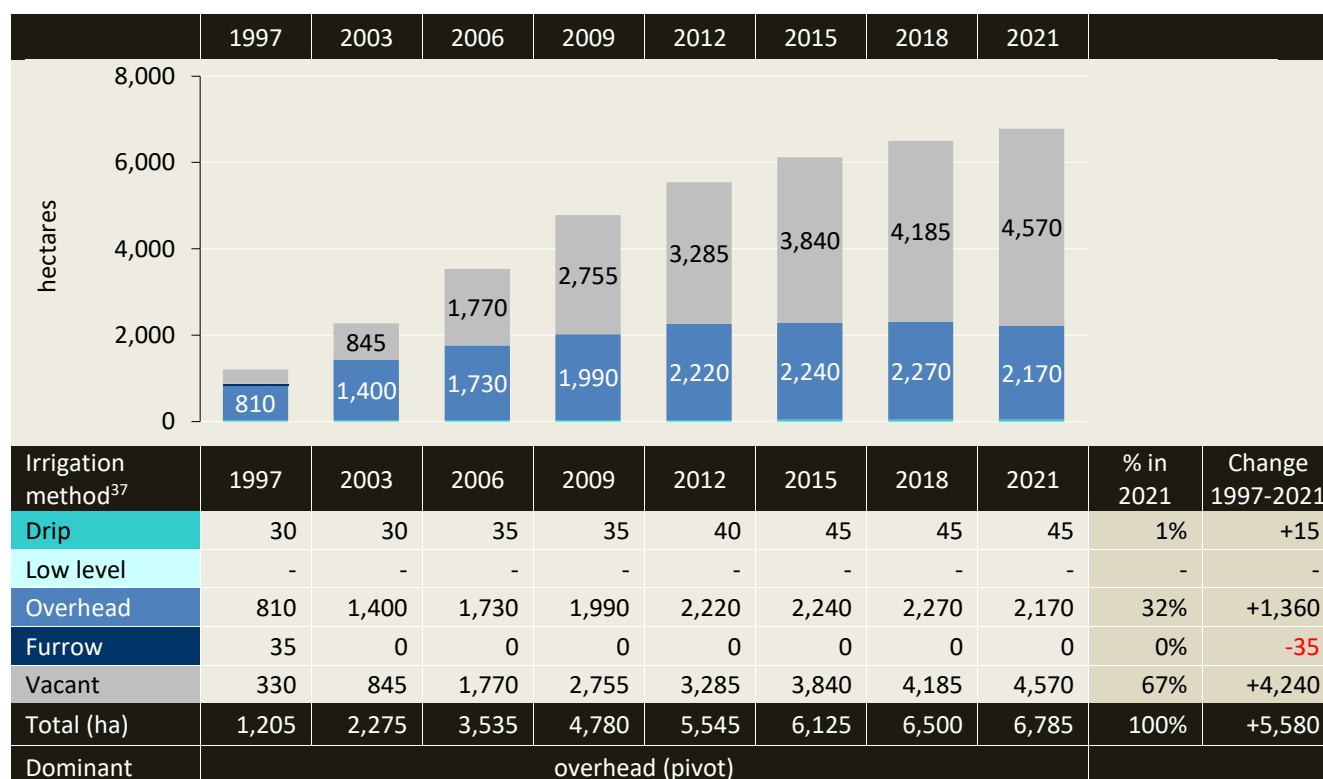


Figure 101: Murrayville GMA - irrigation methods from 1997 to 2021

³⁷ Overhead irrigation includes pivots and lateral move systems. Furrow includes flood irrigation. (Refer to Table 4.)

4.1.5 Murrayville GMA - property change

Figure 102 provides estimates of property numbers and average property size (irrigable area) in the Murrayville GMA from 1997 to 2021.

In 2021:

- there were approximately 18 irrigation properties; and
- 67% of properties had an irrigable area greater than 100 ha.

From 1997 to 2021:

- the number of properties increased by 8, an 80% increase from 10 to 18;
- properties with an irrigable area less than 100 ha remained at 8, while the number over 100 ha increased by 8; and
- average property size (irrigable area) increased from 121 to 377 ha.

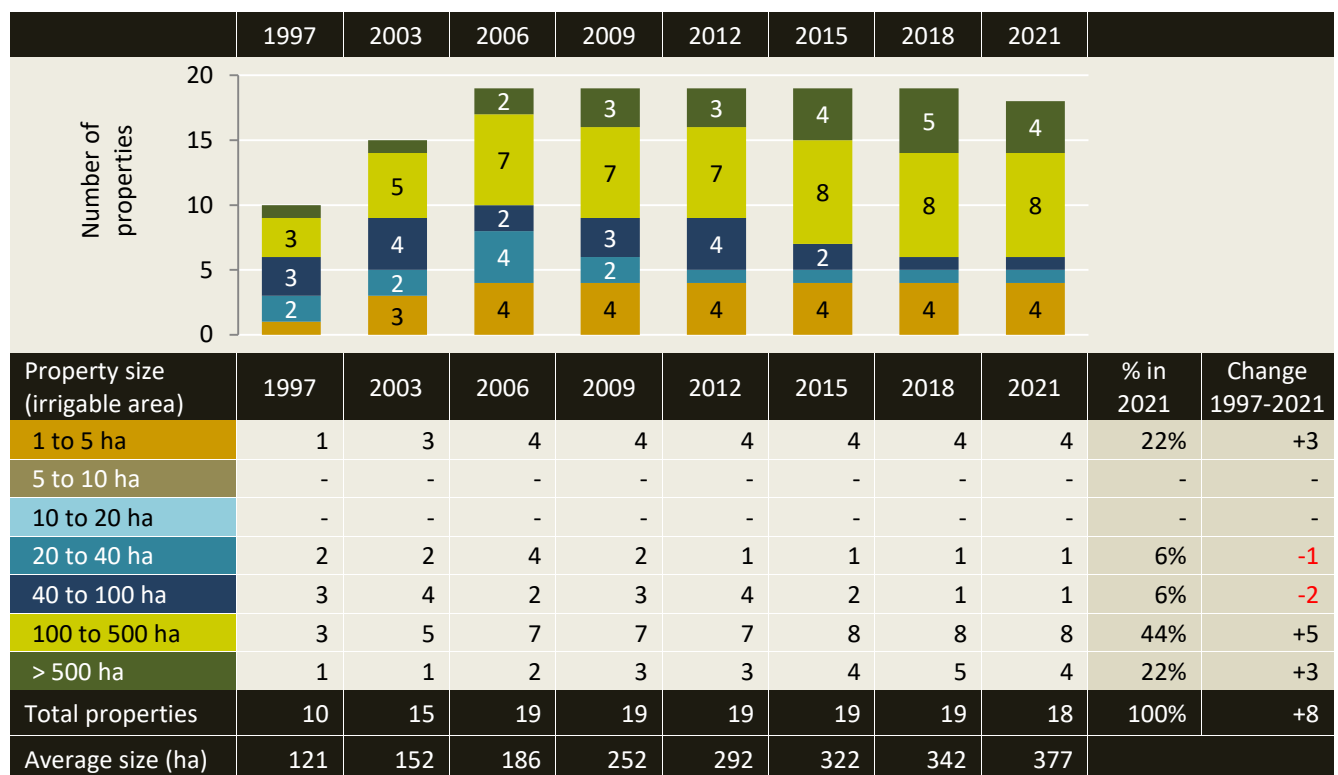


Figure 102: Murrayville GMA - estimate of property numbers and sizes from 1997 to 2021

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Disclaimer

SunRISE Mapping and Research have prepared this report in consultation with individuals and regional organisations. Information contained herein is based on data and information from a range of sources. Whilst SunRISE Mapping and Research has endeavoured to correctly interpret, analyse and present the information, SunRISE Mapping and Research does not warrant that this report is definitive nor free of error and does not accept liability for any loss caused or arising from use of or reliance upon information contained herein.



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