Marlborough District Council

Freshwater Management and Marlborough's Economy

MARLBOROUGH DISTRICT COUNCIL

EM | CONSULTING

Acknowledgements

The willingness and good nature of all the farmers, growers, and others who participated in interviews and shared their invaluable data and knowledge, in some cases over several years. Also, those locals who provided photographs, which have all helped enhance the report. In addition, a report of this nature would not have been possible with the generosity and expertise of Marcus Pickens (Wine Marlborough) and Meagan Littlejohn (Sustainable Winegrowing New Zealand); Esnes Gray, Angie Fisher, and Andrew Burtt (Beef + Lamb New Zealand), David Cooper, Ben Marmont, and Mark Kooter (DairyNZ); Emily MacDonald (Federated Farmers); Justin Stevens (New Zealand Deer Farmers Association); and Leanne Roberts (Horticulture NZ); and Angela Mackenzie (Top of the South Wood Council). Haylee Officer and Kameron Bridges (Talk Visual) for their graphic design work; Marlborough District Council staff, particularly Sarah Pearson, Clementine Rankin, Pere Hawes, Matt Oliver, Tonia Stewart, and Alan Johnson. Finally, Matthew Newman for his good advice and Russell Cannan for his diligent proof reading and unfailing support.

Marlborough District Council is a unitary authority (i.e., the council has both district and regional roles and responsibilities). As this report is written with respect to freshwater management, the administrative area is referred to as a region (i.e., Marlborough Region). When referring to the territorial authority, it is referred to as a district (i.e., Marlborough District Council) because this is how it is generally known within the community.

This report was reviewed by Marlborough District Council.

Citation Advice:

Moran, E., Pearson, L. and McKay, D. (2025). Freshwater Management and the Marlborough Economy. A EM Consulting report for Marlborough District Council, Blenheim.

Marlborough District Council Disclaimer: *This report was prepared between 2023 and 2025 as part of the Council's process towards implementing the National Policy Statement for Freshwater Management 2020 (NPSFM 2020). More specifically, the report will be used to inform future section 32 policy evaluation the Council is required to undertake to support any variation or plan change to the Proposed Marlborough Environment Plan (PMEP), but the report itself does not constitute that evaluation. This report can be used to inform the consideration of options to give effect to the NPSFM 2020 or any future version of the National Policy Statement for Freshwater Management. In general, the report has no attribution of photo sources for privacy reasons.*

Cover image: *Awatere River and surrounding landscape*
Above image: *Grovetown Lagoon*

Executive Summary

This report was commissioned by Marlborough District Council to characterise the region's economy ahead of implementing the National Policy Statement for Freshwater Management 2020 in the region. In doing so, the report creates a socio-economic baseline that will be the starting point in the future for assessing the impacts of possible policy options for fresh water as they are developed. As the topic of this report has the potential to be wide-ranging, its scope is intentionally tailored to the primary sector (Section 1.2). Marlborough's economy revolves around these sectors, which (like many regions in New Zealand) has a relatively narrow base. They are also the ones most likely to be most directly impacted by future changes in freshwater management.

The report begins by setting out the environmental context relevant to economic activities (Chapter 2) and a general summary of the economy (Chapter 3), before it turns to a more in-depth economic analysis[1] of its main land-based sectors: agriculture (primarily sheep and beef farming and dairy farming), viticulture, horticulture, and forestry (Chapters 4, 5, 6, and 7).

Freshwater management, and environmental management more generally, is about considering how we undertake our economic activities within the environment and minimise their adverse effects. It is logical, therefore, that improving our understanding of the economy is a 'necessary condition' for management success. Such efforts also help make sure that shifts in policy are able to occur as 'economically'[2] as possible for people and communities. However, to improve understanding, any economic analysis must be done in a way that is consistent with promoting sustainability.

As a socio-economic baseline, the report is the starting point for assessing the possible impacts[3] of various policy options for the proposed Marlborough Environment Plan in the future. The assessment's end points are forecasts of what businesses, industries, or economy as a whole may look like as a result of a policy option(s). To put this another way, policy impacts are the amount of change (if any) between what things look like 'beforehand' and 'afterwards'. Assessing the impacts of policy options is discussed further in Section 1.4. From Marlborough's perspective, the important impacts are likely to be those that are most relevant to the region in the first instance, such as any changes in employment and/or expenditure within local communities.

Past forecasting efforts for Marlborough have shown that circumstances can change quickly and there is an infinite range of possible futures to compare a policy option against. A major complicating factor is now the changing climate. Climate projections for Marlborough include more hot days, fewer frost days, a shift to larger extreme rainfall events, and increased potential for drought. These projections are likely to result in a shift of the region's hydrological regime towards more hydrological extremes (wet or dry), with mean annual low flows decreasing for most catchments over the longer timeframes. Climate change will have impacts across the region in the mid-term that are exacerbated over the longer term and, along the way, it may alter the range of economic activities that suit the region.

---

1 Microeconomics considers individual households and businesses while macroeconomics takes a wider view of industries and whole economies. Both fields of study are relevant to the topic of this report.

2 Here, 'economically' means minimising the possible impacts, including trying to avoid unintended consequences that are reasonably foreseeable, while resolving environmental issues. An efficiency test is a key requirement of policy evaluation under Section 32 of the Resource Management Act 1991.

3 Impacts fall into three types: direct, indirect, and induced. They refer to the initial, secondary, and tertiary adjustments that can occur as a change works its way through an economy.

The research for this report was undertaken from mid-2023 through to the end of 2024 and it was intended to build on, rather than repeat, the existing understanding of Marlborough's economy available from other sources (both current and historical). An overview of the research approach is available in Section 1.5 and additional explanatory notes are included at the start of most chapters. The approach recognises that to be robust, economics is a necessary mix of quantitative and qualitative information and the importance of context in understanding a regional economy and the complexity within it. In particular, the research uses technical land use mapping of the region (Pearson, 2024) and draws on extensive datasets from multiple sources and interviews with 18 farmers, growers, and technical experts with local knowledge. The value of the interviews is in how they help explain the nuances and complexity of the economy. They also highlight that economics is, ultimately, about people and communities as well as individual decision-making.

General Points

This report covers a lot of territory as it surveys economic activities across Marlborough. While this section touches on many of the points in the main body of this report, it is not intended to be a substitute for reading the report itself as it is not possible to summarise the wealth of information contained within its 200 pages. Those points that turn out to be most important will depend on the future policy process for fresh water.

The natural environment both shapes and supports Marlborough's economy. The region's landscape, climate, and soils together create a unique set of conditions that make it unique to the rest of New Zealand. These components interact in complex ways to influence the way water flows through the region, creating considerable variability within and between catchments. In Marlborough this variability in water flows can change markedly across a year. Key industries within Marlborough's economy are strongly seasonal, with much of their activity being influenced by the region's climate and so are focused on certain times of the year. This seasonality characteristic is discussed in relation to tourism (Section 3.1.1) as well as the primary sector (Chapters 4 to 7).

The tourism sector's central geographic location within New Zealand and a mild climate align with the sector's six attributes: wine, seafood, aviation, heritage arts and culture, Marlborough Sounds, and the natural environment (MDC, 2022). Visitor experiences, services and other products are predominately located in either the Wairau Valley or Queen Charlotte Sound / Tōtaranui, particularly in or around Blenheim and Picton. As the sector consumes some of the gross output of many industries, it tends to be highly connected within the economy. Many tourists (when in their location of origin) are also consumers of the region's products (e.g., wine, lamb, beef, and seafood) in its domestic and international export markets. Tourism activity varies throughout the year, peaking over the warmest and driest months, and seasonal gaps can impact long term investment and the maintenance of infrastructure.

Within the rural sector, the area of farmland decreased from 2002 to 2022 by 29 per cent to 494,717 hectares (partly because of tenure review of Crown Pastoral Lease), while the number of farms declined by 22 per cent to 1,311 farms. These trends largely occurred since 2007 and, more recently, have been gathering pace. Roughly 72 per cent of farms in the region were either vineyards or sheep and beef cattle, with the remaining 28 per cent largely being forestry, dairy, and horticulture. Over 80 per cent of farms are less than 200 hectares. Total urban area increased from 2,472 hectares in 1989 to 3,057 hectares in 2020, although most growth occurred prior to 2007. Within this total area, there are just under 2,200 hectares of towns and rural settlements as well as just over 1,300 hectares of lifestyle properties (Pearson, 2024).

A region's land use patterns (Section 3.2) are closely connected to the impacts of policy options for fresh water. While the dominant characteristic of agriculture in Marlborough in the early 1980s was its diversity, the main trend since has been shifts away from pastoral farming, and more recently arable cropping, vegetable growing, and orcharding, towards grape growing for wine and forestry. This loss of diversity reflects the experience of many other regions in New Zealand, particularly those in the South Island, but here the shift has been towards viticulture rather than dairying. However, many farms in Marlborough are mixed farming systems: sheep and beef farms can include a vineyard enterprise on their better land and dairy farms often include a forestry enterprise on their hill country.

Marlborough has a relatively small proportion of more versatile land (Land Use Capability Classes 1-5) compared to elsewhere, with such land totalling less than one-quarter of the region's developed land. Spatially, it can be seen in the spread of land uses across Marlborough's Freshwater Management Units (FMUs) (Figure A). Some land uses concentrate in specific FMUs and others occur across the region. Overall, the dominance of the Wairau FMU across almost all land uses is clearly evident.

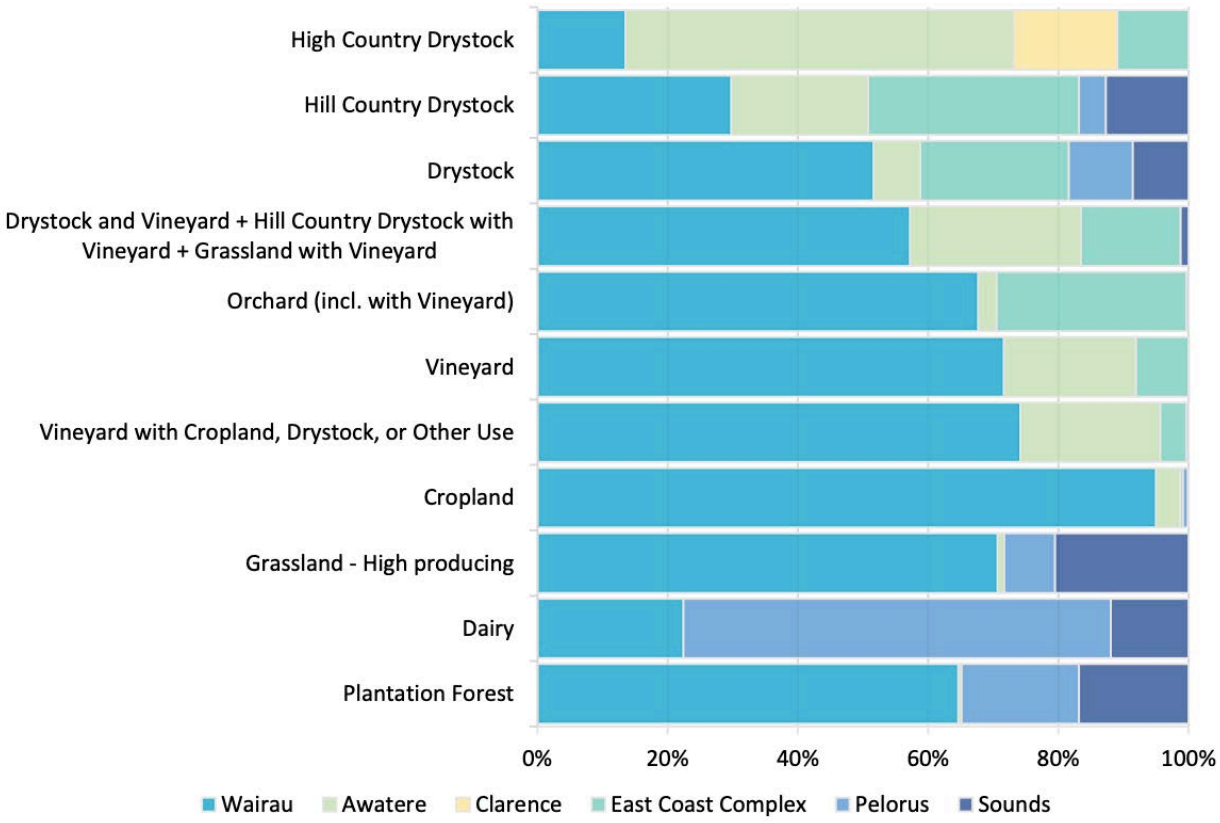


Figure A: Proportional mix of FMUs by land use area within the primary sector in Marlborough[4]
Source data: Marlborough District Council Land Use Map

4 While estimates of land area are generally based on a two-dimensional plan view, actual areas may be greater where sloping land is involved. This point becomes particularly relevant when considering the impacts of freshwater management when estimating linear distances, such as for river lines and riparian margins.

Industries, and so the land uses associated with them, tend to have cycles, partly influenced by the lifespan of its infrastructure (whether on-farm or beyond the farm gate), and land use change usually creates new economic activity and shifting socio-economic outcomes. Infrastructure follows economic returns and as any processing and manufacturing infrastructure associated with a particular industry, is lost from a region it can become more challenging for that industry in the future. However, over time, a region's overall infrastructure may increase where a new industry includes investment in value add, such as with winemaking in recent decades in Marlborough.

Although socio-economic outcomes are beyond the scope of this report, a brief overview is presented (Section 3.3) using indicators that, in turn, influence the structure of the economy. For example, in 2023, the median household income was $81,700 (i.e., half of households had an income below and half above) compared to that for New Zealand of $97,000. Such indicators also influence the Council's rating base and services, such as 3 Waters and flood protection, which makes it possible for people to live and work together across the region.

By area, the rural landscape in Marlborough is dominated by pastoral farming (Chapter 4). Livestock units peaked in Marlborough in 1982 at 2.4 million, largely driven by sheep farming. Since the late 1980s, the number of livestock has gradually declined, settling at around one million livestock units between 2010 and 2019. Most of the change has been in the sheep flock, although it still made up roughly half of the region's livestock units in 2019. Sheep and beef cattle farming in Marlborough is now largely dryland (i.e., non-irrigated) while dairy farming is a mix of irrigated and dryland. Mixed arable farming, once the principal land use around Blenheim and Seddon, is now of limited extent.

Three main features were identified that set sheep and beef farming in Marlborough (Section 4.1) apart from other regions: strong seasonality in pasture production, rolling or steep terrain that is mostly farmed extensively with limited use of arable crops, and some fairly uncommon circumstances (e.g., pressure from and mix with viticulture, the lack of road access in the Marlborough Sounds, and the absence of meat processors for export). Farmers have their own strategies for managing the 'summer dry', with decisions being made in spring as to whether to make more supplement or hold onto livestock, depending on markets and the prospects of the growing season. Unlike elsewhere, their wool accounts still well exceed their shearing expenses despite the decline in importance of wool as a revenue stream. More land is ungrazed now than a generation ago, either being 'set aside' or used for other purposes such as vineyard blocks or farm forestry. Viticulture has provided many farmers with opportunities but it is not 'business as usual' for the rest of the farm and neither is it an option available to everyone.

While dairy farming (Section 4.2) has never been a large industry in Marlborough it has long had importance locally. The regional dairy herd is of a similar size to a century ago. Dairy farming is largely located north of the Wairau River in the following localities: Rai Valley (39%), Pelorus (31%), Linkwater (13%), and Kaituna / Tuamarina (17%). In addition to its limited extent, two main features were identified: it is characterised by a small (and declining) farm population with relatively small herd size that are some distance from milk processing, and dairy farming often co-exists with large areas of forestry and native bush. Forestry accounts for around 1,000 hectares (8%) of the total land on dairy farms, with some variability between catchments, and native bush is even more of a feature, accounting for roughly 3,000 hectares (25%). Between 2017-18 and 2022-23, both the average milking platform and support land within a dairy farm business in the Top of the South has decreased markedly. The average spend per hectare on fertiliser (including nitrogen) has been generally higher than for New Zealand.

With the exception of local variability between the Marlborough Sounds, the Wairau / Awatere Valleys, and south Marlborough, a key finding of this report is that there may be less diversity within sheep and beef farming industry in Marlborough when compared to the industry in other regions. This is not to say that farms in Marlborough are not diverse, just they are more alike than is the situation in some other regions. It is a similar case for dairy farming (i.e., possibly more diversity with the industry in other regions than there is between dairy farms in the region). This finding in relation to agriculture contrasts with regions such as Otago and Southland. Recovering from weather events, such as drought and flooding, can have implications for several subsequent production seasons. All of the pastoral farmers interviewed highlighted the challenge that flood risk can present for riparian fencing.

Horticulture (Chapter 5) is a complex sector that includes a broad range of crops, growing systems, product groups, and industries. This complexity makes it challenging to characterise the sector. Each crop has its own lifecycle and demands for nutrients, temperature, and water (that all vary at different growth stages), as well as needs for space. Marlborough, and particularly the Blenheim area, has long been known for its orchards and market gardens, which have primarily supplied produce to the domestic market (within and beyond the region). Both the number of horticultural growers and the area where fruit and vegetable crops are grown have both reduced dramatically since the 1990s. The flexibility that many growers need in their production systems to achieve a marketable yield is constrained by land and water scarcity. Few growers now remain in the region and outdoor crops largely focus on cherries, apples, sweetcorn, garlic, and pinenuts. There are six growers with commercial greenhouses, with more than half of the indoor crop area being used for tomatoes.

One horticultural industry that has expanded in the region is viticulture (Chapter 6). The Marlborough wine-growing region is the largest in New Zealand and has seven interconnected characteristics: scale and dominance, Marlborough Sauvignon Blanc, diversity within and between vineyards, water use, people, profitability, and land values. In contrast to agriculture in the region, there are high levels of diversity within the industry. In 2023 there were 1,118 vineyards and 47 physical wineries in the region. The larger size of many vineyards in the region means they are more likely to cover a range of soil types, slope classes and aspects, as well as sources of water. On a per hectare basis, the industry's water use is low compared to other land uses and the value of its production from that use is high, allowing more land in the region to be irrigated than in the past. Most growers interviewed saw the relationship between water use and yield as fairly linear. A vineyard's water security (a combination of access and storage) is inextricably linked to its land value, which is relatively high. Several winegrowers anticipate that there may be increasing pressure from banks to invest in water storage.

The interviews with winegrowers tested the possible impacts of reducing water availability and identified a possible continuum roughly based on the degree of change: improvements in irrigation efficiency (including water storage), changes in flavour profile (less vegetative growth), reductions in crop yield, shifts in grape varietals, and finally possibly a change in ownership and/or land use.

Marlborough's forestry sector (Chapter 7) consists predominantly of commercial plantation forestry, mostly located in the Wairau, Te Hoiere / Pelorus, and the Marlborough Sounds, and (to a lesser extent) farm forestry. One characteristic of the sector is the higher level of small-scale ownership (53% of the forest estate) within the forest estate as well as a probable tendency towards smaller plantations. Owners of small-scale forests may be more likely to delay harvest in response to market prices to maximise their

returns, which impacts a range of economic activities (e.g., harvest crews, log transport, earthworks). A second characteristic is the combination of 1) a unique set of conditions that the forestry sector faces in the Marlborough Sounds and 2) the regulatory response to such conditions, such as the use of coastal setbacks (e.g., a 200 metre setback for replanting). Other characteristics are the risk of windthrow and forestry's connections with viticulture. All of these characteristics make the sector relatively diverse compared to forestry in other regions. Parts of the region have one of New Zealand's most severe fire climates and wildfire events can have severe implications for the sector.

One of the topics discussed in this report across the primary sector is the higher rates of inflation that have occurred over recent years. As an issue, inflation is managed using monetary policy, which impacts everyone in different ways (i.e., depending on their varying patterns of consumption, savings, and borrowing). Similarly in freshwater management, people's experience of a policy option is likely to be individual, influenced in part by their own situation and mindset. Consequently, they will each have their own risk profile and decision-making response to policy.

Limitations and Assumptions

This report's purpose was to improve general understanding of Marlborough's economy from the perspective of freshwater management as a starting point for assessing the impacts of fresh water policy options in the future. The intent is that this understanding will help inform those options but, as they are yet to be developed, it does not forecast their impacts. Further research may be needed in this area once those options take shape, particularly where the economy differs markedly from those of other regions.

The report is based on different datasets from multiple sources and more information was available for some industries than others. When combined with the interviews a snapshot of the market component of Marlborough's economy is evident but, without capturing the non-market component, it is only able to give a partial view of the economy. Much of that information is science-based and essential for considering (and accounting for) externalities. Further, the datasets do not show changes in stocks of natural, human, built, and financial capitals over time so the report is silent on the economy's overall sustainability.

The authors recognise that the economy described in this report is not the only one that exists in Marlborough nor was it the first. Eight iwi are mana whenua in Marlborough: Te Ātiawa o Te Waka-a-Māui, Te Rūnanga a Rangitāne o Wairau, Ngāti Toa Rangatira ki Wairau, Ngāti Apa ki te Rā Tō, Te Rūnanga o Ngāti Kuia, Ngāti Kōata, Te Rūnanga o Ngāti Rārua, and Te Rūnanga o Kaikōura. Further research is needed with these iwi to explore the nature of their economies and the role of fresh water within them. Such research may also include specific consideration of Māori agribusiness. It is likely that the impacts of freshwater management for mana whenua will be complex, with the potential for both opportunities and constraints.

Finally, while economic metrics used in this report are relevant to socio-economic outcomes, they do not represent those outcomes in themselves[5]. This report does not specifically consider how economic activity translates into people's living standards in Marlborough nor the general quality of life of its local communities. Economic outcomes are influenced by the market and non-market components of the regional economy and are the result of past decisions both within Marlborough and beyond it.

5 Paul Krugman (2008 Nobel Memorial Prize Laureate for Economic Sciences for his work on international trade and economic geography) noted that what an economy is for is "to serve human needs, not generate favorable statistics" (Krugman, 2023).

Contents

A note on language: *the terms 'effects' and 'impacts' are often used interchangeably. In this report, 'effects' is used to describe environmental changes that are caused by an economic activity; while 'impacts' is used to portray the socio-economic changes for individuals and communities that are result from managing the economic activity and/or its effects. Put simply, an economic activity can have effects on the environment and when an activity is managed for those effects it has impacts. Whether 'effects' and 'impacts' are positive or negative can be subjective. Also, 'effects' and 'impacts' do not usually occur in isolation, i.e., environmental effects can have socio-economic impacts and vice versa.*

1 Introduction

Marlborough's economy is both shaped by, and dependent on, the natural environment. The region has abundant sunshine but strong variation in rainfall patterns both across the region and seasonally. There is around 1,800 km of coastline, much of which is contained within the Marlborough Sounds. Such elements and others are viewed within the economy as the natural resources that, together with people's knowledge and skills, social networks, and built infrastructure, form Marlborough's wealth. It is this wealth that is the basis of community wellbeing for now and the future.

Marlborough District Council has recently developed its proposed Marlborough Environment Plan[6]. This new Plan is combining and updating the existing various resource management policy statements and plans to create a single resource management document for the district. It is the mechanism for which the Council will give effect to the National Policy Statement for Freshwater Management in Marlborough. The Plan will also support the ongoing implementation of other national direction related to fresh water.

All sectors of the economy use water as an input in production systems (in some form or other) and to transport those systems' waste products (even if inadvertently). Water transports waste either via 'end of pipe' discharges to water or to land or diffuse discharges across or through land[7]. Although water is essential in the economy, the value of its use (whether as an input or for waste) is not fully accounted for in our goods and services. Despite some businesses and households facing considerable costs associated with its use, resource users in New Zealand do not pay a fee for the resource itself (i.e., it is a public good).

A water allocation framework has been in place in Marlborough for some 30 years, based on sustainable flow regimes and protecting minimum flows. Within the framework there are three allocation classes; A, B and C. Class A has the greatest security of supply and Class C is solely for taking for storage during higher flows. These classes effectively sit stacked on top of each other with an amount below them representing the amount needed for the river and its ecosystems. Each allocation class is split, with a third of each class being allocated for the river and two thirds being the volume that can be allocated. This flow sharing helps to maintain flow variability.

6 This plan was publicly notified in 2016 to replace the operative Marlborough Regional Policy Statement, Wairau/Awatere Resource Management Plan and the Marlborough Sounds Resource Management Plan. Decisions on submissions were released in early 2024, followed by appeals and Environment Court mediations. At the time of writing, the majority of the provisions were treated as operative, as almost all appeals have been resolved.

7 Technically referred to as point-source discharges and non-point source discharges respectively. While discharges to land usually involve some attenuation of contaminants, such natural processes can be circumvented to varying degrees where land drainage networks are present.

As allocation limits are approached, the proposed Marlborough Environment Plan is placing greater emphasis on efficiency of use and enabling storage to help rural communities build resilience. Water permit applications undergo a 'reasonable use' test, with the amount of water needed for a crop in a specific location being calculated using local climate and soil type information (monthly volumes are allocated over the irrigation season). While the economy has already transitioned to this water allocation framework, discussions about appropriate class volumes and cut-off limits are likely to continue, especially as the effects of climate change become more prominent.

Marlborough's water quality is generally good and contaminant discharges are managed via the proposed Marlborough Environment Plan to maintain this overall state and enhance it where needed. In catchments where there is degradation or the risk of degradation, a Catchment Care Programme is in place to enhance water quality. The good state of water quality in most of catchments reflects their current land use patterns. As such, changes in land use are subject to appropriate management. For example, the conversion of land to dairy farming requires a land use consent. There is also a strong preference for the discharge of contaminants to land, as opposed to water. Permitted activity rules put conditions on discharges of domestic wastewater; dairy shed effluent; vegetable, fish and shellfish processing wastewater and leachate from composting operations to land. Standards are used to manage the risk of adverse environmental effects from such discharges. Certain activities (e.g., excavation, cultivation and filling, plantation forestry activities and composting) have riparian setbacks of varying widths from significant wetlands, rivers and natural state waterbodies.

Freshwater management is one aspect of a broader field that is generally framed as 'environmental management'. This title can be somewhat misleading because the idea that we can 'manage the environment' suggests a level of control over it that is somewhat ambitious to say the least. In reality, the field is more about managing how we undertake our economic activities within the environment and their adverse environmental effects[8]. Consequently, improving our understanding of the economy is a 'necessary condition'[9] to successful environmental management (Moran, 2023).

1.1 Report Purpose

This report was commissioned by Marlborough District Council to improve understanding of Marlborough's economy from a freshwater management perspective. Put simply, the report characterises the economy as it exists now, particularly in relation to fresh water, and identifies what about the economy may be regionally specific. In doing so, a socio-economic baseline is being created for the region that will be the starting point for assessing the impacts of future policy options for fresh water (as these options are developed).

This report (and any subsequent assessment) forms one part of the Council's wider work programme to implement the National Policy Statement for Freshwater Management (NPSFM) 2020 in Marlborough, and it sits alongside ongoing scientific research. It is understood that the Council's intention is implementation of the NPSFM 2020 in the region will occur through the proposed Marlborough Environment Plan (as either a variation to the plan or a plan change, partly depending on timing).

---

8 In economics, an environmental effect that is not accounted for is a type of 'externality'. Dasgupta (2021, p. 189) describes externalities as "the unaccounted for consequences for others, including future people, of actions taken by one or more persons. The qualifier 'unaccounted-for' means that the consequences in question follow without prior engagement with those who are affected." It is common to read externalities as market failure but that is merely to reword 'externalities'.

9 A necessary condition is a condition that must be present for something to occur although alone it is not sufficient to cause it (Moran, McDonald, & McKay, 2024). In other words, all the necessary elements must be there. There have been many examples over the years of where there have been unintended but foreseeable consequences (e.g., the loss of undeveloped land of ecological value resulting from the 1950 Marginal Lands Act) (Moran, 2019).

Improving understanding will help make sure that changes in policy in the future are able to occur as 'economically' as possible for individuals and communities. Here, 'economically' means minimising the possible impacts, including trying to avoid unintended consequences that are reasonably foreseeable, while resolving environmental issues. To achieve this, any economic analysis must be done in a way that is consistent with (rather than contrary to) promoting sustainable management[10] – as is the case with everything that relates to the Resource Management Act 1991. Such consistency is achieved in economics by recognising the meaning of efficiency[11], which has a temporal component to it and includes accounting for the effects of activities on others.

By being both economical with impacts and recognising efficiency[12], the broader 'system' that the people in Marlborough live and work in will be more stable or in balance (in economics this concept is described as being closer to an equilibrium) than may otherwise have been the case.

Image 1: Te Hoiere / Pelorus River near the Department of Conservation Campground in January 2015

10 Where inconsistency exists there is a very real risk that the economic thinking that led to environmental issues in the first place is used to assess policy options designed to resolve them.

11 Efficiency, or more correctly 'economic efficiency', is one of those terms where its usage is so commonplace that few people may ever pause to think about what it actually means. There are three main dimensions (known as 'productive', 'allocative', and 'dynamic') that together assess how well resources are used within an economy over time so as to generate the highest net benefits (Australian Productivity Commission, 2013).

12 The efficiency and effectiveness of a policy option can be inextricably linked (Moran (Ed.), 2023). Constraints on the efficiency of implementing an action may limit its effectiveness. Further, where an action's effectiveness is less than what is needed to resolve an issue then it may be economically inefficient. This is an important topic for further research.

1.2 Report Scope

As discussed in the previous section, the purpose of this report is to characterise Marlborough's economy as it exists ahead of implementing the National Policy Statement for Freshwater Management in the region. While this topic has the potential to be wide-ranging, the scope of this report is tailored. The report begins by setting out the environmental context relevant to economic activities (Chapter 2) and a general summary of the Marlborough economy (Chapter 3), before it turns to a more in-depth economic analysis[13] of its main land-based sectors: agriculture, viticulture, horticulture, and forestry (Chapters 4, 5, 6, and 7).

The main reason for the sector-level focus here is that Marlborough District Council is already well served in terms of economic knowledge. The Council has an Economic Development Team[14], whose work programme is laid out in the Marlborough Economic Wellbeing Strategy 2022-2032. The Council also provides regularly updated information on the regional economy from Infometrics: https://rep.infometrics.co.nz/marlborough-district/economy/growth. This report is intended to complement those sources and it is appropriate to do so as economies are continually evolving.

There are two main reasons for focusing specifically here on land-based sectors. First, the Marlborough economy, which has a relatively narrow base, revolves around these sectors. While the economy has manufacturing and service industries related specifically to viticulture and aquaculture, it lacks many of those that exist in other regions with a larger population base. Second, they are the ones most likely to be directly impacted by future changes in freshwater management. When combined, the agriculture, viticulture, horticulture, and forestry sectors:

- Account for a large proportion of developed land in the region;
- Consist of a large number of businesses that are also diverse in nature;
- Are reliant on water in their production systems; and
- Discharge contaminants to water diffusely, which historically has been less regulated than 'end of pipe' discharges.

Understanding how these industries operate in Marlborough is essential to the policy process. However, as already noted, a further step will be needed to assess the impacts of any future options (refer to Section 1.4).

The scope of this report includes natural capital. Marlborough's economy (like the wider New Zealand economy[15]) is based on the 'flows' of goods and services that are generated from its stocks of natural capital as well as its stocks of human, built, and financial capitals. The stocks of different forms of capital are essentially a region's assets.

13 Microeconomics considers individual households and businesses while macroeconomics takes a wider view of industries and whole economies. Both fields of study are relevant to the topic of this report.

14 *https://marlboroughnz.com/about-our-economic-development-unit/*

15 The Treasury has a long-standing ambition to integrate a broader conception of economics and value into the everyday work of public policy. In a speech on this topic in 2018, Gabriel Makhlouf (Secretary to the Treasury) described natural capital in New Zealand as "all aspects of the natural environment. It includes individual assets such as minerals, energy resources, land, soil, water, trees, plants and wildlife. It also includes broader ecosystems – that is, the joint functioning of, or interactions among, different environmental assets, as seen in forests, soil, aquatic environments and the atmosphere. Many of the benefits of natural capital come from its role in the production of other capitals. Natural capital is managed by many people: by the Crown in, for example, national parks; in common like oceans, rivers or the air; or by private individuals in forests, mines and farm land."

The report's scope also includes the market and non-market components of the economy. In the market component, flows of goods and services (e.g., grocery items, paid labour) are traded using monetary prices that adjust (i.e., rise or fall) in response to changes in supply and demand. In the non-market component, flows of goods and services that underpin the market component (e.g., water, pollination, and voluntary work) are exchanged without having monetary prices attached to them. Both components influence economic outcomes.

While natural capital and non-market flows of goods and services are included in the scope, the economic data available largely just records flows from the economy's market component and human, built, and financial capitals. Consequently, the economic data give only a partial view of the economy. Much of the information on flows of natural capital and non-market goods and services is science-based. Some is indicated by the report's environmental context.

The scope of this report does not specifically consider people's living standards in Marlborough nor the general wellbeing of its local communities. The economic metrics used are relevant to economic outcomes for people and communities but they do not represent those outcomes in themselves. This said, information is included on levels of socio-economic deprivation in the region (Section 3.3.1). As noted above, a long-term view on the economy and wellbeing in the region is available in the Marlborough Economic Wellbeing Strategy 2022 – 2032 (Marlborough District Council, 2022).

Finally, it is recognised that the economy described in this report is not the only one that exists in Marlborough – nor is it the first. Further work is needed with Marlborough's iwi to understand the nature of their economic activities in relation to fresh water (e.g., mahinga kai).

1.3 Report Structure

In reading this report it is important to keep in mind its structure. The main body of this report is divided into seven chapters (Chapters 2 to 7) that together form the characterisation of the economy, which is the purpose of this report. General points from this research are included in the Executive Summary.

> ***Chapter 2: Environmental Context*** *– this chapter briefly describes the region's landscape, climate, soils, and physiographic environments. These elements shape the regional economy, creating both opportunities and constraints.*
>
> ***Chapter 3: The Marlborough Economy*** *– this chapter gives an overview of the economy before presenting land use and demographic information for each of the region's six Freshwater Management Units (FMUs).*
>
> ***Chapter 4: Agriculture*** *– this chapter takes a more in-depth look at Marlborough's pastoral and arable farming industries.*
>
> ***Chapter 5: Horticulture*** *– this chapter considers the region's remaining orchards, berry fruit and vegetable growing operations.*
>
> ***Chapter 6: Viticulture*** *– this chapter surveys winegrowing across Marlborough.*
>
> ***Chapter 7: Plantation Forestry*** *– this chapter considers commercial plantation forestry (farm forestry is included in chapter 4).*

1.4 The Impacts of Policy Options

As a socio-economic baseline, the report provides the starting point for forecasting the possible impacts[16] of various future policy options for the proposed Marlborough Environment Plan. The end point is what a business, industry, or economy may look like as a result of a policy option(s). To put this another way, policy impacts are the amount of change (if any) between what things look like 'beforehand' and 'afterwards'.

Policy options generally consist of a combination of:

1. An environmental action(s), which focuses on avoidance, mitigation, and/or remediation of an activity or its adverse effects; and
2. One or more mechanisms for putting those environmental actions in place, such as the use of education, setting conditions on a permitted activity or a consent, or some financial incentive[17]. More informal mechanisms may include voluntary catchment efforts that have various social drivers (e.g., stewardship, competitiveness, peer pressure).

The order of these two components is important. A policy option ideally starts with the set of actions and, once these are determined, it turns to the mechanisms needed to put them in place – rather than the initial choice being a regulatory or non-regulatory approach and then considering the actions that may be needed.

In forecasting impacts, a policy option is usually tested in a simplified way as a 'scenario' that may include one or two variations on the theme. However, the reality is that the impacts of a policy option will depend on multiple factors, some of which are within the control of decision-makers and others that are either external to their decisions or act as constraints. Image 2 identifies eight main factors and, in doing so, it highlights the complexity of the forecasting task. In other words, a simple answer to a question about what the impacts might be is, "it depends". Of note in Image 2 is that any impact depends on the implementation of a policy option as well as its design.

This report is helpful for at least three of the factors in Image 2: #4 the extent to which an action(s) may be relevant within an economy, #7 the current economic situation of people and communities, and #8 the connectivity between activities within the economy.

16 Impacts fall into three types: direct, indirect, and induced. They refer to the initial, secondary, and tertiary adjustments that can occur as a change works its way through an economy.

17 A detailed discussion of environmental actions and mechanisms can be found in Chapter 1 of Otago's Rural Businesses and Environmental Actions for Fresh Water (Moran (Ed.), 2023).

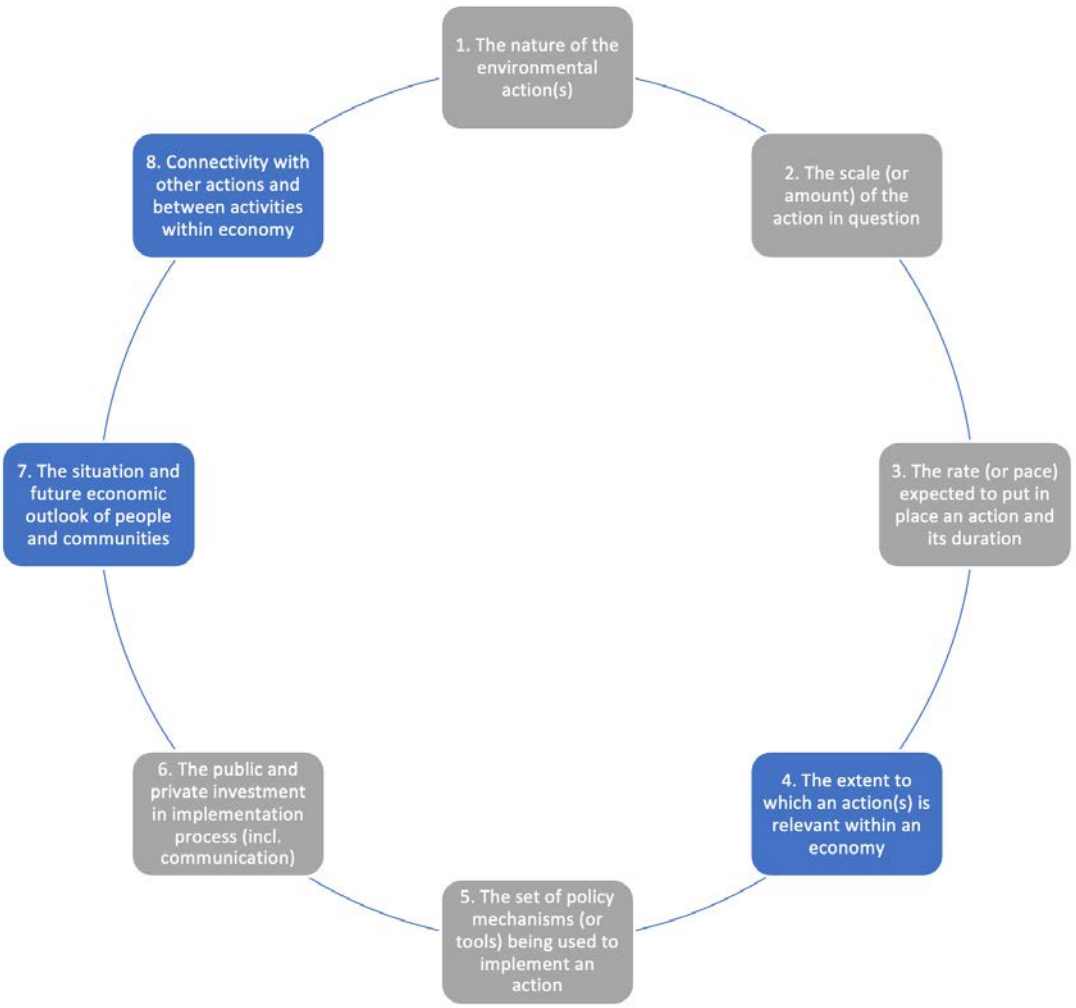


Image 2: Eight factors that can influence the impacts of a policy option for resource users
Source: Moran et al. (2024)

Robust testing of a policy option's impacts commonly relies on a labour-intensive case study approach that involves data collection, modelling, and analysis for a specific sector (e.g., agriculture, horticulture, or municipal water services) or a range of activities within a catchment. This report shows how the use of interviews and real-world examples can be a valid alternative to case studies. It also indicates the extent of diversity in the primary sector and so the range of situations that may exist, underlining the importance of not relying on 'types' of businesses in this area of work.

When forecasting the impacts of a policy option, it is important to be clear on the change being represented. National direction that is not yet fully implemented (e.g., the requirement to have a certified and audited Freshwater Farm Plan) is separate from what may be required through a regional plan. The impacts of national direction are relevant in that they may shift the socio-economic baseline. Along similar lines, the level of compliance with existing policy is not part of the equation.

Some of the challenges involved in forecasting the future can be seen by reflecting on past efforts. The Marlborough Regional Development Council's survey of regional resources is a good example (Duckworth, Fletcher, Higham, & Pope 1976). The report first noted that, particularly with the advent of irrigation, the future of arable farming in Marlborough was looking positive: "It appears likely that processing crops will increase vastly in both area and range of crops, especially for export" (Duckworth *et al*., 1976: p 145). The report also recorded the emergence of viticulture in the region:

> *Montana Wines Ltd. are approaching their target 400 ha of grapes for wine production. A small harvest of Reisling Sylvaner and Cabernet Sauvignon was made in autumn of 1976 and the grapes transported to Gisborne to be made into wine. Plans are afoot to commence the building of a winery at Riverlands about 5 km south of Blenheim.*
>
> ***Duckworth et al. (1976: p148)***

However, by the early 1980s it was predicted that the 5,800 hectares currently under horticultural or arable cropping around Blenheim would increase to 9,400 hectares over a 30-year period – predominantly as grape production – along with an increase in livestock in Marlborough of between 42 and 70 per cent (Ashworth-Morrison Cooper, 1982)[18]. 30 years later, the extent of arable farming had declined considerably, vineyards actually covered 22,630 hectares, and livestock had also declined by 57 per cent.

In retrospect, it is clear that a key factor that was unknown (and unknowable) to the authors at the time of writing was the impacts for Marlborough of upcoming government policies to deregulate the New Zealand economy in the 1980s. The point of this example is to underline how circumstances can change quickly, and so the general uncertainty involved in forecasting. There is an infinite range of possible futures to compare a policy option against (this topic is explored in Vergara, Harvey, McDonald, & Brown, 2020).

1.5 Research Approach

This research was undertaken between mid-2023 and the end of 2024. The approach used recognises that economic analysis is a necessary mix of quantitative and qualitative information (one cannot be understood without the other). It also recognises the importance of the broader environmental context when considering economic activities. To this end, a technical land use map was commissioned by Marlborough District Council (Pearson, 2024).

In general terms, the approach used in the research to inform this report followed a set of five steps:

Step 1 – A stocktake of existing literature relevant to Marlborough's economy and fresh water. The stocktake of existing literature formed the basis of the references of this report.

Step 2 – The creation of two map series (presented throughout the report) to show an overview of 1) landscape, climate, and soils in the region; and 2) land use and socio-economic deprivation by freshwater management unit. To this end, Marlborough District Council commissioned Dr Lisa Pearson (Pearson Consulting) to develop a detailed land use map for Marlborough. Dr Pearson also produced all of the other maps used in this report.

18 Provision for vineyards as a land use was made in the Marlborough District Scheme in the late 1970s (Planning Tribunal, 1979). This step was challenged because restrictions that existed at the time around aerial spraying within 8 km of a vineyard meant there may be potential conflicts with preparing gorse-covered ground for commercial forestry.

Step 3 – Sourcing and analysis of time series data from rural industry groups within the primary sector. This data was considered along with Stats NZ Census of Population and Dwellings (2018 and 2023) and Stats NZ Agricultural Production Census (2017) and subsequent statistics. This data was not analysed until after the interviews in Step 4 were undertaken.

Step 4 – Gathering local knowledge from 18 farmers, growers, and technical experts through a series of recorded interviews (all of which were conducted online using TEAMS software). The interviews were undertaken in advance of any data analysis, with questions being informed by existing research on the economic impacts of implementing the National Policy Statement for Freshwater Management in other regions in New Zealand. The recordings were carefully transcribed and the knowledge gained was used to 'round out' the information-base developed in the previous three steps.

This research approach takes a different tack from the two economic reports undertaken for the proposed Marlborough Environment Plan: Economic Value of Water in the Marlborough Region (Executive Finesse, 2011) and Economic Profile: Marlborough (Infometrics, 2012). As such, the approach used here is intended to build on, rather than repeat, those reports and so the existing understanding of Marlborough's economy in relation to freshwater management (both current and historic[19]).

Image 3: Blairich River in January 2023, Awatere Valley

19 Marlborough has a wealth of historical baseline reports, such as the report titled *Marlborough: a survey of present resources and future potential* compiled for the Marlborough Regional Development Council in 1976, the *Marlborough Primary Production and Transport Study* undertaken for the Marlborough United Council and the Ministry of Works and Development in 1982 and 1983, and *Issues and Options for Forestry and Farming in the Marlborough Sounds* prepared by Marlborough District Council in 1992.

2 Environment Context

As already noted, the natural environment both shapes Marlborough's economy and supports it with different types of essential services (for more information see Dymond, 2014). The abundance of land and low population base mean the economy has been assessed in the past as being relatively sustainable (e.g., Smith & McDonald, 2008). The landscape, climate, and soils create a unique set of conditions that mark the region out from the rest of New Zealand. However, these components interact in complex ways to influence the way water flows through the region, creating considerable variability within and between catchments. This chapter gives a brief overview of this environmental context to set the scene for the following chapters on the economy and its rural land-based sectors.

2.1 Landscape

Marlborough is located in the northeast of New Zealand's South Island and covers a land area of approximately 14,357 km^2 (or 1,435,780 hectares). The region shares borders with Nelson and Tasman to the west and Canterbury to the south. Close to the Canterbury border, between the Awatere and Waiau-toa / Clarence catchments is Tapuae-o-Uenuku, Marlborough's highest peak. It reaches 2,885 metres and is the highest point in New Zealand outside of the Southern Alps. The mountain is sacred to mana whenua.

In the early 1960s, J.P. Beggs (Farm Advisory Officer, Dept. of Agriculture) described Marlborough as:

> *Hilly to mountainous, with relatively small areas of flat land separated by hills or mountain ranges. Most of Marlborough is either steep or flat country and the main area of undulating land is around Seddon and Ward. For convenience, the district could be divided into three main topographical units: Northern Hill Country (steep, narrow valleys with small but useful areas of flat land), Lower Wairau and Awatere Valleys (flat to undulating country), and Southern Hills (steep, rugged country).*

Notably absent from this description is the Marlborough Sounds, which is a complex network of sounds, peninsulas, and offshore islands that together characterise the north of the region. The sounds are river valleys that were drowned as the block of land on which they sit has tilted and lowered them into the Cook Strait (in contrast, fiords are flooded glacial valleys) (Foster, 1998). There is little flat land, and the coastline stretches for over 1,500 km.

As with elsewhere, Marlborough's landscapes are governed by its underlying geology. The strong and weak metamorphic rocks, which begin in Fiordland and Otago and run the length of the South Island's Alpine Fault, reappear in Marlborough and are relatively resistant to weathering processes. These rocks have created landforms that intersect those made up of sedimentary rock and unconsolidated rock that tend to be more susceptible to such processes, and so are more prone to erosion (Image 4). The results can be seen in the striking variations in regional elevation (Image 5) and topography (Image 6) as well as the maps in Section 2.3 Soils and 2.4 Physiographic Environments.

The slope classes in Image 6 are: flat to gently rolling 0-4°, undulating 4-8°, rolling 8-16°, strongly rolling 16-21°, moderately steep 21-26°, and steep to very steep above 26° (Newsome *et al*., 2008). The red lines on Image 6 represent the state highways. The towns shown on the map were chosen as reference points to help with orientation, rather than because of their population size. More detailed information is available in the Marlborough Landscape Study: Section B: Introduction to the Marlborough Landscape (Boffa Miskell, 2015).

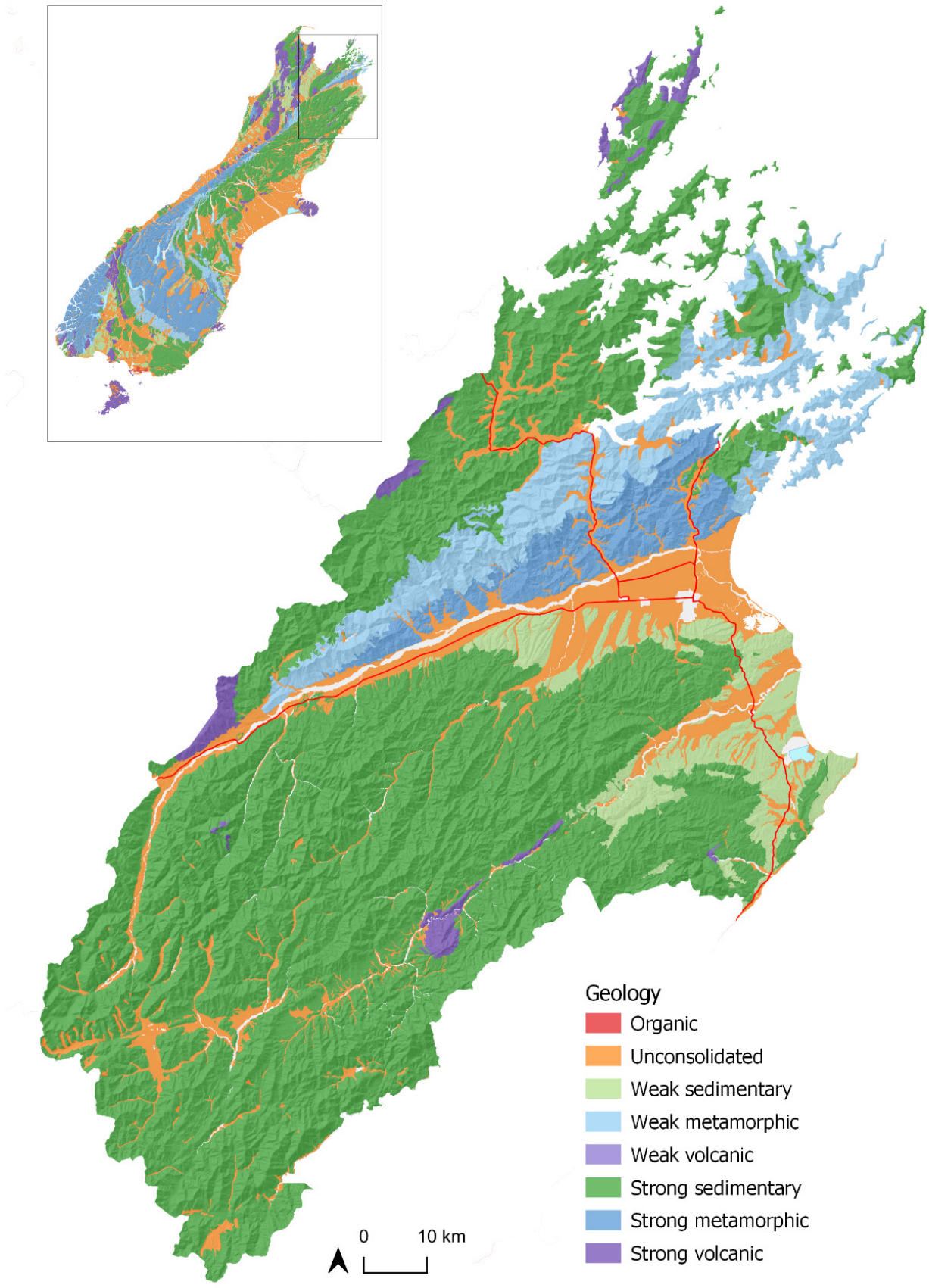


Image 4: Geology of Marlborough by rock type (interactive versions of many of the maps in this chapter are available at https://landscapedna.org/maps/other-information/altitude)

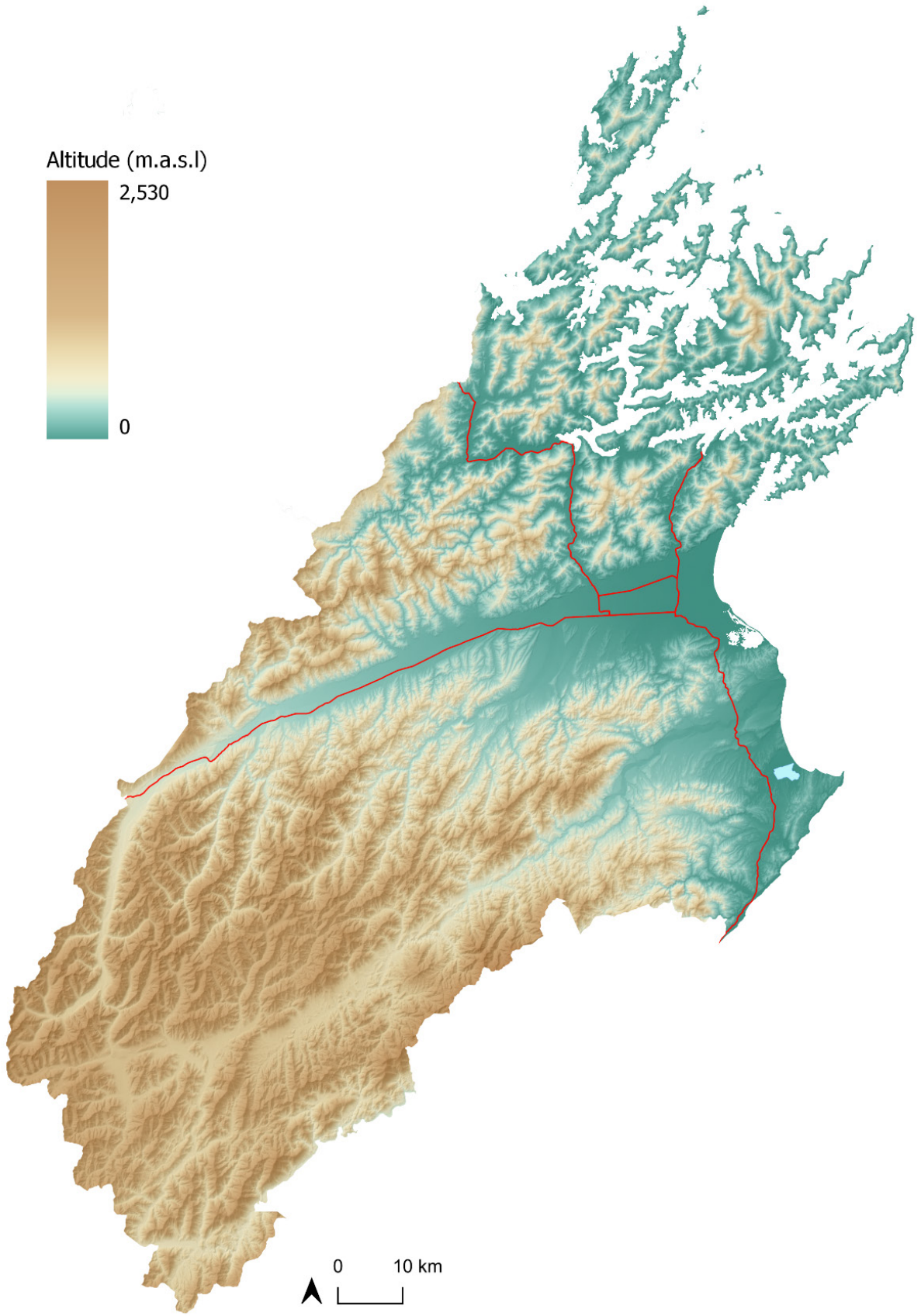


Image 5: Variation in altitude across Marlborough

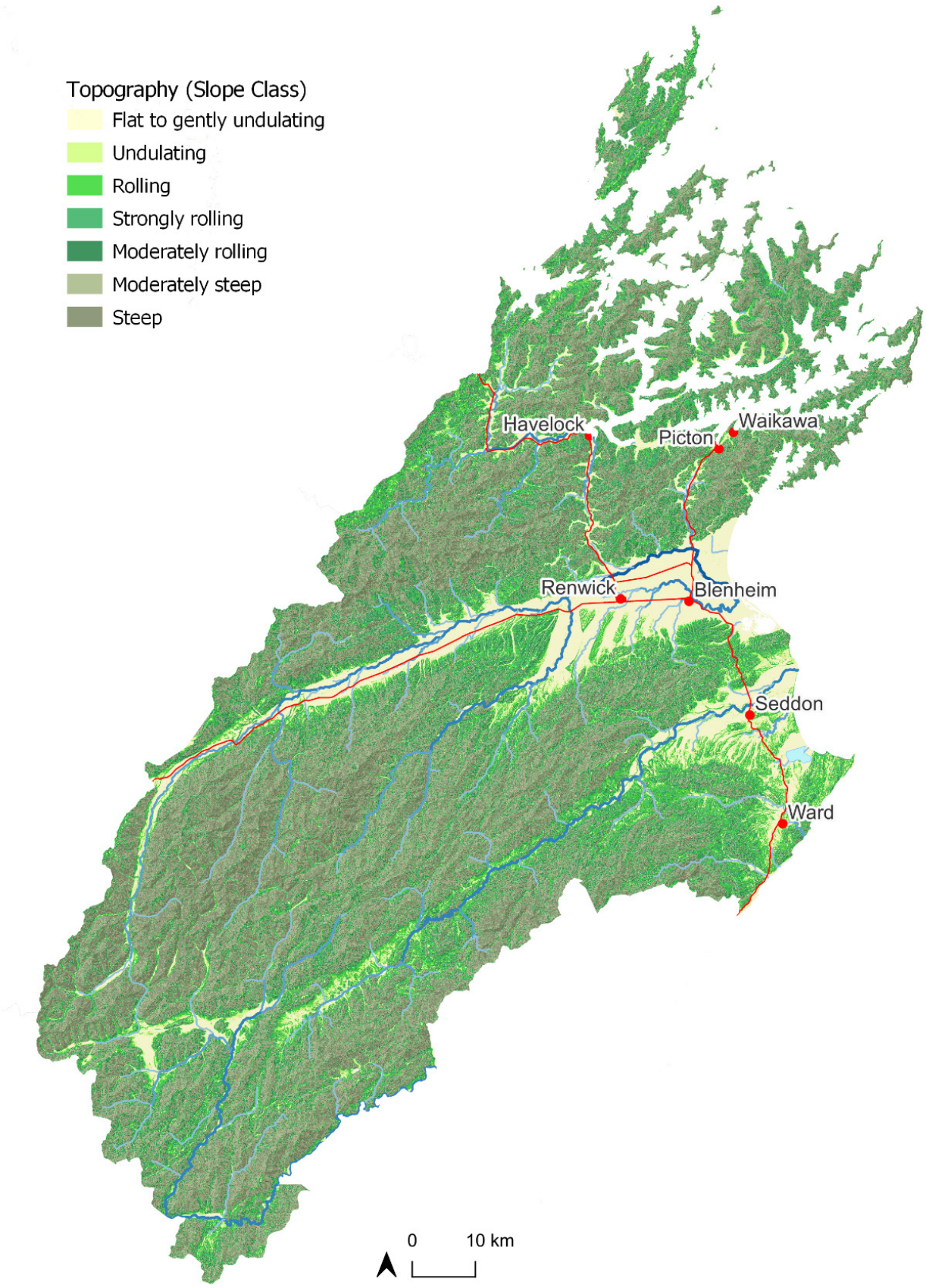


Image 6: Topography of Marlborough

2.2 Climate[20]

New Zealand's weather is dominated by eastward moving anticyclones that are usually accompanied by fine weather and intervening troughs of low pressure that contain cloud and, when they are more active, a belt of rain. These troughs, however, result in little rain in much of Marlborough because of its position in a rain shadow. The region is one of the driest parts of the country, and is accustomed to periods of low rainfall that occasionally result in drought[21]. A less common weather system seen in the region is an ex-tropical cyclonic storm, which can bring large amounts of moist air. Flooding and high winds from extreme weather events can cause considerable damage and disruption.

Marlborough has a high annual wind run[22], which contributes to evapotranspiration and dry summer climate (Marlborough District Council, 2015). Wind is highly influenced by the local topography and the windiest parts of the region are coastal. Westerlies and north-westerly winds are common, as are southerlies in eastern parts of the region (e.g., Cape Campbell, northeast of Ward). The outer Marlborough Sounds are exposed to frequent gales that buffet nearby Cook Strait. In contrast, Blenheim has the lowest mean wind speeds with its sheltered location in the Wairau Valley. Spring is generally the windiest season throughout the region, while winter records fewer strong winds.

As with other regions on New Zealand's east coast, Marlborough is not 'well-watered' but its annual rainfall can be more variable across the region than elsewhere (Image 7). The Wairau and Awatere valleys are sheltered from the pre-dominant westerly rain-bearing troughs, and areas around and inland from Blenheim and Seddon can receive less than 800 mm of rainfall per year. Some locations in the Awatere Valley (e.g., around Lake Grassmere and south of Cape Campbell), receive less than 600 mm. In contrast, the Marlborough Sounds receives between 1,600 and 1,800 mm of rainfall per year with over 2,000 mm in parts of the Richmond and Raglan Ranges.

Rainfall also varies throughout the year. Summer is the driest season, with the share of annual rainfall ranging from 17 per cent in Waitohi / Picton to 23 per cent at Aotea, Rangitahi / Molesworth, and Te Hoiere / Pelorus Sound. 'Rain days' (where at least 0.1 mm of rain falls) are less frequent from January to March and occur most often between June and September. No clear season is the wettest (i.e., maximum rainfall) and in most places there are only a few more rain days in winter than in spring. Te Hoiere / Pelorus Sound has the highest average annual number of rain days with 157 days and the area around Rangitahi / Molesworth has the lowest with 84 days[23].

Median annual average temperatures vary with elevation, from less than 6 °C in alpine areas in the region's southwest to around 12.5 °C in low-lying areas around the coast, and the Wairau and lower Awatere Valleys (Image 8). While summer afternoon temperatures in alpine areas may not exceed 15 °C, temperatures in the lowlands and lower elevation valleys of the Richmond Ranges can be above 22 °C. The lower Wairau and Awatere valleys have a high number of average annual 'growing degree days'[24] with a base of 10 °C or higher (e.g., 1,328 days in Blenheim and 1,449 at Lake Grassmere). By comparison, Rai Valley had 1,059 growing degree days and Rangitahi / Molesworth Station just 495.

---

20 This section is largely based on Chappell (2016). All results given are calculated from a 1981-2010 period.

21 A drought's impacts partly depend on adaptation, but they can continue for several years (Nixon *et al.*, 2021).

22 Windrun measures (in distance travelled) the total wind received over a particular time period.

23 The frequency of 'rain days' is assumed to be higher in the Richmond and Raglan Ranges than Pelorus Sound, but no data was available for those areas. For reference, a 'wet day' is where 1 mm of rain or more falls.

24 Growing degree days measure heat accumulation above a selected base temperature that is used as a threshold for plant growth (e.g., 5˚C for pasture and 10˚C for crops, such as wheat and grapes). They indicate how much warmth is available for a plant's growth over a time period. The length of the growing season (as well as its start and end) for different plants influences the nature of agriculture and horticulture in a locality.

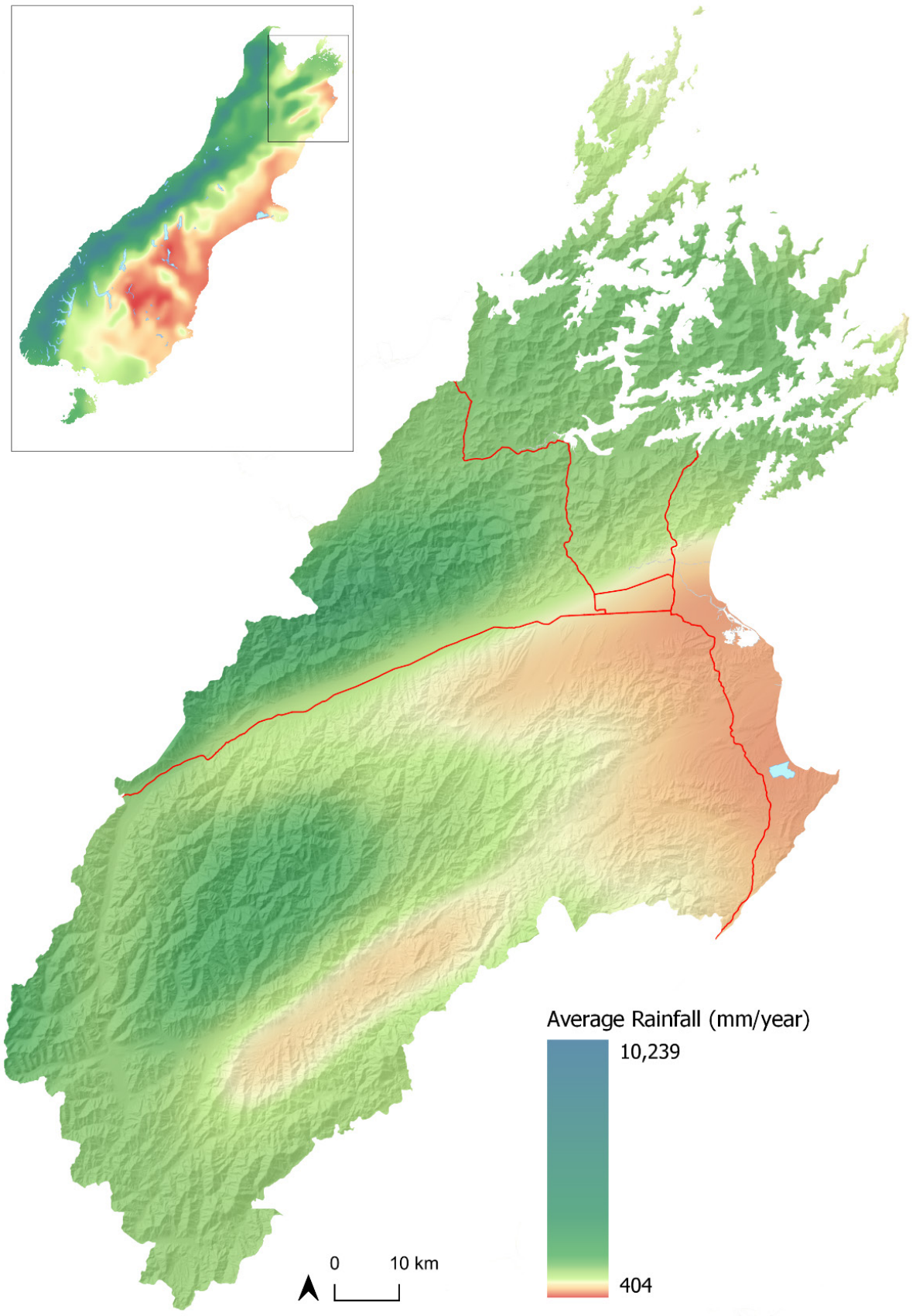


Image 7: Average annual rainfall for Marlborough (Ministry for the Environment and Statistics New Zealand, 2017)
Notes: The scale is determined by the range in rainfall across New Zealand. The transition from green to red occurs at approximately 800 mm/ year and red lines on map are state highways.

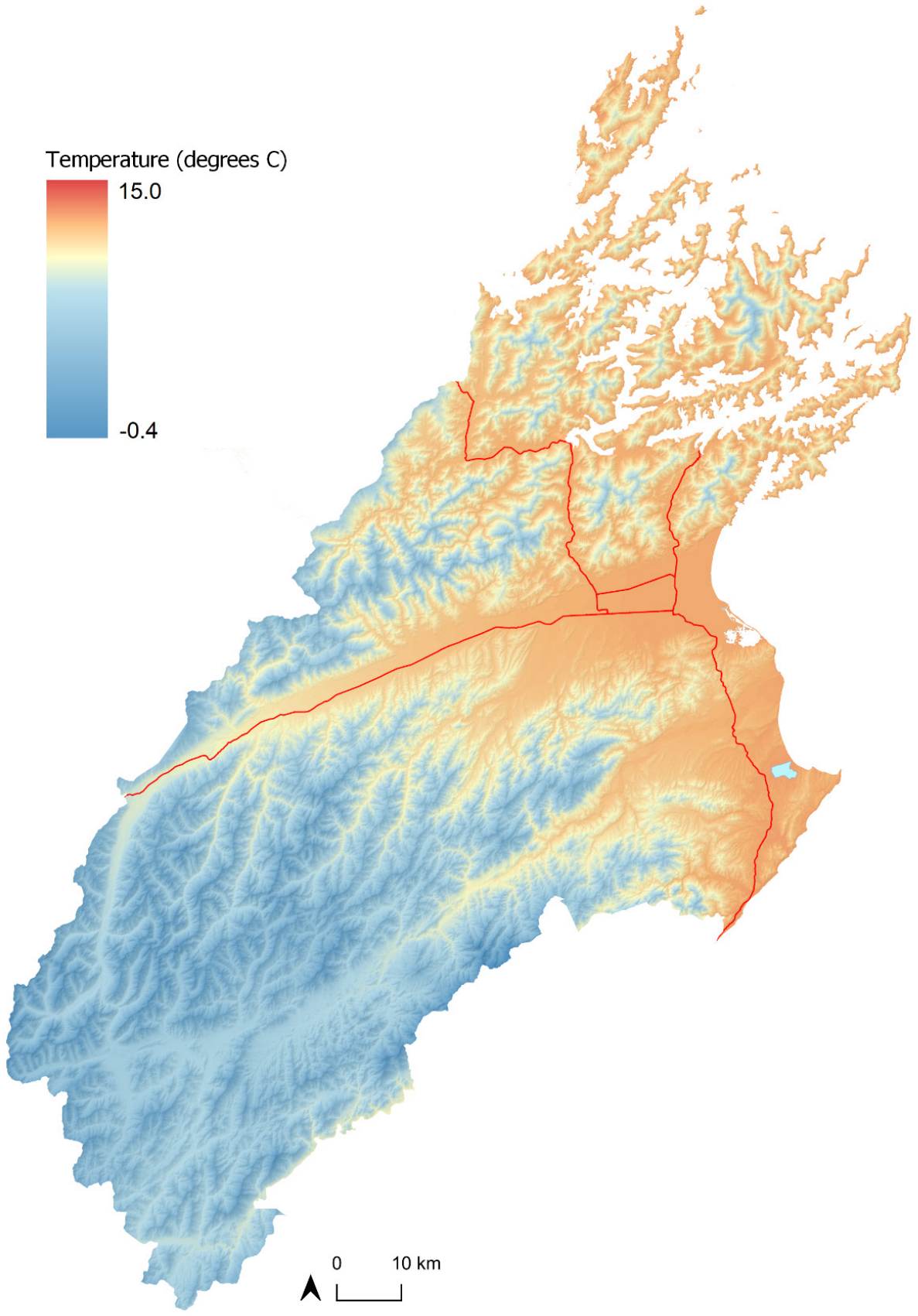


Image 8: Average annual air temperature for Marlborough (Leathwick et al., 2002)

2.2.1 Climate Change[25]

Changes to Marlborough's climate in the future are likely to be marked (Macara *et al.*, 2021). Some of the main projections include more hot days, fewer frost days, a shift to larger extreme rainfall events, and increased potential for drought. These projections are likely to result in the region's hydrological regime shifting towards more hydrological extremes (wet or dry). One effect is that mean annual low flows are expected to decrease for most catchments. A changing climate will have impacts across the region (Table 1). It is anticipated that these impacts will occur in the mid-term and be exacerbated over the longer term.

Table 1: Summary of key potential impacts of a changing climate in Marlborough (reproduced from Macara et al., 2021)

Topic	Potential climate change impact
Exotic forest	Increased productivity due to increased temperatures and carbon dioxide. Increased severity of droughts and fire risk. Increased rainfall intensity – impacts on erosion, landslides, movement of slash, access to forests for trucks and machinery. Increased incidence of pests and diseases as temperatures increase.
Horticulture	Increased temperature causing changes to place development stages and evaporation rates, affecting the quality and quantity of the harvested crop. Extreme heat may impact suitability of some crop types. Reduced frost damage, new opportunities for crop diversification. Increased biomass with increased carbon dioxide. Rainfall reductions and more severe droughts mean more irrigation may be needed. Increased rainfall intensity – impacts on erosion, sedimentation, quality of fruit and vegetables.
Ecosystems	Loss of habitat due to sea-level rise and coastal erosion (coastal squeeze) – this impact could be made worse by human responses to climate impacts e.g., sea walls. Risks to indigenous ecosystems and species due to the increased spread of invasive species. Warming oceans may impact the distribution of marine species (native and invasive). Ocean acidification may affect marine species with carbonate shells (e.g., paua and oysters) and fish behaviour.
Human health	Direct impacts on health via increased flooding, fires, and infrastructure damage, displacement of people, extreme heat. Indirect impacts on health via things such as harmful algal blooms, microbial contamination, food availability and quality, mental health and wellbeing, outdoor air quality, and carriers of new diseases.

Marlborough is in the Nelson-Marlborough FENZ[26] district (in Region 4, Te Ihu). The region has one of the most severe fire climates under current conditions (Langer *et al.*, 2021)[27]. A 'new wildfire climate is likely to emerge this century for much of New Zealand and large parts of the east coast of the South Island[28] are projected to experience the most extreme Fire Severity Rank (Rank 6) and not limited to just remote rural areas. Areas of northern Marlborough together form one of five 'hotspots' in New Zealand based on increases in fire danger and fire season length (Langer *et al.*, 2021).

25 This section is based on the NIWA report titled *Climate Change Projections and Impacts for Marlborough* (Macara *et al.*, 2021).
26 Fire and Emergency New Zealand.
27 A severe drought occurred during the summer of 2000-2001 (Chappell, 2016). In Blenheim, rainfall was less than half of normal from December 2000 to May 2001 and soil moisture deficits approached 150 mm of deficit (wilting point) between January and March. On Boxing Day wildfires razed over 7,000 hectares of farmland, across 17 farms, killing more than 2,000 sheep and cattle. By March, there had still been not enough rain to re-sow the pastures destroyed by the fires, and the economic impact was severe as stock had to be sold off early.
28 It is predicted that the conditions that led to the devastating 'Black-Summer' fires in Australia may occur every 3 to 20 years in areas of Marlborough (as well as the Mackenzie Country and Central Otago) (Langer *et al.*, 2021).

2.3 Soils

Marlborough's topography and climate largely determine the broad soil pattern in the region (Duckworth *et al.*, 1976). Along with topography and climate, soils influence what land uses are possible and where a land use generally occurs within the landscape. Soils are essential for land-based primary production systems, and while they can be bolstered with organic matter, soils are effectively a non-renewable resource as they can take centuries to develop. This section gives a brief overview of soil orders, soil rooting depth, and soil drainage in the region.

While soil maps are available for the whole region, they are generally legacy maps at coarse scales. There is detailed information for soils mapped on the Wairau Plain and the lower Awatere Valley at a 1:50,000 scale, while the rest of Marlborough has more outdated 1:250,000 scale soil mapping information. Marlborough District Council is currently refining these maps and standardising the mapping to S-Map (a digital soil map for New Zealand)[29]. As part of that process the following areas have recently been re-mapped: Awatere Valley, Upper Wairau Valley, Koromiko, Rai / Ronga catchment, Linkwater / Kaituna. There are soil characterisation reports for these areas as well as the Wither Hills. A characterisation report and new S-Map for Blind River (south of the Awatere Valley) is expected to be completed in 2025. Future work includes the Flaxbourne area, updating the lower Wairau Valley and the hill country of the Marlborough Sounds and South Marlborough.

There are 15 soil orders at the most generalised national level of the New Zealand Soil Classification[30], of which nine are identified in the Marlborough Region (Table 2 and Image 9). Gibbs and Vucetich (1962) described Marlborough as *"particularly interesting because it is the meeting ground for the soils and the farming from the North and South Islands of New Zealand". Beggs (1962) noted that "the area of flat, fertile soils in Marlborough is small and, in general, we must depend on fertility-building operations for any great increase in production".*

Table 2: NZ Soil Classification Soil Orders in Marlborough

NZSC Soil Order	Mapped area (ha)	Percentage of region
Brown	551,242	52.42
Pallic	222,403	21.15
Ultic	88,573	8.42
Recent	56,848	5.41
Podzol	52,579	5.00
Raw	48,590	4.62
Melanic	16,283	1.55
Gley	10,942	1.04
Organic	350	0.03

Data source: Fundamental Soil Layer, Manaaki Whenua – Landcare Research

29 https://smap.landcareresearch.co.nz/

30 Many farmers and growers will be familiar with level 4 of the classification (soil series or family) that typically uses the local name from the original soil surveys to describe the soil at that location (e.g., Tekoa, Kenepuru, Muller).

Brown soils are the most extensive soil order covering 52 per cent of the region. They are mature soils that have well developed top and subsoil horizons. Iron oxides give the soil a yellow to brown colour. Brown soils occur where summer dryness is uncommon and that are not waterlogged in winter (Hewitt, 2010). There are at least 32 soils classified as Brown soils in Marlborough with the most extensive being Tekoa, Kenepuru, Kaikōura, Hurunui, and Patriarch soil series.

Pallic soils cover just over one fifth of the region along the eastern boundary and are identifiable from their pale colours (low iron oxides), weakly weathered high base status, high slaking potential, and dense subsoils. They have water deficits in summer and soil water surpluses in winter and spring (Hewitt, 2010). The most extensive of the 24 Pallic soils are the Muller, Haldon, and Flaxbourne soil series.

Ultic soils are strongly weathered, clay-rich acid soils that form on stable land surfaces (Hewitt, 2010). They are predominantly found in the Te Hoiere / Pelorus catchment and northern Marlborough Sounds. They are naturally low in fertility and their clayey subsoils have poor drainage that are prone to wetness in winter with attendant risks of compaction or pugging, and drought prone in summer. The presence of clay minerals, such as kaolinite, halloysite, vermiculite, and smectite, makes the soil vulnerable to cracking under soil moisture deficit. There are two soil series, Ketu and Opouri, classified in the Marlborough region as Ultic soils.

Recent soils are found on young landscapes, mainly recent alluvial floodplains in the Marlborough region, where conditions are suitable for soil to develop a topsoil. The concept of the order relates predominantly to weak soil development rather than to the length of time of soil formation (Hewitt, 2010). The most extensive of the 24 Recent soil series are the Waimakari, Tasman, and Wairau[31].

Many of the limiting properties of the soils in Marlborough have been overcome with human intervention. The largest modification to soils has been the use of synthetic fertilisers to address nutrient deficiency and the installation of irrigation reducing climate limitations. An important limiting factor for primary production is soil depth. Soil development is slow in dry climates resulting in shallow rooting depths across large areas of the Marlborough region (Image 10). Where soils are shallow, they also have limited water holding capacity, with these areas being more dependent on irrigation and vulnerable to erosion.

Soil drainage is a key factor when assessing suitability of a soil for production, with the most favoured land typically being flat and well drained. However, what is ideal soil drainage conditions is strongly dependent on the product being produced. For example, Recent soils in Marlborough are sought after for wine production and do not match the typical description of soil suitability. Image 11 shows the drainage class of the soils in the region without any modification by artificial drainage.

Finally, soil erosion is a long standing issue in Marlborough. A scientific assessment of soil erosion in the region was undertaken in 1945 and the incidence of soil erosion at that time in catchments such as the Clarence and the Awatere was later described as “alarming” (Duckworth *et al.*, 1976: p79). A recent soil state survey of the region using aerial photography found that 11.5 per cent of the sample points were erosion-prone but inactive surfaces, 36.0 per cent were actively eroded and eroding surfaces, and 11.6 per cent were bare soil (mostly due to natural processes). The remaining 52.5 per cent of the sample points were on stable surfaces (Marlborough District Council, 2010).

31 More information is available at: *https://www.marlborough.govt.nz/environment/land/soils*; *https://soils.landcareresearch.co.nz/tools/fsl/maps-fsl/*; and *https://soils.landcareresearch.co.nz/topics/soil-classification/nzsc/*

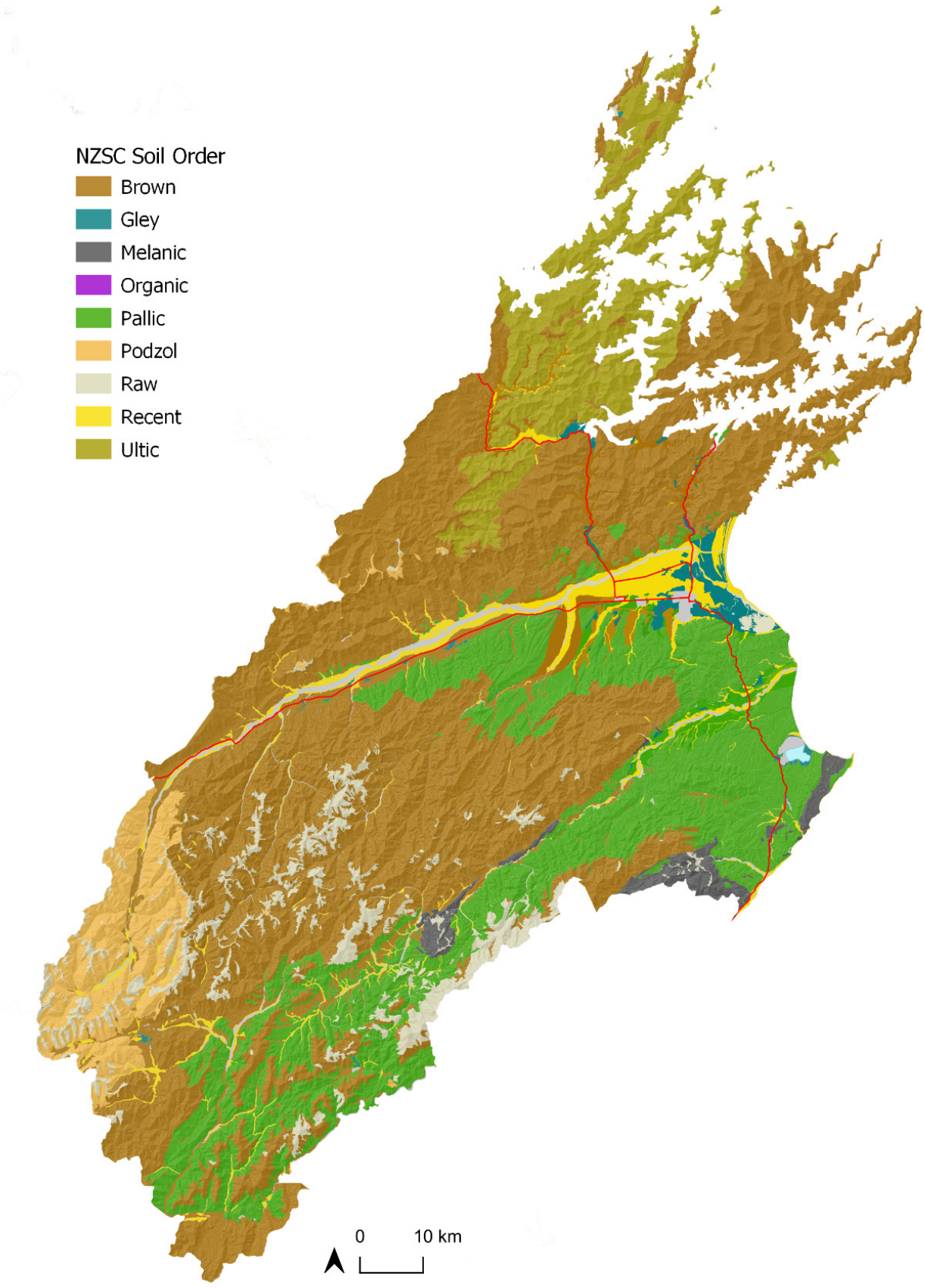


Image 9: New Zealand Soil Classification Orders in Marlborough

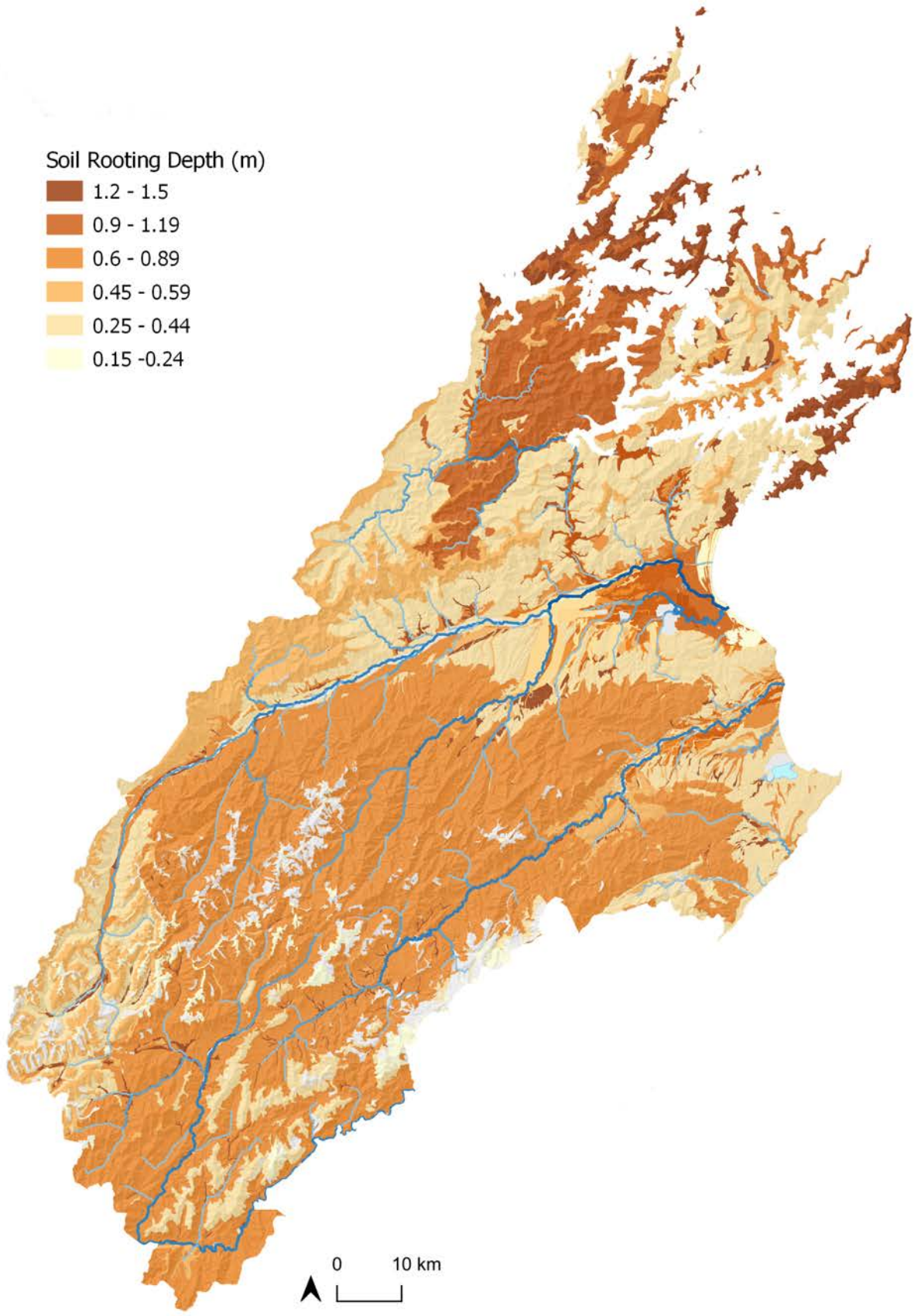


Image 10: Soil rooting depth in the Marlborough Region
Note: Blue lines on map are large rivers.

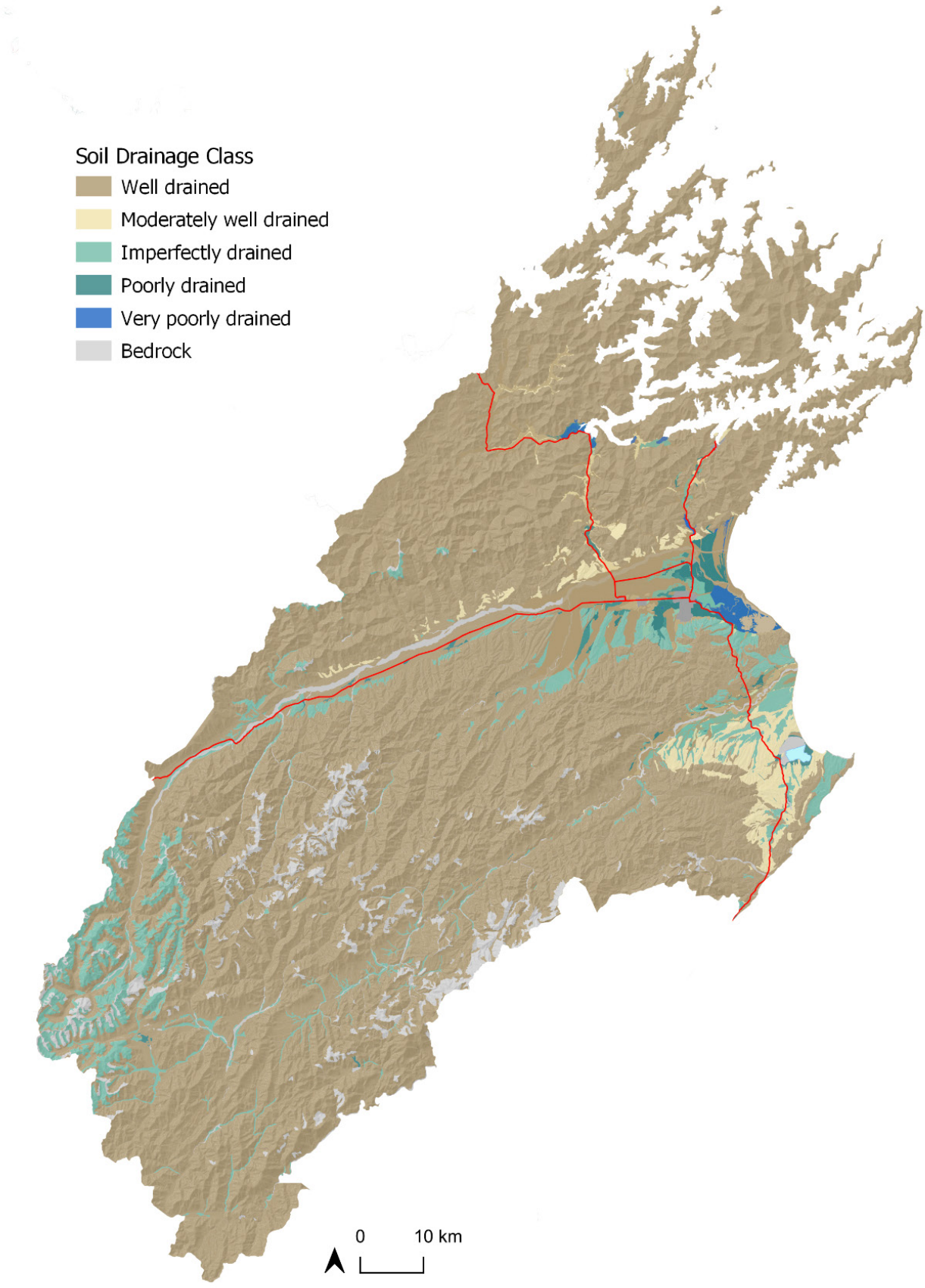


Image 11: Soil drainage in Marlborough (Pearson and Rissman, 2021)
Note: Red lines on map are state highways.

Image 12: Looking south from Severn Peak down to the Acheron Valley in November 2023[32]
Source: Raymond Ford

2.4 Physiographic Environments

Physiographic Environments of New Zealand (PENZ) is a new classification system that uses earth sciences (including chemistry) to explain why water quality in lakes, rivers, and estuaries varies across New Zealand - even when there are similar land uses on the surrounding land[33]. The classification system accounts for:

1. The composition of water and the hydrological pathways that different contaminants take as they travel from the land; and
2. The landscape processes that regulate contaminants, such as resistance to erosion, filtration and adsorption, dilution, and attenuation of excess nutrients (e.g., nitrogen and phosphorus).

In total there are ten physiographic environments in New Zealand. Each one has distinct properties (and variants) that can be used to predict its susceptibility for contaminant loss independent of land use (i.e., the source of a contaminant). Together, the ten environments help with both the productive capacity of the landscape and its inherent risks. Image 13 (on the next page) shows the distribution of these physiographic environments across Marlborough.

In the Wairau Catchment there is a large area of riverine and reducing soils on the river flats and surrounding hills. The dilution potential from alpine-sourced water in the riverine environment and denitrification in the environments with reducing soils minimises groundwater contamination from nitrate leaching. The

32 The Conservation Management Plan for Rangitahi/Molesworth Recreation Reserve is currently under review. The balance between farming, recreational access and activities, and pest and weed management will all have important implications for freshwater management in this part of Marlborough.

33 https://ourlandandwater.nz/project/physiographic-environments-of-new-zealand/ While this classification system is new, the term 'physiography' has been in usage since the mid-19th Century (albeit with various meanings).

strong rainfall divide along the Wairau River limits the transport potential of contaminants in the south but increases risk in the north. The weak bedrock environment is the most susceptible to sediment loss where there is sufficient rainfall to mobilise it. The extent of the oxidising environment, which is most susceptible to nitrate leaching, is far smaller than in Canterbury. The Marlborough Sounds is particularly vulnerable to contaminant losses from runoff, especially sediment and sediment bound nutrients and microbial contamination. Overall, water availability strongly limits the intensity of land uses across much of the region.

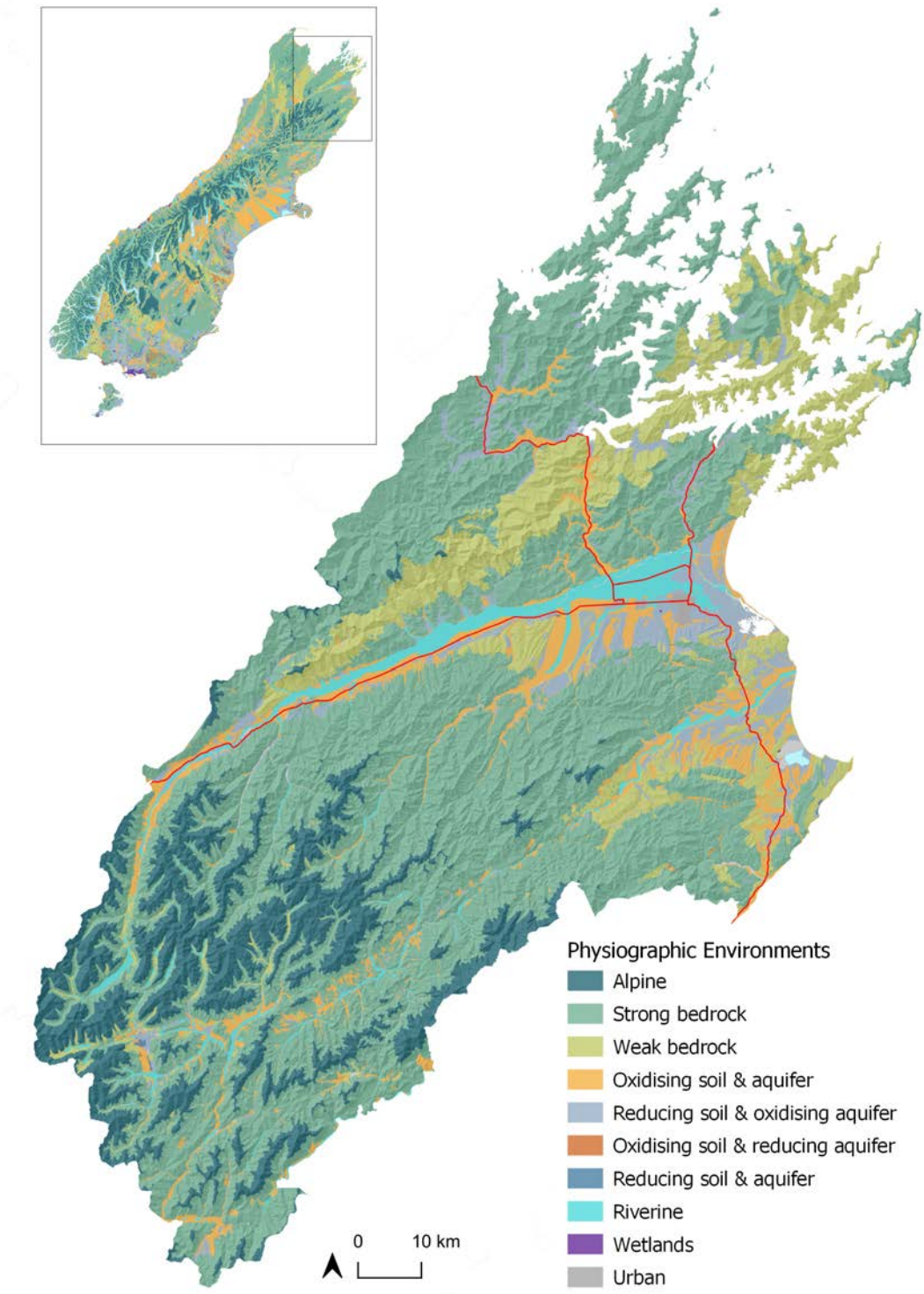


Image 13: Physiographic Environments of New Zealand (PENZ) in Marlborough (Landscape DNA)

3 Marlborough's Economy

As discussed in Chapter 1, this report's purpose is to improve understanding of the regional economy in relation to fresh water and its management. Having surveyed the economy's environmental context in the previous chapter, the report now turns to the matter at hand. Chapter 3 begins with an overview of the economy, paying specific attention to tourism and rural businesses. It then explores the region's 'land use capability' and current land use patterns before presenting a summary of demographics for local communities.

The uses that land is put to are important because they connect a community's economic activities with water takes and discharges of contaminants. As with economic activities, a region's land use patterns across its developed land tend not to permanent – such patterns are continually evolving and, in some cases, can be cyclical. The remaining chapters will explore the region's land-based sectors, and the industries within them, in more depth.

3.1 Overview

Broadly speaking, an economy is made up of economic agents (firms, households, government, and banks) who work together through a complex network of relationships to produce and consume its goods and services. Their economic activities generally occur across three sectors: primary (extraction and agriculture), secondary (processing and manufacturing), and tertiary (services). Within each of these sectors, economic activities fall into one industry or another based on similarities in products, behaviours, and markets. For precision, the Australian and New Zealand Standard Industrial Classification (ANZSIC) system is used here to identify industries but as they can be 'wordy' the industry names are highlighted in blue to help with readability.

An economy's size is usually measured as the amount or level of its economic activity. To be clear, the level of activity within an economy is a quantity metric – it does not necessarily say anything about the quality of those activities (i.e., their contribution to a community or how sustainable they are). The focus is on output, valued in dollar terms, rather than outcomes. The standard metric used for economic activity (and growth) is gross domestic product (GDP).

Image 14: Taylor River looking towards the Crinoline Bridge in Central Blenheim

Another quantity metric (but not one reported here) is gross output, which is useful when considering industries or sectors within a specific geographic area (Moran, McDonald, & McKay, 2024). While economic activity is useful, other viewpoints are also needed. Employment, in particular, is a critical metric for assessing the impacts of change (whether from policy options or other factors) on local communities (Moran *et al*., 2024).

In 2018 Marlborough's annual gross domestic product was $3.06 billion, which was around one per cent of New Zealand's total gross domestic product. The region had a compound annual growth rate of seven per cent in the decade from 2008 to 2018, compared to six per cent for New Zealand. In 2023 Marlborough's annual gross domestic product had grown to $3.95 billion and its share of New Zealand's total gross domestic product was the same as in 2018.

Figure 1 shows trends in economic activity (as measured by nominal gross domestic product) for Marlborough on a per capita basis since 2000 – Nelson / Tasman and New Zealand are also included for comparison. Overall, key industries within the economy are strongly seasonal, with much of their activity being influenced by the region's climate and so are focused on certain times of the year. This seasonality characteristic is discussed in relation to tourism (Section 3.1.1) as well as rural industries in the following chapters.

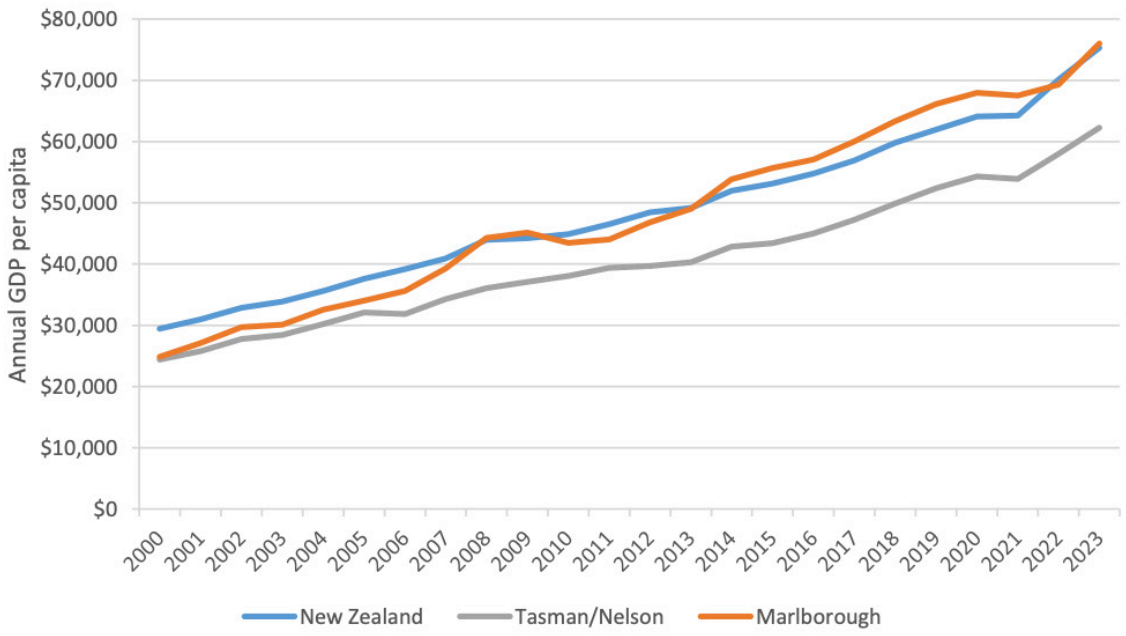


Figure 1: Economic activity in Marlborough compared to New Zealand 2000 to 2023
Source data: Stats NZ (gross domestic product by region – current prices)

An important reason for the recent growth in Marlborough's economic activity is the regional specialisation[34] in several industries (some of which are connected): Fruit and tree nut growing; Beverage manufacturing; Fishing and seafood processing; and Agriculture and fishing support services (MBIE, 2019). Despite the growth in such industries, Marlborough tends to be more reliant on trade with other regions than the average for New Zealand. Overall, businesses in Marlborough depend more heavily on Auckland and Wellington for

34 Regional specialisation is a measure of which industries are concentrated in Marlborough. If the region specialises in an industry it means that the industry's share of employment in that region is higher than the industry's share of employment nationally (MBIE, 2020).

imports of goods and services than they do for exports (MBIE, 2019). This said, the region exports more than it imports to Canterbury, Otago and the Bay of Plenty. The industries most dependent on other regions are Manufacturing and Agriculture although Forestry, fishing, mining, electricity, gas, water and waste services as well as Rental hiring and real estate services and Construction also feature strongly.

Figure 2 shows the contribution of selected aggregated industries to Marlborough's economy over time. The contribution of many of these industries tends to vary by region – depending on both diversity within the economy and its size. As an example, Agriculture directly contributed 10.0 per cent to Marlborough's economy in 2022, 19.3 per cent in Southland, and 7.3 per cent in Canterbury (4.6% to the New Zealand economy) (MBIE, 2024). Collectively, the industries in Figure 2 accounted for over half of economic activity in the region – the remaining half being service industries such as Transport, postal, & warehousing; Financial & insurance services; Rental, hiring, & real estate services; Education & training; and Health care & social assistance. The service sector makes up the core of most economies.

In Figure 2, Primary manufacturing, which here includes Beverage manufacturing, clearly dominates the economy as does Agriculture, which here includes Fruit and tree nut growing, and Forestry, fishing, mining, elect, gas, water, & waste services. However, Primary manufacturing has had mixed fortunes in Marlborough over the past decade, with the impacts of the Global Financial Crisis on demand for wine, Talley's ending its processing of field peas in 2017 (the company retained other vegetable and mussel processing capacity in the region) and Fonterra closing its Tuamarina milk processing plant in 2023[35].

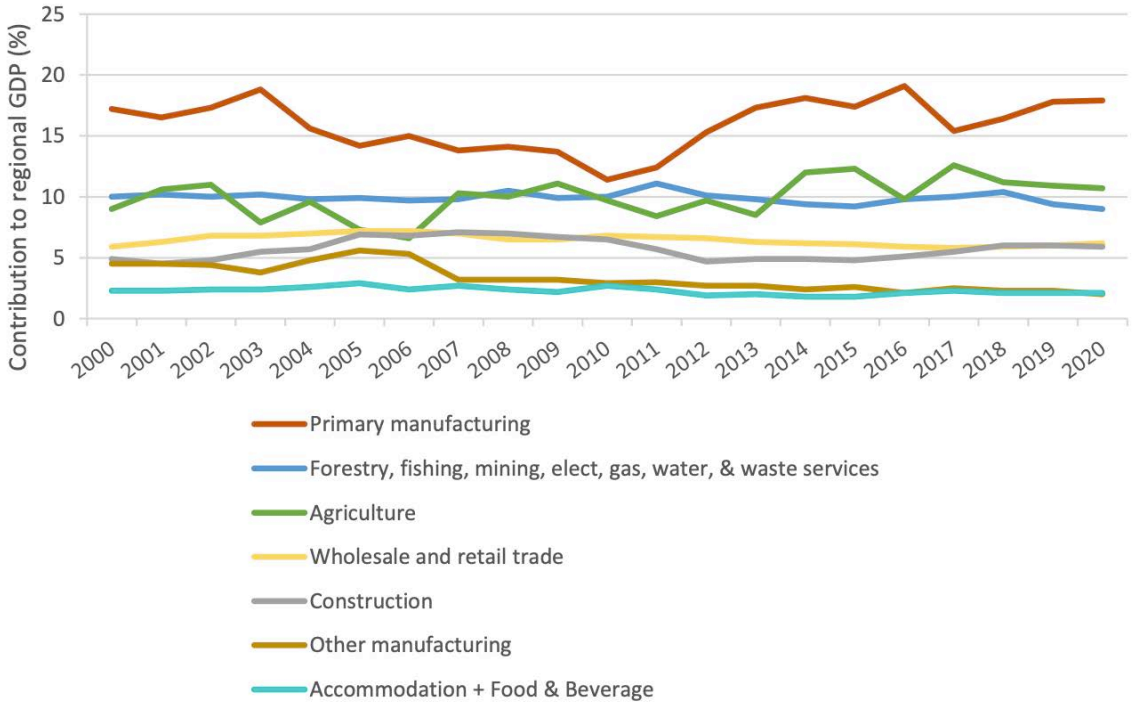


Figure 2: Value added contribution to Marlborough's economy by selected aggregated industries 2000-2020
Source data: Stats NZ (gross domestic product by region – current prices)
Note: Forestry, fishing, mining, electricity, gas, water, and waste services is aggregated because of data confidentiality issues.

35 The milk-concentration plant replaced a cheese factory that burnt down in 2004. Fonterra used the plant to remove water from the milk to reduce the volume of liquid trucked to Fonterra's Clandeboye factory in South Canterbury. The cheese factory was originally owned by the Waitohi Co-operative Dairy Factory Company and later by the Marlborough Cheese Company. A history of the Waitohi Co-operative Dairy Factory (formed in 1895) is available at: https://tamiro.massey.ac.nz/nodes/view/1698#idx13658

Almost all businesses in New Zealand are small and those in Marlborough are no exception[36]. In 2018 Marlborough was home to 7,065 firms (or businesses) with 96.4 per cent of these firms either being self-employed or small firms (less than 20 employees) (MBIE, 2020). At the time the largest employment industries in the region were the Agriculture and fishing support services[37] (2,820 employees), Fruit and tree nut growing (1,910 employees), and Beverage manufacturing (1,710 employees) (MBIE, 2020). The three industries with the most self-employed workers at the time were Fruit and tree nut growing, Sheep, beef cattle and grain farming, and Residential building construction. The importance of employment in primary production for Marlborough's economy is long standing (e.g., McLintock, 1966; Ashworth-Morrison Cooper, 1982), although over time there have been changes in emphasis between industries.

By 2023, the number of firms in Marlborough had risen to 7,359, largely because of increases in self-employed firms and medium-sized firms (20 to 49 employees). Table 3 compares the distribution of firms by size for 2018 and 2023. In year to June 2024, the share of working-age people employed in Marlborough (69.8%) and the region's labour force participation rate (72.2%)[38] were both just above those for New Zealand's employment (68.8% and 71.8% respectively) (MBIE, 2024).

Table 3: Comparison of firm-size (number of employees) between 2018 and 2023 in Marlborough

Year	Self-employed	Small firms (less than 20 employees)	Medium-sized firms (20 to 49 employees)	Large firms (50 employees or more)
2018	4,758 (67.3%)	2,058 (29.1%)	168 (23.8%)	81 (11.5%)
2023	5,097 (69.3%)	1,992 (27.1%)	186 (25.3%)	84 (11.4%)

Source data: Taranaki Regional Council

The Stats NZ Business Frame[39] is useful for looking at the types of industries in different areas, although the data is recorded 'as of February' so it may not always be a good fit for industries with seasonality changes, such as horticulture and viticulture. In 2020, migrant/seasonal workers made up around 12 per cent of the workforce in Marlborough (MBIE, 2020). Demand for temporary migrant workers is seasonal, with the highest demand occurring in March. In the year ended February 2024, there were 1,242 temporary migrant workers working in agriculture, forestry, and fishing in Marlborough (an increase from 1,005 workers in 2020).

36 New Zealand is a nation of small businesses – including self-employed. In total there are around 546,000 small businesses, which is 97% of all firms. Small businesses account for 29.3% of employment and contribute over a quarter of New Zealand's GDP. Small businesses in most other countries are defined as having fewer than 50 employees. *https://www.mbie.govt.nz/business-and-employment/business/support-for-business/small-business*

37 As an example, Kiwi Seed are Marlborough owned and operated Grain and Seed Merchants who employ 14 staff *https://www.kiwiseed.co.nz/about*

38 The employment rate is the number of employed as a share of the working-age population. The labour force participation is the labour force (including both employed and unemployed) as a share of the working-age population (MBIE, 2024). Stats NZ Business Frame Employment Count dataset relies on Inland Revenue's Pay As You Earn (PAYE) information and so does not include working proprietors. The owners of small businesses are usually paid through dividends or 'drawings' from their business.

39 The Business Frame links ANSEC coded data from Inland Revenue Department (IRD) and Accident Compensation Corporation (ACC), and reports business counts and employment counts. The dataset is produced annually, compared to the employment data in the Census of Population and Dwellings, which is four-yearly. The dataset is a headcount of employees rather than a full-time equivalent (FTE) so if, for example, a person has two jobs then they will be counted twice.

3.1.1 Tourism

Tourism expenditure in Marlborough totalled $370 million for the year ending April 2020 (just as New Zealand and the rest of the world faced COVID-19), which represented one per cent of national tourism expenditure at the time. During the previous five years, tourism expenditure had grown an average of one per cent per year, compared to the national annual growth rate at the time of four per cent. In year to June 2024, there were 13.5 guest nights per capita in Marlborough, which was just under 1.8 times the national value (for comparison, there were 120.1 guest nights per capita in Kaikōura and 12.2 in Tasman) (MBIE, 2024).

Marlborough's tourism sector has the geographic advantages of a central location within New Zealand and a mild climate (MDC, 2022)[40]. These advantages align with six tourism attributes: wine, seafood, aviation, heritage arts and culture, Marlborough Sounds, and the natural environment (MDC, 2022). Differing mixes of these attributes occur across four 'valley' environments in the region: 1) Te Hoiere (Pelorus Valley from Rai Valley to D'Urville island), 2) Tōtaranui – Queen Charlotte Sound from Anakiwa to Arapaoa Island and beyond, 3) the Wairau Valley from Nelson Lakes to the Wairau Bar, and 4) the Awatere Valley with South Coastal Marlborough.

The tourism sector is unlike other sectors in the economy in that it is not defined by the goods and services it produces - rather it is defined by the distinctive set of goods and services consumed by tourists (Patterson & McDonald, 2004). In other words, the sector is defined on the basis of consumption rather than production. It consumes a share of the gross output of industries in other sectors of the economy (e.g., 'Accommodation, restaurants and cafes'). Consequently, tourism tends to be highly connected within an economy. As well, tourists (when in their location of origin) may also be consumers of a region's products (e.g., wine, lamb, beef, and seafood) in its domestic and international export markets.

Image 15: View of Moikarurangi Bay looking south to Waikawa in 2005

40 More information is available at *https://marlboroughnz.com/about-destination-marlborough/*. Destination Marlborough is a not-for-profit Trust responsible for marketing Marlborough as a visitor destination.

The tourism sector in Marlborough is seasonal. Figure 3 shows how the contribution of domestic and international tourism to the Marlborough economy varies throughout the year, peaking over the warmest and driest months. Ongoing seasonally based gaps in visitor numbers can impact long term investment and maintenance of current infrastructure. Domestic tourists in Marlborough spending using electronic cards was $9.8 million in July 2024 (-9.3% compared to July 2023). The spending of international tourists in the region was $1.3 million in July 2024 (-7.1% compared to July 2023).

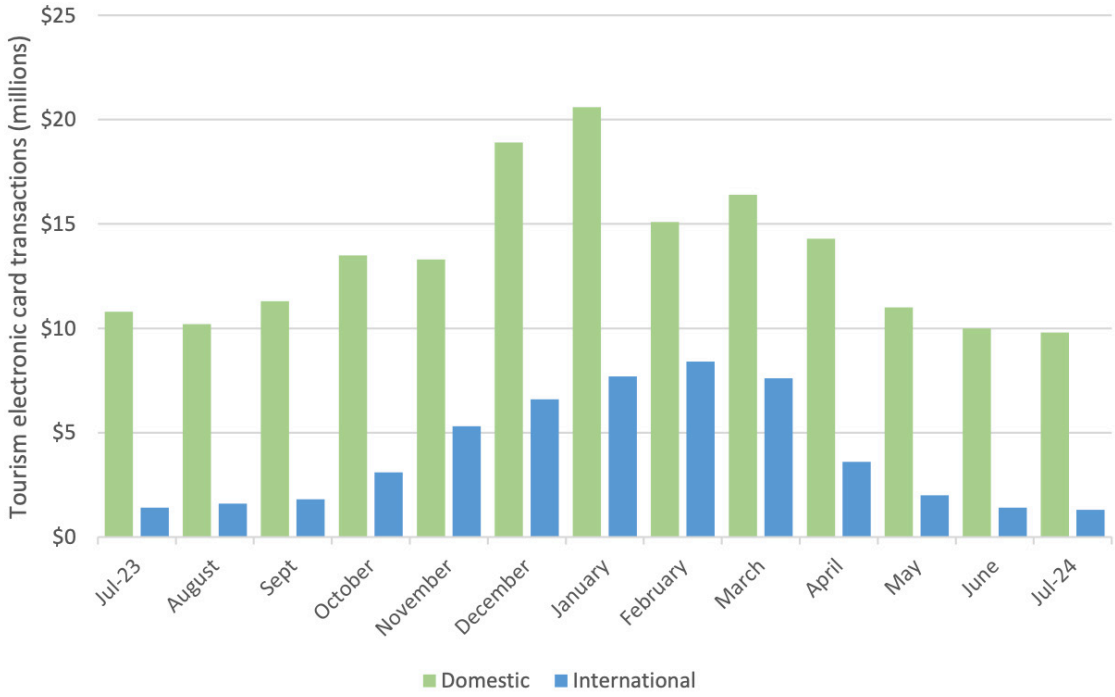


Figure 3: Monthly electronic tourist expenditure in Marlborough between July 2023 and July 2024
Source data: https://teic.mbie.govt.nz/teiccategories/datareleases/tects/

Before the COVID-19 pandemic, annual expenditure from the cruise ship industry in Marlborough had grown from 8.5 million in 2015-16 (financial year to end of June) to just over $29 million in 2019-20, when it accounted for roughly 25 per cent of the region's international visitor spend. During the same 5-year time period, the total number of cruise ship passengers increased by 86 per cent, from just under 51,500 to just over 95,500. However, since 2019-20, Stats NZ has stopped reporting this type of information. In 2022-23, 47 cruise ships visited Picton and in 2023-24 55 cruise ships visited, including 10 maiden visits, carrying 100,859 passengers and 43,876 crew members (Port Marlborough, 2023 & 2024)[41]. The vessels vary in size, carrying between 180 and 4,000 passengers.

41 More information is available at *https://portmarlborough.co.nz/shipping-schedules/*

Figure 4 shows that the region's visitor experiences, services and other products are predominately located in either the Wairau Valley or Queen Charlotte Sound / Tōtaranui, with many in or around key visitor service towns of Blenheim and Picton. One of several potential risks identified in the Marlborough Destination Management Plan 2022-2032 is environmental pressure applied by traditional primary production and pre-Covid tourist visitor volumes could reduce the regional appeal. Image 16 shows the most popular locations in Marlborough with locals.

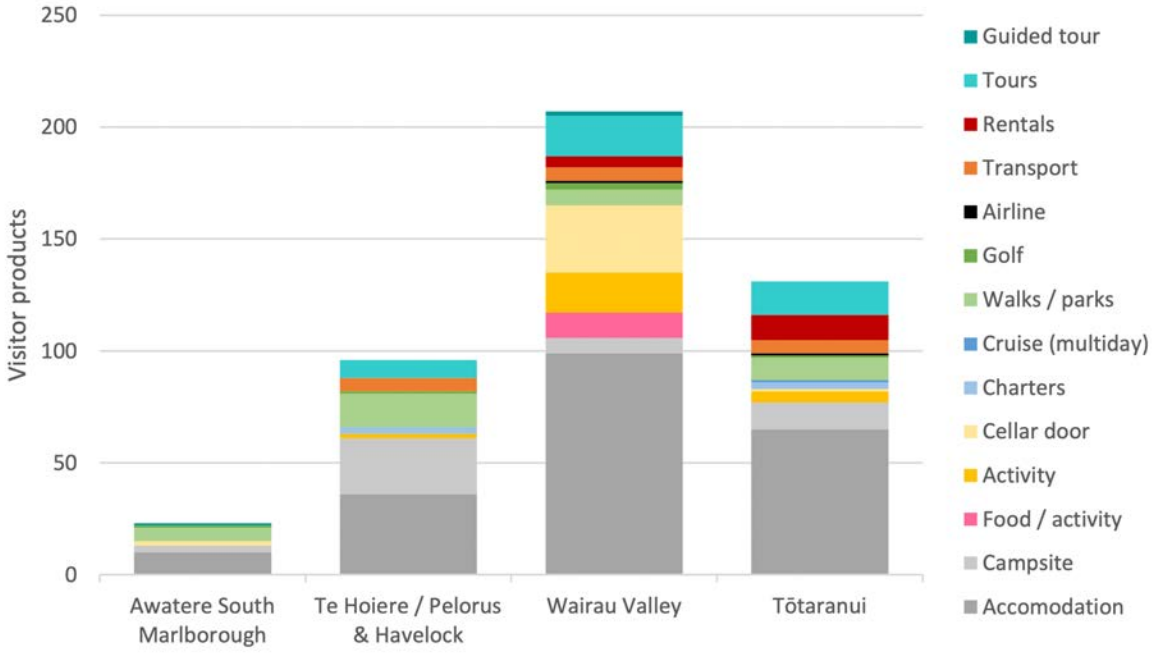


Figure 4: Results from Marlborough commercialised visitor products and experiences audit 2021
Source data: Marlborough Destination Management Plan 2022-2032

Image 16: The most popular locations in Marlborough visited by locals in 2021 and 2022
Source: Results of a community survey in Marlborough Destination Management Plan 2022-2032

Wine tourism is a rapidly growing and high-value activity for the wine growing region and wineries host thousands of visitors every year from New Zealand and abroad. Wine is central to Marlborough's tourism product, having grown exponentially since around 2010 (except for the interruption from COVID-19). Wine and food features strongly in the Marlborough Destination Management Plan as one of their main drivers of visitor numbers. The wine industry offers tastings and sales at between 30 and 35 cellar doors throughout the region. The industry also supports the region's cafes, restaurants, and wine merchants to stock local produce. Wine tourism is used internationally by Tourism New Zealand and by Air New Zealand to attract visitors.

Most cellar doors are represented on the Marlborough Wine Trail Map[42] and some are long term operators so clearly see the value in the exercise. For wineries in Marlborough that are small and privately owned, cellar door sales can make up a considerable proportion of their revenue. However, the relative importance of cellar door sales varies greatly. In cases where a winery does not have export markets or distribution, the cellar door is their only source of revenue. The Sale and Supply of Alcohol (Winery Cellar Door Tasting) Amendment Act 2024 allows winery cellar doors without on-licences to charge visitors for samples. The amendment is expected to reduce cost and grow, or at least maintain the number of cellar doors in the region (Marcus Pickens, pers. comm., September 2024).

3.1.2 Rural Businesses

Two important measures for understanding the nature of an industry and the impacts of policy are the number of businesses and their geographic extent (i.e., land area). Stats NZ define a 'farm' for its Agricultural Production Survey as a business that is:

1. Classified by Stats NZ's Business Frame as being engaged in horticulture, cropping, livestock farming, or exotic forestry operations; and
2. Goods and services tax (GST) registered and earn over $60,000 during a financial year[43].

In this context, 'earn' refers to a business' 'turnover'[44] (i.e., its gross revenue). However, a commercial farm business usually needs a turnover far in excess of $60,000 to be viable.

Using the Stats NZ definition and data, farmland in Marlborough decreased in area between 2002 and 2022 by just over 200,000 hectares (-29%) from 696,049 hectares to 494,717 hectares, while the number of farms declined by 379 (-22%) from 1,690 to 1,311. Some of the decrease in the area will be as a result of tenure review of Crown Pastoral Leases. This decreasing trend has largely occurred since 2007 and more recently it has been gathering pace.

Figure 5 shows how farmland in Marlborough varies by industry (classified based on largest percentage of income[45]). Land area is just one way of measuring a farm's 'size'. Other metrics include employment, gross revenue, and environmental footprint. Roughly 72 per cent of farms in the region were either grape growers (44%) or sheep and beef cattle (28%) with those remaining largely being forestry, dairy, horticulture, and arable. Most horticultural operations (excluding viticulture) cover a small area, although the data suggests there were several sizeable 'vegetable' growers, 'kiwifruit' growers, and 'other fruit and tree nut' growers. However, this Stats NZ data does not appear to be entirely consistent with the data for the area of horticultural crops reported in Chapter 5.

In total, around 71 per cent of farms are less than 100 hectares and another 10 per cent have an area from 100 to 200 hectares. Land use patterns in Marlborough are discussed in the next section. Specific maps indicating the spatial distribution of farms for each rural industry are included in subsequent chapters.

---

42 The Marlborough Wine Trail Map 2024-25 with identified goods and services is available at: *https://static1.squarespace.com/static/61bbfc1dcf4b237f9d917b26/t/666b67c2a0440c0326161aa3/1718314947825/Wine+Trail+2024+Base+FIle_28May24+%28Final%29.pdf*

43 This data comes from the Agriculture Production Survey (APS). Every five years Stats NZ conducts a census of all farms in New Zealand (e.g., 52,300 farms in 2017) and a sample survey in non-census years (e.g., 28,700 farms in 2019). *https://www.stats.govt.nz/indicators/farm-numbers-and-farm-size-data-to-2022/*

44 Inland Revenue describes 'turnover' as the amount of money made from selling goods or services over a particular period. Turnover is not the same as profit, which is the money left after paying expenses. *https://www.ird.govt.nz/gst/registering-for-gst*

45 Up to five sources of farm income are able to be identified on the Agricultural Production Survey form.

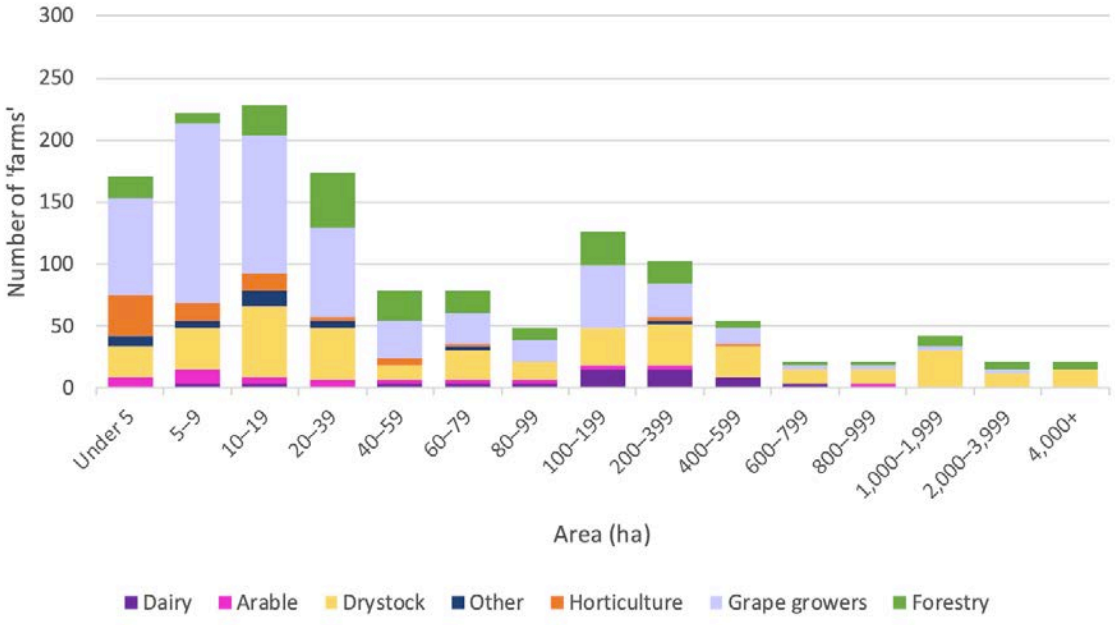


Figure 5: Estimated distribution of 'farms' by area in Marlborough at end of June 2022
Source data: Stats NZ Agricultural Production Statistics

3.2 Land Use

Since land development began in New Zealand in the mid-19th century, land uses have evolved with the changing fortunes of different industries and communities. Reasons for change are usually complex but can include shifts in the supply of inputs, demand for products, market access, new or aging infrastructure, transport, technology, entrepreneurialism, and government policy. The opportunities and constraints created mean that land use cycles vary in length – some may be relatively transient while others are more persistent and become part of the economic and social fabric of a place. Following New Zealand's deregulation of its markets in the 1980s, the rates of change have been rapid. The nature of land use patterns in a region over time is closely connected to the policy options for fresh water and their impacts.

In 1983 Marlborough contained over 5 per cent of New Zealand's 'occupied' land (the province included Kaikōura at the time) but had proportionally fewer farms and less improved land, crops, and exotic forestry (Yeoman, 1983). Rural land use was summarised as follows:

> *On the 1,332 holdings in Marlborough, the types of production are too numerous to discuss in any detail. They include production of vegetables - both fresh and processed, vegetable seed, a wide range of orchard fruits, kiwifruit, prime lambs, store stock, both fine and crossbred wool, beef, dairy products, town milk, deer meat and velvet, Angora fleece, cereal crops, and a range of herbage seeds. If there is a dominant characteristic of Marlborough's agriculture, it is its diversity.*
>
> ***Yeoman (1983)***

The region's main trend in rural land use since this time has been shifts away from pastoral farming, and more recently arable cropping, vegetable growing, and orcharding, towards grape growing for wine and forestry. While the overall loss of diversity is a similar trend to that in many other regions in New Zealand, particularly those in the South Island, it differs in that the shift has been towards viticulture

rather than dairying. The following excerpt illustrates some of the land use changes in Marlborough over the past 50 years:

> *Growing up on the family dairy farm in the lower Wairau near the Grovetown Lagoon, Robert Kennedy was the third generation to farm the land. In the late 1970s and early 1980s, he converted the property and planted an extensive fruit orchard with apples and kiwifruit and a large market garden growing crops such as squash, garlic, onions, brassicas, and greens… As the popularity of Granny Smith then Red Delicious apples waned in the mid-1990s, Robert started converting some of 32-hectare property into vineyards. "Unlike fruit and vegetables, which were largely for the domestic market, wine has always been about export, so we weren't competing against anyone else."*
>
> ***Kat Pickford (2022)***

The Land Use Capability System is used to assess the land's capability for sustained primary production, while considering its physical limitations and its versatility (Lynn *et al.*, 2009)[46]. These limitations include susceptibility to erosion, steepness of slope, climate, susceptibility to flooding, liability to wetness or drought, salinity, and depth, texture, structure and the soil's nutrient supply.

> *LUC Classes 1 to 4 are suitable for arable cropping (including vegetable cropping), horticultural (including vineyards and berry fields), pastoral grazing, tree crop or production forestry use. Classes 5 to 7 are not suitable for arable cropping but are suitable for pastoral grazing, tree crop or production forestry use, and in some cases vineyards and berry fields. The limitations to use reach a maximum with LUC Class 8. Class 8 land is unsuitable for grazing or production forestry and is best managed for catchment protection and/or conservation or biodiversity.*
>
> ***Lynn et al. (2009: p9)***

Figure 6 shows Marlborough's relatively small proportion of more versatile land (LUC Classes 1-5), with it totalling just 23 per cent of developed land in the region[47]. In neighbouring Tasman, for example, the proportion of more versatile land is 36 per cent. The only regions in New Zealand with proportionally less LUC 1-5 land are Nelson (9%) and Gisborne (15%). As a comparison, LUC 1-5 land accounts for 71 per cent of developed land in Southland and 66 per cent in Taranaki. Most of Marlborough's more versatile land is located in the lower Wairau and Awatere Catchments. In general terms, the market value of land at a point in time is determined by its 'highest and best' land use that is practical, feasible and legally permissible (Moran, McDonald, & McKay, 2023).

It has been previously estimated that the total urban area[48] in Marlborough increased by almost half between 1985 and 2002 from 1,982 hectares to 2,946 hectares (90% of the additional area having occurred by 1997) (Rutledge, Briggs, Lynn, & Price, 2010). An estimate using LUCAS, indicates the total urban area in 1989 was 2,472 hectares, 2,945 hectares in 2007, and 3,057 hectares in 2020. The difference between the two approaches is largely explained by how lifestyle blocks are identified. The LUCAS dataset formed the basis of the Marlborough Land Use Map 2023 (refer to Image 13 below), which was used to estimate 2,191.5 hectares of urban and rural settlement as well as 1,306.8 hectares of lifestyle (Pearson, 2024).

---

46 In 2010, Landcare Research undertook an in-depth analysis of Marlborough's land-use change trends and their impact on soil resources, particularly in relation to urbanisation (Rutledge *et al.*, 2010). There are some differences in the methodology used (e.g., their inclusion of estuaries, lakes, rivers, quarries, and urban areas), which accounts for slight variability in the results compared with the assessment used in this report.

47 In the 1970s it was noted that the "better class flat to rolling country most suited to cropping of pastoral use" comprises about 78,000 ha or seven per cent of the province and about 12,000 ha of this land is suited to regular cropping (Duckworth *et al.*, 1976: p140).

48 Urban was defined by the authors as Built-up Area, Surface Mine, Transport Infrastructure, Urban or Lifestyle Blocks. The estimates were made using LRI, LCDB2, and LCDB1 respectively.

In general terms, agricultural businesses tend to have a mixed topography, with any LUC 1-4 land on a property usually being central to a production system (Moran (Ed.), 2023). In horticulture, vegetable growing tends to focus on LUC 1 and 2 while the free-draining properties of the soils on the higher LUC classes are well suited to orchard crops. LUC Classes 1–3 are highly versatile soils suitable for arable agricultural production (Rutledge *et al*., 2010). For viticulture, prime grape growing soils are not always the most fertile soils and, in some circumstances (e.g. in Central Otago) they can include higher bands of the LUC classification system. The distribution of LUC Classes on Marlborough's developed land are reflected in the current land use patterns (Image 13) and the broad distribution of economic activities across the landscape.

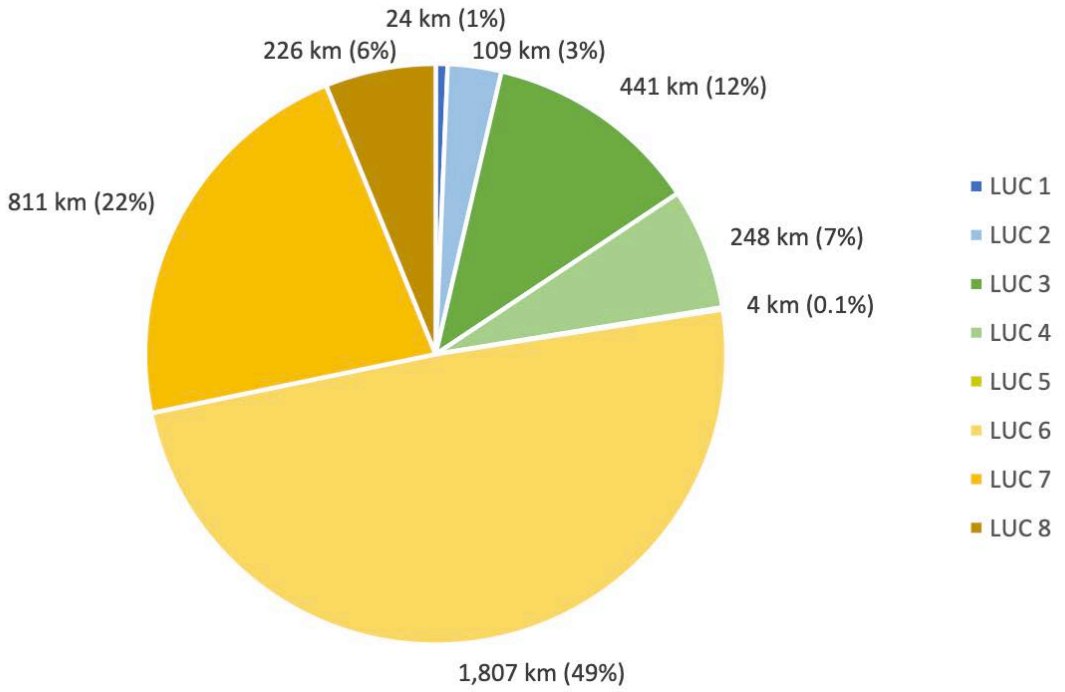
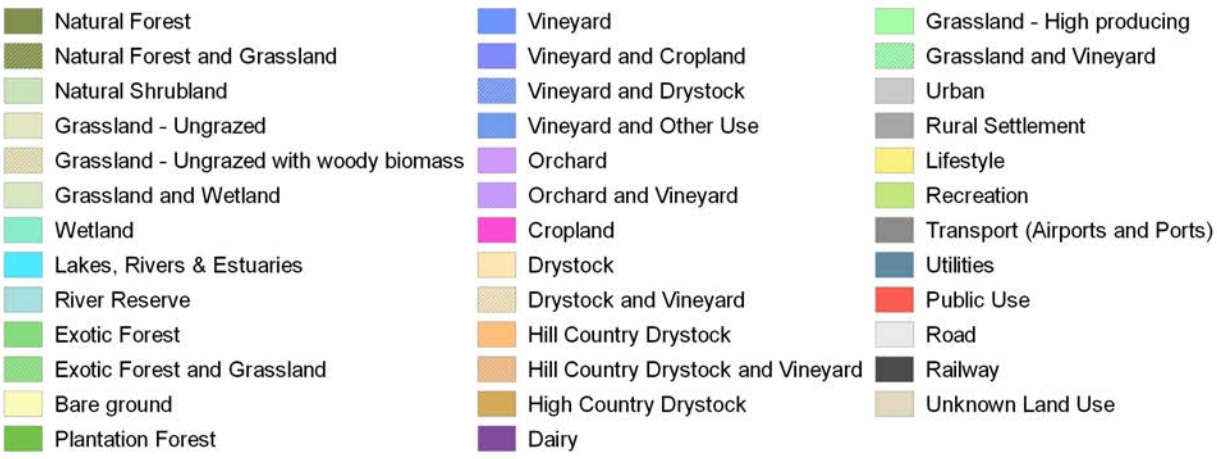


Figure 6: Distribution of developed land by Land Use Capability Class in Marlborough
Source data: Manaaki Whenua – Landcare Research36
Note: A km² is 100 hectares and thus 1,000 km² = 100,000 hectares.



Key for Image 17 Marlborough Land Use Map 2023 (next page)
Source: Marlborough District Council Land Use Map

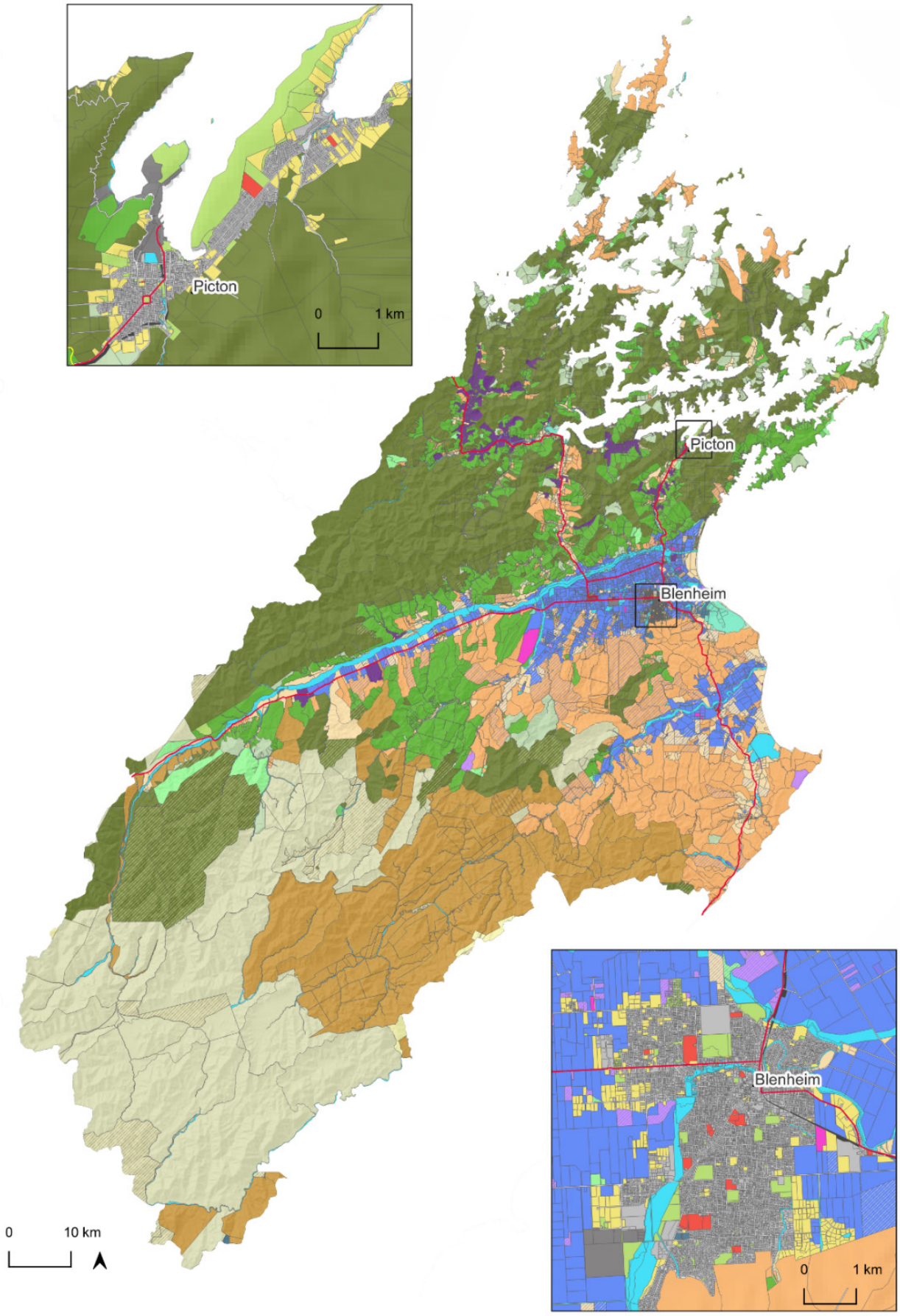


Image 17: Marlborough Land Use Map 2023
Source: Marlborough District Council Land Use Map

3.2.1 Freshwater Management Units (FMUs)

As part of implementing the National Policy Statement for Freshwater Management (NPSFM) 2020, each regional council will set 'Freshwater Management Units' for their region. A Freshwater Management Unit (or FMU) is the spatial scale that a regional council views as appropriate for freshwater management and accounting purposes. This spatial scale can include all or any part of a water body or water bodies and their related catchments. In Marlborough there are six proposed FMUs: Waiau-toa / Clarence, Awatere, East Coast Complex, Wairau, Te Hoiere / Pelorus, and the Marlborough Sounds Complex. Each FMU has its own unique character and level of complexity, and both aspects influence freshwater issues as well as policy options, and their impacts. The six FMUs and their broad spatial extent are shown in Image 18. A comparison of the relative mix of land uses between the FMUs is presented in Figure 7.

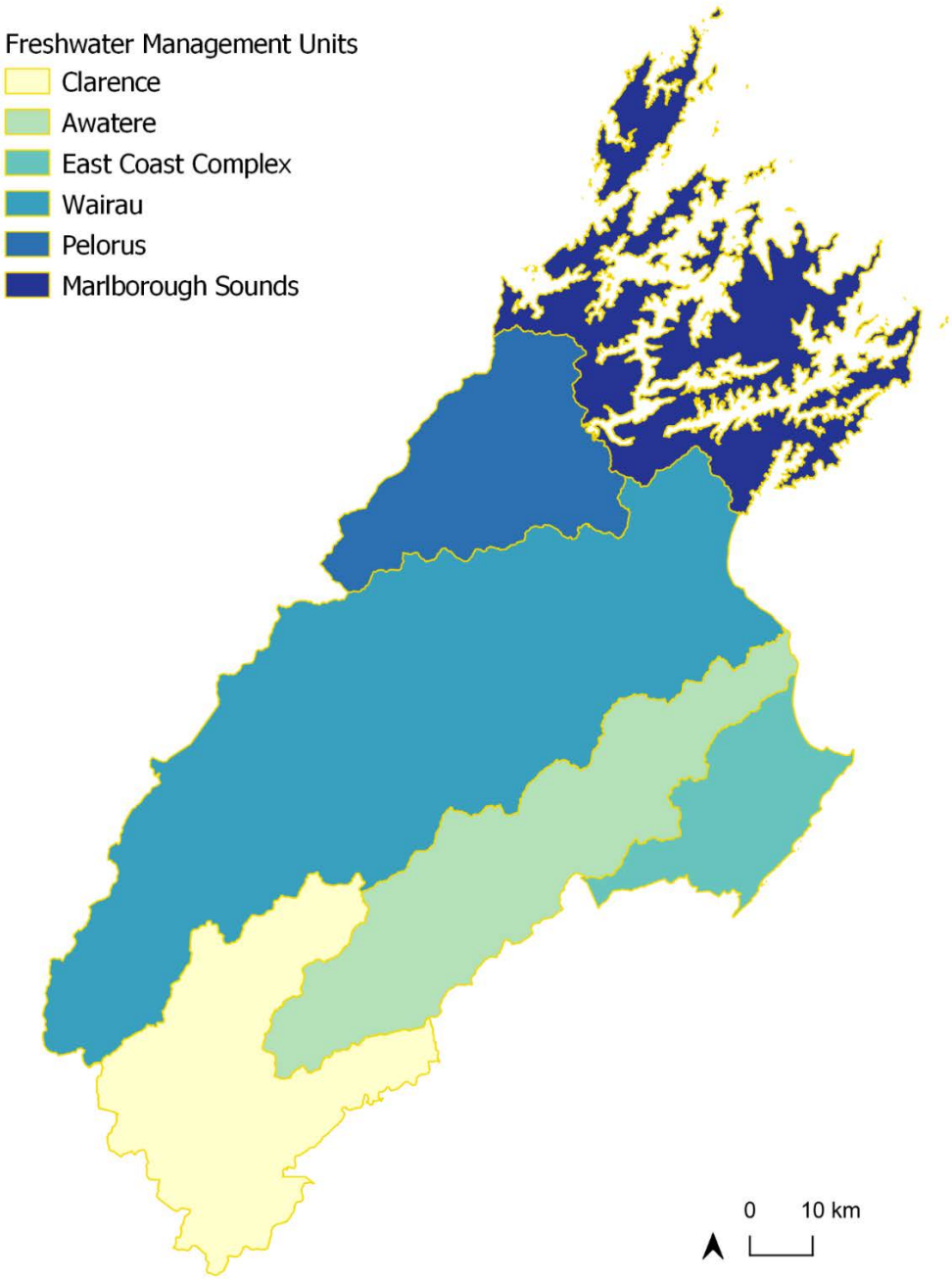


Image 18: NPSFM 2020 Freshwater Management Units in Marlborough
Source: Dr Lisa Pearson (Land and Water Science) & Marlborough District Council

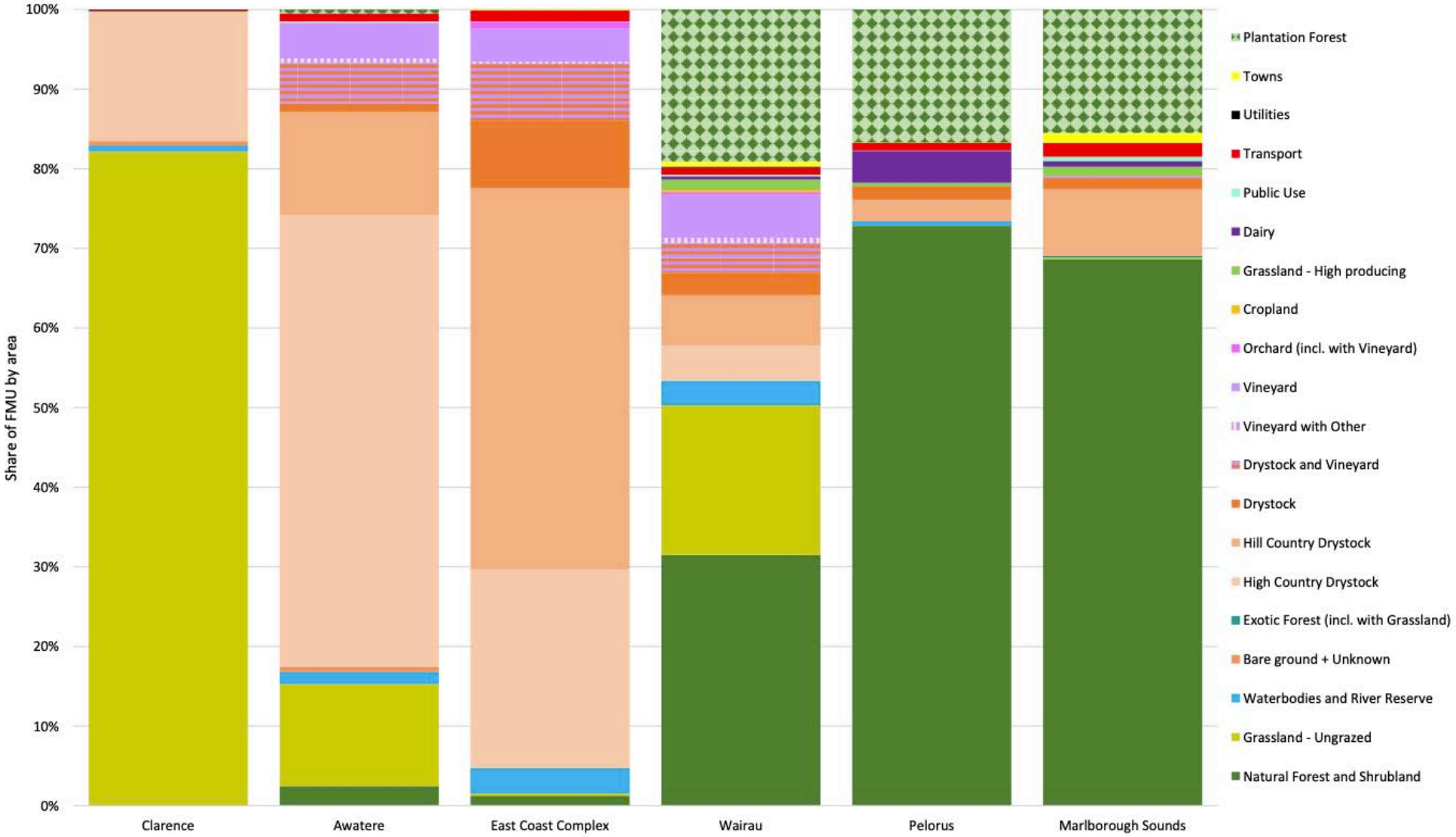


Figure 7: Proportional mix of land uses within each NPSFM 2020 FMU in Marlborough
Source data: Marlborough District Council Land Use Map

Image 18 (above) showed a simple 'plan view' of Marlborough's FMUs. A 'plan view' is a flat or two dimensional representation of a three dimensional landscape, as if looking down from above, as opposed to how the terrain may look using an elevation or surface view. The other maps in this report are also plan views but visually indicate the region's topography. While estimates of land area are generally based on a plan view, actual areas may be greater where sloping land is involved. This point becomes particularly relevant when considering the impacts of freshwater management when estimating linear distances, such as for river lines and riparian margins.

An alternative way of looking at the information used in Figure 7 is the spread of land uses within the primary sector across the FMUs (Figure 8). Using this viewpoint, it is clear that some land uses concentrate in specific FMUs while others occur across the region. For example, dairy farming is predominately in the Te Hoiere / Pelorus FMU while cropland and plantation forestry are more orientated towards the Wairau FMU. Vineyards centre on the Wairau, the Awatere, and East Coast Complex FMUs. In contrast, drystock farming is present in all six FMUs. Overall, the dominance of the Wairau FMU across the land uses in Marlborough is evident.

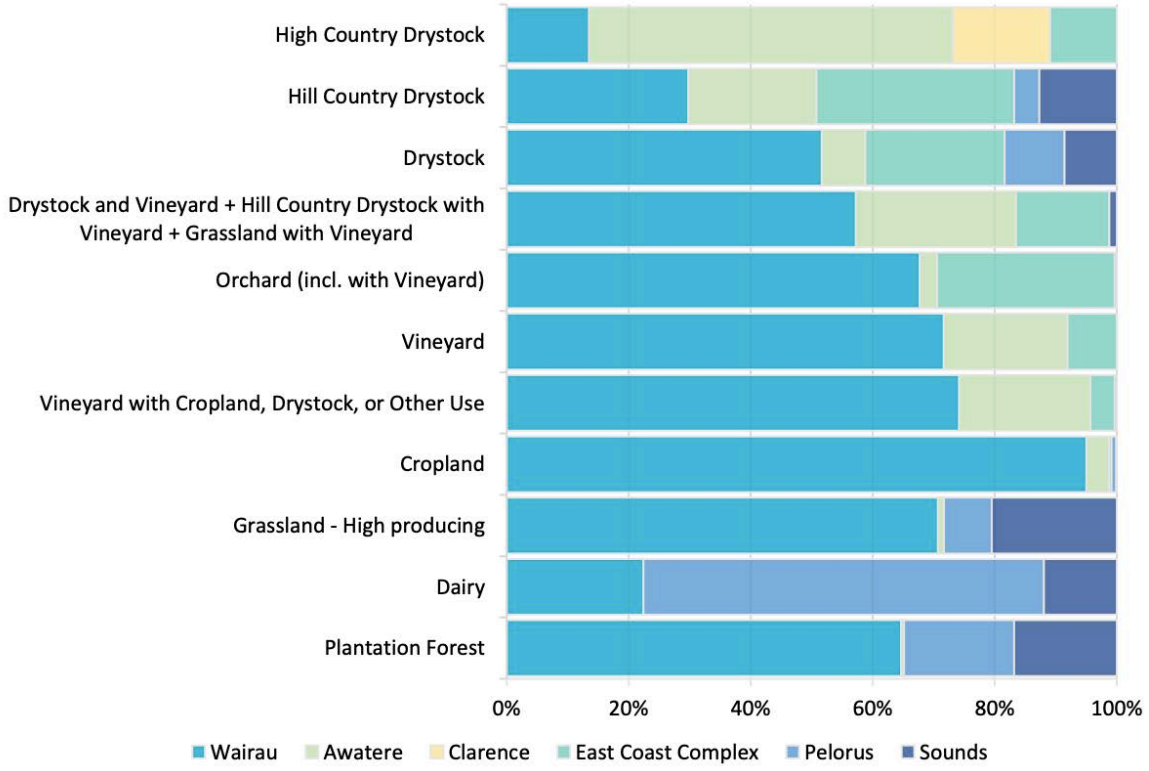


Figure 8: Proportional mix of NPSFM 2020 FMUs by land use area within the primary sector in Marlborough
Source data: Marlborough District Council Land Use Map

The following subsections explore the estimated land use patterns for each of the six FMUs in turn before summary demographic information is presented for Marlborough's local communities.

3.2.1.1 Waiau-toa / Clarence

The Waiau-toa / Clarence FMU is located in the southeast corner of the region and has an area of 1,543 km^2. It captures the upper half of the Waiau-toa / Clarence River catchment[49], which also traverses Canterbury's Hurunui and Kaikōura districts. The FMU is less complex in terms of economic activity than other FMUs in Marlborough. There are no settlements in the Waiau-toa / Clarence FMU and few residents. The Department of Conservation has several visitor huts, and it administers the Rangitahi / Molesworth station – New Zealand's largest farm of which much is located within the FMU (Pāmu or Landcorp Farming Ltd are currently responsible for this farming operation under a fixed-term lease agreement).

Table 4: Key land uses in the Waiau-toa / Clarence FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	831	0.5	42.1	1
Grassland - Ungrazed (incl. woody biomass or wetland)	126,792	82.2	52.9	37
High Country Drystock	25,173	16.3	15.9	13
Lakes, Rivers & Estuaries + Wetlands + River Reserve	1,101	0.7	5.2	17
Natural Forest (incl. with Grassland) + Natural Shrubland	11	0.0	0.0	1
Transport (Roads, Rail, Ports)	225	0.1	2.0	16
Utilities	121	0.1	14.8	1
Developed land	25,518	16.5	4.7	-
Land with natural cover	128,960	83.5	19.8	-
Total	154,253	100.0	13.0	86

Image 19: View from the start of the Saxton River Track down the Acheron Valley to Mt Augade in November 2023
Source: Raymond Ford

49 Approximately 70 kilometres of the Waiau-toa / Clarence River's 230-kilometre length is in Marlborough.

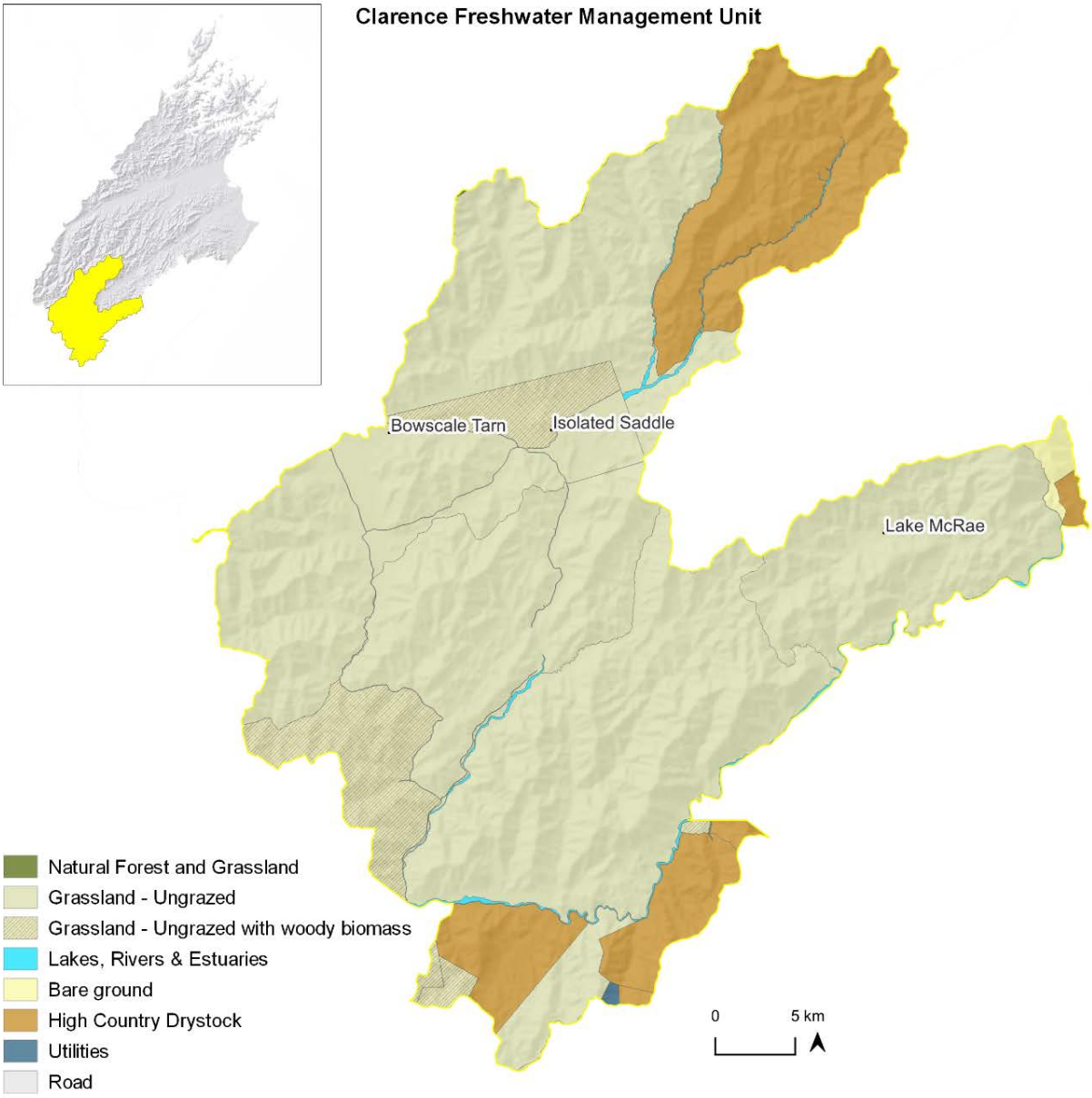


Image 20: Main land uses within the Waiau-toa / Clarence NPSFM FMU in 2023

3.2.1.2 *Awatere*

The Awatere FMU is located in the southeast of the region and has an area of around 1,664 km^2. The FMU is dominated by the 110 kilometre long Awatere River, which has several major tributaries. The FMU is sparsely populated, and its one urban centre is Seddon towards the eastern end of the FMU. Seddon had a population of 590 people on 30 June 2024 and it services the surrounding rural areas. The land uses are largely drystock farming as hill and high country stations, most notably Rangitahi / Molesworth Station, and some plantation forestry. Much of the lower valley has now been converted to viticulture.

Table 5 Key land uses in the Awatere FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	1,018	0.6	0.56	4
Cropland	59	0.0	3.7	1
Drystock	1,842	1.1	7.1	86
Exotic Forest (incl. with Grassland)	3	0.0	0.7	1
Grassland - High producing	89	0.1	1.0	5
Grassland - Ungrazed (incl. woody biomass or wetland)	21,336	12.8	8.9	68
High Country Drystock	94,440	56.8	59.6	39
Hill Country Drystock	21,523	12.9	21.0	77
Drystock and Vineyard + Hill Country with Vineyard + Grassland with Vineyard	8,465	5.1	26.2	59
Lakes, Rivers & Estuaries + Wetlands + River Reserve	2,500	1.5	11.7	126
Orchard (incl. with Vineyard)	53	0.0	2.8	15
Natural Forest (incl. with Grassland) + Natural Shrubland	4,108	2.5	1.1	19
Plantation Forest	786	0.5	0.5	16
Public Use + Recreation	97	0.1	5.3	12
Transport (Roads, Rail, Ports)	1,625	1.0	14.4	350
Utilities	21	0.0	2.5	1
Urban + Settlements + Lifestyle	65	0.0	1.3	294
Vineyard	7,434	4.5	20.3	170
Vineyard with Cropland, Drystock, or Other Use	917	0.6	21.5	14
Developed land	137,419	82.6	25.3	-
Land with natural cover	30,586	17.4	4.7	-
Total	**166,380**	**100.0**	**14.1**	**1,357**

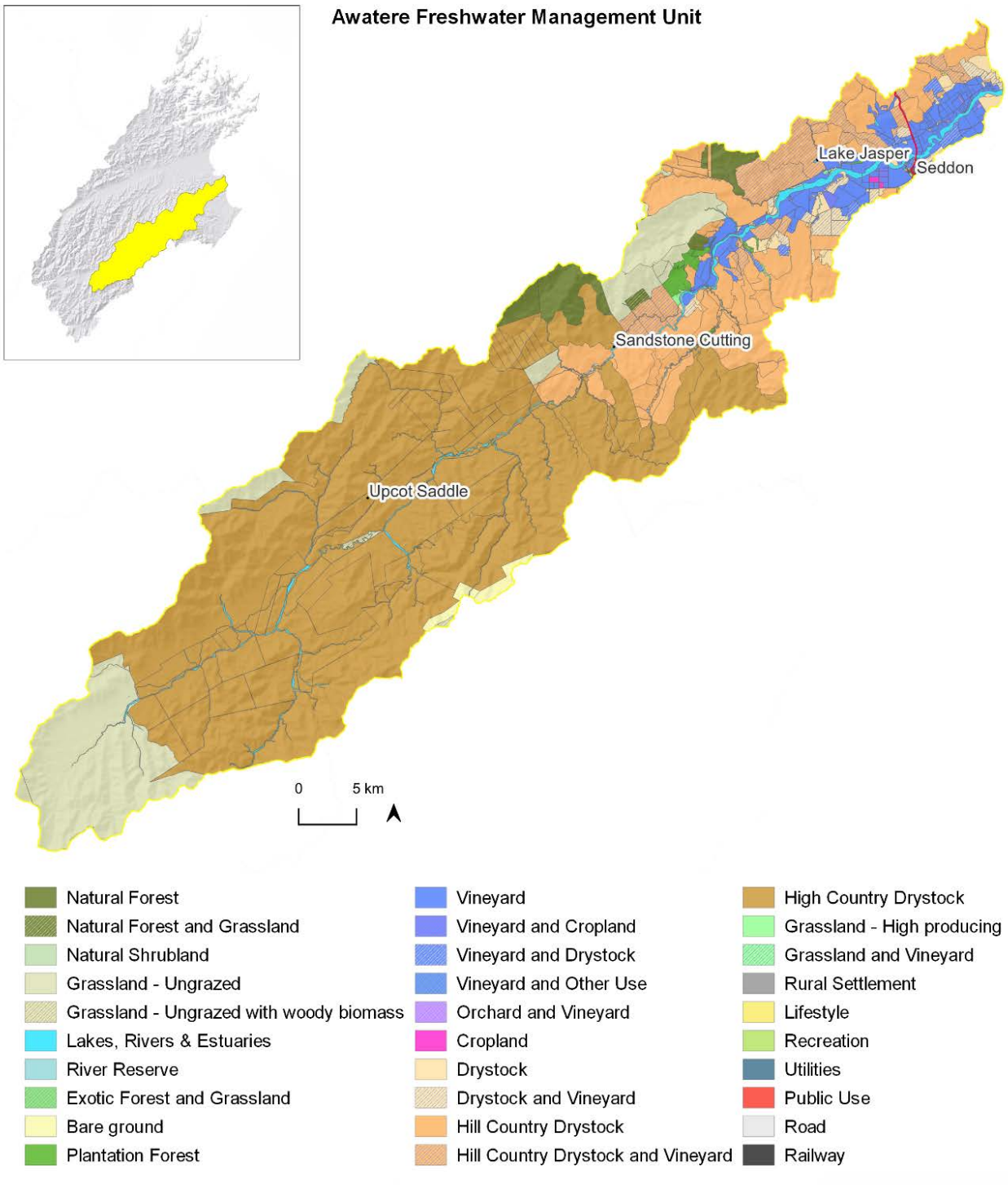


Image 21: Main land uses within the Awatere NPSFM FMU in 2023

3.2.1.3 *East Coast Complex*

The East Coast Complex FMU is located in the east of the region and has an area of just under 700 km^2. The FMU includes the Blind River, Flaxbourne River, and Waima (Ure) River as well as Lake Grassmere and Lake Elterwater. The FMU is sparsely populated, and its main urban centre is Ward, the southern-most town in Marlborough. Ward is a small service town for the surrounding rural areas and had a population of 90 people on 30 June 2024. Hill and high country drystock farming dominates the FMU and, more recently, there has been some conversion to viticulture in the north of the FMU.

Table 6: Key land uses in the East Coast Complex FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	0	0.0	0.0	1
Cropland	6	0.0	0.4	2
Drystock	5,892	8.5	22.8	204
Exotic Forest (incl. with Grassland)	1	0.0	0.3	1
Grassland - Ungrazed (incl. woody biomass or wetland)	195	0.3	0.1	21
High Country Drystock	17,326	25.0	10.9	4
Hill Country Drystock	33,173	47.9	32.4	96
Drystock and Vineyard + Hill Country with Vineyard + Grassland with Vineyard	4,940	7.1	15.3	42
Lakes, Rivers & Estuaries + Wetlands + River Reserve	2,178	3.1	10.2	60
Orchard (incl. with Vineyard)	548	0.8	29.1	8
Natural Forest (incl. with Grassland) + Natural Shrubland	873	1.3	0.2	12
Plantation Forest	3	0.0	0.0	4
Public Use + Recreation	10	0.0	0.5	15
Transport (Roads, Rail, Ports)	941	1.4	8.3	265
Urban + Settlements + Lifestyle	91	0.1	1.8	85
Vineyard	2,953	4.3	8.1	57
Vineyard with Cropland, Drystock, or Other Use	169	0.2	4.0	5
Developed land	66,054	95.3	12.1	-
Land with natural cover	4,187	4.7	0.6	-
Total	**69,299**	**100.0**	**5.9**	**882**

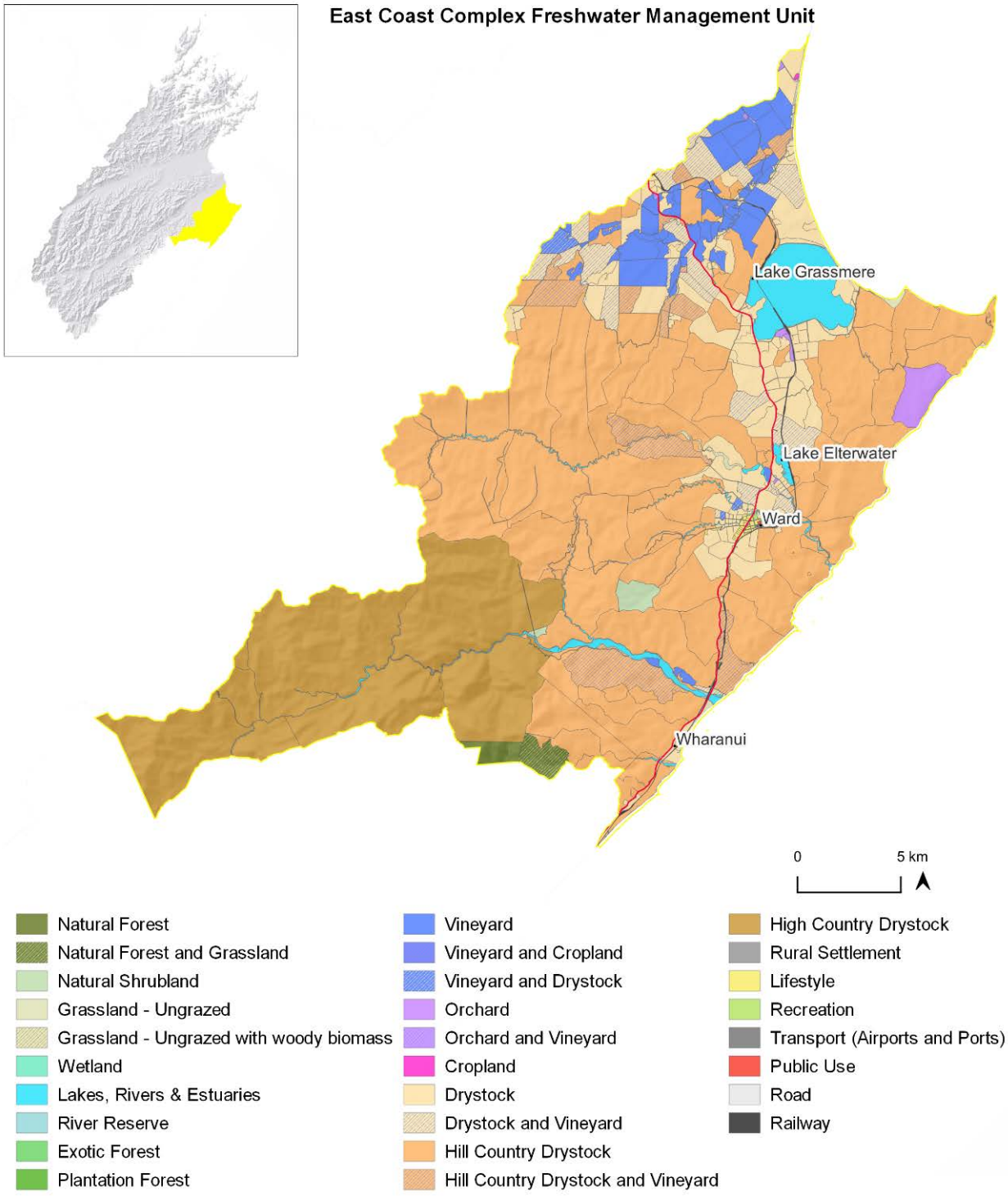


Image 22: Main land uses in the East Coast Complex NPSFM FMU in 2023

3.2.1.4 Wairau

The Wairau FMU is centrally located across the region and covers an area of around 4,835 km^2. The FMU is defined by the 170 kilometre long Wairau River and its tributaries, and includes Grovetown Lagoon and Wairau Lagoon. The FMU is the region's most populated with the region's main urban centre, Blenheim, as well as Renwick, Wairau Valley, Grovetown, Spring Creek, Tuamarina, and Koromiko all located here. Blenheim had a population of 30,600 people on 30 June 2024. The FMU is characterised by vineyards, plantation forestry, and drystock farming. It also contains a small amount of dairy farming.

Table 7: Key land uses in the Wairau FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	125	0.0	6.3	10
Cropland	1,515	0.3	95.0	42
Dairy	2,119	0.4	22.4	67
Drystock	13,336	2.8	51.7	783
Exotic Forest (incl. with Grassland)	142	0.0	33.5	3
Grassland - High producing	6,190	1.3	70.7	49
Grassland - Ungrazed (incl. woody biomass or wetland)	91,103	18.8	38.0	109
High Country Drystock	21,429	4.4	13.5	32
Hill Country Drystock	30,501	6.3	29.8	265
Drystock and Vineyard + Hill Country with Vineyard + Grassland with Vineyard	18,481	3.8	57.3	168
Lakes, Rivers & Estuaries + Wetlands + River Reserve	14,628	3.0	68.7	977
Orchard (incl. with Vineyard)	1,275	0.3	67.7	413
Natural Forest (incl. with Grassland) + Natural Shrubland	152,096	31.5	40.4	332
Plantation Forest	92,510	19.1	64.6	445
Public Use + Recreation	824	0.2	45.5	421
Transport (Roads, Rail, Ports)	4,355	0.9	38.6	2703
Utilities	670	0.1	82.5	27
Urban + Settlements + Lifestyle	2,844	0.6	55.5	15,505
Vineyard	26,232	5.4	71.6	1,468
Vineyard with Cropland, Drystock, or Other Use	3,159	0.7	74.2	102
Developed land	225,583	46.7	41.5	-
Land with natural cover	262,307	53.3	40.3	-
Total	**483,535**	**100.0**	**40.9**	**23,921**

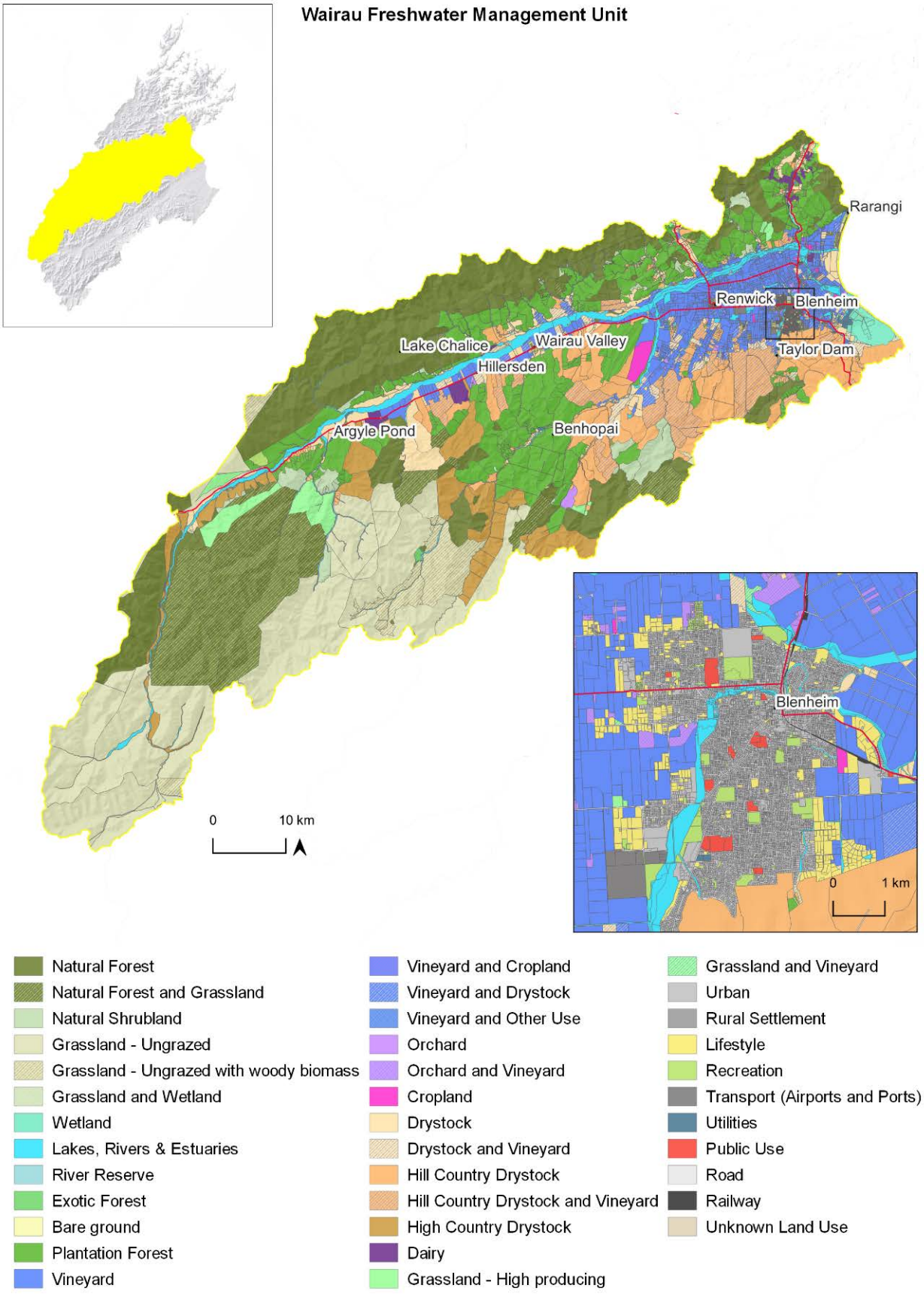


Image 23: Main land uses in the Wairau NPSFM FMU in 2023

3.2.1.5 Te Hoiere / Pelorus

Te Hoiere / Pelorus FMU is located in the northwest of the region and covers an area of 1,547 km^2. The FMU is defined by its largest river, the 45-kilometre-long Te Hoiere / Pelorus River and its main tributary the Rai River. Te Hoiere / Pelorus River enters Te Hoiere / Pelorus Sound at Motuweka / Havelock Estuary. Other rivers in the FMU are the Ronga, Tunakino, Opouri, Wakamarina and Kaituna Rivers. The largest township in the Te Hoiere / Pelorus FMU is Havelock, which provides services for the local communities as well as tourists. Havelock had a population of 640 on 30 June 2024. Smaller centres in the FMU are Canvastown and Rai Valley. The vast majority of the land uses (almost 90%) is forestry, both natural and plantation, with some dairy and a small amount of hill country drystock.

Table 8: Key land uses in Te Hoiere / Pelorus FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	0	0.0	0.0	7
Cropland	12	0.0	0.8	3
Dairy	6,199	4.0	65.6	185
Drystock	2,538	1.6	9.8	361
Grassland - High producing	686	0.4	7.8	20
Grassland - Ungrazed (incl. woody biomass or wetland)	71	0.0	0.0	22
Hill Country Drystock	4,238	2.7	4.1	109
Drystock and Vineyard + Hill Country with Vineyard + Grassland with Vineyard	0	0.0	0.0	1
Lakes, Rivers & Estuaries + Wetlands + River Reserve	807	0.5	3.8	135
Orchard (incl. with Vineyard)	6	0.0	0.3	2
Natural Forest (incl. with Grassland) + Natural Shrubland	112,621	72.8	29.9	337
Plantation Forest	25,802	16.7	18.0	216
Public Use + Recreation	59	0.0	3.3	37
Transport (Roads, Rail, Ports)	1,470	1.0	13.0	483
Utilities	1	0.0	0.2	1
Urban + Settlements + Lifestyle	128	0.1	2.5	445
Vineyard	2	0.0	0.0	1
Vineyard with Cropland, Drystock, or Other Use	14	0.0	0.3	2
Developed land	41,156	26.6	7.6	-
Land with natural cover	114,968	73.4	17.7	-
Total	**154,655**	**100.0**	**13.1**	**2,367**

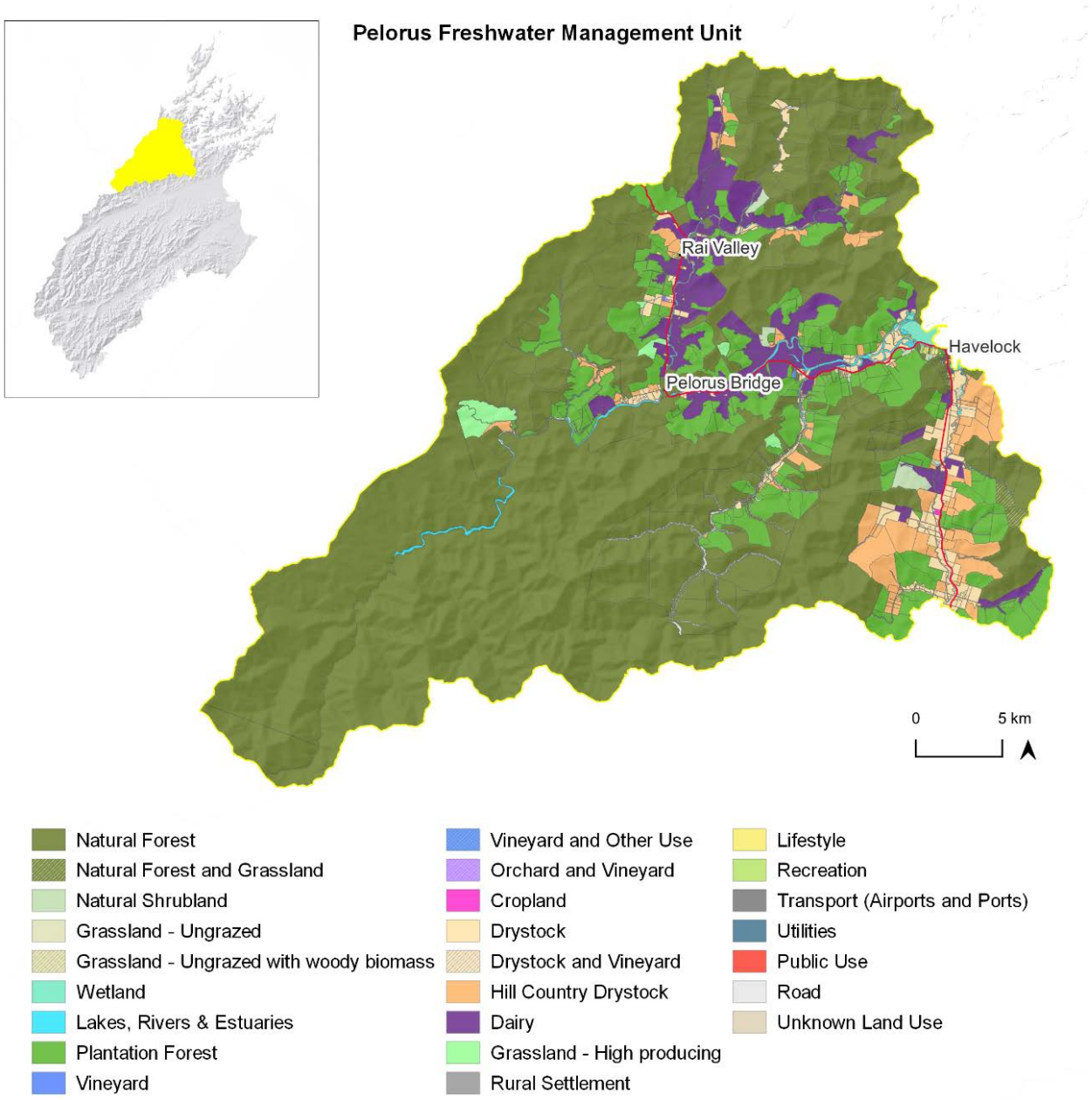


Image 24: Main land uses in the Te Hoiere / Pelorus NPSFM FMU in 2023

3.2.1.6 Marlborough Sounds Complex

The Marlborough Sounds Complex FMU is made up of a group of catchments in the northeast of the region that flow into the Marlborough Sounds, Cook Strait and Tasman Bay. This FMU has an area of around 1,550 km^2 and has an extensive coastline, roughly equating to one-tenth of the coastline of New Zealand. Many of the rivers and streams in this FMU remain unnamed, but others include Cullen Creek, the Duncan, Ada and Waikawa Streams and the Waitohi and Graham Rivers. The Barnes Dam serves as part of the water supply for the port town of Waitohi / Picton.

Waitohi / Picton and Waikawa are the main urban centres, with both being situated towards the head of the Tōtaranui / Queen Charlotte Sound. Waitohi / Picton's population was 4,840 on 30 June 2023, while Waikawa's was 1,720. Waitohi / Picton is the South Island base of the Cook Strait ferries and a tourism hub, while Waikawa has one of New Zealand's largest marinas and provides access to the Marlborough Sounds. Beyond these towns, the population is dispersed primarily in the inner sounds of Tōtaranui / Queen Charlotte Sound and Te Hoiere / Pelorus Sound. Important industries in this FMU include tourism, marine aquaculture, forestry (both natural and plantation), which is the largest land use at 84 per cent, as well as some hill country drystock and a small amount of dairy farming.

Table 9: Key land uses in the Marlborough Sounds Complex FMU

Land use	Total land in this FMU (ha)	This land use's share of total FMU land (%)	Share of this land use that is present in the region (%)	Number of properties in this FMU
Bare ground + Unknown use	0	0.0	0.0	10
Cropland	1	0.0	0.1	3
Dairy	1,128	0.7	11.9	41
Drystock	2,207	1.4	8.5	163
Exotic Forest (incl. with Grassland)	278	0.2	65.6	36
Grassland - High producing	1,793	1.2	20.5	74
Grassland - Ungrazed (incl. woody biomass or wetland)	383	0.2	0.2	112
Hill Country Drystock	12,973	8.4	12.7	312
Drystock and Vineyard + Hill Country with Vineyard + Grassland with Vineyard	392	0.3	1.2	3
Lakes, Rivers & Estuaries + Wetlands + River Reserve	68	0.0	0.3	484
Natural Forest (incl. with Grassland) + Natural Shrubland	106,466	68.6	28.3	2344
Plantation Forest	24,049	15.5	16.8	319
Public Use + Recreation	822	0.5	45.4	250
Transport (Roads, Rail, Ports)	2,674	1.7	23.7	1,247
Urban + Settlements + Lifestyle	1,993	1.3	38.9	5,933
Developed land	48,312	31.1	8.9	-
Land with natural cover	109,590	68.9	16.8	-
Total	**155,228**	**100.0**	**13.1**	**11,331**

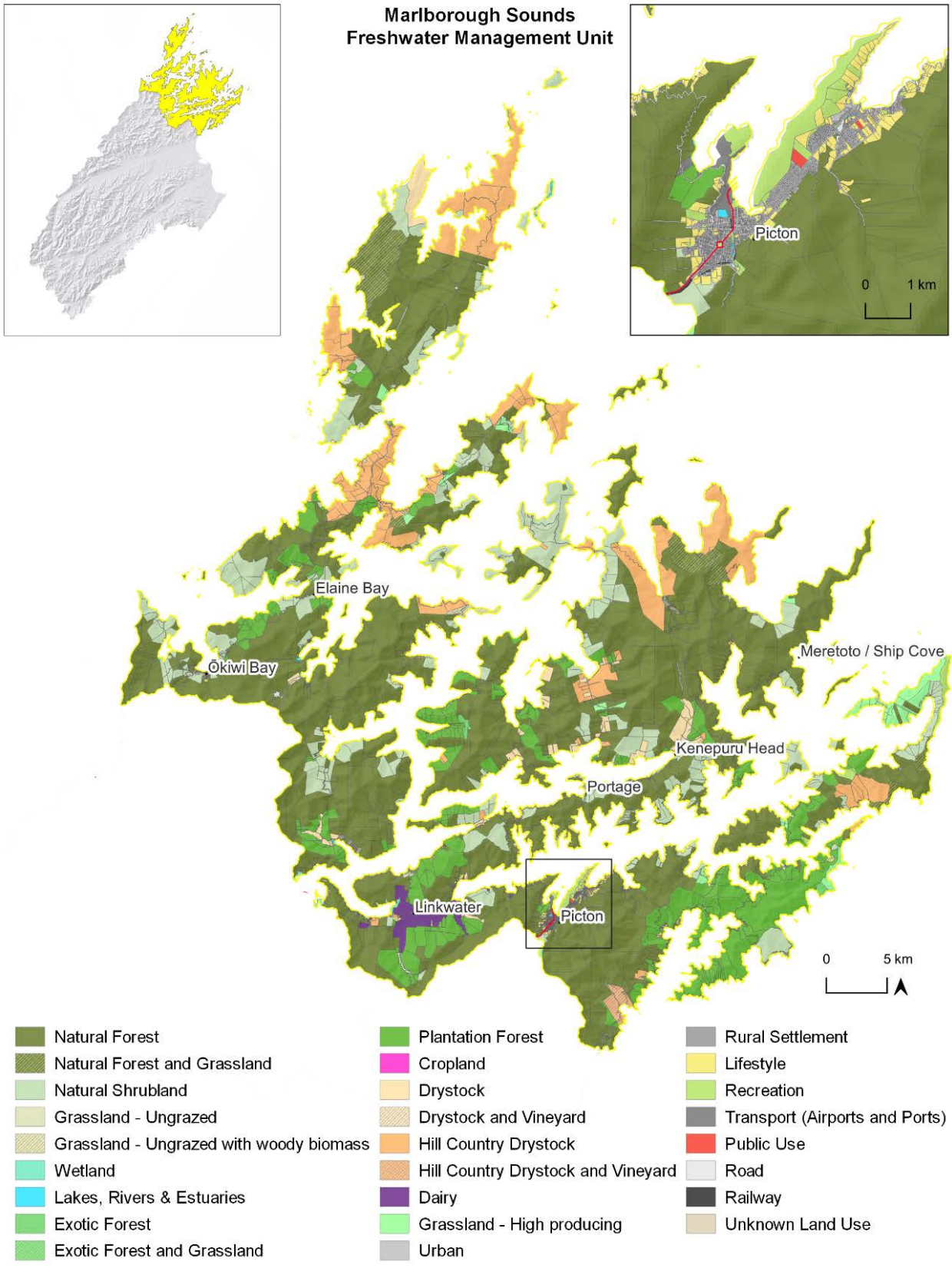


Image 25: Main land uses in the Marlborough Sounds Complex NPSFM FMU in 2023

3.3 Local Communities

The outcomes of Marlborough's economy are evident in the first instance in the quality of life of its local communities. Quality of life is a complex topic that encompasses different cultural perspectives, values, and knowledge systems[50] that are beyond the scope of this report. However, as a starting point, this section gives a brief overview of Marlborough's population, formal education, and household income before presenting information on the relative socioeconomic position of geographic areas within the region. These indicators, in turn, influence the structure of the economy (refer to section 3.1), as well as the Council's rating base and the provision of services.

In the 2023 Census of Population and Dwellings a total of 49,431 people usually resided in Marlborough, meaning that the region is the second least populous in New Zealand after the West Coast. In general, there are roughly five people per km^2 in Marlborough compared to just over 18 per km^2 for New Zealand. However, over half of the population live in and around Blenheim leaving much of the rest of the region more sparsely populated. In 2023 there were 24,807 dwellings in the region, which was an increase of 2,088 (9.2%) over the five years since 2018.

Eight iwi have mana whenua status in Marlborough[51]: Te Ātiawa o Te Waka-a-Māui, Te Rūnanga a Rangitāne o Wairau, Ngāti Toa Rangatira ki Wairau, Ngāti Apa ki te Rā Tō, Te Rūnanga o Ngāti Kuia, Ngāti Kōata, Te Rūnanga o Ngāti Rārua, and Te Rūnanga o Kaikōura. The median age in 2023 for Maori was 28.5 years and was 46.1 years across all ethnicities (compared to 36 years in 1996). For context, the median age in New Zealand across all ethnicities was 38.1 years (8 years younger than in Marlborough). Figures 9 and 10 show the total population and general pattern of its ethnic groups.

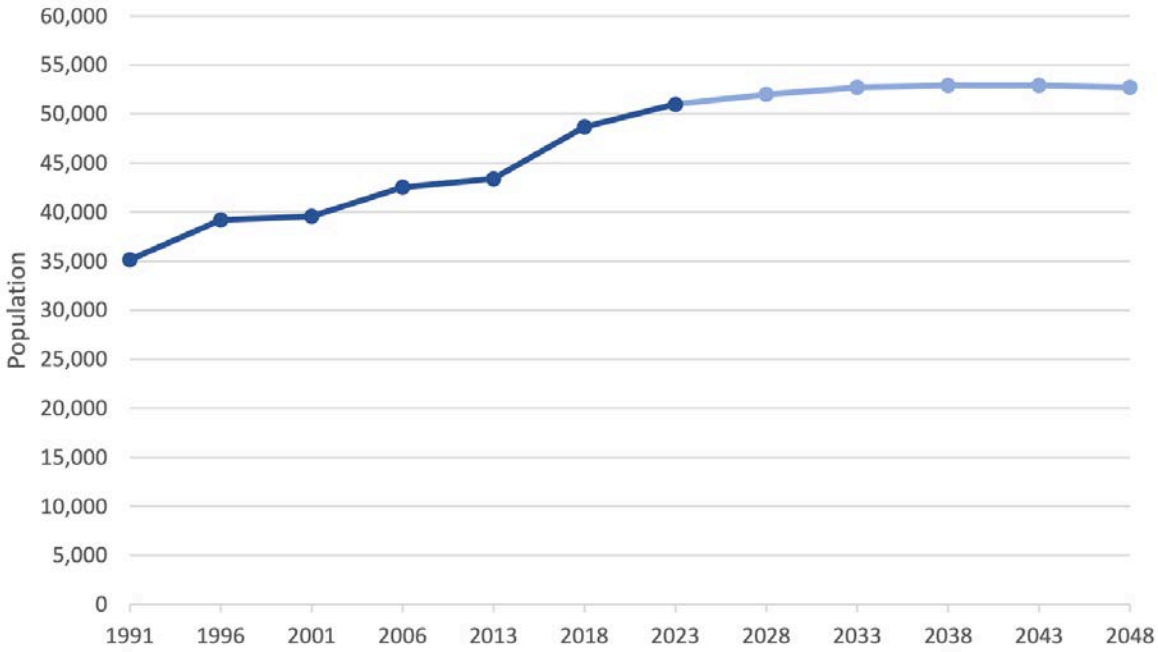


Figure 9: Actual (dark blue) and projected (light blue) population for Marlborough from 1991 to 2048
Source data: Stats NZ
Note: The 7-year gap between 2006 and 2013 is as a result of the Christchurch earthquake a fortnight before the 2011 Census. The projection from 2023 is Stats NZ 'medium' scenario.

50 https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/using-lsf-and-he-ara-waiora
51 Information on an individual iwi history and the relationship of each iwi with the Marlborough environment can be found in iwi management plans and the relevant Deed of Settlement. Collectively, these eight iwi are referred to in the proposed Marlborough Environment Plan as Marlborough's tangata whenua iwi.

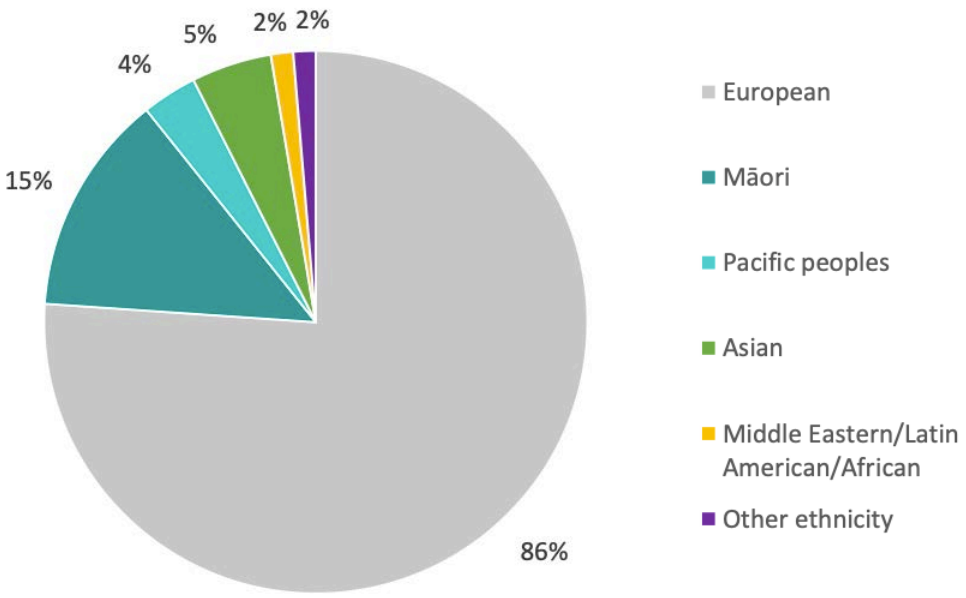


Figure 10: Distribution of ethnic groups in Marlborough in 2023
Source data: Stats NZ
Notes: A person may identify with multiple ethnic groups and is counted in each group they give as a response. No comparison is made with any previous census because of changes in methodology and differences in response rates.

In general terms, proportionally fewer people in Marlborough have higher formal qualifications than in New Zealand as a whole, and it is somewhat reflected in income levels. In 2023, 5,868 of adults (15 years and over) in Marlborough had a Bachelor degree or higher (Figure 11). This number represented 18.5 per cent of those within the usually resident population who stated their qualifications[52], which was an increase from 12.8 per cent in 2013, but lower than the 27.1 per cent for New Zealand in 2023. The number of adults with no formal qualification in 2023 was 7,794 (19.7%), which was higher than the 15.7 per cent of adults for New Zealand, but a decrease from 25.6 per cent of adults a decade ago.

Figure 12 shows the household income distribution for Marlborough in 2023 for the roughly 19,000 households in Marlborough with stated income in the 2023 Census of Population and Dwellings (621 households, or 3.2%, did not provide this information). The median (or middle) value was $81,700. In other words, half of households had an income below $81,700 and half had an income above. This value represented a 25.5 per cent increase from that in 2018 however there have been elevated inflationary pressures since 2021[53]. For context, the median household income for New Zealand in 2023 was $97,000. At an individual level, median personal income for people aged 15 years and over in Marlborough was $39,400.

52 A total of 39,657 people stated their qualifications out of a total of 41,196 people (1,542 people are not included in the statistics reported).

53 Using the Reserve Bank of New Zealand's inflation calculator, General (CPI) that cost $81,700 in the first quarter of 2023 would have cost $67,825 in the first quarter of 2018. In other words, there was an overall increase in the General Consumer Price Index between 2018 and 2023 of 17%, which represented a loss in purchasing power of just over 20%. *https://www.rbnz.govt.nz/monetary-policy/about-monetary-policy/inflation-calculator*

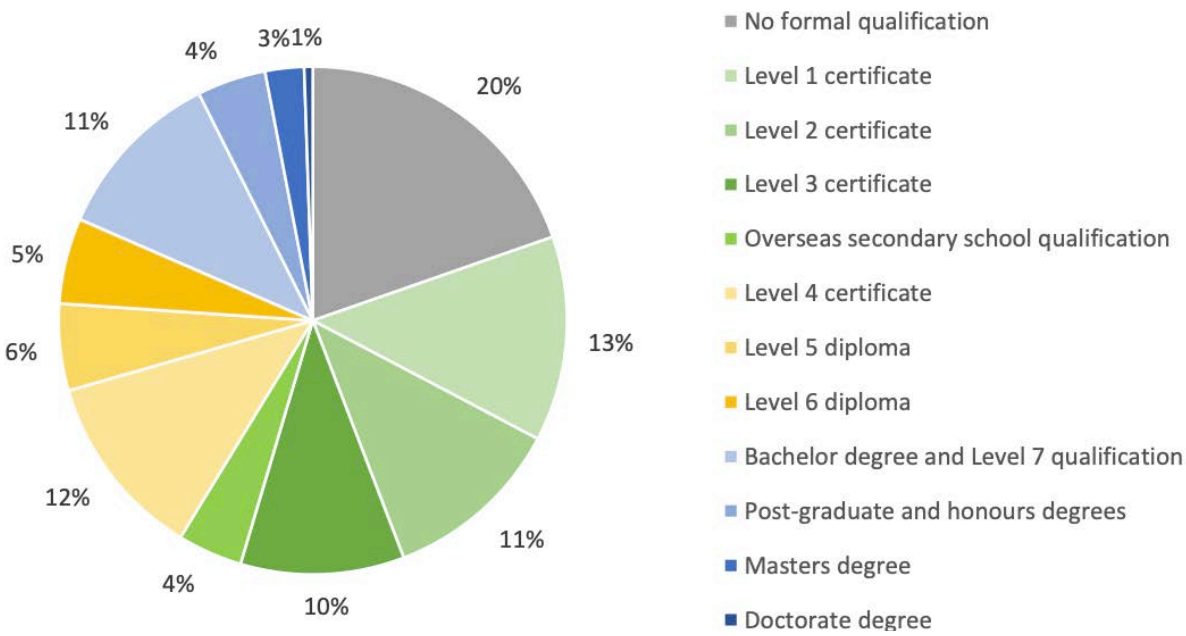


Figure 11: Distribution of qualifications for Marlborough's usual resident adult population in 2023
Source data: Stats NZ

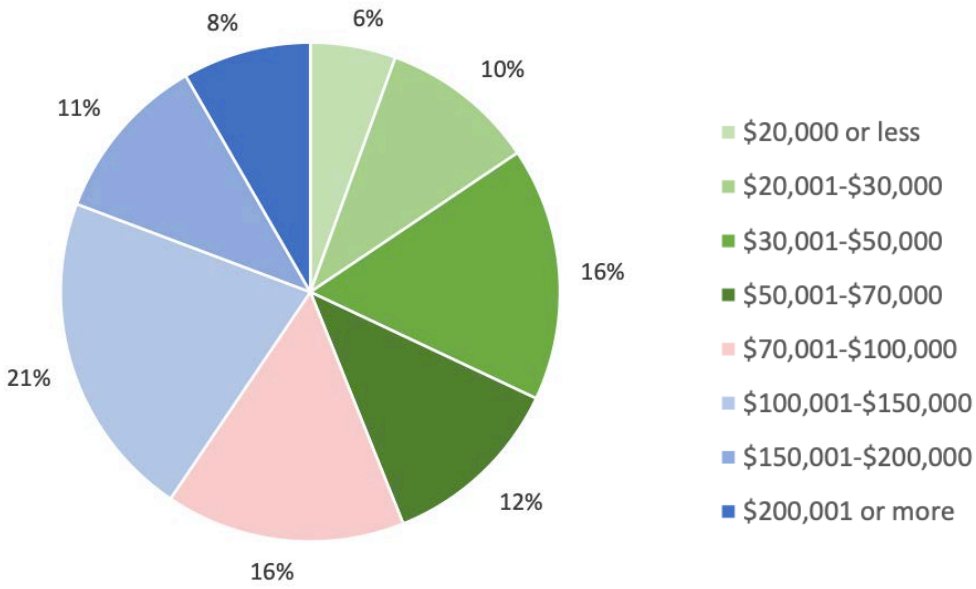


Figure 12: Distribution of total household income for Marlborough in 2023
Note: Total household income is the sum of the personal income of each household member aged 15 years and over in the year ending 31 March 2023. The colouring of the segments is based on the median household income of $81,700.

3.3.1 Socioeconomic Position[54]

The New Zealand index of socioeconomic deprivation (NZDep) estimates the relative socioeconomic position of small geographical areas across New Zealand. The estimates are based on data for nine variables from the New Zealand Census of Population and Dwellings (the indicators selected may change from one census to the next). The results are displayed using deciles (i.e., tenths), with each decile being equivalent to about 10 per cent of the NZDep areas in New Zealand. Decile 1 represents the areas with the least socioeconomic deprivation (as measured by the NZDep)[55] and Decile 10 the areas with the most within New Zealand.

Table 10 summarises the nine variables combined in the NZDep2018 from the 2018 census that reflected different dimensions of socioeconomic deprivation. Table 11 gives the overall distribution of Marlborough's population and households across the NZDep2018 deciles. Image 26 shows the information spatially across the region (the decile scores for areas in conservation estate are not shown).

Table 10: List of variables included in NZDep2018 (reproduced from Atkinson, Crampton, & Salmond, 2021)

Dimension	Description of variable (in order of decreasing weight in the index)
Communication	People with no access to the Internet at home
Income	People aged 18-64 receiving a means tested benefit
Income	People living in equivalised* households with income below an income threshold
Employment	People aged 18-64 unemployed
Qualifications	People aged 18-64 without any qualifications
Owned home	People not living in own home
Support	People aged <65 living in a single parent family
Living space	People living in equivalised* households below a bedroom occupancy threshold
Living condition	People living in dwellings that are always damp and/or always have mould greater than A4 size

Table 11: Relationship between population, households, and NZDep 2018 deciles for Marlborough

2018 Census metric	NZDep 2018 Decile									
	1	2	3	4	5	6	7	8	9	10
Usual resident population count	7,464	3,615	4,194	5,115	4,722	7,236	4,578	5,943	3,843	612
Number of households	2,823	1,344	1,605	2,109	1,938	2,844	1,842	2,457	1,497	228
Share of households	15.1%	7.2%	8.6%	11.3%	10.4%	15.2%	9.9%	13.1%	8.0%	1.2%

54 https://www.otago.ac.nz/wellington/departments/publichealth/new-zealand-deprivation-index-analysis-from-2018-census

55 The NZDep is a partial measure of socioeconomic position. In describing the research approach, Atkinson, Crampton, & Salmond (2021: p6) note: *Measures of socioeconomic position, depending on the particular method of their construction, attempt to measure just one dimension that relates to individuals, whānau and communities—that is, where they fit into the social ordering of wealth, employment, education, life opportunities and so on. Measures of socioeconomic position should not carry a moral judgement; they give no indication of the moral or social worth of individuals or communities. Just as there are many forms of wealth, there are many forms of deprivation, socioeconomic deprivation being just one of them.*

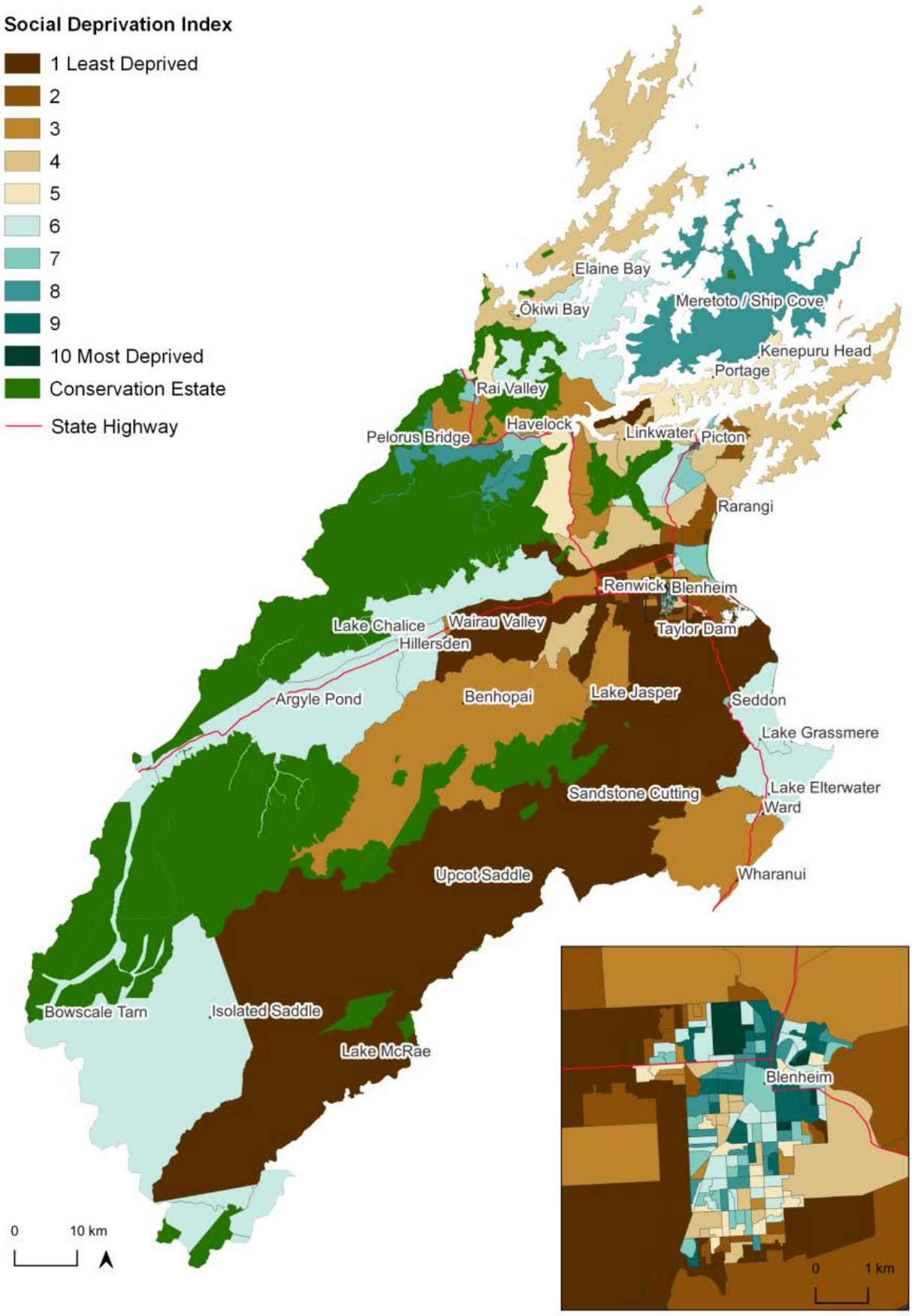


Image 26: Socioeconomic Deprivation Index Scores for Marlborough in 2018
Source data: New Zealand Deprivation Index

The supply of essential services relevant to water, such as drinking water, wastewater, stormwater, and flood protection, is a sizeable investment for local communities that makes it possible for people to live and work together (Moran, McKay, Bennett, West, & Wilson, 2018). These essential services form part of a local community's assets or 'wealth' and, where they are delivered sustainably, they contribute to a community's wellbeing. Although water is vital to life, many towns have an uneasy relationship with water, both in terms of water quantity (e.g., flooding and drought) and water quality (e.g., pollution). Towns and settlements tend to be located on valley floors near rivers and streams (and, in some cases, lakes) or are coastal. The towns are also connected by the region's land transport networks, which weave around and across these water bodies. While much of domestic wastewater is discharged to land, municipal wastewater is discharged to water (the discharge from Blenheim is to land when possible, while the others are to coastal marine area).

Image 27: Havelock Marina and township looking south up the Kaituna Catchment

4 Agriculture

As described in the previous chapter, agriculture in Marlborough is dominated by pastoral farming. Sheep and beef cattle farming is generally located more towards the south of the region and scattered through the Marlborough Sounds, while dairy farming is focused in specific areas in the north, such as Rai Valley and Linkwater. This chapter surveys each of these two industries in turn, with a short summary of arable farming included at the end of this introduction. Image 29 shows the distribution of drystock (sheep, beef, and deer), dairy, and cropland across the region in 2023. It also includes vineyards where they are mixed with agriculture. Viticulture, horticulture, and plantation forestry are surveyed separately in the following chapters.

In New Zealand, the farming of ruminant species (e.g., sheep, beef cattle, dairy cattle, deer, and goats) is based primarily on pasture and forage production (Bywater & Moot, 2011). The main climatic factors constraining pasture is rainfall and temperature. Spring and summer rainfall accounts for 60 per cent of the variation in pasture growth across the country (Radcliffe & Baars, 1987, as cited in Bywater & Moot, 2011). Temperature is a particularly important influence on pasture growth in winter and early spring (Baars & Waller, 1979, as cited in Bywater & Moot, 2011). These climatic factors are in turn controlled by a region's latitude and its topography. In 1962, J.P. Beggs observed that "Farming in an area is always controlled by topography and this is certainly a most important feature in Marlborough."

On the general topic of pastoral farming in the region, one farmer interviewed noted, "I think we farm in the best place in New Zealand. It's very healthy here, lots of sunshine – we don't have as many internal parasites or drench resistance, we don't have facial eczema." Another farmer observed, "You need to farm to the conditions. There's not a lot else you can do with much of Marlborough because it's so dry. It is ideally suited to finer wool sheep and cattle, conservatively farmed. It always was one of the best farming places in the country. No one much talked about it, but it always had a really good name."

Image 28: Looking down on the Medway River, inland from Seddon Township (south Marlborough) in November 2014

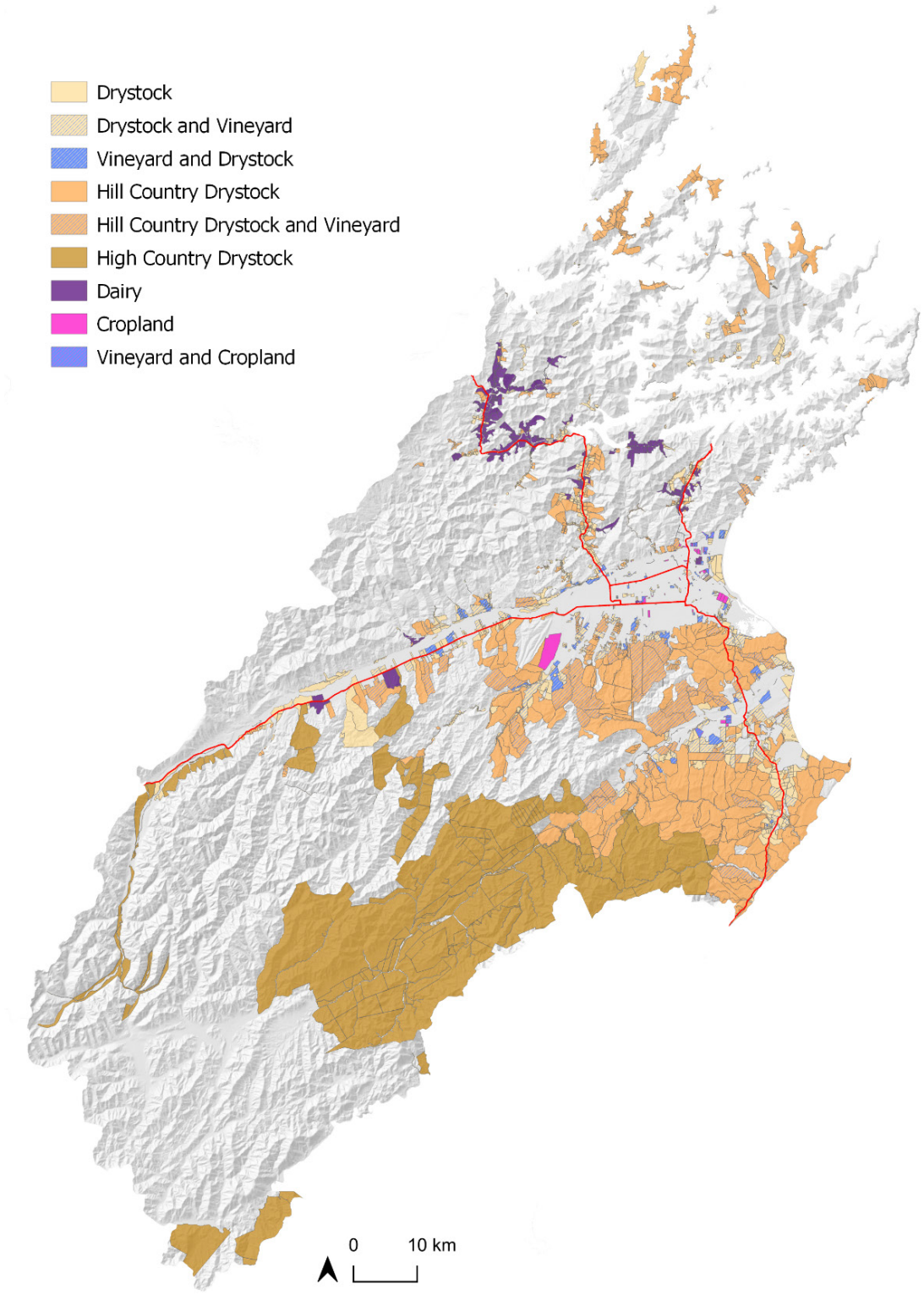


Image 29: Estimated distribution of agricultural land uses in Marlborough in 2023
Note: This map only shows vineyards mixed with agriculture. The total extent of vineyards is presented in Chapter 6.
Source: Marlborough Land Use Map 2023

Rural land use patterns in Marlborough over the past 50 years have seen shifts in the types and level of mixed farming. In 1962, J. P. Beggs described Marlborough as having various types of mixed farming, "The main one is mixed arable cropping and fat lamb production plus small seeds production. There are also sheep plus dairying, sheep plus small seeds production, and dairying plus small seeds production." The range and spread in mixed farming types can be seen in Image 30 and Figure 13.

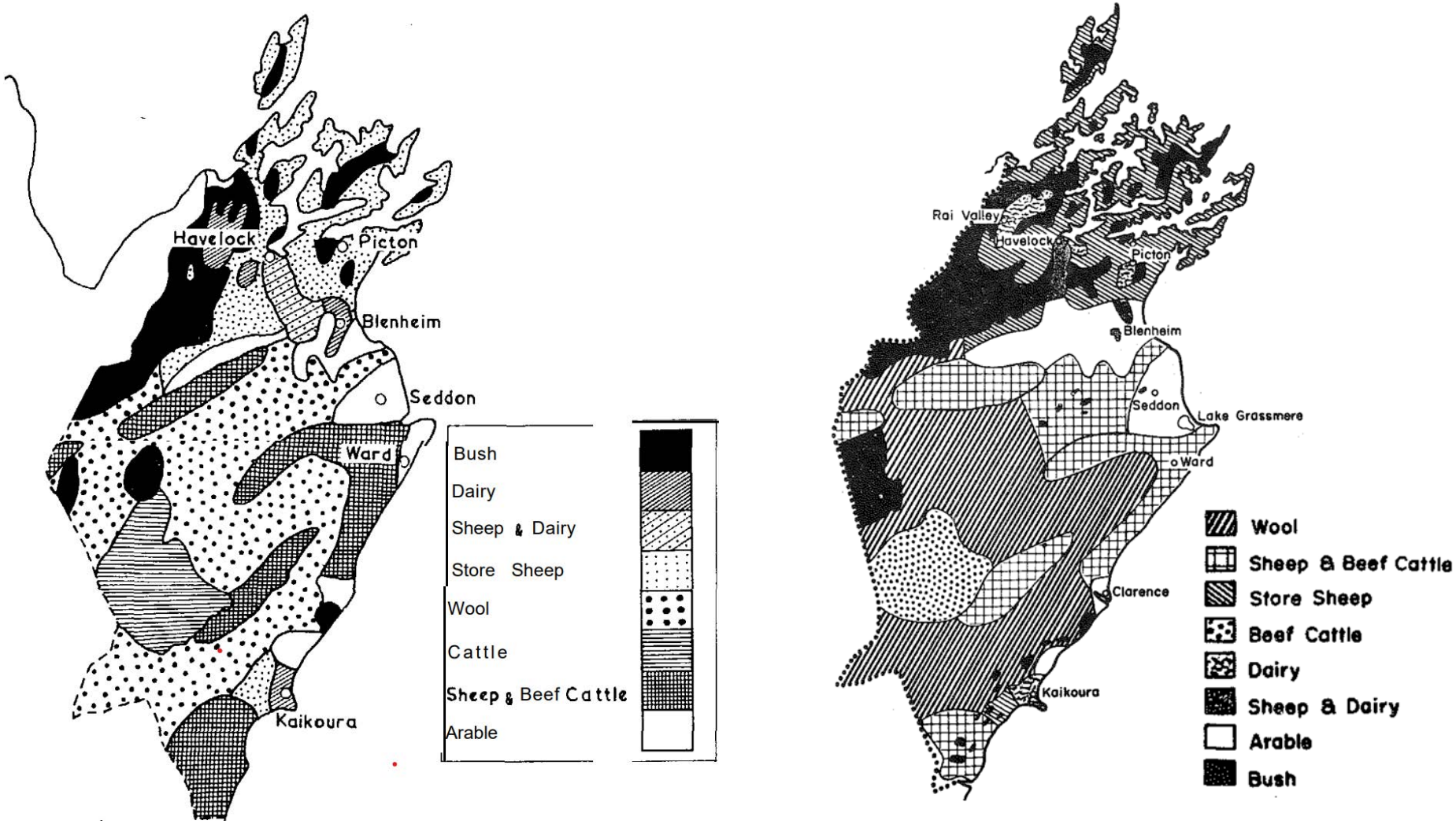


Image 30: Historic farming patterns in Marlborough (at the time the province included Kaikōura)
Note: Some land uses are represented differently between each map (e.g., the pattern for wool and beef cattle swaps)
Sources: On left Beggs (1962) and on right Duckworth (1976)

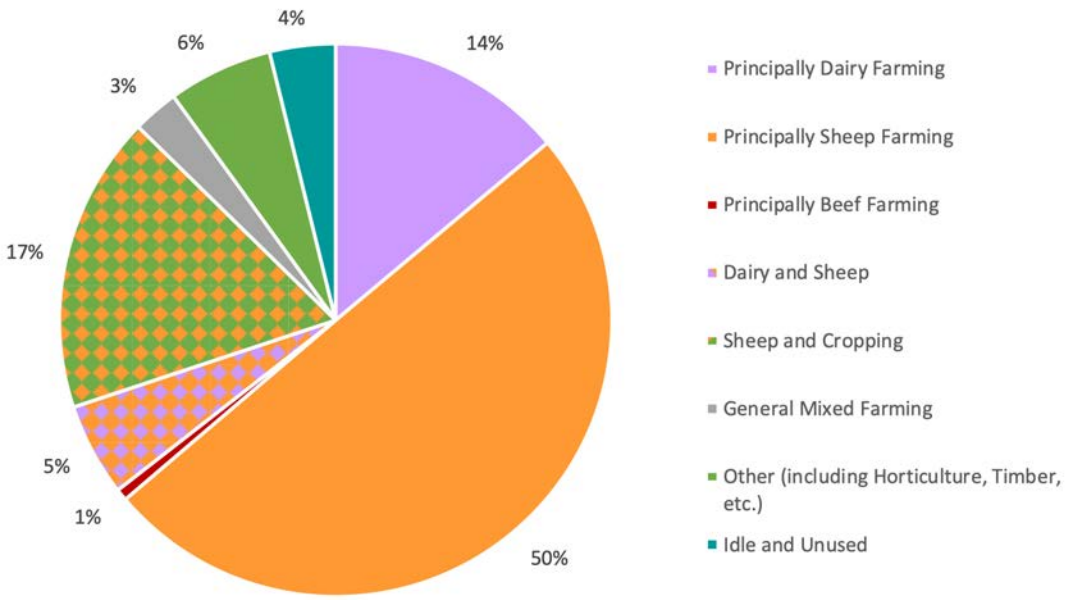


Figure 13: Relative distribution of land uses in Marlborough 1959-60
Source data: 1961 New Zealand Yearbook

Livestock numbers and production steadily increased into the 1970s, although the increase in output in Marlborough was not as dramatic as in other parts of New Zealand (Duckworth *et al*., 1976). Beef cattle increased by 33 per cent from 1969 to 1972, mainly in sheep breeding country, and this trend was expected to continue (Duckworth *et al*., 1976). As well, 87 properties in the region ran pigs and the total pig population was roughly 22,000 (4.6% of the New Zealand pig population) (Duckworth *et al*., 1976). Most piggeries were connected to dairy farms and those in dairying localities had the advantage of whey supplies as cheap feed. However, the trend at the time was towards larger, more specialised operations that relied on grain feed (Duckworth *et al*., 1976).

Livestock units peaked in Marlborough in 1982 at 2.4 million, largely driven by sheep farming. At the time, livestock numbers in Marlborough were projected to increase by between 42 per cent and 70 per cent over the subsequent 30 years (Ashworth-Morrison Cooper, 1982). Yeoman (1983) noted that, "The moist areas, with climate and soils akin to much of the North Island, have similar types of sheep farming. This type of farm is generally found north of the Wairau River and in the Marlborough Sounds. High fertiliser inputs, high costs and reversion problems have resulted in a reduction in the number and extent of farms in this area over recent years. It is also this area where exotic forestry has had its greatest impact." The author also observed that Marlborough's share of New Zealand's "farms, improved land, crops and even exotic forestry" was smaller than its "occupied land" area.

Since the late 1980s, the number of livestock has gradually declined, settling at around one million livestock units between 2010 and 2019. Some of this decline can be attributed to a boundary realignment in 1992 when the Kaikōura district became part of the Canterbury region. Most of the change is the sheep flock, although as of 2019, it still made up roughly half of the region's livestock units and, in contrast to expectations in the mid-1970s, the beef herd also reduced in size. Figure 14 shows the change in stock units over the 45-year period from 1974 to 2019 using the data available from New Zealand Yearbooks and Stats NZ (these data sources occasionally have gaps).

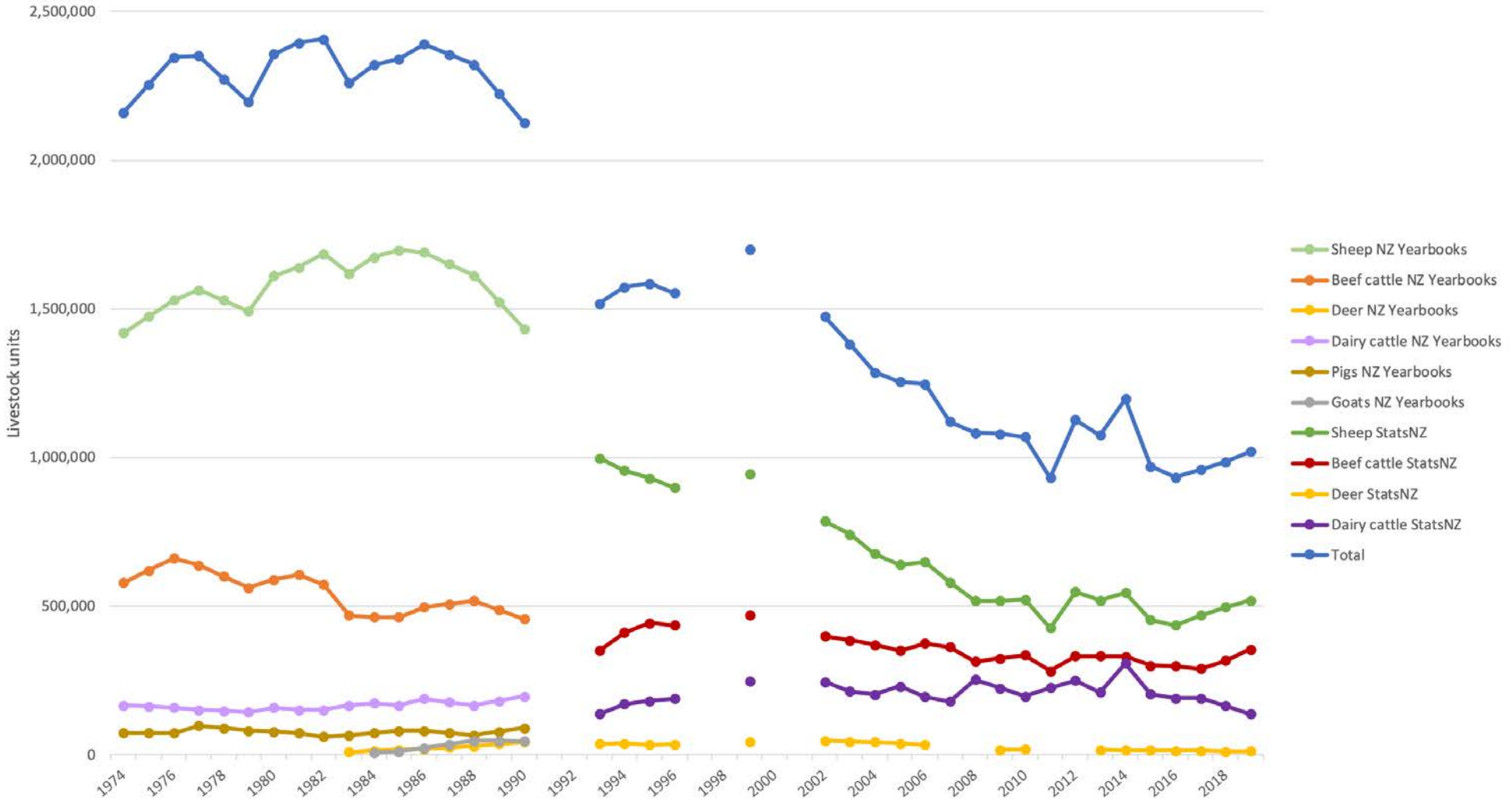


Figure 14: Livestock units in Marlborough 1974-2019
Source data: New Zealand Yearbooks and Stats NZ

Sheep and beef cattle farming in Marlborough is now largely dryland (i.e., non-irrigated) while dairy farming is a mix of irrigated and dryland. There are a few examples of deer farming and goat farming (either specialist operation or as an enterprise within a sheep and beef farm). Dryland areas in Marlborough exhibit similar variability and growth patterns to Canterbury but, being further north, they generally experience a slightly earlier start in spring (Bywater & Moot, 2011).

Figures 15 and 16 highlight the dominance of sheep farming and the lesser focus on dairy grazing in comparison to elsewhere in the South Island[56]. A farmer interviewed for this report commented that the practice of wintering sheep amongst vines may be slightly "distorting" the grazing situation in Marlborough: "Some, the farmers who own a vineyard block as part of their farm are not paying for it, it's all part of the farm business, so they are grazing winter lambs 'on-farm'. Whereas others, the farmers that don't own vines, they're grazing their lambs 'off-farm' during winter and processing them as hoggets from there."

With the ongoing conversion of land away from pastoral farming, the saleyards in Blenheim closed[57] and now much of the store livestock is sent to Canterbury Park (Christchurch)[58] (E. Gray, pers. comm., 2023))[59]. Prime livestock is sent for processing as far afield as Pareora (Silver Fern Farms) near Timaru or across Cook Strait to plants in the North Island, such as Wellington (Taylor Preston)[60] or Feilding (Ovation)[61] (E. Gray, pers. comm., 2023)[62]. The closure of the 138 year old Smithfield plant (Alliance) in Timaru at the end of 2024 may impact livestock farming as far afield as Marlborough in the future.

56 There is anecdotal evidence from the farmer interviews that dairy grazers may come north from Kaikōura but may be less likely to travel from locations further south, such as Culverden.

57 With changes in pastoral farming, the once monthly stock sales became four sales a year and the site has become one of the largest overnight stock transit areas in the upper South Island for stock firms moving animals north and south. In 2015 around 12,300 stock were sold at the yards through the three calf sales and one spring sale. *https://www.stuff.co.nz/business/farming/85168382/saleyards-employee-a-true-gentleman*

58 Canterbury Park runs weekly prime cattle and a prime and store sheep sale, with regular store cattle sales along with many annual sales including ram fairs and seed stock dispersal sales. *https://www.canterburypark.co.nz/about-us*

59 B+LNZ Economic Service Manager - Northern South Island.

60 *https://www.taylorpreston.co.nz/*

61 *https://www.ovation.co.nz/*

62 There was a freezing works at Picton from 1900 until 1983. In the 1970s, 400 people were employed during the peak of the season. Leading up to its closure, an expansion option was being investigated because its capacity was not sufficient to process all livestock and some was transported to Nelson, Christchurch and the North Island (Duckwork *et al.*, 1976). The works were known as the 'Picton University' – their closure was because they did not meet modern health and safety standards and the site was converted into a second port for log export (*https://www.stuff.co.nz/national/106489138/picton-university-reunion-joy*). An abattoir in Blenheim handled livestock for the local market (Duckwork *et al.*, 1976).

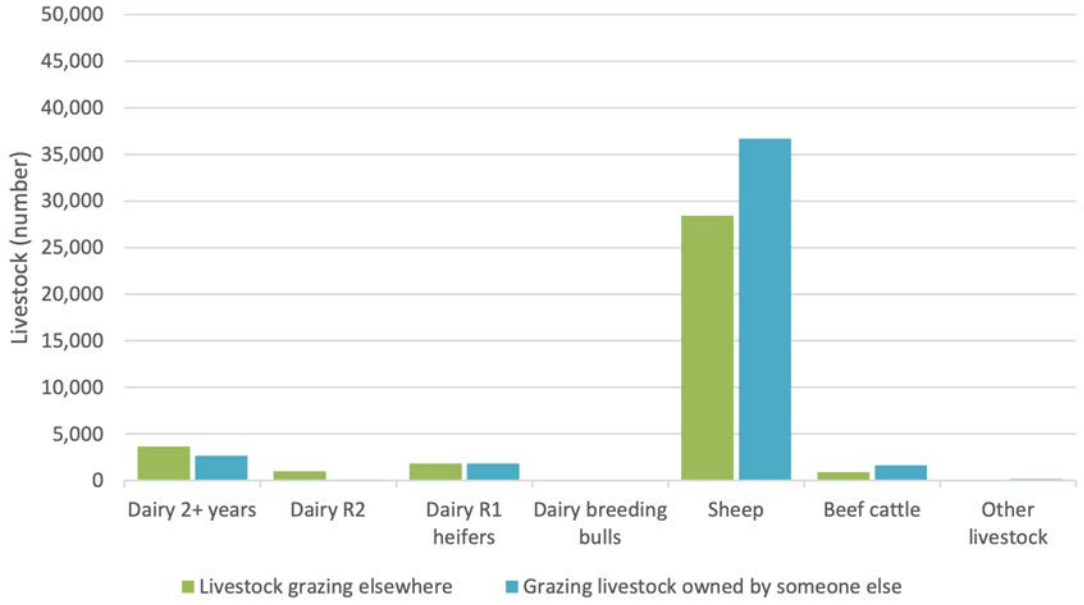


Figure 15: Grazing patterns in Marlborough by livestock type in 2021-22
Source: Stats NZ Agricultural Production Statistics 2022

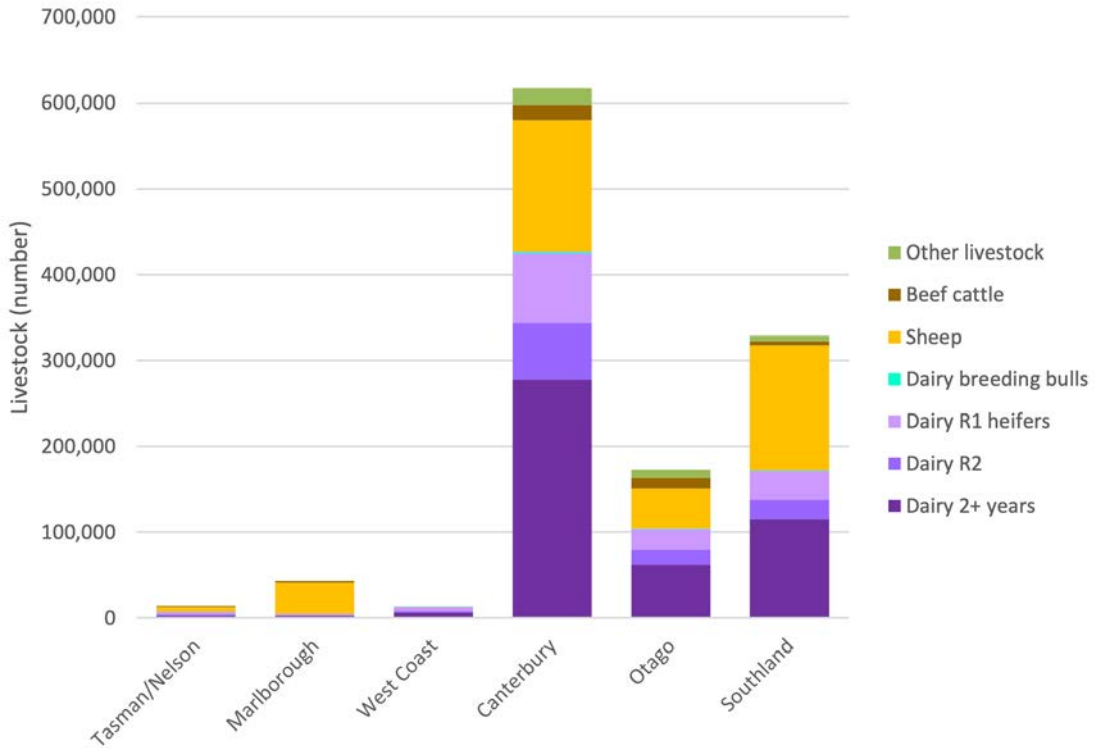


Figure 16: Distribution by region in the South Island of grazing livestock owned by someone else for 2021-22
Source data: Stats NZ Agricultural Production Statistics 2022

Arable cropping involves the growing of cereals (for either human consumption or stock feed), herbage and vegetable seed, as well as a multitude of other crops for both domestic and export markets (Moran (Ed.), 2022). Arable crops are central to New Zealand's pastoral industries as the seed source for animal pastures, vegetable seeds, and cereal and silage for complementary animal feed (Moran (Ed.), 2022). While in the past arable farming occurred to a far greater extent in regions such as Marlborough, the industry has over time lost much of its processing capacity and now only exists at scale within Canterbury[63].

Mixed arable farming was once the principal land use around Blenheim and Seddon, reflecting the favourable weather conditions (i.e., high sunshine hours and low annual rainfall). Mixed cropping and export lamb production featured on the lower Wairau Plain near Blenheim and cropping and small seeds production was also carried out on export lamb farms near Seddon (Duckworth *et al*., 1976). In the 1960s, crops grown included cereals, peas, grass and clover seeds, vegetables, and flowers (McLintock, 1966). A total of 16,452 acres (6,658 ha) in 1960 in the Marlborough and Awatere counties was devoted to the production of cereals (particularly wheat) and peas.

In the 1970s, the main crops were wheat, barley, and peas (for both seed and processing). Lucerne for meal production was important on farms near Blenheim and the area and yield was increasing annually. Also, there was limited areas of beans and maize grown around the lower Wairau Plains area. The main small seeds grown were broad red clover and lucerne, which "yield well in Marlborough's hot dry summers" (Duckworth *et al*., 1976: p145). At the time, Blenheim was also the principal centre in New Zealand for the production of onion seed as well as flower[64] and vegetable seed crops (Duckworth *et al*., 1976).

> *The bulk of vegetable seed produced in New Zealand is grown in Marlborough. The normal hot dry summer is of assistance in harvesting seed in good condition, though it is likely that the trend will be towards mechanical drying because it is much quicker and certainly more reliable. The main crops grown for seed in 1975/76 were French and runner beans (215 ha), broadbeans (100 ha), onions (50 ha), sweetcorn (10 ha), pumpkins, cauliflowers, cabbages, silverbeet, carrots, parsnips, and tomatoes.*
>
> ***Duckworth et al. (1976: p149)***

Other crops grown at varying scales include potatoes, ryegrass, white clover, lupin, and kale. While crop areas fluctuated from one year to the next, largely as a result of weather conditions and the profitability of livestock farming, the overall trend in the 1970s was towards an increase in the use of land for crops (Duckworth *et al*., 1976). Sprinkler irrigation systems were being installed on mixed cropping farms with lighter and drier soils. These systems were largely mechanical shift (e.g., 'side roll' and 'tow-a-line') and lifted yields of peas, beans, wheat, barley, and lucerne (Duckworth *et al*., 1976).

In 2009, the area of cereals harvested in Marlborough included just 300 hectares of wheat and 800 hectares of barley (Dymond (Ed.), 2014) and by 2022 these areas had declined to 22 hectares of wheat (used for milling[65]) and 198 hectares of barley. Marlborough was still an important region for herbage seed in 2009, mostly producing lucerne seed (Dymond (Ed.), 2014). However, by 2022 the area of herbage seeds harvested

63 As an example, the evolution of the industry in Otago is discussed in Section 5.4 of Moran (Ed.) (2022).

64 Asters, Iceland poppies, pansies, ranunculus, and anemones were periodically grown for seed production. Seed from ranunculus and anemones were used to produce corms for sale to commercial growers and the public.

65 The data for area of wheat harvested for other uses was suppressed.

for seed production was just 142 hectares with an additional 13 hectares of vegetable seed harvested[66]. The importance of locally grown seeds for managing the 'summer dry' was noted by one of the sheep and beef farmers interviewed (refer to Section 4.1.7). A new development for the region is medical cannabis at the Puro breeding facility, a research and indoor growing site in the Waihopai Valley[67].

In addition to cereals and process vegetables, Figure 17 shows the arable crops grown for livestock feed in Marlborough in 2022. In that year, 11,480 hectares were grown, which was the smallest area of any region in the South Island except for Nelson but similar in scale to Tasman and the West Coast (the extent grown in Canterbury, Otago and Southland was at least another order of magnitude). Of this area, 50 per cent of the area used for cropping was pasture/lucerne for making hay, silage, and baleage. In addition, 22 per cent was lucerne (and either used or sold) and 25 per cent was either forage brassicas or other supplementary feed crops. The 1,490 hectare area of forage brassicas in 2022 was just over 5 per cent less than in 2018 when 1,574 hectares were grown in the region (57% occurred on sheep and/or beef farms while 31% occurred on dairy farms).

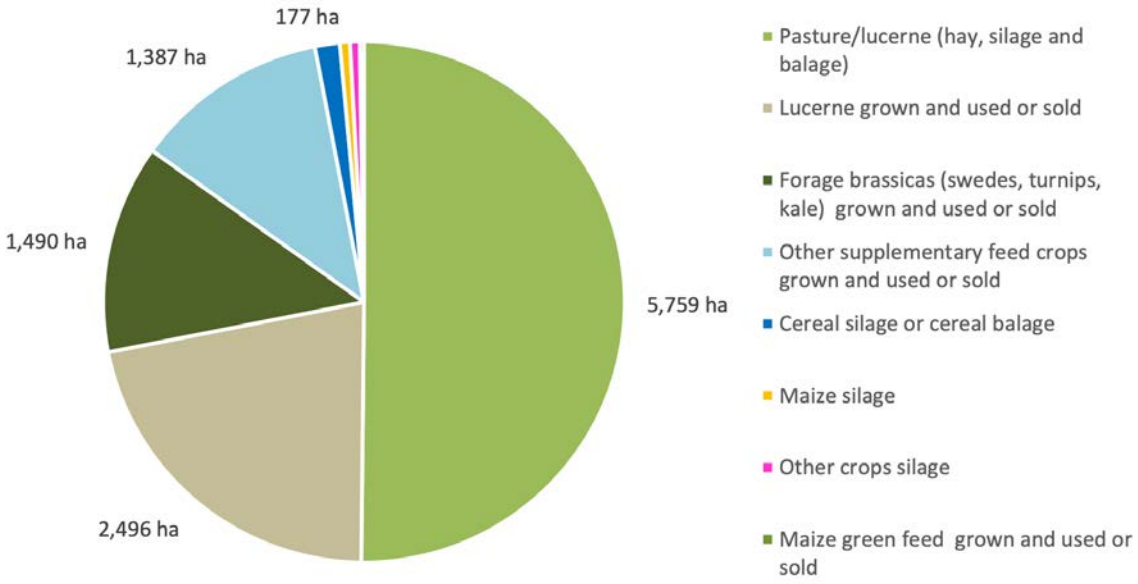


Figure 17: Mix and extent of arable crops grown in Marlborough in 2021-22
Source data: Stats NZ Agricultural Production Statistics 2022

66 The future of arable farming in New Zealand was a topic that was recently explored in the Transition Pathways theme of the National Science Challenge: Our Land and Water *https://ourlandandwater.nz/project/future-scenarios-for-arable-agriculture/*

67 *https://puro.co.nz/plans/*

4.1 Sheep and Beef Farming

This section primarily draws on four interviews and data from the B+LNZ Sheep and Beef Farm Survey[68], through which B+LNZ's Economic Service collect financial and production data for farms across New Zealand. In the B+LNZ Sheep and Beef Farm Survey, Marlborough is included in a 'Marlborough-Canterbury' region. The sample size for the 'Marlborough-Canterbury' region is a total of 128 commercial sheep and beef farms, nine of which are in Marlborough (around five cent of the region's total sheep and beef farms). A draft of this section was reviewed by B+LNZ staff and Justin Stevens (local farmer and Chair of the New Zealand Deer Farmers Association).

4.1.1 Introduction

Sheep and beef farming in Marlborough occurs on various combinations of soil types, topographies, and microclimates, although it is increasingly being confined to hill country. In 2022, there were 183 sheep and beef farms in the region of at least 80 hectares in size[69]. Over time, farmers have adapted (and continue to adapt) their production systems to their own unique set of environmental conditions – as well as the financial aspects of their businesses.

The region's industry has (at least) three main features that set it apart from other regions. First, there is strong seasonality in pasture production, with pasture growth in spring being crucial for production because the summer is typically dry – and thus the region is considered 'summer dry'[70]. Second, much of the farmland is either rolling or steep terrain and farmed extensively, with very low stocking rates. The extent of arable crops, grown for feed or as a cash crop[71], is now limited where there is a more profitable land use. Third, there are some fairly uncommon circumstances in the region, such as pressure from and mix with viticulture, the lack of road access in the Marlborough Sounds, and the absence of meat processors for export. With the exception of the sheep and beef farms in the Marlborough Sounds, there may be less diversity between sheep and beef farms within Marlborough than there is between sheep and beef farming in Marlborough and other regions.

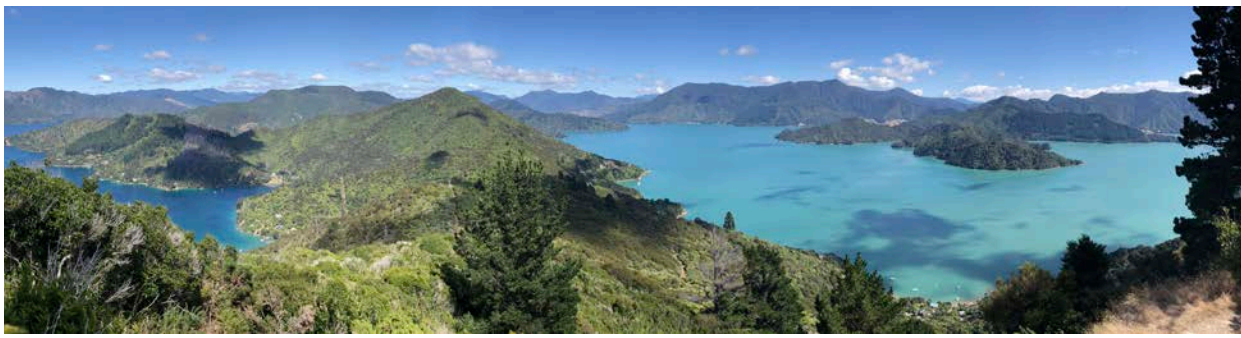


Image 31: Torea Bay with view of Queen Charlotte Sound on the left (brighter blue) and Pelorus Sound on the right (milky appearance due to higher sediment load)

68 The B+LNZ Sheep and Beef Farm Survey has been conducted annually since 1950, having been established following the New Zealand Government's 1949 Royal Commission that was instructed to "Inquire Into and Report Upon the Sheep-Farming Industry". In its inquiry, the Royal Commission found that "*there is considerable division of opinion with no unchallenged premises of facts from which deductions could be safely made to formulate conclusions and proposals*". The recommendations included the amalgamation of the then Meat and Wool Boards and to collect and document "factual information" concerning farm production and economics. The Sheep and Beef Farm Survey is now over 70 years old, making it one of the longest running such primary sector surveys in the world.

69 As well, sheep and beef cattle were farmed on an additional 78 properties of between 20 and 79 hectares. In the context of this report, a property less than 20 hectares is considered to be a lifestyle block or small holding. The data source is Stats NZ Agricultural Production Statistics Year to June 2022.

70 As a comparison between regions, the growing season in Southland has a late start, which means that the period from weaning to selling lambs off-farm is particularly critical to success (Moran, 2017).

71 Cash crops is terminology used by pastoral farmers who may see an opportunity to improve their cashflow by putting in a cereal crop. Arable growers do not tend to refer to cash crops.

4.1.2 Historical Context

Sheep farming commenced early in Marlborough, when two main flocks of sheep were brought in during the 1840s, and it remained the most important type of farming for well over a century (Beggs, 1962). However, between 1921 and 1951 the number of sheep declined in some counties or hardly increased in others (McLintock, 1966). The situation improved, following the introduction of aerial topdressing of superphosphate[72] and New Zealand's 'wool boom' driven by the Korean War, although increases in livestock numbers in Marlborough were at lower rates than those that occurred nationally and they concentrated in a few localities (McLintock, 1966)[73]. Post-World War II development saw "a greater differentiation occurring within the region and the focusing of development upon the richer and more favoured lowland areas" (McLintock, 1966: p502) (Figure 18)[74].

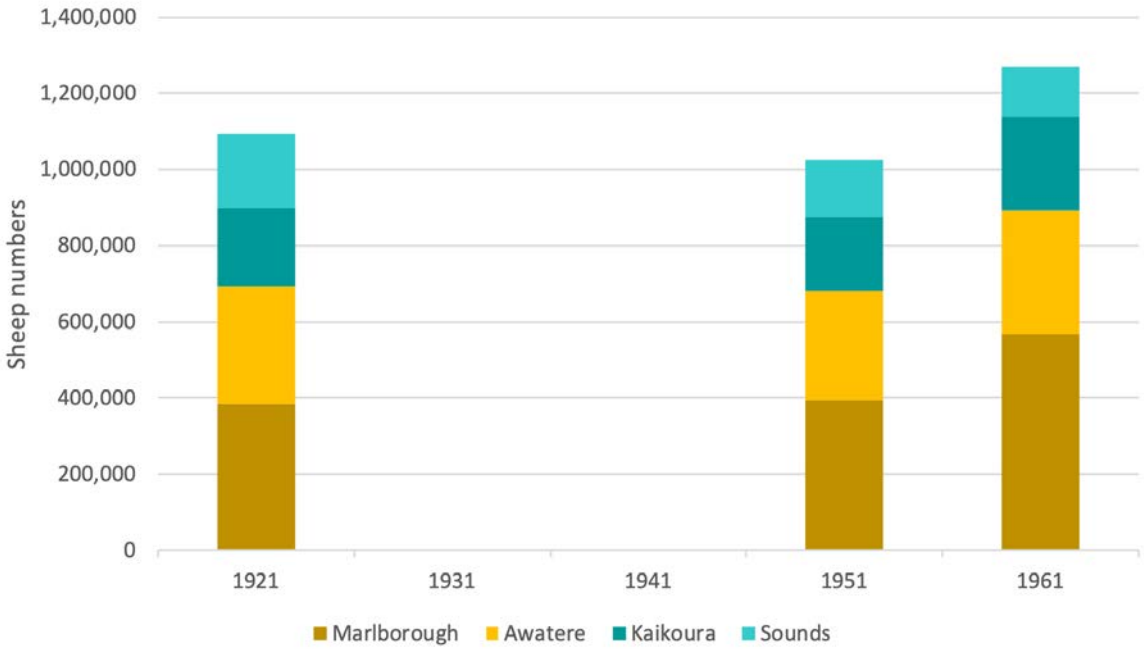


Figure 18: Sheep flock by county in Marlborough during the mid-20th Century
Data source: An Encyclopaedia of New Zealand (McLintock, 1966)
Note: The years reported in the graph (1921, 1951, and 1961) were all that was available in the source reference. Kaikōura became part of the Canterbury region in 1992.

By the early 1960s, it was being reported that good quality sheep had been bred over the years to suit the conditions, and the main breeds in the high country and hill country south of the Wairau River were Romney, Halfbred, Corriedale, and Merino[75] (in that order) (Beggs, 1962). The lower hills were sheep breeding country while the focus in the higher country was on wool. Some sheep finishing was done on a few properties on

72 Scherp (1962) described the effects of aerial sowing of fertiliser and seed from 1942 to 1962 for their Marlborough hill country farm at Hillersden in the Wairau Valley. The cattle story began on this farm in 1956, "when it was realised that further means of feed utilisation would be needed, as the sheep had never really caught up with the feed supply… Since 1956 the cattle have been increased considerably on the back country, doing a good job in controlling roughage and at the same time continuing to grow well and put on weight."

73 An interviewee reported that there were thirteen grain and wool stores in Blenheim in the 1950s.

74 Marlborough County incorporated the sparsely populated Sounds County in 1965 and Awatere County in 1976 (*https://teara.govt.nz/en/interactive/31794/local-government-in-marlborough-1859-2011*).

75 Since it was imported in 1998, a breed of merino seen occasionally in South Marlborough is Dohne, which is a South African meat merino. *https://rarebreeds.co.nz/dohne.html*

easier country. Beef cattle numbers were increasing, which helped with the control of rank pasture and weeds, and further increases were seen as "both likely and desirable, although farmers in areas subject to periodic droughts have to be careful not to proceed too far in this respect"[76] (Beggs, 1962).

J.P. Beggs (1962) described the unique circumstances for farming in the Marlborough Sounds at the time:

> *Farmers in the Marlborough Sounds face many difficult and unusual conditions, the most notable being transport problems and costs. All transport is by water: sheep and cattle are punted, groceries go out by launch, the future house cow in the form of a calf goes out on the mail launch, a trip to town (which does not come often) is made, at least part of the way, by launch, and the mail arrives by launch (twice a week). All this makes for high transport costs and much handling. For example, landing of lime on the beach and putting it under cover is not an easy operation; it is still harder to go out and sow it by hand on the hills.*
>
> *The country is almost all hills and most properties have only enough flat land for the placement of buildings. The country is of very low fertility, and, as it is difficult and costly to apply fertiliser, the battle against weeds (fern, tauhinu, and Spanish heath) is continuous and difficult. It is necessary to use fire frequently to keep this second growth at bay.*
>
> *The sheep carried are mostly Romneys, and store stock are produced, ewes being sold for fat lamb production in more favoured parts of Marlborough. A few farmers who have an area of flats are able to fatten some of the lambs. However, the aeroplane is now operating on many properties in the Sounds and this will assist greatly in the control of weeds and will permit more fattening of stock to be done.*

By the early 1970s, there were 1.5 million sheep in Marlborough (including lambs shorn) and just over 100,000 beef cattle. In 1974, 22 high country runs made up almost half of the farmland but carried just 6.7 per cent of the sheep and 23 per cent of cattle production (Yeoman, 1983). During the decade the agricultural sector in New Zealand started to face both political and economic headwinds (Fisher & Burtt, 2022). In particular, New Zealand's guaranteed market for its lamb exports effectively ended when Britain joined the 'Common Market' in 1973. In the mid-1970s, lambing percentages ranged from 70 per cent in the high country and the Marlborough Sounds to 120 per cent on export lamb farms – the district average was around 92 per cent (Duckworth, 1976).

Duckworth (1976: p109) observed that "Over the last ten years there has been a substantial increase in the numbers of beef cattle, which have doubled, and these are farmed mainly on the traditional sheep breeding areas." There were recent increases in cattle being finished on easier lowlands and plains, and dairy beef production came into prominence. It was forecast that the increases in cattle numbers would continue (Duckworth, 1976). However, the regional beef cattle herd peaked in 1976 with 660,000 animals (NZ Yearbook).

During 1977 and 1978, the government introduced subsidy schemes to make cheap loans available to develop unproductive land, encourage farmers to carry more stock, and guarantee farmers price stability for their products, despite declining international prices[77].

---

76 F. L. Ward, New Zealand Meat and Wool Boards' Economic Service (1962) described beef cattle as follows: "In the past New Zealand cattle have acted more as living agricultural implements than as direct profit earners, but now, owing to an increased demand for beef, particularly good quality young beef, cattle have come to be regarded as meat producers in their own right."

77 Lee (1983) contemporaneously described their experience of developing a summer-dry hill country farm in the Waima (Ure) Valley (south of Ward) from the mid-1970s to the early 1980s. The development programme was undertaken with the help of finance from the Land Development Encouragement Loan Scheme, the Livestock Incentive Scheme, and the Rural Bank. More recently, Dawkins & Dawkins (2008) reflected on benefits gained for their farm in the Waihopai Valley from the encouragement of land based industries by the third National government.

The bulk of Marlborough's increase in stock numbers over the past 20 years has been on the relatively dry hill country, south of the Wairau River and below about 700 metres. Figures provided by the Rural Banking and Finance Corporation show that some 310 Land Development Encouragement Loan programmes were approved. This represents in the order of 40 per cent of all farms that could have been eligible for the scheme. The uptake of the Livestock Incentive Scheme has been similarly well ahead of any national responses.

Yeoman (1983)

The 1980s brought well-documented changing fortunes for the industry, particularly with the removal of farming subsidies (Fisher & Burtt, 2022). The regional sheep flock peaked in 1985 with just under 1.7 million animals (NZ Yearbook). Since then, sheep and beef cattle farmers have been more fully responding to consumer demand for lamb and beef, and from the early 1990s, the returns from wool declined markedly. The time period from the 1990s (and in some cases earlier) are explored in the following sections. By 2019, there were 518,000 sheep and 64,000 beef cattle in Marlborough (Stats NZ Livestock Numbers).

A farmer interviewed for this report described how changes in consumer demand for lamb over time have affected the nature of their production system:

- *We put terminal sires over as many sheep as possible so we get a lamb that grows quickly and get that away before Christmas. But with the increase in the weight of the lambs on the schedule prices we're getting fewer lambs away – in the early 1990s, we used to be able to sell a 13.5 kg lamb (finished) but now they want them 15.5 kg (carcass weight). We are shifting from producing finished lambs to store lambs (for someone else to finish).*

4.1.3 Sheep and Beef Cattle Farm Classes

The B+LNZ Sheep and Beef Farm Survey represents the diversity in the sheep and beef farming industry across New Zealand. This survey is a random sample of commercial sheep and beef farms[78] from the StatsNZ Business Frame, which is a register of the individual economic units that make up the New Zealand economy. While generally referred to as 'farms', a commercial sheep and beef farm is a business that carries over 750 livestock units and may consist of more than one property (among other things).

Farms in the B+LNZ Sheep and Beef Farm Survey are grouped with like farm businesses and classified using a system of eight farm classes: five for the South Island and three for the North Island. The three farm classes relevant to Marlborough are highlighted in blue below. This **Farm** Class system is distinct from the **Land Use Capability** (LUC) Class system, which rates the versatility of land for agricultural uses by its physical attributes, such as soil and slope (refer to Chapter 2 of this report). While two neighbouring farms may have a similar Land Use Capability Class (or classes), the way in which these farms are managed as businesses may mean that they are different farm classes. For example, the availability of irrigation water may mean the difference between a farm being Farm Class 2 (South Island Hill Country) and Farm Class 6 (South Island Finishing-Breeding).

78 The B+LNZ Economic Service defines a commercial sheep and beef farm by a number of criteria, the most significant of which are that the farm carries at least 750 sheep and beef stock units over winter and earns at least 70% of its revenue from sheep, beef cattle, long-term dairy grazing and crops.

Farm Class Descriptions

Farm Class 1 – South Island High Country: Extensive run country at high altitude carrying fine wool sheep, with wool as the main source of revenue. Located mainly in Marlborough, Canterbury, and Otago.

Farm Class 2 – South Island Hill Country: Mainly mid-micron wool sheep mostly carrying between two and seven stock units per hectare. Three quarters of the stock units wintered are sheep and one-quarter beef cattle.

Farm Class 3 – North Island Hard Hill Country: Steep hill country or low fertility soils with most farms carrying six to ten stock units per hectare. While some stock are finished, a significant proportion are sold in store condition.

Farm Class 4 – North Island Hill Country: Easier hill country or higher fertility soils than Class 3. Mostly carrying between seven and 13 stock units per hectare. A high proportion of sale stock sold is in forward store or prime condition.

Farm Class 5 – North Island Intensive Finishing: Easy contour farmland with the potential for high production. Mostly carrying between eight and 15 stock units per hectare. A high proportion of stock is sent to slaughter and replacements are often bought in.

Farm Class 6 – South Island Finishing-Breeding: A more extensive type of finishing farm, also encompassing some irrigation units and frequently with some cash cropping. Carrying capacity ranges from six to 11 stock units per hectare on dryland farms and over 12 stock units per hectare on irrigated units. Mainly in Canterbury and Otago. This is the dominant farm class in the South Island.

Farm Class 7 – South Island Finishing: High producing grassland farms carrying about 10 to 14 stock units per hectare, with some cash crop. Located mainly in Southland, South and West Otago.

Farm Class 8 – South Island Mixed Cropping and Finishing: Located mainly on the Canterbury Plains. A high proportion of their revenue is derived from grain and small seed production as well as stock finishing.

There are important interdependencies between farm classes within the sheep and beef industry, both within and between regions, as each farmer matches their production system to the carrying capacity of the land. For example, the breeding and finishing of lambs within a single production season (1 July to 30 June) often needs to occur across more than one property. There also can be strong connections with the dairy industry.

For example, one farmer interviewed purchased 90 calves from dairy farmers annually: 40 Holstein Friesians for finishing, and 50 Jerseys that were then sold-on or leased to the dairy industry for mating. They noted that some Marlborough farmers also take on dairy cows for grazing as it is “a good way of turning a growthy summer/autumn to profit”. However, other farmers run a closed production system. A second farmer explained that “We don’t trade lambs or dairy grazers, mainly to avoid bringing in any diseases. My dad wouldn’t ever buy hay because he reckoned you were just buying everybody else’s weeds. I suppose that rolled over to stock as well.”

Such interdependencies within the value chain are often dependent on long-standing business relationships, sometimes based on family connections. Two of the farmers interviewed highlighted the importance of having professional and family connections as well as the opportunities they can create.

- *You've got to have a good rapport with your stock agents and meat companies so that they can help you out when you need it. Having those contacts is really important. They're vital really when the chips are down.*
- *We've been doing the Jersey bulls for awhile now and they mainly go to the same properties each year across in Tasman and down the West Coast. We've got a very good stock agent and it's a long-term relationship that we probably take for granted – if we didn't have it then we may not do as much dairy support and it might be easier to just run a beef herd.*

Figure 19 shows the estimated distribution of sheep and beef farms across New Zealand by farm class and B+LNZ 'region' in 2021-22. The most common farm class in Marlborough is Farm Class 2: South Island Hill Country, which comprised 105 farms or 68 per cent of the commercial sheep and beef farms. There are also a handful of Farm Class 1 – South Island High Country (15 farms or 10%)[79] and Farm Class 6 – South Island Finishing-Breeding (35 farms or 23%). In 2021-22, there were nine Marlborough farms in the B+LNZ Sheep and Beef Farm Survey sample - mostly Farm Class 2: Hill Country located in the southern half of the region, reflecting the current broad distribution of the industry in the region.

Anecdotally, one farmer interviewed thought that "there are limited sheep and beef farms left in the region, maybe around 90 farms with 2,500 stock units or more". Another farmer reflected on the expanse of high country in south Marlborough:

- *The Awatere Valley is classic high country – the high country runs up the Awatere Valley are all still there – even with the fine wool prices. In the back of Ward, once you get up on the hills and look back towards the Awatere, there's a huge amount of country up there that's just quietly ticking over with sheep and beef cattle.*

While there are not currently any Marlborough Sounds farms included in B+LNZ's Sheep and Beef Farm Survey, these farms are a unique feature of the industry in the region (as highlighted in the previous section)[80]. They tend to receive more rainfall than further south, face additional transport challenges, and largely consist of steep terrain.

This chapter presents data from the Sheep and Beef Farm Survey for Marlborough and Marlborough-Canterbury and New Zealand for comparison. The data is usually weighted averages across all relevant farm classes.

79 As a point of comparison, in the in 1970s there were 22 high country stations or 'runs' that made up almost half of the occupied area of Marlborough (including the 182,000 hectare Rangitahi / Molesworth Station) (Yeoman, 1983).

80 Some resources that describe sheep and beef farming in the Marlborough Sounds are: https://marlboroughapp.co.nz/rural/a-history-of-farming-in-the-sounds-portrayed; https://marlboroughapp.co.nz/rural/the-sounds-challenges-and-opportunities; https://www.nzherald.co.nz/the-country/news/sheep-travel-by-barge-in-marlborough-sounds/MMQE3NMT3XGVGQH3U6RLEYZ2LA/; https://country-wide.co.nz/farming-without-a-road/; https://www.ruraldelivery.net.nz/posts/Moleta-Family

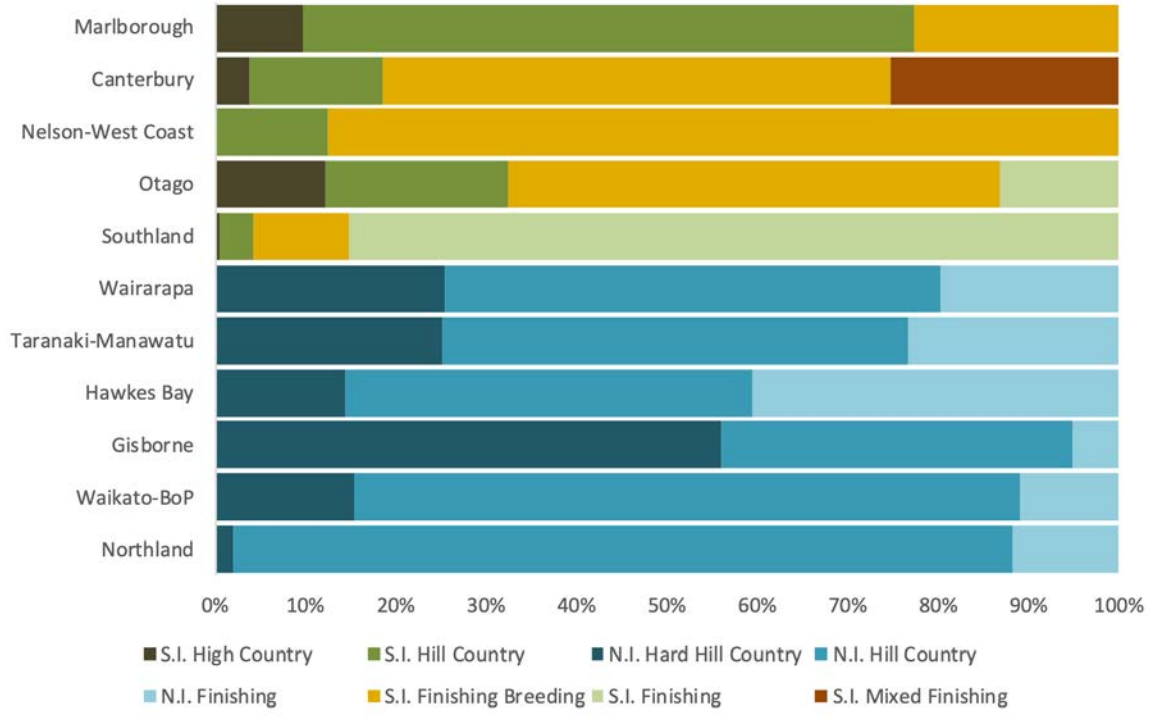


Figure 19: Estimated percentage of farms by farm class and region 2021-22
Source data: B+LNZ Economic Service

In recent years, the irrigated flat land on many of Marlborough's Farm Class 6 and some Farm Class 2 farms has increasingly been converted from growing arable and vegetable crops, such as lucerne, sweetcorn and field peas, to grapes for wine. Esnes Gray (B+LNZ's Economic Service Manager - Northern South Island) noted that farmers have shifted over time from only having a limited part of their farm in vines and a smaller income stream, to the point where the income coming in from the vines contributes a large share of farm profitability. "The farmers I've been dealing with have been using it to their advantage and there is an element of the grapes on most of the nine survey farms". Esnes Gray also noted that families appear to have used viticulture in one way or another to help with farm succession.

The uses of a vineyard within a business appear to range from those where the vineyard is treated as a separate unit and buying in store lambs, to those who have the vineyard fully integrated within their production system and are using it to winter sheep and, in some instances, for lambing in late winter/ early spring. Where there is full integration, a farm may have remained as a Farm Class 6: South Island Finishing Breeding, albeit with slightly less livestock than before. However, where there is separation (e.g., the farm's 'flats' are in vines and the hill is pastoral) they become more of a store stock property (i.e., limited to breeding rather than breeding and finishing).

A farmer described the transition that has occurred in Marlborough:

- *In the early days the idea was that if you plant a few hectares of vineyard then you will have the income to invest in improving your pastoral platform. As people began to realise the returns of viticulture, sheep and beef farming tended to get sidelined and stock managers were employed to look after the farm, keep it ticking over. Meanwhile, the hugely productive vineyard provided opportunities and that is allowing people to develop at a rate of knots, including environmentally.*

While some farmers have developed a vineyard enterprise (via a range of ownership and lease arrangements) within the farm system, the option is not always available (E. Gray, pers. comm., 2023). Reasons highlighted in the interviews were a lack of irrigation water, the farm's 'flats' being either of insufficient size or shape, the microclimate being too cold because of inversion layers or wind, or simply they were farmers not viticulturalists. Vineyard management can also be a factor in decision-making. One farmer noted that "We're quite fortunate here with a pragmatic vineyard manager who embraces the livestock. If you have a manager who isn't overly supportive of the livestock, they may just ring up one day and say, "I want those sheep gone"".

As an example of the mixed farming system, a local farmer explained that: "The vineyard is about 10 per cent of the farm when we take into account the headlands that are not planted, but the vineyard gives us half our income. On the rest of the farm, we have a stocking rate of seven stock units per hectare with a total gross income of about $240 per stock unit." However, another farmer with a successful vineyard block noted that while it provides opportunities (e.g., better income, gain in capital value, easier farm succession) the loss of land can also constrain the rest of the farming operation: "You can't just take out the best paddocks on farm and not have an impact." "You can ruin what already exists while you are thinking that you're creating more. You've got to be careful that you don't end up with a grape farmer's debt with a sheep farmer's income."

The farmers interviewed noted that the use of land for vineyards was not 'business as usual' and saw an opportunity cost for the rest of the farm:

- *People might say you can still graze but let's be honest, you don't have paddocks, a vineyard is just one great big area, you can't get a rotation going on. You can't really have improved pastures like you can in a normal paddock situation. In the middle of winter, once the vines are pruned, they want to mulch the whole vineyard, so they're mulching all that winter feed into the ground and you can only utilise some of it.*
- *You make about three times the income by having your capital stock grazing the vineyards, using your lambs as opposed to buying in stores. Integrating a vineyard is not that straightforward for other properties. With store lambs you've got that flexibility, whereas if your whole system, particularly lambing, is geared around your best land, you can't just exit your livestock. Under the right circumstances the two can work together, but in many cases a vineyard may kneecap the farm business.*
- *Usually, the pasture in a vineyard is just unimproved grass. In fact, a lot of wineries prefer a lawn-type grass that doesn't grow because they just have to mow it more. So, you'd have a poor pasture species, you'd be mulching it into the ground in the middle of winter. And then of course, 40 per cent of the area is sprayed out.*

More than one farmer compared grazing in a vineyard with grazing amongst solar panels: "You can't put a tractor under the solar panels and crop or renew your pastures. Yes, you can graze it a wee bit, but it's not the same as farming." Some of the issues relating to stock grazing can be addressed with planning. One farmer explained that: "Using improved pasture species in the vineyard that is autumn and winter active allows pasture covers to be built in the vineyard and a 'pick-up' mulcher help avoid all the winter grass from being chewed off. Also, the width between vine rows may allow for seed drilling, and installing dripline irrigation helps avoid sheep tripping when being shifted through a vineyard. But these things take more time and so additional expense."

While the B+LNZ farm classes are a useful classification system, there is considerable diversity within a farm class. For example, there is a lot of diversity within Farm Class 6 – Finishing and Breeding, even between Nelson and Marlborough they are different farming systems (E. Gray, pers. comm., 2023). Overall, the farms in south Marlborough tend to be closer to those in North Canterbury (i.e., the Hurunui District) than in Nelson-Tasman, particularly where they are dryland farming. A Wairau Valley farmer commented that Marlborough farms have similar stocking rates to North Canterbury, but the latter can tend to have more scale. A farmer from Ward thought their local situation was likely to be drier[81] than North Canterbury and the wind run higher, especially with the 'nor'westers'.

4.1.4 Size and Topography

Over the past 40 years, the size of sheep and beef farms and the topography included within them have altered considerably across much of New Zealand for reasons ranging from changes in their relative profitability (compared to other rural land uses) to tenure review of Crown pastoral leases[82]. In Marlborough, this alteration has largely occurred since the early 2000s. As a weighted average across farm classes, the total average area of the Marlborough farms in the Sheep and Beef Farm Survey increased 58 per cent from around 1,300 hectares in 2000-01 to just under 2,200 hectares in 2021-22. As it is elsewhere, the size and topography of sheep and beef farms is diverse. The Hill Country and High Country farms are larger than those in the North Island and there are an estimated 15 sheep and beef farms in the region that are 4,000+ hectares in size.

In addition to variation in size, each sheep and beef farm has its own blend of topography, including flat, rolling, and steep land, which influences other characteristics of the farm business. A farm's flatter land is usually its most versatile. The grazed area of the Sheep and Beef Farm Survey farms in 2021-22 was 45 per cent larger than in 2001-02, but the share of flat land had decreased as a share by two-thirds from 19 per cent of a farm's grazed area to 12 per cent. The grazing part of a sheep and beef farm produces food and fibre, while the non-grazing part relates to forestry blocks and areas of bush, scrub, wetlands, some tussock areas, riparian zones and similar, which are sometimes referred to as areas that are 'set aside'[83] (Fisher & Burtt, 2022).

A consequence of increasing scale for a farmer is it involves more work. Another is that there may be fewer people living in the rural community. One farmer commented on their approaching retirement: "We'd like to go to town (Blenheim), but we've still got to earn some money at some point if we want to give the next generation a fair chance. We can't just sell up, buy a house in town (that will cost the best part of a million dollars), and have enough to live on. So, we'll just have to stay here as long as we can." Overall, these farms now include smaller shares of either flat land or flat to rolling land than they did in the mid-1980s. Table 12 gives a breakdown of average farm area and topography for sheep and beef farms in 2021-22 while Figure 20 shows how they have changed over time.

---

81 The farmer added, "Our average rainfall is only 26 inches (660 mm) or something like that here, it can get down to virtually nothing. The last two or three years (prior to 2023-24) we've had what we'd call wet years, we probably had about 30–36 inches (762–914 mm)."

82 A map of the 15 Crown Pastoral Leases in Marlborough and the others in the South Island is available at *https://www.linz.govt.nz/our-work/crown-property-management/pastoral-land/location-crown-pastoral-land*

83 For clarity, the 'grazeable' part of a farm includes the area occupied by the farmhouse and some curtilage (the land surrounding the house up to one hectare), fenced tracks (known as 'lanes' or 'races' on dairy farms), unfenced tracks, and roads (if any). Set-aside areas used to be referred to as 'un-improved' or 'ineffective'.

Table 12: Estimated average area and slope mix for sheep and beef farms in Marlborough compared to Marlborough-Canterbury and New Zealand in 2021-22

Region	Flat	Rolling	Hill	Grazed area	Non-grazed area (ha)	Total Farm area (ha)
Marlborough	12%	27%	62%	1,920 (88.5%)	249	2,169
Marlborough-Canterbury	24%	30%	45%	965 (88.3%)	128	1,093
New Zealand	21%	38%	41%	700 (84%)	133	833

Source data: B+LNZ Economic Service Sheep and Beef Farm Survey

One farmer interviewed had flats and rolling country, another was on quite steep country, and the third was across two river terraces. Comments from the farmers interviewed on size and topography included:

- *We have a medium sized farm that is diversified with a vineyard block on the flats and a pine plantation on the more difficult land. The remaining land is sheep and beef. We run about seven stock units to the hectare – about 55 per cent sheep and 45 per cent beef cattle. We do a bit of Friesian dairy beef, buying weaners and selling them as two-year olds, and Jersey bull calves that we lease to dairy farmers.*
- *I don't know how farmers with fewer than 3,000 stock units actually make money if their lambs are averaging down around $110 and $120. As a guess, you'd want at least 4,000 stock units, closer to 5,000 I would think (and a better lamb price).*
- *Without debt, a minimum economic unit in south Marlborough might be about 2,500 to 3,000 stock units. It depends though.*

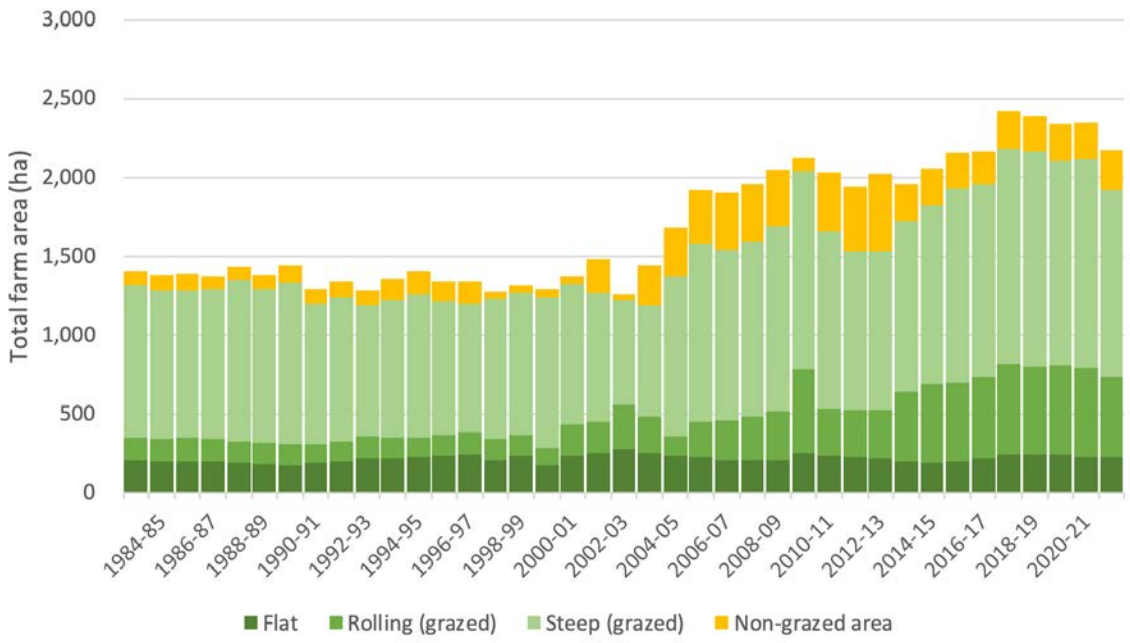


Figure 20: Size and topography of farms in the Sheep and Beef Farm Survey in Marlborough 1983-2021
Source data: B+LNZ Sheep and Beef Farm Survey

Not all land on a sheep and beef farm is used to graze livestock[84]. The share of land categorised as 'grazed' was around 92 per cent of a farm's total area throughout the 1980s and 1990s. From 2004 it gradually declined as farms increased in scale from the mid-2000s to around 86 per cent in 2021-22. This trend was fairly consistent with sheep and beef farms across New Zealand as a whole (84% in 2021-22). Or to put this another way, more land on sheep and beef farms in Marlborough is ungrazed now than a generation ago, either being 'set aside' or used for other purposes such as viticulture or farm forestry. A farmer noted that it can be difficult to calculate the grazing in a vineyard because roughly 40 per cent can be bare earth year-round.

There is more of an element of native bush on the hill country farms, especially in the gullies, and the high country farms tend to have large native areas (E. Gray, pers. comm., 2023). However, lowland farms can also contain biodiversity, such as broken limestone country that contains rare native plants, or wetlands and areas of coastal scrub[85]. The low stocking rate in Marlborough means the line between grazed and ungrazed areas of a farm can be blurred, particularly where there is tussock country. In some cases, a part of a farm may only be in grazed at certain times of the year. On large extensive farms the proportion of ungrazed area may not be closely considered.

One of the farmers interviewed commented:

- *The tussock areas are very important to my farm. We use cattle in wintertime to tidy up the rubbish and the tussocks will grow back because they've got a bit of moisture, but not in summertime as the plants will just be pulled out of the ground. The tussocks are shelter during lambing and if you get a reasonable spring it will allow the area to come away with the sub clover for our lambs.*

From 1991-92 to 2021-22, the presence of farm forestry (not including agroforestry[86]) on sheep and beef farms in Marlborough has been similar to New Zealand as a whole. In 2021-22, less than one per cent of the total area of the Marlborough sheep and beef farms in the Sheep and Beef Farm Survey were used for farm forestry. For example, one farmer explained "We've got a block of pine trees that have been there ever since we came here in the early 1990s. It is probably about 20 acres (8 hectares), but it is just sitting there because it takes them a long time to grow here." Another farmer noted that forestry was restricted in their area because it is so dry[87]. A few farmers use a forestry block for farm succession, where the parents will live off the income (E. Gray, pers. comm., 2023).

One farmer with plantings of radiata pine (i.e., Monterey pine) and other exotic species for their amenity value observed:

- *Interest in farm forestry is very limited in Marlborough. Knowledge of trees is lacking in the farming community. There's new interest in poplars for erosion control and natives for riparian protection, but people planting sizeable proportions of the farm in trees is not overly common.*

---

84 The line between grazed and ungrazed is not necessarily clear cut. For example, a farmer may use a gully or bush block on a farm seasonally for livestock protection, such as for lambing and fawning, during a weather event, or when they are tight on feed or need shade.

85 Local examples are highlighted by the Lake Elterwater-Ruakanakana Restoration Group. *https://www.rnz.co.nz/news/ldr/421619/marlborough-spectacular-limestone-landmark-to-be-protected*; and the Avon Valley Catchment Group *https://www.marlborough.govt.nz/environment/biodiversity/community-restoration-groups*. Aviss (2023) summarises the results of Marlborough District Council's Significant Natural Areas Project for 2022 to 2023. This project has been running since 2001.

86 An area that has been planted but provides grazing until the pasture production is negligible when shaded out by the trees.

87 The Proposed Marlborough Environment Plan controls afforestation in three specific areas to the south of the Wairau River (Southern Dry Hils and Wairau Southbank) and the Flaxbourne River catchment. The very low rainfall in these areas makes them vulnerable to changes in water yield resulting from changes in land use from the pasture into forestry. This control is intended to help protect the flow reliability that existing water users within a catchment have come to depend upon.

4.1.5 Livestock Mix

Sheep and beef cattle are typically run together In New Zealand because the two stock types are complementary (Fisher & Burtt, 2022). Each stock type has different feed requirements so the growth and use of pasture can be balanced within a farm across the year. As well, they can be used to manage pasture while minimising their individual exposure to parasites. One farmer expounded on their complementarity: "Cattle are a tool and I wouldn't want to farm without them. Just to tidy up, get rid of the 'tag'[88], virtually groom the place ready for the lambs to come through." Together, sheep and beef cattle create two main revenue streams, which helps diversify the farm business.

Although the stock types are complementary, the ratio of sheep to cattle varies to match a farm's conditions. Consequently, there has historically been a broad sheep/cattle gradient throughout the country, with relatively more sheep in the South Island than in the North Island. However, in recent years the gap in the size of the sheep flocks between the South Island and the North Island has closed to be roughly equal, with some variation between production seasons (A. Fisher, pers. comm., 2025).

A farmer's sheep:cattle ratio also tends to fluctuate over time as they continually respond to various push and pull factors, highlighting the need for flexibility within their production systems and retaining the ability to innovate. One influence is a farmer's life stage. For example, one interviewee commented that their farm, "was a traditional fine wool sheep place with just a few Angus beef cattle," but they had changed it to a 50/50 sheep and beef cattle as they got older, and now they are largely focused on the beef cattle, which the farmer saw as easier.

Figure 21 shows changes in the ratio of sheep to beef cattle over the past fifty years. In Marlborough, the ratio of sheep to beef cattle peaked in 1983-84 at 29:1 (the national average at the time was 22:1). However, from this time it generally declined up until the late 2000s, although not as steeply as occurred in Canterbury. Since 2012-13, the ratio of sheep to cattle has been more settled and was consistently higher than for Marlborough-Canterbury for the first time. In 2021-22, the ratio was 10:1 (the average for New Zealand as a whole was 7:1). When sheep are considered as 'stock units', in 2020-21 they represented an average of 65 per cent of a farm's total 'stock units' in Marlborough.

Image 32: Hill country sheep and beef farm by Taylor Pass Road near Nina Brook, Awatere Valley

88 For example, grass that has gone to seed, rank grass, grass with weeds.

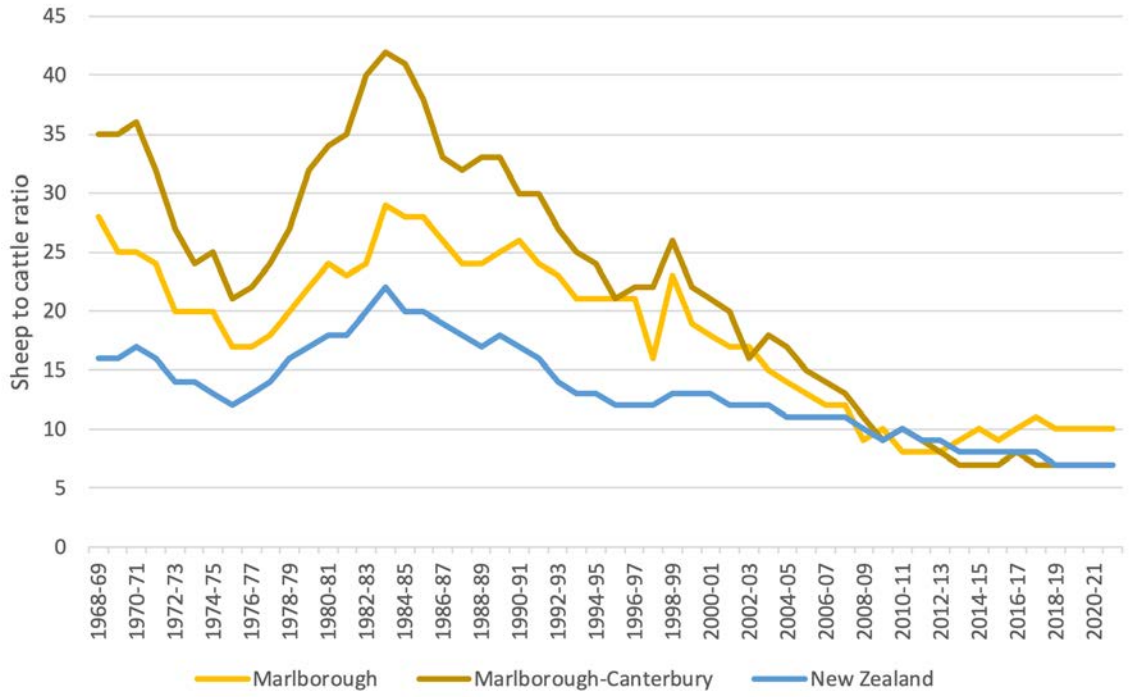


Figure 21: Changes in sheep to cattle ratio on sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand from 1968 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

Alongside changes in livestock mix over time (sheep, beef, and occasionally deer[89]), stocking rates on a grazed hectare basis have stayed fairly constant over the last 50 years despite the recent changes in topography within the Marlborough sheep and beef farms in the B+LNZ Sheep and Beef Farm Survey (Figure 22)[90]. The average stocking rate over this period was very low when compared with New Zealand averages, being just under three stock units per 'grazed' hectare (or 2.7 per total ha). This trend is offset by the value of a stock unit gradually increasing over time. As well, some farmers are grazing dairy cattle (largely heifers). Importantly, stocking rates vary within a farm, depending on the block[91], and across a production season as farmers match feed supplies and demands.

Overall, the livestock mix on Marlborough's sheep and beef farms changed from averaging 83 per cent sheep and 17 per cent beef cattle in 1968-69 to 65 per cent sheep and 34 per cent beef cattle in 2021-22 (measured using stock units rather than stock numbers). The proportion of sheep initially dropped through the 1970s but was back to 84 per cent by the mid-1980s before declining from 81 per cent in 1998-99 to 59 per cent in 2010-11 (-27% over 12 years). Since 2010-11 the proportion of sheep on farms in Marlborough has increased again – in contrast to Marlborough-Canterbury (as a whole) and New Zealand.

89 An article on deer farming and pasture management during drought in Marlborough is available at *https://www.deernz.org/home/our-stories/drought-arrives-in-marlborough-time-for-some-sacrificial-hay/*

90 The total stock units measure includes all the livestock on farm. The Cattle stock units capture both beef cattle and dairy cattle as follows: young dairy heifers (R1 and R2s) grazing most or all of the year but not dry (i.e., non-lactating) dairy cows grazing over winter. For the Marlborough farms in the B+LNZ Sheep and Beef Farm Survey in 2021-22 the inclusion of dry cows increases total stock units from 6,137 to 6,153 (as a weighted average across the farms) (A. Fisher, pers. comms., 2025).

91 Figure 28 in (Chrystal, Fisher, & Burtt, 2023: p86) illustrates this variation for sheep and beef farms in Otago.

Two farmers interviewed for this research, currently had stocking rates of between five and seven total stock units per 'grazed hectare'. The third saw their sheep:cattle ratio as necessarily flexible: "I could give you a figure, but it won't be accurate in six months' time because if the season is good I'll carry the cattle, but if not then they'll be the first to go."

One farmer explained that "there are a few things to keep in mind: If you call one sheep one stock unit and the bulls five then it works out one way, but if you did it on a line weight basis it could be either more or less. Also, to mulch in, is where you have the grazing of the vineyard block through the winter." The second noted the relationship between stocking rates and farm debt: "We have an extensive grazing run and as we got rid of the mortgage, we've gradually decreased stock numbers so it was easier on the land, and we had a little less workload. The third farmer linked stocking rate to being able to finish lambs: "We like to finish everything here so I am not overstocked, but in some years we might have to sell stores."

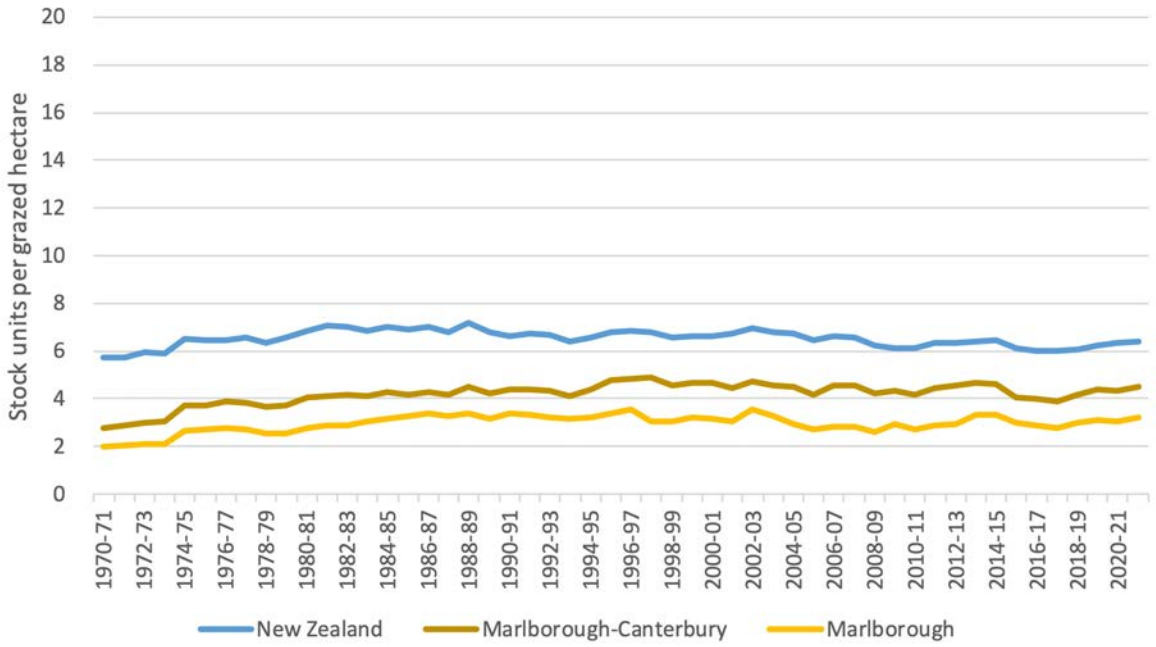


Figure 22: Changes in stocking rates on sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand from 1970 to 2021
Source: B+LNZ Sheep and Beef Farm Survey

4.1.6 Revenue Streams, Expenditure, and Profitability

Commercial sheep and beef farms have a range of revenue streams but in Marlborough around 89 per cent of revenue is from the two main stock types. Many farms include an additional form of revenue, such as dairy grazing, deer, goats, viticulture, farm stays and tours, apiculture (i.e., beekeeping), and farm forestryy. Figure 23 shows changes in the relative importance of different revenue streams for Marlborough's sheep and beef farms since the mid-1990s. In 2021-22, sheep accounted for 67 per cent of Gross Farm Revenue and 22 per cent was gained from beef cattle (on average), which when combined represented 89 per cent of total Gross Farm Revenue.

Clearly evident in Figure 23 is the declining revenue from wool (discussed below) and the growing importance of sheep (sold as store lambs, finished lambs, or for breeding). Over the last 30 years, cash crops have declined as a revenue stream while dairy grazing has increased for some farm businesses[92]. As well, revenue from farmed deer (venison and velvet) has been fairly consistent, albeit more minor.

92 In 2021-22 average revenue from dairy grazing cows and heifers in Marlborough was $46,000 compared to $38,000 for New Zealand and $78,000 for Marlborough Canterbury.

A farmer from south Marlborough commented that: “The climate is quite changeable, and our incomes can vary +/- 50 per cent from a good year to a drought year, and then it can take three or four years to recover.” The same farmer sold land and undertook dairy support for a while, to help the next generation with farm succession. A deer farmer commented: “Our family has been on this farm for about 50 years and what used to provide a good living for one family now provides a comfortable living for three families even though some land was sold off awhile back for my parents to retire on.”

Revenue from other sources has also been variable: rent, horticultural crops (likely to be wine grapes), farm forestry, apiculture, occasionally tourism-related activities (e.g., accommodation). Some farms, particularly those that are more marginal in terms of being an economic unit, will also have off-farm income – with more opportunities likely to exist near Marlborough’s townships.

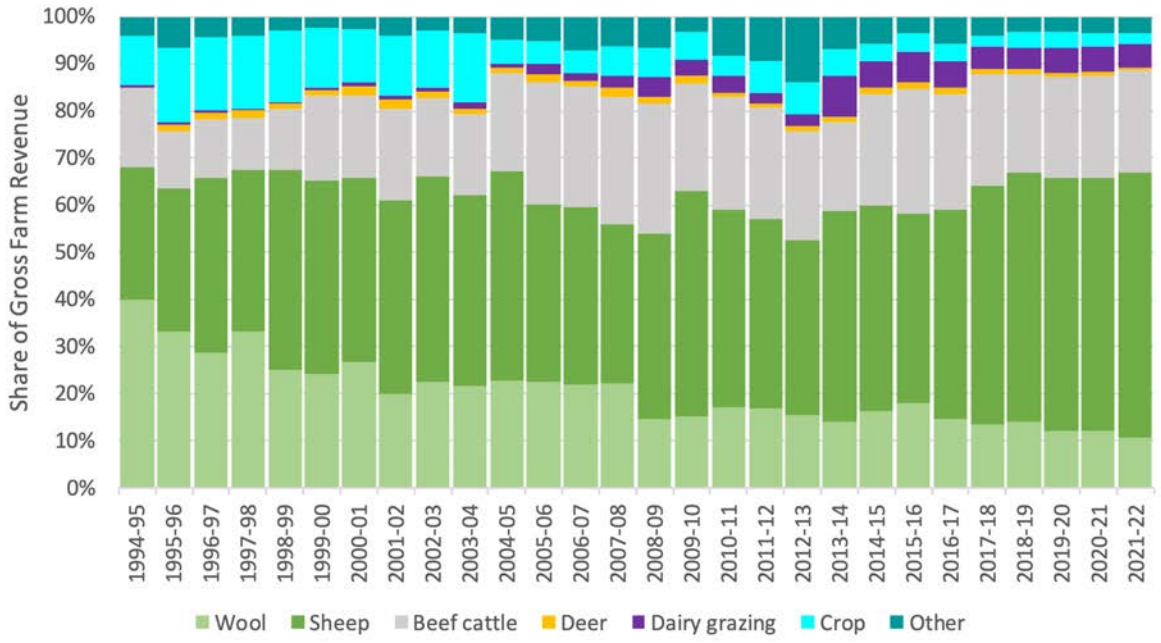


Figure 23: Changes in revenue for sheep and beef farms in Marlborough from 1994 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey
Note: ‘Other’ can include sources such as rent, horticulture, farm forestry, apiculture, and tourism etc.

Marlborough farmers’ wool account peaked in the 1988-89 production season at just under 60 per cent of Gross Farm Revenue. The decline since has been amplified with farmers switching from Corriedales to composite breeds and the introduction of a second shear each year. However, as vineyards have replaced sheep and beef cattle on lowland properties, fine-wool merinos are now likely to be a higher share of the regional sheep flock than prior to the 1980s. A farmer interviewed noted that “Most of the farms around here (south Marlborough) are either mid micron or fine wool and they’ll handle the dry a lot better.” Another commented that “When you get good seasons here (those with more rain) it’s too good for fine wool, and when it’s a drought that’s when you probably want your fine wool.”

Figure 24 shows that, despite the decline in importance of wool as a revenue stream, Marlborough farmers' wool accounts still well exceed their shearing expenses (as averages)[93]. However, one Marlborough sheep and beef farmer reported that their wool revenue is currently less than one per cent of Gross Farm Income. The farmer shears twice a year viewing shearing as an animal health treatment, and as maximising returns from meat. Their net cost of shearing is currently about $3.50 per ewe.

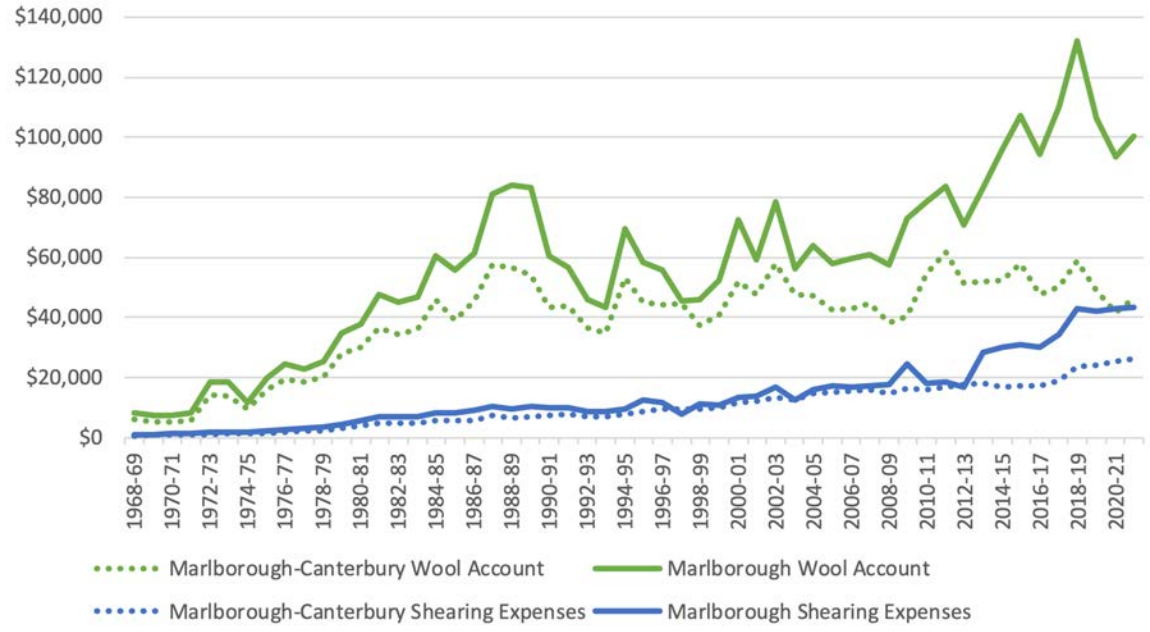


Figure 24: Comparison of wool account and shearing expenses for sheep and beef farms in Marlborough and Marlborough-Canterbury from 1968 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

Revenue, however, is not equivalent to profitability. Farm profitability is the sum of the various revenue streams minus expenditure and depends on a complex set of interacting factors, some of which are within a farmer's control and many that are not. Two key factors are the weather, which plays a critical role in pasture and animal production, and market prices for sheepmeat and beef. Up until the mid-1990s, the profitability of sheep and beef farming in Marlborough was similar to Marlborough-Canterbury (as a whole) and New Zealand, but since then it has tended to be relatively less profitable up until recently. There are interdependencies between farm classes; and the peaks and troughs reflect the mix of livestock and the fortunes of each one (Burtt, 2019).

Table 13 gives a breakdown of farm financials in 2021-22 (as a weighted average across farm classes). Operating expenses for sheep and beef farms in Marlborough Sounds expenses are likely to be higher for many items where there are additional costs of delivery because of their location. Most sheep and beef farmers are the main source of labour on-farm, relying on contractors (where finances allow) or family for help (where it is available) with specific tasks, such as lamb tailing, shearing, weed spraying, and fencing.

93 In 2021-22, shearing expenses were just over $43,000 while the wool account was around $100,000, In addition, general animal health expenses were $44,000.

Table 13: Farm financials for sheep and beef farms in Marlborough in 2021-22

Item	Per farm (1,920 eff. ha)	Share of total	Per grazed hectare
Gross revenue	**$939,193**	**-**	**$489.15**
Wages & rations	$69,229	13.6%	$36.06
Animal health	$44,055	8.7%	$22.95
Dogs	$6,436	1.3%	$3.35
Weed & pest control	$30,627	6.0%	$15.95
Total shearing expenses	$43,282	8.5%	$22.54
Fertiliser, lime & seeds	$105,815	20.8%	$55.11
Vehicles	$20,851	4.1%	$10.86
Fuel	$23,408	4.6%	$12.19
Electricity	$5,037	1.0%	$2.62
Purchased feed & grazing	$42,165	8.3%	$21.96
Irrigation charges	$12,494	2.5%	$6.51
Cultivation	$17,027	3.4%	$8.87
Crop expenses	$982	0.2%	$0.51
Repairs and maintenance	$54,272	10.7%	$28.27
Cartage	$11,021	2.2%	5.74
Administration	$21,449	4.2%	11.17
Total farm working expenses	**$508,150**	**100%**	**$261.31**
Standing charges[94]	$127,169	-	-
Interest and rent	$83,072	-	$43.26
Depreciation	$54,006	-	-
Total farm expenditure	**$689,325**	**-**	**$359.02**
Earnings before interest, tax, and rent (EBITR)	**$332,940**	**-**	**$173.41**
Farm profit before tax	**$249,868**	**-**	**$130.14**

Source data: B+LNZ Sheep and Beef Farm Survey

On a per hectare basis, sheep and beef farms in Marlborough have tended to be less profitable over time than for New Zealand as a whole, reflecting their very low stocking rates (Figure 25). However, since 2015 profitability per farm has been slightly higher than the national average (Figure 26). In general terms, profitability per grazed hectare for more extensive farm classes (e.g., Farm Class 1 High Country and Farm Class 2: Hill Country) tends to be lower than those on easier land (e.g., Farm Class 6: Finishing Breeding) but these farms are usually much larger to compensate. This said, there is a wide range of farm sizes within each farm class. Profitability is highly variable between farms as well as from one production season[95] to the next.

94 Standing charges include items such as ACC levies, rates, and insurance.

95 It is a convention in New Zealand that sheep and beef production is measured using a season that runs from 1 July to 30 June.

Since 2021-22, sheep and beef farm profitability has declined for New Zealand as a whole (at the time of writing, this data was not available specifically for Marlborough).

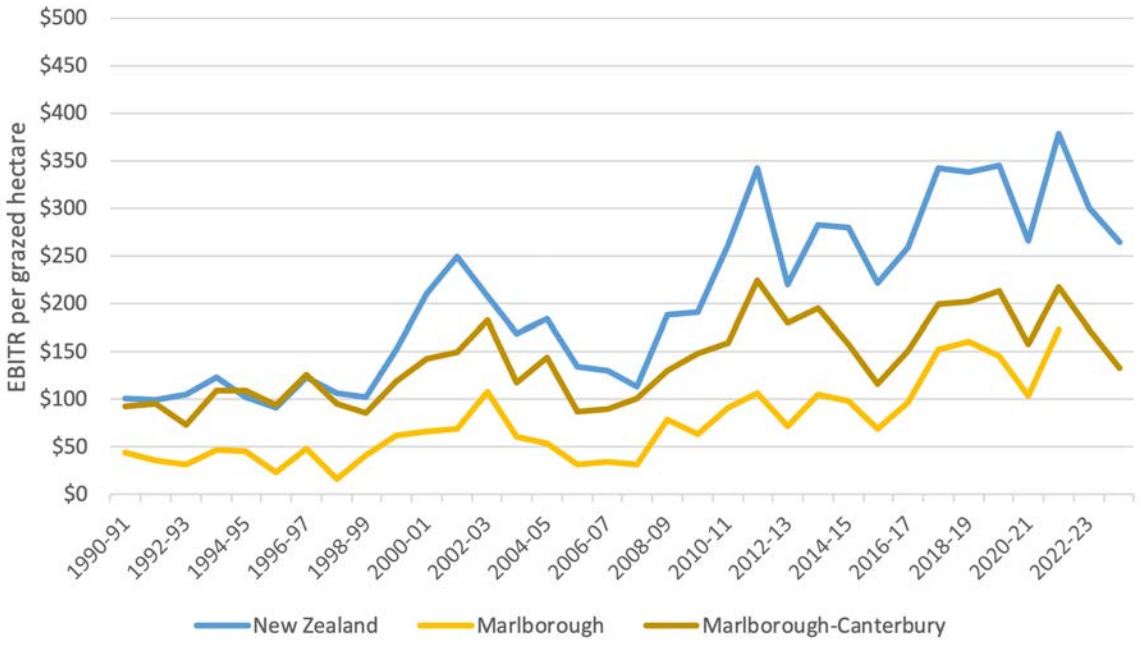


Figure 25: Profitability per hectare for Marlborough, Marlborough-Canterbury, and New Zealand from 1991 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

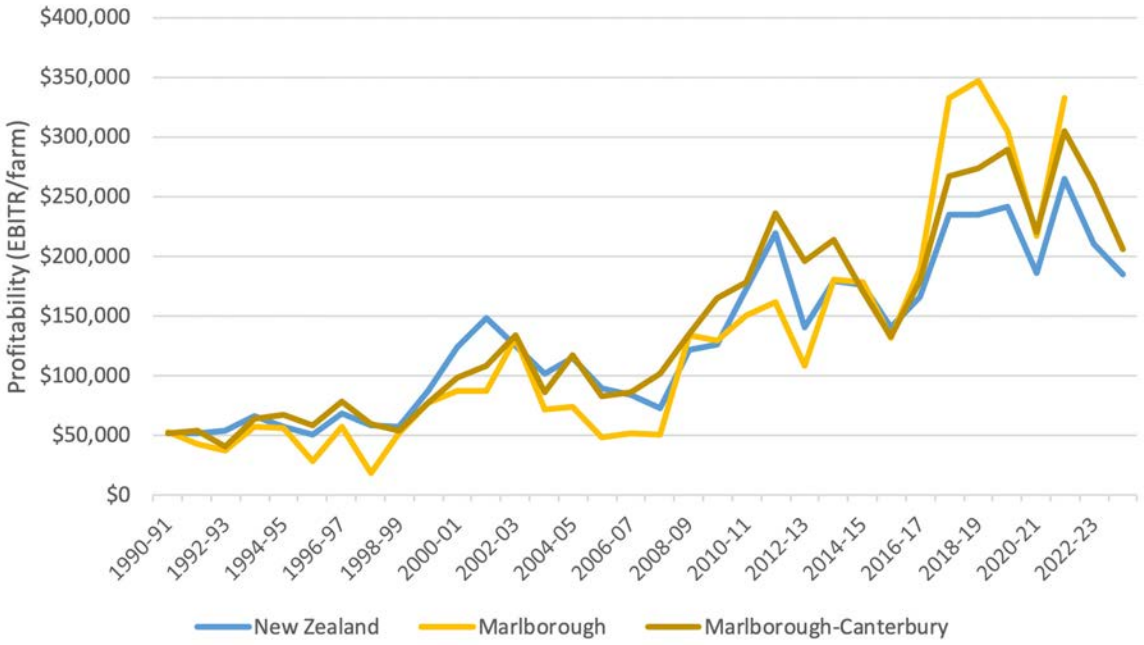


Figure 26: Profitability per farm for Marlborough, Marlborough-Canterbury, and New Zealand from 1991 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

Pastoral farmers are largely 'price takers', having little ability to influence prices for their products, particularly in export markets. As a general rule, farm input costs increase over time, while market prices fluctuate for products sold (Fisher & Burtt, 2023). Farmers work to keep pace by improving both productivity[96] and production. When the costs of inputs are high and market prices are low, farmers endeavour to reduce their expenditure. However, because sheep and beef farming is usually a lower intensity land use, there are fewer inputs that can be varied (e.g., the quantity, timing, and type of fertiliser) before revenue and profit margins are impacted. Where profit margins remain low, forward contracts or deferred spending (e.g., for repairs and maintenance or vehicles[97]) will be carefully considered bearing in mind the impact a decision for one year has on future seasons' expenditure and production, which is variable due to the climatic fluctuations.

In 2021-22, Farm Working Expenses totalled $508,000 per farm in Marlborough, and much of this expenditure occurs within the region's economy. A major share of this expenditure is fertiliser, lime, and seeds. Figure 27 shows changes since the late 1970s in this share (together with weed and pest control). In 2021-22, the share accounted for 27 per cent of Farm Working Expenses for sheep and beef farms in Marlborough (compared with 30% for New Zealand and 33% for Marlborough-Canterbury).

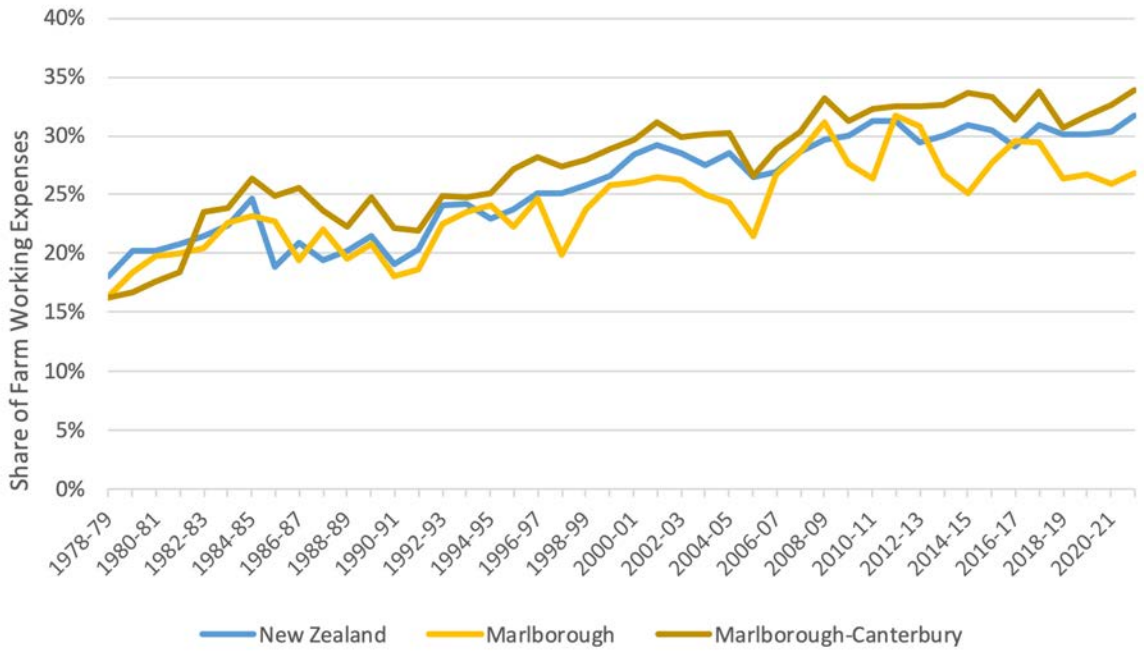


Figure 27: Expenditure on fertiliser, lime, seeds, and weed and pest control as a share of Farm Working Expenses on sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand from 1978 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

96 Although there are key indicators of productivity improvements, such as the change in lambing performance over time, no single factor drives profitability, and other factors (e.g., limiting livestock losses) are also important (Burtt, 2019).
97 In 2021-22, expenditure on repairs and maintenance was $54,000 and vehicles was just under $21,000.

In the year to March 2023, on-farm inflation for New Zealand's sheep and beef farms was 16.3 per cent, the highest rate since 1981, and followed 10.2 per cent on-farm inflation in the previous year (Table 14). A key driver was interest costs as most farm borrowing is on a floating rate basis, but prices have increased across all types of inputs[98]. Each business' experience of inflation is individual, depending on the nature of their production system and their use of inputs and debt as a business management tool (Fisher & Burtt, 2022). In Marlborough the cost of owning or leasing land (a combination of interest and rent) in 2021-22, accounted for 13 per cent of Total Cash Expenditure for the Marlborough farms in the Sheep and Beef Farm Survey (roughly the same as 15% for New Zealand in the same year) but it has likely risen since. The 20-year average in the cost of land was 16 per cent for Marlborough (and 19% for New Zealand).

Table 14: Key Points from B+LNZ Annual On-farm Inflation Reports

Sheep and Beef On-farm Inflation 2021-22

The increase in farm input prices is largely due to the increase in prices for three core areas of expenditure on farm: Fertiliser, Lime, and Seeds (+23.0%), Interest (+5.9%), and Repairs, Maintenance and Vehicles (+10.4%). Fertiliser, lime, and seed prices are significant for sheep and beef farmers because this area of expenditure comprises 17.5% of total farm expenditure. The prices of almost one third of categories of farm expenditure increased by 10% or more.

Sheep and Beef On-farm Inflation 2022-23

The largest increase was for Interest (+86.5%), which contributed substantially to the overall increase in on-farm inflation because it comprises 10.9 per cent of total farm expenditure. Floating interest rates doubled from March 2022 to March 2023, while fixed and overdraft interest rates increased by around 50 per cent. Prices increased in all 16 categories of inputs. The areas of expenditure that increased the most over the March year were Interest (+86.5%), Feed and Grazing (+14.8%), and Fertiliser, Lime & Seeds (+14.0%).

Source: B+LNZ Economic Service
Note: Total farm expenditure for the Sheep and Beef Farm Survey farms 2021-22 in Marlborough is reported (as a weighted average) in Table 13 (above).

4.1.7 Feed Conservation and Cropping

Most sheep and beef farms in New Zealand are substantially self-sufficient for feed, meaning a farm is usually able to grow enough feed for its livestock (Chrystal, Fisher, & Burtt, 2023). Budgeting of feed[99] throughout a year for optimal pasture management[100] is key, which involves balancing feed demand and feed supply. In Marlborough, sheep and beef farming revolves around making the most of spring growth. Growing lambs quickly for sale means that more feed, which is often scarce over summer, can be put into improving ewe weights for mating that in turn can increase lambing percentages in the next production season.

98 To put this in context, consumer price inflation was 6.7 per cent in the same year. The 2023 on-farm inflation report for the sheep and beef industry in New Zealand is available at: *https://beeflambnz.com/sites/default/files/2023-06/Sheep-Beef-On-Farm-Inflation-23.pdf*

99 Feed budgeting identifies pasture shortages in advance and allows them to be countered by nitrogen application, cropping and hay conservation or purchase. The aim is to maintain overall pasture cover between 1,000 and 2,500 kg of dry matter per hectare. Outside these limits both animal and pasture performance will suffer. More information is available at: *https://beeflambnz.com/knowledge-hub/PDF/guide-feed-planning-sheep-farmers.pdf*

100 Pasture production needs livestock for grazing otherwise it must be mown or 'topped' to prevent it going to seed and turning 'rank' (so is inedible) and needing more weed management.

Grigg, Grigg, and Lucas (2008) described the importance of fast spring growth in Marlborough for Tempello Station, which covers 4,800 hectares of the hills between the Wairau and Awatere Valleys (at the time around 54% of the property was grazeable):

> *The farm typically has fast spring growth but a slow summer pasture growth curve. Summers are typically hot and dry. The regular summer dry means the management policy is to sell all lambs at weaning by late November. The more weaned lambs that go prime, the better the returns. Of the arable country at Tempello (around 60 ha total), an area of 13 hectares has been converted into vineyards so there is little scope to finish weaned lambs on crops and no financial incentive to do so.*
>
> ***Grigg et al. (2008)***

The farmers interviewed echoed the importance of spring, for example:

- *For us the aim of the game, which is probably differing from other regions, is improving lamb survival and to sell everything at weaning. We have a skim draft on the first week of November, and then the third week of November is our main weaning, and all of the lambs go then. We do have another draft pre-Christmas – that's just the late lambers and the hoggets.*
- *Whether it be a drought or a good year, spring has always given us enough to pay the bills basically. Farming in Marlborough here is based on sub clover basically, it gives us the ability to finish our lambs by Christmas. We can't do much for the rest of the year, so we have to be quick.*

A management shift in the 2000s to maximise subterranean clover at Tempello Station (along with sub-division, fertiliser, and water reticulation) dramatically increased the growth rates of their lambs that are then sold at weaning in late November ahead of the summer dry[101].

> *Clover content in the sward of up to 50 per cent in spring is achieved through letting subterranean clover establish in autumn. Ewes are not grazed on the blocks following germination until at least five leaves are present. Cattle and ewes are used to graze grass cover off paddocks in early winter (May and June) so that clover can compete. Paddocks are then spelled for up to 2 months prior to lambing, to let clover grow. Short-rotation ryegrass is used to feed some ewes during this time.*
>
> ***Grigg et al. (2008)***

Farmers make the most of pasture growth by conserving it when there is a surplus for use during deficits or 'feed pinches'. Historically, this occurs by making hay and silage, and more recently, baleage. Some also use forage crops to supply livestock with more concentrated nutrition, to protect the farm's pasture during inclement weather, and as a phase in the renewal of pasture. A farmer commented that "the only forage crop we grow is kale and that is mainly just to get us a new grass paddock each year." On lowland farms, 'cash' crops may be grown for sale[102].

---

101 "The more weaned lambs that go prime, the better the returns. Of the arable country at Tempello (around 60 ha total), 13 ha has been converted into vineyards so there is little scope to finish weaned lambs on crops. Nor is there a financial incentive to do so." (Grigg *et al.*, 2008).

102 A cash crop is one that sheep and beef farmers grow to be sold either as stock feed or for human consumption (Fisher & Burtt, 2022). There is considerable planning, negotiating and risks taken when planting cash crops or other crops to generate revenue for the farm. Around 12 to 18 months may elapse from the time of planting the crop through to harvesting and final payment, during which time the farmer has outlaid for numerous expenses before final payment on delivery of the crop (payment for contracted crops is typically negotiated before farmers plant cash crops).

Farmers also make complex choices about livestock and their timing on a farm within a year. For example, one farmer was of the view that a mob of lactating Angus beef cows has a high feed demand and so can be difficult to carry during a dry summer. Another farmer observed they often have dry Septembers and are short of grass in spring: "When the sheep and lambs get on top of the grass growth you may never get your pasture covers back"[103].

The hills are not usually irrigatable and can be extremely dry. If there is rain, then it results in rapid pasture growth and excess feed. With good pasture growth, farmers are able to buy extra stock and make supplement (hay bales or silage). Without it, such as when there is a dry autumn that carries on into winter, they may have to sell their capital stock and buy again the following year. One farmer noted that they take care to source replacement stock from either Marlborough or North Canterbury that are used to the hot and dry conditions. Less feed may also negatively affect mating success and result in lower lambing and calving percentages the next production season. In Marlborough the situation and outlook for farmers can change quickly.

- *Traditionally we would always make 2,500 to 3,000 little bale's equivalent of hay or sileage. Hopefully, about once in fifteen years we have to start feeding that out in February to get through autumn, but usually we start feeding the twinning ewes and some fat cattle if they're there in June to get through to the end of August.*
- *We save the grazing on our flats – shut them up if we can. Hopefully it rains in the autumn so we've got good fresh grass and save it for cold southerly days when we were short of feed. They're sheltered and the ewes could go out there and graze them off and then we'd leave the flats for the lambs in the spring.*

Some water is used to irrigate arable crops. However, those farmers with irrigation can also face challenges. For example, one farmer described their shared water take: "We have a water take from the river with our neighbours for irrigation storage. My neighbour's take is just over six litres per second a day, but the pump runs at 13 litres per second, which is fine if we are both taking water but if I am not then the pump's maximum is reached and it times out for the day."

On the whole, sheep and beef farms in Marlborough tend to be run as quite traditional production systems. Lambing largely runs from late July to the start of September with farmers trying to grow many of their lambs during spring and sold pre-Christmas. Decisions are made in spring as to whether to make more supplement or hold onto livestock, depending on markets and the prospects of the growing season. Cull hoggets are grazed over winter (now often in the vineyards) and shorn before being sold for processing. Replacement hoggets are seen as particularly productive, especially on Farm Class 6 finishing and breeding farms. Farmers are achieving high lambing percentages[104], which is important with the decline in the profitability of wool. Cattle are a fairly even mix of Angus and Hereford. Weaners tend to be sold in April and more weight is put on large cattle to finish them through winter, often using forage crops. Lucerne is grown for both grazing and silage, depending on the production season. However, change is occurring with the inclusion of a vineyard enterprise and its impacts on the rest of the farm's production system.

103 Sheep, cattle, and deer all have different physiological grazing abilities.

104 In 2021-22, lambing percentage for nine Marlborough farms in the B+LNZ Sheep and Beef Farm Survey (as a weighted average across all farm classes) was 121%. For Marlborough-Canterbury the lambing percentage in 2021-22 was 128.5%.

The farmers interviewed all had their own strategies for managing the 'summer dry'[105]:

- *Twenty-plus years ago we used to keep our stock and rely on peas or hay. You'd 'box along' and hope that you could get through. Stock were worth more and costs weren't so high, but our pastures were chewed out more. Now we just cash out and then try and buy back. Cattle usually all go but we still try and keep a core flock. You need a stock policy that's flexible but there has to be a line in the sand, where you can make those decisions, otherwise your business will fail – especially if you are in debt[106].*
- *We focus on nutrition by getting pasture covers up as well as selling as many prime lambs as we can and not playing catch-up with store lambs. Good nutrition is the driver between those lamb growth rates and trying to sell your stock before the summer dry kicks in. We have a soil moisture deficit in about the third week of October every year and it is all downhill from there. So, feeding your animals properly through the winter and spring and shut up shop for the summer.*
- *In Marlborough you need to match the pasture species for summer production. We have lucerne and brassicas in the ground and Forage King maize[107]. These plants respond well when you get summer rain. All the lambs are sold by Christmas, young replacement stock are on brassicas, and the Jersey bulls come back at the end of January (having been off farm since mid-October). The bulls graze the maize, which sets them up well for mating and the next year's production – that's pretty much how the system works.*
- *During the 1998 drought there was a lot of talk about pasture renewal but some of our best paddocks are those that were sown in the 1980s. We haven't touched them because they're much better than the new ones that are just there for a few years and then gone. You have to be very careful what you sow. It used to be good when there was a seed dressing plant in Blenheim[108] where you could buy local grass seed. It came from dry land and not easier country like down in Canterbury.*
- *In a really dry year, we cut back to just capital stock. We wean early and sell all the lambs at the end of November and then go through the hoggets and lift off the bottom quarter. If our 18-month trading cattle aren't prime by October, because we didn't have any grass, then they are sold and we drop right back to capital stock. You can't do that though if you've got calves on cows.*

Figure 28 shows a gradual increase in extent of winter feed area since the early 2000s, which reflects the growing scale of farms in Marlborough rather than more winter feed in total. Also, evident is a decrease in the extent of arable and vegetable crops grown. Crops mentioned in the three farmer interviews included summer brassica, forage king maize, oats, rye grass, kale, winter rape, and lucerne.

---

105 In addition, a useful Marlborough case study on the experience of the 2021 drought for 'The Homestead', a sheep and cattle farm with 1,550 grazed hectares at Ward Beach is available at *https://www.mpi.govt.nz/dmsdocument/45748-Case-study-Managing-a-sheep-and-beef-farm-through-drought-The-Homestead*

106 The farmer linked Marlborough's climatic variability with the ability to adapt, through flexible farm management policies and low farm debt. He was guided by "the old 20% rule: don't have a mortgage any greater than 20% interest of your gross farm profit. It stands as true today as it did years ago. You can't afford to be too far in debt."

107 Forage King maize is a C4 plant. C4 grasses dominate in humid tropical savannah and dry tropical-subtropical grassland (steppe) regions which account for 17% and 10% of the global land surface area (Shaw 2000, as cited in Crush & Rowarth, 2007). Crush & Rowarth (2007) discuss difficulties in the current use of C4 grasses in New Zealand pastoral systems and explore possible future roles.

108 Unfortunately, it was unclear from the interview which seed company was being referred to. Conroy's Grain and Seed Cleaning (now owned by OsGro Seed Services) has been operating in Marlborough for over 20 years and "has a strong reputation in the New Zealand seed industry for dressing seed to the highest standards" (*https://www.osgroseed.co.nz/conroys-seed-cleaning*). Another grain and seed company in Blenheim is Kiwiseed, was founded in 1989 and offers "independent advice and product options to the agriculture and horticulture community throughout NZ" (*https://www.kiwiseed.co.nz/about*).

An ex-arable farmer summarised their situation:

- *Historically, the family grew traditional cereal crops like wheat, barley, seed peas, and a lot of lucerne for seed, as well as for hay and baleage. The wheat was transported to Canterbury or up north for processing or used as feed wheat for poultry. From the late 1990s, we grew process crops for Talleys – processed peas, sweetcorn, beans – and crops like garlic and shallots. Since Talleys finished with crops in Marlborough all the cropping land that they've owned in this valley is now being converted into vineyards. Our last arable crop was malting barley, which went across Cook Strait to Marton[109].*

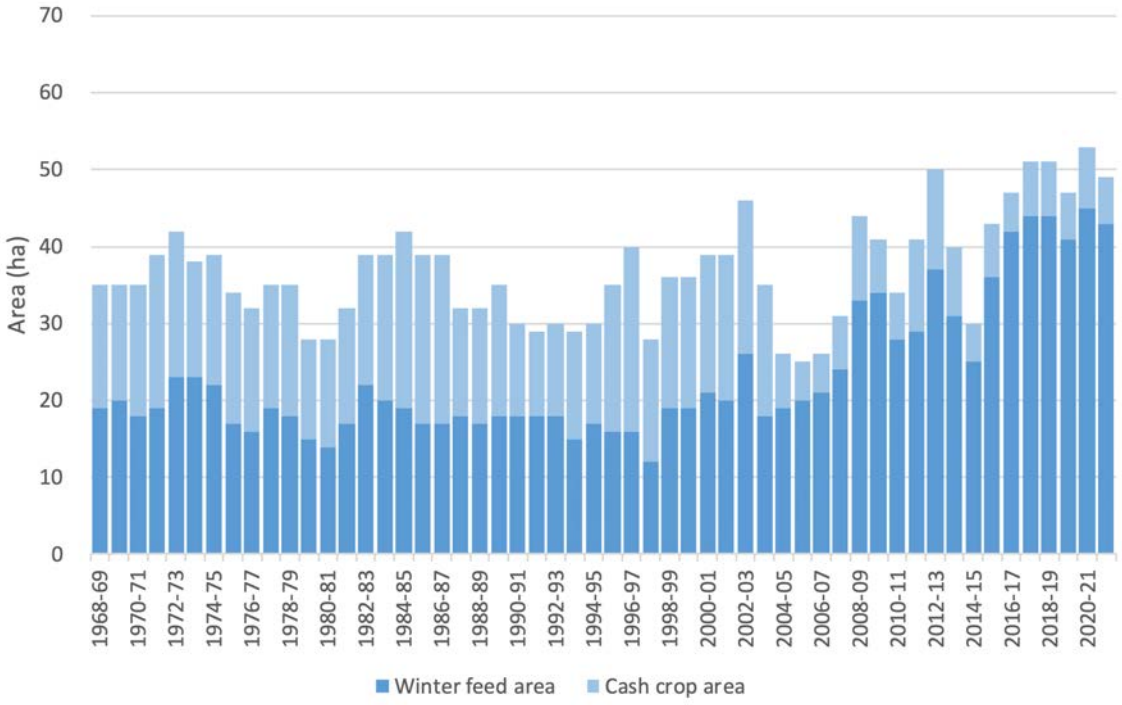


Figure 28: Extent of winter feed plus cash crops on sheep and beef farms in Marlborough 1968-2021
Source data: B+LNZ Sheep and Beef Farm Survey

Table 15 indicates the average extent of winter feed and cash crops on sheep and beef farms in Marlborough over the five most recent years for which there was data, in comparison to Marlborough-Canterbury and New Zealand as a whole. Cultivation for cropping is usually limited to easier country (i.e., LUC Classes 1-4). The average areas of winter feed are almost twice that for New Zealand, but the cash crop area is half. However, the winter feed area as a share of grazed area is half that for Marlborough-Canterbury as a whole.

Marlborough farmers' approach to winter appears similar to North Canterbury's, although there is probably less dairy grazing (E. Gray, pers. comm., 2023). Forage crops, such as rape, kale, and turnips, are largely used in the hill country for cattle (the high country is very low-stocked), and some hoggets go off-farm down to the vineyards for winter grazing (E. Gray, pers. comm., 2023). As an example, a farmer noted that, "Our heavy bulls go on feed carried over from the summer, so standing hay type stuff. Lighter bulls are behind a polywire on winter grazing – we do about 12 hectares."

109 https://www.malteurop.com/en/new-zealand

Table 15: Extent of winter feed and 'cash' crops as five-year averages for sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand (from 2017-18 to 2021-22)

Region	Winter feed area (ha)	Winter feed area as a share of grazed area	Cash crop area (ha)
Marlborough	43	2.2%	6
Marlborough-Canterbury	45	4.7%	41*
New Zealand	23	3.3%	12

Source data: B+LNZ Sheep and Beef Farm Survey
** Canterbury is the largest cropping region in New Zealand.*

4.1.8 Nutrient Management

Overall, fertiliser use on sheep and beef farms in Marlborough for pasture and crop is relatively low and highly targeted. It makes no economic sense for a farmer to apply fertiliser in a manner that effectively results in losses of the nutrients that the farmer has paid for (Chrystal, Fisher & Burtt, 2023). Fertiliser use tends to vary between years because of environmental factors, such as seasonal conditions (e.g., drought or a cool damp spring), which impact feed availability as well as financial considerations (e.g., the absolute and relative prices of fertilisers).

Figures 29 and 30 show, in turn, the use of elemental phosphorus and elemental nitrogen on pasture over the past thirty years[110]. These fertiliser application rates are for the areas to which fertiliser was applied, which is generally much less than the farm's grazed area – in 2021-22 pasture fertiliser was applied to 75 per cent of the grazed area (as a weighted average across the farm classes). As well, fertiliser applications do not equate to losses of excess fertiliser. Fertiliser application rates are higher for crop than pasture but the areas where applied are far smaller (Table 16). For example, the crop area fertilised in Marlborough was roughly one-seventh of the area of pasture to which fertiliser was applied (as five-year averages).

Table 16: Use of elemental phosphorus and nitrogen fertilisers for pasture and crop as five-year averages for sheep and beef farms in Marlborough compared to Marlborough-Canterbury and New Zealand (from 2017-18 to 2021-22)

Region	P rate for pasture	N rate for pasture	Pasture area fertilised (ha)	P rate for crop	N rate for crop	Crop area fertilised (ha)
Marlborough	13	10	482	27	63	70
Marlborough-Canterbury	16	24	295	28	130	109
New Zealand	20	18	336	33	106	43

Note: All fertiliser rates are kg/ha/year applied.

110 That is, the actual nutrient applied, which is carried by a 'filler' when fertiliser is spread.

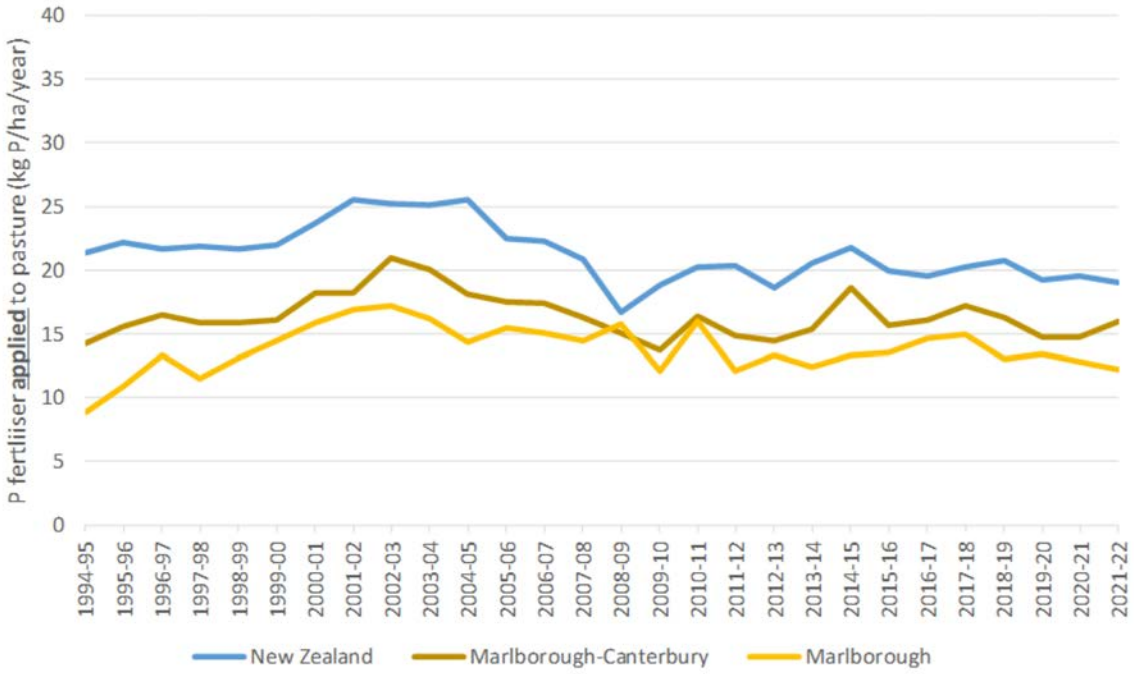


Figure 29: Use of phosphorus fertiliser on pasture on sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand from 1992 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey

Figure 30: Use of nitrogen fertiliser on sheep and beef farms in Marlborough, Marlborough-Canterbury, and New Zealand from 1994 to 2021
Source data: B+LNZ Sheep and Beef Farm Survey
Note: The scale of 0-100 on the vertical or 'y' axis is used to put the results in perspective. The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 includes a nitrogen cap for pastoral land in a landholding of 190 kg N/ha/year (excluding land used to grow annual forage crops).

Sheep and beef farmers tend to be 'tactical' rather than 'strategic' in their use of nitrogen fertiliser. For example, it may be used as a dressing in July prior to lambing or even calving rather than in regular widespread applications[111]. Nitrogen fertiliser use is a decision that varies farmer-to-farmer with many factors coming into play (e.g., weather, cost, and profitability) (Moran *et al*., 2024). As a farmer's fertiliser applications change from one year to the next mean that it is more accurate to consider nitrogen fertiliser use over multiple years, rather than just in a single year (Chrystal, Fisher, & Burtt, 2022).

Two of the farmers interviewed had contrasting nitrogen fertiliser policies in response to their differing farming situations:

- *Overall, we use about 25 kg per hectare a year of urea or N-Protect on our grazed area. That's about 12 units of nitrogen. We put it on our lambing platform in the autumn (mid-April), which other farmers may not be doing. That allows us to build pasture covers for lambing - it's up to the top of your gumboots or higher and really drives our system. If you're putting it on in spring, then you've lost your opportunity in Marlborough. I have also just flicked a bit onto our baleage[112].*
- *We don't put nitrogen fertiliser on every year and when we do it is only a couple of tonnes in spring because the weather in autumn is too unreliable (you don't know if there will be any rains). It's $1,000 a tonne now so you don't want to waste it. When it starts blowing in July, and the nor'wester doesn't really stop, you know it's going to be dry and we'll put on two or three tonne of nitrogen fertiliser on our bare paddocks. Not every year, but it does help.*

Also raised in the interviews was the issue of pugging:

- *If you're not careful here in the winter time the paddocks can pug and you try to avoid. A plus for the Jersey cross compared to the Angus or perhaps the Hereford is they're not so heavy, they're a smaller footed animal, and their growth rate is probably pretty good. It is also about margins and money – you can buy your Jersey crosses a lot cheaper than your Herefords or your Anguses.*
- *We don't have any cattle on our heavier flats in the winter. They get a bit wet and pug so cattle are out on the hill – where they are not making a mess. There is drainage installed in our heavier soils but in the 2016 Kaikōura earthquake it was all tipped up away from the creek and now it is draining back towards the hill.*

Image 33: Sheep grazing in a vineyard in the Southern Valleys, Marlborough

111 In other words, nitrogen fertiliser is used to cover a seasonal shortfall in pasture production after wet springs and/or dry summers rather than being used every year for a farm system that is dependent on it. (Chrystal, Fisher, & Burtt, 2023).

112 This farm had an estimated nitrogen loss of 11 kg of nitrogen per hectare per year, which was the average for nitrogen loss rate for sheep and beef farms nationwide.

4.1.9 Riparian Management

Riparian management on farmland in Marlborough may be more variable than other regions with more consistent rainfall. Where rainfall is less regular there tends to be fewer occurrences of water flowing overland as well as more limited water available to sustain new plantings (without irrigation). When rainfall occurs as a storm event it may cause damage to riparian plantings, although this depends in part on the nature of the planting. This said, there are rural catchments with stock exclusion and well-established plantings along rivers and streams, such as the Avon Valley and the Rai Valley. Another example is the Tempello Biodiversity Project.

The farmers interviewed made the following comments in relation to this topic:

- *In terms of riparian planting, I just think it comes down to land use and possibly soil types as well. There just isn't the stocking intensity of other regions. We have mature poplars that were planted to stop erosion, but we're don't have highly erodible soils where we are. Through the Weld Pass, out towards Seddon and Ward, you see that tunnel gully erosion and there's a lot of poplar poles going in to try and prevent that.*
- *The cost of establishing a block of natives in dryland Marlborough is high. Initially, you're looking at $10,000 to $20,000 a hectare, then some will fail, especially if you strike a dry summer and you've got to go through and replant. You need a pre-plant spray and then release sprays to make the most of the moisture that is available, so there may be a bit more maintenance than elsewhere. We found there was a lot of natives already in the river gorges. Once stock were excluded we did a lot of weed control too, but it was amazing how the existing seed in the ground just came away (e.g., kowhai, kahikatea).*
- *We have done the easier fencing for the cattle and we will do more. We use broken grape posts and two wires because it went up quickly and we were saving money. Everything we fenced will get a flood over it once or twice a year, so a seven-wire or netting fence is not going to stay there. We used a lot of electric reel (not permanent wires). It won't rain until June, and we'll wind them up when there is a forecast of decent rain.*
- *One of our biggest issues is weeds. When you fence off riverbeds and you're not grazing them then there will be gorse, broom, Nasella tussock and everything. You've still got to keep it tidy. Nasella tussock is an exotic that looks identical to the silver tussock but has a pink flower – it spreads and smothers everything. Nowadays we use knapsacks and spray, but before we used to have to 'grub' (i.e., physically remove weeds from the ground by digging up their roots) the whole place in working beats over the winter.*
- *Sheep fencing will cost around $15 to $20 per metre installed. We did one around a Significant Natural Area that came in at roughly $10 per metre but we did that ourselves mainly – that was on hill country and was a seven-wire standard.*

A central Marlborough sheep and beef farm provided costs of retirement planting (Table 17). In the second year 'blanking out' is needed, which involves replacing plants that have not survived. The farmer noted that "Although not everyone uses tree guards and wool mats, if they are not used then there is additional labour costs to clear grass from around the plants". Riparian fencing can be less if only one side of a waterway is within a property.

Table 17: Financial cost for one hectare of retirement planting in year one

Item	Cost
400 m fencing at $25/metre	$10,000
1,000 trees at $3.50 each	$3,500
Tree guards and wool mats	$5,000
Pre-plant and release spraying	$800
Planting labour	$1,000
Total	**$20,300**

The costs of stock exclusion are extremely variable and depend to a large extent on 1) the situation on the ground, 2) a farmer's preferences (influenced by finances), and 3) the supply (i.e., availability and pricing) of materials and labour. For example, there are choices around the use of standards (fibreglass, plastic, metal) or wooden fence posts (quarter rounds, half rounds, or full rounds), spacings between standards/posts, the number of wires on a fence, or netting (e.g., for sheep and deer). As well, prices for materials can differ markedly by supplier, customer, and locality. Ongoing inflationary pressures are likely to have continued increasing these costs since the research was completed in 2023, yet such pressures are unlikely to have markedly changed the understanding that it provides.

Image 34: Riparian plantings, farm forestry, water storage, and an orchard on a Marlborough sheep and beef farm

Another farmer described their challenge of riparian fencing with flood risk: “Our river can become a wall of water roughly once a year. Usually after being really dry and suddenly you get a downpour of rain. I’ve only seen it happen once, because it is usually at night, but the after-effects – many times. It was bank to bank, seething and taking everything with it. The river can be bank-to-bank for a day or two, and it drops as quickly as it comes up, but it has taken everything downstream.”

Image 35: Flaxbourne River near Ward Township (south Marlborough) on 5 November 2023 (top) and from the same position on 12 July 2022 (bottom)
Note: Winter 2022 was one of the wettest season in Marlborough in a century.
Source: https://www.marlborough.govt.nz/your-council/latest-news-notices-and-media-releases/media-releases?item=id:2n7tvh97o1cxbygu5qy4

4.1.10 Stock Drinking Water

All pastoral farms need reliable sources of clean drinking water for livestock. Farmers with waterways that run dry each year may already have an alternative water source (e.g., water reticulation) for at least some of their paddocks. However, a south Marlborough sheep and beef farmer highlighted that "The most expensive thing out of all of this is trying to get more water."

Their farm is fenced north to south with shelter belts to protect stock from the wind run and it has a series of artificial ponds for stock drinking water. From the farmer's perspective, the river is fairly reliable until around Christmas but then dries up until sometime between March and July. Over time two water tanks, multiple water troughs, and water storage have been installed to improve water security (the take for water storage is from the river). While the water is there, they use their take to irrigate the farm's flats. The plan is to harvest some water off the hill block in winter with a small dam and gravity feed it to those paddocks.

- *We have a small dam and run K-lines on less than five hectares over summer. We irrigate until Christmas and then stop because there is no benefit (too hot, dry and windy). If there's anything left in the dam, we'll pump the last of it on the paddock for the cows in March. Our water storage isn't typical – it is usually only the farmers with grapes who have any.*

For this farmer, excluding livestock from the creeks may mean reconfiguring some paddocks to maintain their access to drinking water.

- *We have two more big gullies requiring fencing, cutting off water to a considerable area. This is quite a problem and we will need a new water source (probably a bore) and scheme. It also totally mucks up stock management in these blocks cutting the flats in half. I'm not really sure how we can do this to the letter of the law.*

The farmer supplied two examples of the costs of delivering drinking water to their paddocks (Tables 18 and 19). Both examples are associated with the installation of fencing on specific farm blocks to exclude livestock accessing water in creeks. The first example was part of a capacity upgrade for the farmhouse scheme and the paddocks affected by stock exclusion regulations were nearby. The second is in the planning stage and is awaiting sufficient capital to be saved before going ahead.

The costs in the examples are for materials only and are GST inclusive. The farmer described the costs detailed as 'the barest minimum'. The costings do not include the costs of installation, which can be considerable with the labour and machinery involved in laying pipes, particularly under gateways and laneways. Water troughs also need to be on gravel pads to prevent any pugging issues. Water sources are not covered in the examples and for some farmers will involve drilling to groundwater. Also not included are the costs of repairs and maintenance (a farmer's time and any expenditure), which are essential for security of supply for livestock.

Table 18: Example 1 – Cost of materials to install stock drinking water on 'House Block' (2023)

Item	Cost (incl. GST)
Pump (the existing pump was too small)	$2,390
30,000-litre tank	$3,800
Tank fittings	$728
Tank fill time and services delivery line (40 mm)	$1,970
Low-density polyethylene (LDPE) pipes to paddocks approx. 1,100 metres (25 at $20 / metre)	$3,063
7 water troughs	$3,893
Trough valves, fittings, taps, tees etc.	$630
Total	**$16,474**

Note: These costs will have increased since.

Table 19: Example 2 – Cost of materials for stock drinking water on 'Beach Block' (2023)

Item	Cost (incl. GST)
Solar pump (Perkins 50 HF)	$7,950
30,000-litre tank	$4,049
2 x 750-litre troughs (sourced from Hynds)	$1,200
Tank fittings	$538
350 metres of 25 mm pipe ($329 / 100 metres)	$1,151
200 metres of 20 mm pipe ($269 / 100 metres)	$538
Pipe fittings	$167
Total	**$15,600**

Note: These costs will have increased since.

In the second example (Table 19), there is a need to pump a distance of 40 metres at a minimum, from head to tank. The farmer noted that the solar pump may seem an expensive option compared to petrol or diesel pump, but the location is close to a road and so at risk of being stolen. A more important consideration for them was that someone would have to go down and start it every other day in summer, so a petrol or diesel pump was time consuming, which itself is costly. This size pump is necessary to keep up with 100 cows and calves in a coastal location that has no other water in summer except for the adjoining river.

4.1.11 Environmental Management[113]

Sheep and beef farms are generally low-input and low-intensity farming operations, which can limit the on-farm actions that they have available to them for environmental management. In general, the main contaminants of concern on sheep and beef farms are phosphorus, suspended sediment, faecal microbes (which are indicated by *E. coli*) and, to a lesser extent, nitrogen. Water abstraction on sheep and beef farms is mainly used for livestock drinking and irrigation where needed (e.g., growing crops).

B+LNZ supports an established list of Good Farming Practice Principles that cover the areas of general principles, nutrients, waterways, land and soil, effluent, and water and irrigation[114]. In 2007, B+LNZ introduced Land Environment Plans that, through several versions and iterations, have eventually evolved into Farm Environment Plans[115]. To date, the Council has not required sheep and beef farmers in Marlborough to complete nutrient budgets, as is the case in Canterbury. There are instances of catchment groups undertaking monthly monitoring for *E. coli*, nitrogen, phosphorus, and macroinvertebrates.

The personal view of one of the farmers interviewed was: "I think every farmer is a bit of a greenie at heart, I don't think any of us want to be on the land, spend our life on the land you know, to see it degraded and go backwards. But I just wonder how some farmers make any money, let alone having that $10,000 or $20,000 to plant trees or riparian fence. I wish they'd changed their farm systems so they're more profitable, then they might be able to invest in this environmental-type work."

The topic of Freshwater Farm Plans, which are legislated requirements under the Resource Management Act 1991, elicited various responses from the farmers interviewed. However, at the time of writing the implementation of Freshwater Farm Plans were on pause while central government explored ways to make them "more cost-effective and practical for farmers"[116].

For example, one farmer was biding their time and waiting to see exactly what was expected before going ahead. "Our farming is such low intensity. The beef cows are better in the wintertime spread out on the hills than on some rolling country on a break feed behind kale getting fed hay. We manage our flats so that we don't get pugging and try to reduce runoff into creeks. I do see some practices though on my way to the beach for a surf that make me think though."

The next farmer had been to B+LNZ Environment workshops and was considering the farm plan concept. However, they were concerned about the expense and wanted to see some return for their investment. "I've got projects that I think are a lot more valuable to this property than doing some environmental plans that may or may not work. I'd like to talk to the people with these aspirational ideas and see if we can marry them up, but if I can't then maybe I'll give up farming."

---

113 This section is based on a similar section in Chrystal, Fisher, & Burtt (2023) for Otago. More detailed information on this topic is available in that report.

114 These principles are considered by B+LNZ to be more relevant to sheep and beef farming than set lists or 'bundles' of Good Management Practices (GMP) and Good Management Practices Plus (GMP+) (Chrystal, Fisher, & Burtt).

115 An interesting local example is AgFirst's *Integrated Land Use and Farm Environment Plan* for Rangitahi / Molesworth Station (van Reenen, 2020). This document gives a detailed picture of drystock farming in southern Marlborough. This said, Pāmu New Zealand has a unique mix of strategic goals for Rangitahi / Molesworth Station and some, such as to "further enhance recreational access", are not necessarily relevant to privately-owned farms.

116 *https://environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/freshwater-farm-plans/*

The third farmer questioned what else Freshwater Farm Plans could achieve that was not already being done in their catchment over a long timeframe, particularly if there did not seem to be the water quality issues in a catchment to justify it. They were also concerned that the expense of gaining a Freshwater Farm Plan, especially if it needs to be certified and audited, will have opportunity costs in terms of repaying debt or reinvesting in their farm (including environmental actions), particularly during a time when the industry was less profitable. "The whole farm plan principle is an issue to me, not just little bits and pieces that we might be required to do. We've been doing the right thing for generations, but we've got no excess income to be wasting on bureaucratic processes that will have questionable outcomes."

The interviews also highlighted that sheep and beef farming tends to be more solitary in comparison to other rural industries such as viticulture, which can affect farmers' levels of engagement. One farmer commented that "it is just in the nature of some farmers – to keep to themselves. It takes a fair bit of humility and self-confidence to seek advice from others. They can prefer to do their own thing and maybe there is a bit of 'do what they've always done'." Another farmer elaborated on the benefits of a catchment group:

- *Normally we don't do much together but now we've joined forces. In our catchment group we had some funding and are doing a lot of environmental work. All these fellas now have Farm Environment Plans and Biodiversity Plans, catchment condition surveys are done, and they're retiring and planting out areas (thanks to subsidies and cheap access to trees and planting). We've had dung beetle releases and are working on controlling old man's beard and barberry, which is really rewarding. The benefit of the group is it gets people doing things and brings them along on a journey on stuff they may not usually be interested in. Another benefit is you've got the Council's scientists up yarning to everyone and now they all know each other, whereas previously those connections just may not have happened.*

4.2 Dairy Farming

This section primarily draws on two interviews, DairyNZ time series data, and additional information contained in two annual DairyNZ publications (the DairyNZ Economic Survey and New Zealand Dairy Statistics).

The time series data was provided by DairyNZ in 2023 for the period from 1989 to 2020. Data was also sourced from the DairyNZ Econ Tracker Tool (Farm Economics)[117] in early 2024[118] for the most recent five years at the time of writing, although in this tool Marlborough is grouped with Nelson, Tasman and the West Coast.

On request, DairyNZ provided additional data from DairyBase for 2017-18 to 2022-23 for farms sampled from the 'Top of the South' regions only (i.e., Marlborough, Nelson, and Tasman)[119]. Where a data point falls short of the 20 farms needed to create a DairyBase benchmark it is recorded as an estimate (and highlighted blue in the tables). Marlborough-only data was not an option because of the region's small sample size and so the need to protect farmer confidentiality. The farms included in the sample can change slightly year on year, which is a factor in the variability of results between years.

The use of all this data was supported by interviews with a Marlborough dairy farmer and a local technical expert. A draft of this section was reviewed by DairyNZ staff.

117 https://www.dairynz.co.nz/tools/dairynz-econ-tracker-tool/

118 The timing coincided with the two interviews. The Economic Tracker is updated quarterly, so actuals can change when new historical data is entered into DairyBase, which happens when new farms join, and their data is added retrospectively for previous production seasons.

119 DairyNZ refer to the combined regions of Marlborough, Nelson, and Tasman as the 'Nelson / Marlborough' dairy region.

4.2.1 Introduction

The dairy industry in Marlborough is largely located north of the Wairau River. As of 2022 dairy farming (based on the land area in pasture) was distributed between the following localities: Rai Valley (39%), Pelorus (31%), Linkwater (13%), and Kaituna / Tuamarina (17%). In addition to its limited extent, the industry has two main features that set it apart from other regions, particularly Canterbury, Otago, and Southland. First, it is characterised by a small (and declining) number of established farms with relatively small herd size that are now some distance from milk processing. Second is the mix of land uses within a farm property, with dairy farming often co-existing with large areas of forestry and native bush. These characteristics partly reflect the climate, topography, and soils on which dairying occurs in the region. As with sheep and beef farming in Marlborough, there may be more diversity between dairy farming in Marlborough and that of other regions than within Marlborough's dairy farms themselves.

4.2.2 Historical Context

While dairy farming has never been a large industry in Marlborough (e.g., Duckworth *et al.*, 1976) it has long had importance locally, particularly in the Rai Valley (McLintock, 1966). Dairy cow numbers in Marlborough Country in the 1950s was similar to what they were in the 1920s but had declined in both the Sounds and Awatere Counties (Figure 31).

> *Dairying is not widespread in Marlborough, but is important in a few localities such as Rai Valley, Mahakipawa, Koromiko, and Kaikōura. There are cheese factories at Rai Valley, Koromiko, and Tuamarina and butter factories at Blenheim and Kaikōura. Town milk supply as well as some ordinary dairy farms are located on the lower Wairau Plain.*
>
> ***J.P. Beggs (1962)***

Traditionally, most milk produced in New Zealand was separated and the cream was used for the manufacturing of butter (roughly 73% of total milk produced). The remainder was used either for cheesemaking (16%), the town's milk supply[120] (8%) and the balance was used in condensed milk, whole milk products or fed to calves (Dept. of Agriculture, 1963). In 1961 in Marlborough, there were two creameries producing butter and three cheese factories (Dept. of Agriculture, 1963). At the time, growth of skim milk powder production was being encouraged in New Zealand by the development of tanker collection with the milk being separated at the factory.

120 In the 1960s, New Zealanders consumed 303 pints of milk per person annually – or almost one pint a day (NZ Dept. of Agriculture, 1963).

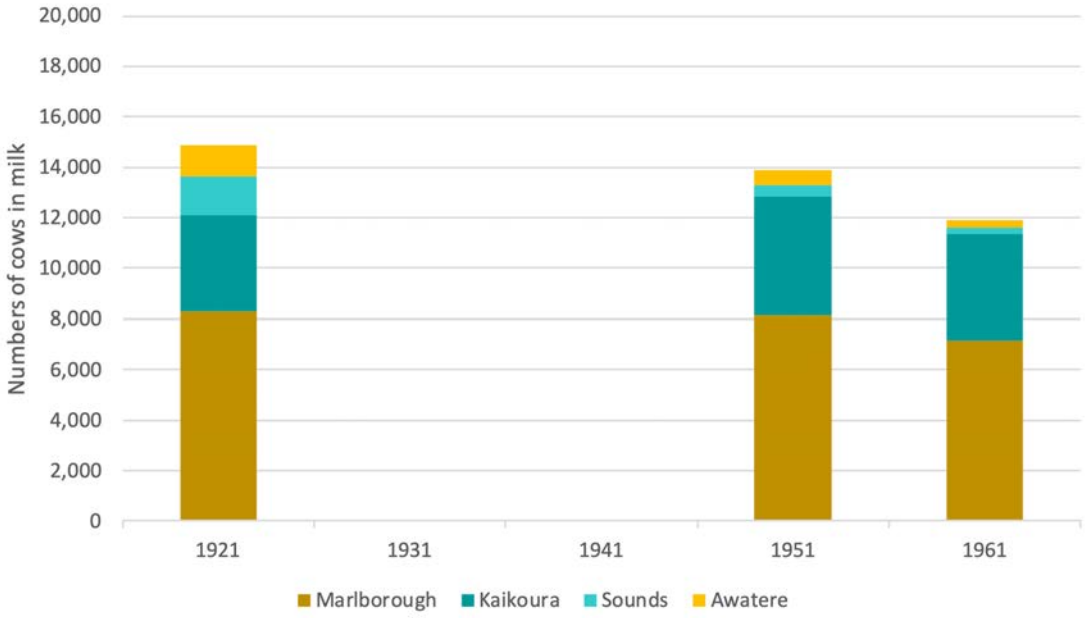


Figure 31: Dairy cows by county in the Marlborough Provincial District from early to mid-20th Century
Data source: An Encyclopaedia of New Zealand (McLintock, 1966)
Note: The years reported in the graph (1921, 1951, and 1961) were all that was available in the source reference. Kaikōura became part of the Canterbury region in 1992.

During the 1970s, the number of dairy farms declined from 172 to 118 (31%) (Ashworth-Morrison Cooper, 1982). In the mid-1970s there were 146 suppliers to the region's five factories, and the total number of dairy cattle in the region (around 23,000) had remained fairly constant over the previous 50 years (Duckworth *et al.*, 1976). Larger herds were becoming more common and the most popular cattle breeds at the time were Jersey and Holstein-Freisian (Duckworth *et al.*, 1976). New management techniques were being adopted, such as rotational grazing, irrigation, and herd testing, and production was increasing as a result (Table 20). Production of butterfat in 1974/75 was less than one per cent of that for New Zealand (Duckworth *et al.*, 1976).

Table 20: Production of butterfat in Marlborough in 1974/75

Factory	Number of suppliers	Butterfat (kg)	Change from 1973/74
Koromiko	17	184,923	+14.9%
Rai Valley	49	508,971	+4.3%
Waitohi (cheese)	30	388,663	+4.6%
Blenheim (butter)	7	349,735	+7.3%
Kaikōura	43	529,345	+12.5%
Total	**146**	**1,961,637**	**+8%**

Source data: Ministry of Agriculture and Fisheries cited in Duckworth et al. (1976)
Note: Kaikōura is included here because at the time it was part of Marlborough

In the early 1980s P.G. Yeoman[121] (1983) reported that: "While dairy farm numbers have declined to the present figure of approximately 100, and the number of dairy factories has recently been reduced from four to two, the number of cows has expanded over the years and the industry is at present staging something of a resurgence." Dairy cattle numbers were showing almost the reverse of national trends, from 20,000 dairy cattle in 1962 to 21,000 in 1983, an increase of 4 per cent (Yeoman, 1983).

Figure 32 shows that from 1989 to 2020, the regional dairy herd increased by roughly 5,700 cows (+56%), although there was some variation in the intervening years. While this growth was notable for Marlborough, it was modest in comparison to many other regions in New Zealand during this time. The number of cows rose during the 1990s from around 10,000 to a peak of 19,000 in 1998 and has been reasonably stable since, ranging between 16,000 to 19,000 up until 2020. Using DairyNZ data, there were a total of 48 dairy herds in Marlborough in 2020, which is consistent with Stats NZ data that estimates a total of 48 dairy farms in the region in June 2022. Alongside these trends, dairy farmland (dairy platform only) in the region decreased slightly between 1989 and 2020 to 5,467 effective hectares (-1%).

Marlborough District Council data from their Dairy and Stream Crossing Survey indicates that the number of operating dairy farms decreased from 50 farms in 2018-19 to 46 farms in 2020-21.

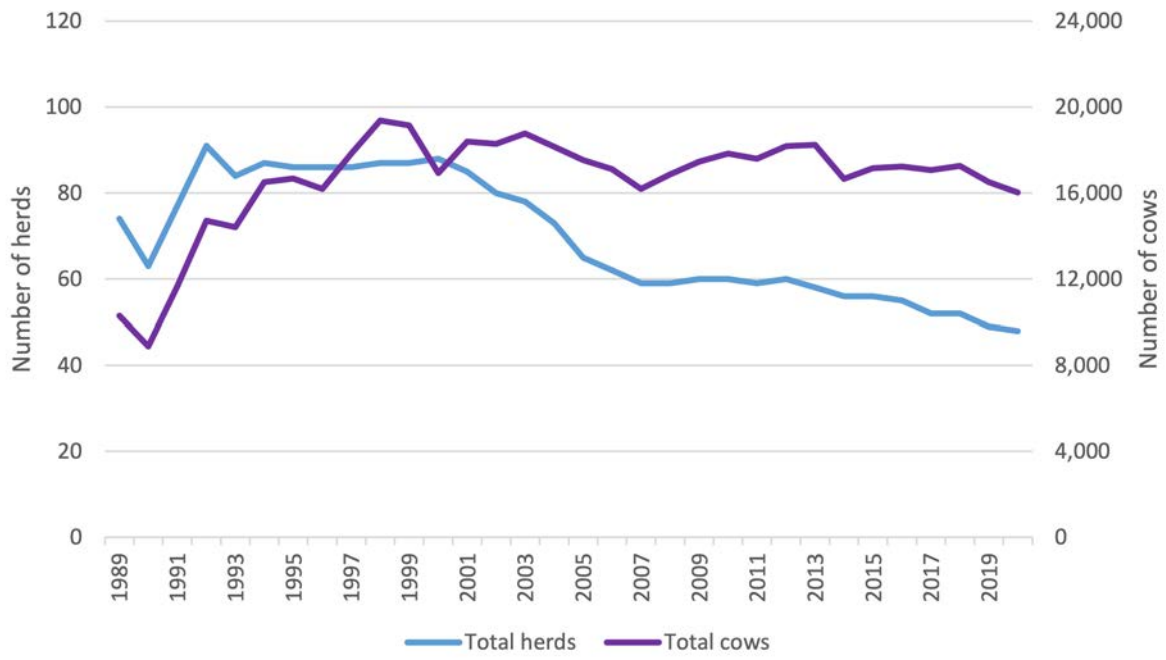


Figure 32: Total number of dairy cows and total number of herds in Marlborough 1989-2020
Source data: DairyNZ

121 Ministry of Agriculture and Fisheries (MAF), Blenheim.

4.2.3 Farm Systems

The DairyNZ Economic Survey reports on the variability in dairy cattle farm systems across New Zealand. It defines its geographic districts using the 69 territorial authorities across the country. These districts are amalgamated into eight 'dairy' regions, five in the North Island and three in the South Island. Data for national averages are weighted by the regional proportion of herds reported in the New Zealand Dairy Statistics[122].

Dairy farms are broadly grouped into five farm production systems based on the timing, purpose and amount of imported feed used. Imported feed includes purchased supplements and/or grazing off-farm[123] for dry cows (winter grazing). While no region-wide data are collected on the system type for all farms, DairyBase captures a sample of farms that have voluntarily entered data and collects a user defined system type. After increasing from System 3 in 2017-18 to closer to System 4 in 2018-19, the average system type of the Top or the South farm sample has more recently moved back towards a high System 3. This trend partly reflects rapid inflation and some farms reducing inputs in order to cut expenses.

System 1 – All grass self-contained, all stock on the dairy platform. No feed is imported. No supplement fed to the herd except supplement harvested off the effective milking area and dry cows are not grazed off the effective milking area.

System 2 – Feed imported, either supplement or grazing off, fed to dry cows. Between one and 10 per cent of total feed is imported. There is a large variation in percentage because in high rainfall areas and cold climates such as Southland, most of the cows are wintered off.

System 3 – Feed imported to extend lactation (typically autumn feed) and for dry cows. Between 10 and 20 per cent of total feed is imported.

System 4 – Feed imported and used at both ends of lactation and for dry cows. Between 20 and 30 per cent of total feed is imported onto the farm.

System 5 – Imported feed used all year, throughout lactation and for dry cows. Between 25 and 40 per cent (but can be up to 55%) of total feed is imported.

A dairy cow's lactation, which influences its feed requirements, starts with calving. The planned start date[124] for calving in Marlborough is at end of July and into the start of August for most farmers. This date is more in line with Otago and Southland than Canterbury (or the North Island) (Dairy Statistics, 2022-23). The median calving date (i.e., the mid-point), which indicates the distribution of spread of calving within a herd, is the middle of August and aligns with cooler, wet winters.

In general, dairy farm businesses in New Zealand tend not to be diversified. Additional revenue streams are usually small and tend to be focused on dairy support or raising beef calves. However, in Marlborough, dairy farming occurs on a much smaller share of total dairy farm land as many dairy farms also contain a farm forestry enterprise as well as areas of native bush (Figure 33). From 2017-18 to 2022-23, the average non-dairy effective area for 'Top of the South' dairy farm sample in the DairyBase farm sample has ranged from 22 hectares to 59 hectares (23% of total dairy and non-dairy effective area as an average across the five year period).

---

122 The New Zealand Dairy Statistics (LIC & Dairy NZ) have been compiled in their current form since the 1990-91 production season.

123 Off-farm generally refers to off-milking platform and does not include any support block or non-dairy area of a farm business. A milking platform is the area grazed by milking cows during production. Run-off land supports the dairy operation e.g. grazing and feed. Non-dairy area is land used for other farming or horticultural enterprises.

124 The planned start of calving date is 40 weeks from the date that mating is started in a herd (Dairy Statistics, 2022-23).

Across the region, forestry accounts for around 1,000 hectares or just over eight per cent of dairy farmland, which totals just under 12,000 hectares. There is some variability between catchments, ranging from four per cent for dairy farm land in Havelock Valley to 11 per cent in Kaituna / Tuamarina / Northbank. Native bush is even more of a feature, accounting for roughly 3,000 hectares or just over 25 per cent of total dairy farm land in the region. The variability between catchments ranges from 11 per cent of the land used for dairy farming in Rai Valley (to Pelorus Bridge) up to 42 per cent in Havelock Valley. In total, roughly one-third of the land managed by dairy farmers is in trees or native bush.

This mix of land uses within dairy farms is likely to be a particularly important factor in the impacts of freshwater management. These findings are consistent with comments made by the dairy farmer interviewed:

- *There's not a whole lot of flats. We're more gullies and river edges and that sort of stuff – there's only some of this terrain that you can farm effectively.*
- *Farm forestry is not that unusual for our area – we get a reasonable rainfall and there's quite a bit of plantation forestry around. Some unproductive areas have been turned into pines. Where there would have been sheep, and later deer, here running round on the hills, that now is converted to forestry.*

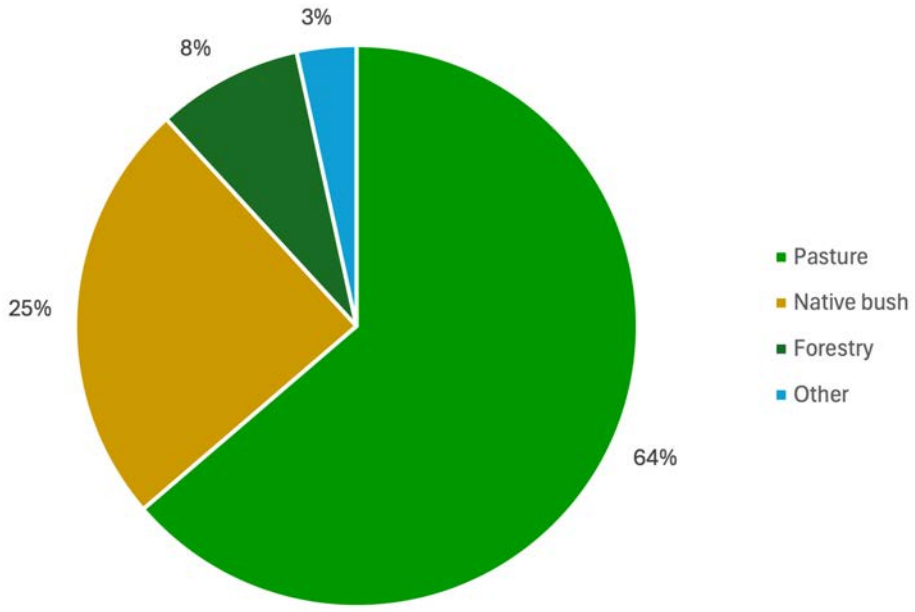


Figure 33: Estimated distribution of land cover on total dairy farm land (milking platforms and run off blocks) in Marlborough in 2022
Source data: Marlborough District Council
Note: An adjustment of two per cent was subtracted from the data for 'Pasture' and added to 'Other' to more accurately account for effective and non-effective areas (e.g. dairy sheds, effluent ponds, dwellings, and curtilage).

125 'Pasture' includes dairy platform and non-platform; 'Forestry' is intentionally planted forestry stands (largely pines, but includes all species); 'Native Bush' includes mature bush, developing/reverting bush and scrub (all non-grazed); and 'Other' is non-effective land, such as areas eroded to rivers, or located under dairy sheds/dwellings.

Herd homes or winter barns are relatively uncommon in Marlborough, but some dairy farms have feed pads. The farmer interviewed noted that "Covered barns are up near the one or two million dollars depending on how many cows you have. It's basically comparable with the price of a new cowshed"

- *There have been two new milking sheds in our valley in the last say five years. One was two farms being combined, and another was an older dairy farm upgrading to a new herringbone. There's probably quite a few older farms around that may be wanting to put in a new milking shed but it's not economic at the moment.*

4.2.4 Key Dairy Statistics

For the past 30 years, dairy land (milking platform only) in Marlborough has stayed fairly steady, at between 5,500 and 7,500 effective hectares[126]. However, during this time dairy farms have increased in both average size and intensity but, even with this consolidation, the herd size is still relatively small compared to Canterbury, Otago, and Southland. Table 21 and Figure 34 shows changes in the total number of cows milked, total effective hectares, and total milksolids from 1989.

In Table 21 the statistics for Marlborough are compared with those for Taranaki, a much larger dairying region, but where dairy farms also tend to be small and there have been similar trends in herds and dairy land. This comparison helps highlight differences in changes in total cows and total milksolids over the time period. Between 1989 and 2020, there was a 35 per cent decline in the number of herds and a one per cent increase in total effective area across Marlborough. In 2000 there were around 80 dairy farms and they were characteristically traditional family-run farms of around 40 to 60 hectares and 100 to 300 cows (P. Hawes, pers. comm., 2024).

Alongside these changes, the average size of a dairy farm in the region grew 55 per cent between 1989 and 2020, albeit from a small base, from 74 to 114 effective hectares. More dramatically, average milksolids per effective hectare increased 150 per cent from 495 kg to 1,240 kg (Figure 35). In New Zealand there is a close relationship between milksolids production per cow and required feed demand per cow (Newman & Davidson, 2019) (feed is discussed in Section 4.2.7).

Table 21: Key dairy statistics for Marlborough and Taranaki – comparing 2020 with 1989

Region	Total herds		Total cows		Total effective area (ha)		Total milksolids (tonnes)	
	2020	Change from 1989	2020	Change from 1989	2020	Change from 1989	2020	Change from 1989
Marlborough	48	-35%	16,028	+56%	5,467	+1%	6,780	+152%
Taranaki	1,553	-38%	465,896	+24%	167,167	+11%	194,312	+80%

Data source: DairyNZ

126 Using DairyNZ data. No data was supplied for total area, but this topic is returned to in Section 4.2.7.

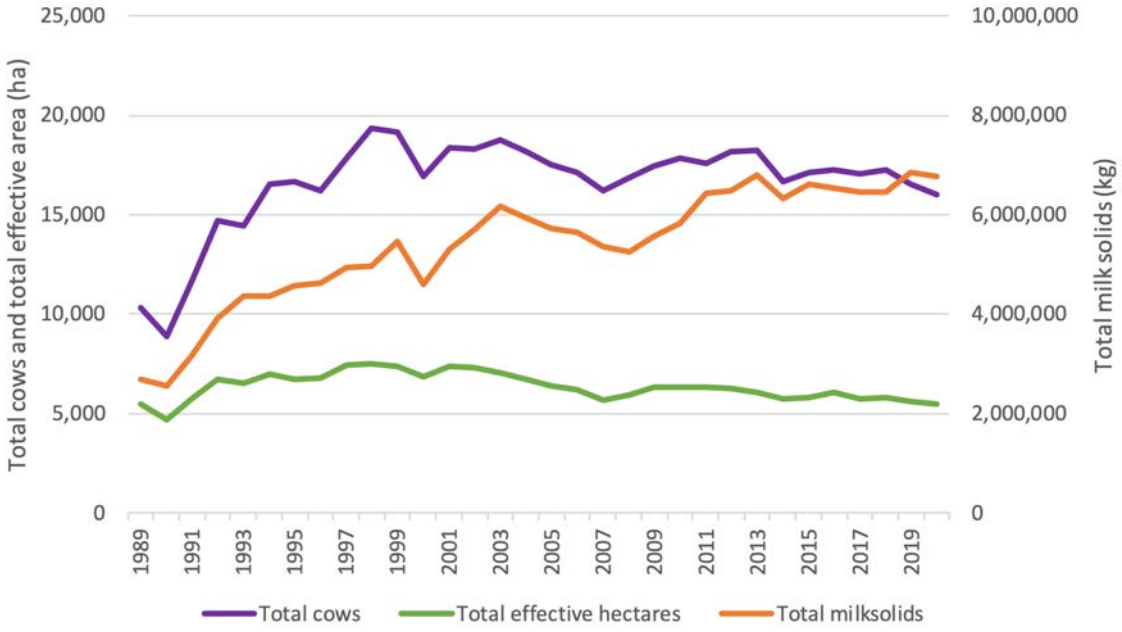


Figure 34: Change in key dairy statistics in Marlborough 1989-2020
Data source: DairyNZ

Stocking rates increased steadily during the 1990s and 2000s but have been fairly stable since 2013 (Figure 35). In 2020, the average stocking rate in Marlborough was roughly 2.9 cows per effective hectare, similar to the national average (but higher than the 1.9 cows per hectare in 1992). In 2021-22, the average stocking rate in the Top of the South was 2.91 cows per effective hectare, down from 2.97 four years earlier in 2017-18 (in 2022-23 the estimated[127] rate was 2.76). The conversion of dairy cattle to stock units depends on the age and breed of cow. In general terms, a Jersey cow is a lighter breed and so converts to fewer stock units than a Holstein-Friesian, which is a heavier breed.

The herd analysis for Marlborough in 2023-24 was 42 dairy herds (compared to 48 herds in 2020), 14,597 dairy cows, and 5,570 effective hectares (DairyNZ, 2024). On average, the herd size was 348 cows, the effective area was 133 hectares, with a stocking rate of 2.62 cows per hectare (DairyNZ, 2024). For context, the respective national averages in the same year were 448 cows, 162 hectares, and 2.76 cows per hectare. Using the Marlborough District Council compliance data for 2024, there were 12,874 dairy cows across 38 dairy farms. The range in herd size across the farms was from around 50 dairy cows to just over 1,000 dairy cows (median was 323 cows and average was 339 cows).

The farmer interviewed commented:

- *We're about 2.7 cows stocking rate and I think that's pretty usual for most of the farms in this area. There are a few that are more 3 cows, a little bit higher, but there's not too many high input farms around here. Most farms are between system 2 and system 4 but there are a couple of system 5 farms around.*

127 Refer to the start of Section 4.2 for an explanation of estimated benchmarks.

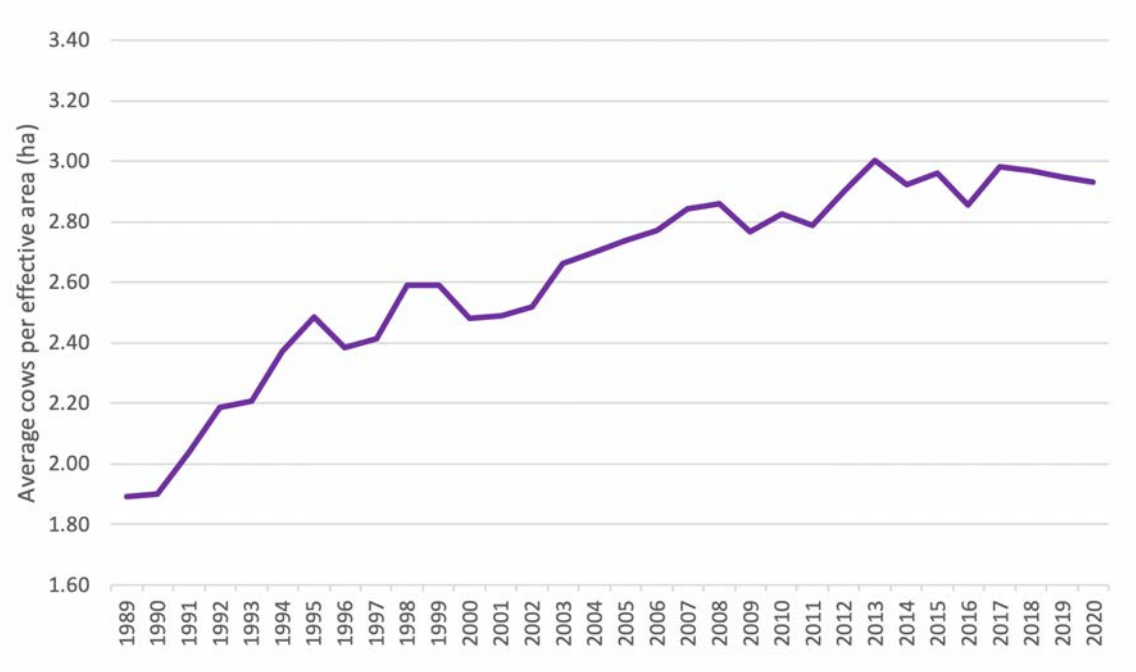


Figure 35: Dairy farm stocking rates in Marlborough 1989-2020
Source data: DairyNZ
Note: To show more detail, the vertical of y-axis begins at 1.6 cows per hectare (not zero).

Over recent years, dairy farmers in New Zealand have been increasingly shifting from Holstein-Friesian to Holstein-Friesian/Jersey crossbreed cows to benefit from the efficiencies of hybrid vigour and get the best traits from the two main dairy breeds[128]. Figure 36 shows the distribution of cattle breeds in Marlborough. Traditionally, many of the dairy herds in Marlborough were Jersey, and while it is still a relatively common breed compared to other regions, Jersey cows are far less prominent than they once were. The shift to Friesians largely occurred in the 1970s and 1980s, with relevant factors being their efficiency in converting feed to milk and the growing market for dairy beef. Holstein-Friesians are usually popular with sharemilkers and are worth more when sold, which is an important consideration (particularly for sharemilkers)[129].

128 In total, just under 60% of all dairy cows were Holstein-Friesian/Jersey crossbreed, followed by Holstein-Friesian cows (24.4%) and Jersey cows (7.6%) (Dairy Statistics, 2022-23).

129 Holstein-Friesians can also earn more from dairy-beef calf sales.

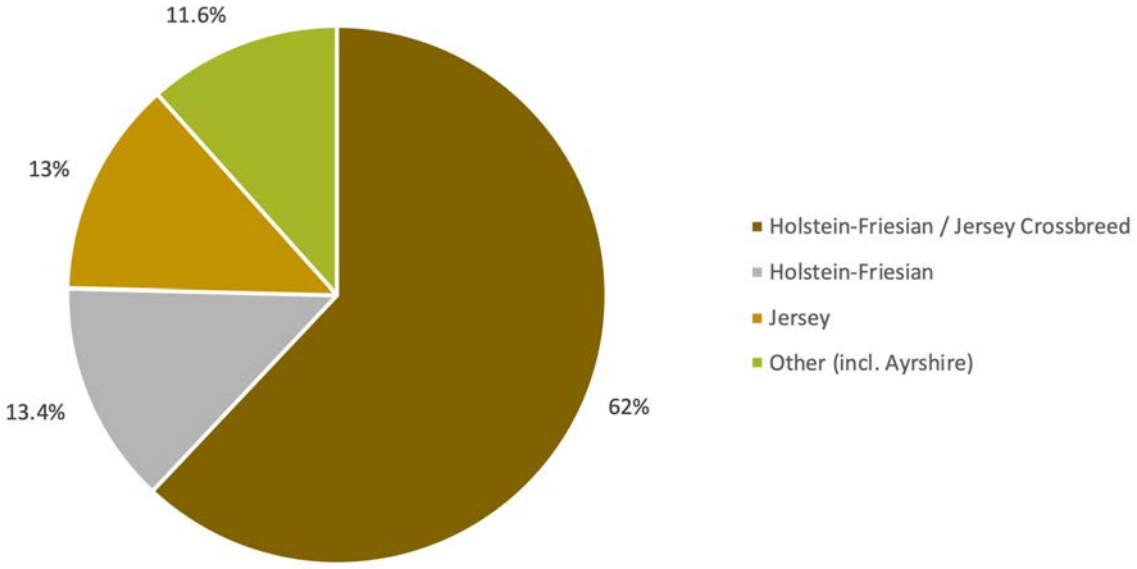


Figure 36: Distribution of dairy cattle breeds in Marlborough for 2022-23
Source data: Dairy Statistics 2022-23

From 1989 to 2020, total milk production[130] in Marlborough increased by around 4,000 tonnes of milksolids (+152%) from roughly 2,693 tonnes to 6,780 tonnes (a compound average annual growth rate of 0.63%). Over this time period, average milk production in the region (measured as kg MS/eff. ha) increased by 150 per cent from 495 kg in 1989 to 1,240 in 2020 (Figure 37).

It is the combination of the physical performance of the farm reflected through milksolids production, the average cost of production, and milk prices that drives a farm's financial results (DairyNZ Economic Survey, 2013-14). Key physical indicators include the amount of feed eaten, days in milk, cow condition, reproduction performance, soil fertility, and fertiliser use. Some of these indicators are within a farmer's control while others are more dependent on seasonal conditions, which can change markedly from one production season to the next.

The location of milk processing changes throughout the season. The farmer interviewed commented:

- *It used to go to Tuamarina in Blenheim, where they reduced it before sending it by train to Clandeboye in Canterbury. Otherwise, it goes to Brightwater, and they truck it to Canterbury. I think at the peak, they send some down to the Golden Bay plant just to manage the flow.*

130 Production is a measure of output. A farm's productivity is its outputs divided by its inputs (i.e., the resources used in production).

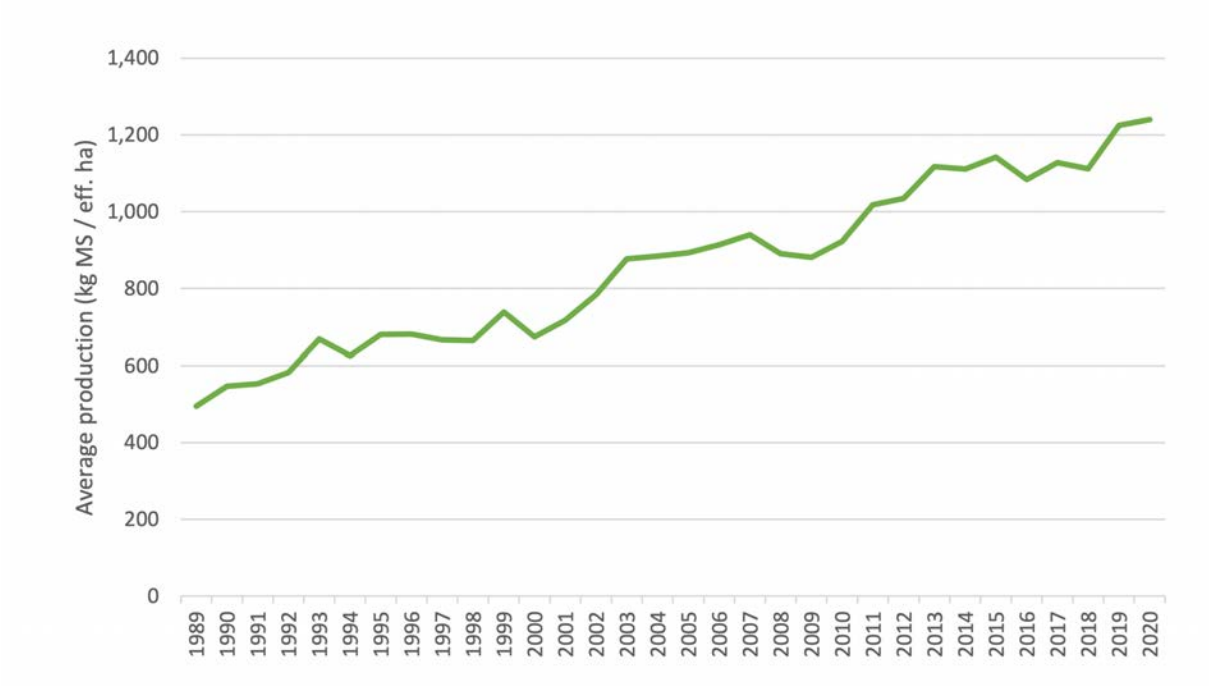


Figure 37: Average milk production in Marlborough 1989-2020
Source data: DairyNZ

On average, herd production for Marlborough in 2023-24 was 137,518 kg milksolids per herd, 1,037 kg milksolids per effective hectare and 396 kg milksolids per cow (DairyNZ, 2024).

A dairy farm's operating profit is usually measured as Earnings Before Interest and Tax (EBIT). Essentially, it is equivalent to total farm revenue minus its operating expenses. Table 22 and Table 23 give median farm financial information for the most recent five years for which data was available. Comparisons are made with the Top of the South and New Zealand for context. While the per hectare basis adjusts for differences between farm size, the whole farm measure is an equally relevant consideration, particularly given the smaller farms in Marlborough.

While there is some variability between production seasons, the region's median farm working expenses (FWE) per kilogramme milksolids produced have been somewhat lower than those for New Zealand as a whole over recent years. For comparison, median farm working expenses for New Zealand as a five-year average from 2018-19 to 2022-23 were $4.89 per kg milksolids and ranged from $4.44 in Taranaki up to $5.27 in Northland.

For context, the five-year average dairy co-operative payout in New Zealand for 2018-19 to 2023-24 was $8.43 per kg milksolids (and $9.25 when adjusted for inflation) (DairyNZ, 2024). In 2021-22 the average dairy co-operative payout was $9.52 per kg milksolids, which was the highest average payout on record at the time and up from $7.76 in the previous season (DairyNZ, 2022). This record payout was followed by $9.26 per kg milksolids in 2022-23 of (the second highest on record) (DairyNZ, 2023) and $8.90 per kg milksolids in 2023-24 (DairyNZ, 2024). However, these payouts have been tempered by high on-farm inflation (largely driven by interest rates) which in 2022-23 was the highest it has been for a decade.

Table 22: Average farm financials for the Top of the South farm sample by milksolids from 2018-19 to 2022-23

Metric	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Payout Received ($/kg MS sold)	$5.77	$5.59	$6.18	$7.41	$9.24	$8.59
West Coast & Top of the South – Breakeven Milk Price ($/kg MS sold)	-	$6.24	$6.57	$6.48	$8.13	$8.30
Farm Working Expenses[131] ($/kg MS sold)	$5.13	$5.31	$5.05	$5.50	$7.28	$7.06
New Zealand – Farm Working Expenses ($/kg MS sold)	-	$4.32	$4.48	$4.56	$5.45	$5.84

Source data: DairyNZ DairyBase
Note: Unless otherwise specified, the data reported is for Top of the South dairy farms (owner-operators). Payouts received and breakeven milk prices vary by farm and by region.

Table 23: Average farm financials for the Top of the South farm sample from 2018-19 to 2022-23

Metric	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Dairy Gross Farm Revenue (per farm)	$1,039,957	$985,770	$1,102,467	$1,095,842	$1,250,307	$967,709
Farm Working Expenses (per farm)	$848,858	$857,167	$838,734	$765,467	$928,288	$734,295
Farm Working Expenses (per eff. ha)	$5,737	$5,842	$5,648	$5,982	$7.365	$7,413
Total Operating Expenses (per farm)	$844,417	$834,613	$844,447	$803,811	$927,223	$733,414
Dairy Operating Profit (EBIT per farm)	$212,008	$155,853	$270,819	$303,313	$334,711	$235,159
Total Operating Profit (EBIT per farm)	$230,556	$208,699	$280,463	$305,684	$332,543	$236,097
Interest and Rent (excl. support block)[132] (per farm)	$176,914	$162,119	$169,458	$127,939	$110,627	-
Tax (per farm)	$35,047	$37,423	$43,603	$66,363	$99,400	-
Total Operating Profit per hectare Top of the South (EBIT/eff. ha)	$1,558	$1,422	$1,889	$2,389	$2,638	$2,384
Total Operating Profit per hectare New Zealand (EBIT/eff. ha)	-	$1,879	$2,377	$2,829	$3,644	$2,873

Source data: DairyNZ DairyBase
Note: Unless otherwise specified, the data reported is for Top of the South dairy farms (owner-operators).

131 Before adjustments for livestock, labour, feed, support blocks, and depreciation.
132 Support block lease is included in Farm Working Expenses.

Image 36: A dairy farm in the Te Hoiere / Pelorus Catchment in June 2023

4.2.5 Farm Size

Although there are relatively few dairy farms in Marlborough, there is substantial variability in their size. Using Stats NZ data, a quarter of the farms are less than 100 hectares, a quarter are between 100 and 199 hectares, another quarter are between 200 and 399, and the final quarter are between 400 and 799 hectares. The smaller farms (i.e., less than 200 ha) are unlikely to be able to afford additional staff. This regional pattern differs to neighbouring Nelson / Tasman where the dairy farms tend to be larger (Figure 38).

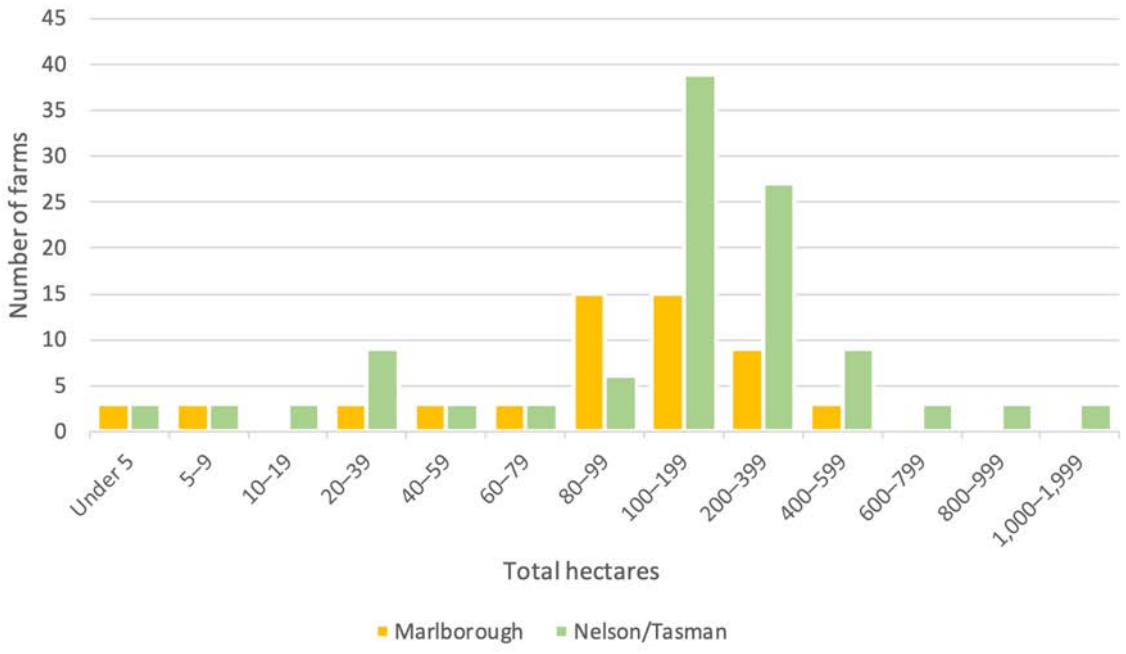


Figure 38: Distribution of dairy 'farms' by farm size (total hectares) in Marlborough and Nelson/Tasman in June 2022
Source data: Stats NZ Agricultural Production Statistics

Overall, these results are broadly consistent with the available DairyNZ data, which indicates that in 2020 the average effective area of dairy farms in the region was 114 hectares. A dairy farm's effective area is the land within the milking platform that the milking herd grazes (including any crop even if used for wintering)[133]. Figure 39 shows how the size of dairy farms in Marlborough (measured using effective area) has increased over the last 30 years. Average herd size in the region in 2022-23 was 334 cows, which was relatively small (the regions with the smallest herd sizes were Taranaki with 314 cows and Auckland with 283 cows). Average herd sizes in Marlborough are considerably smaller than in Canterbury, Otago, and Southland[134].

There are instances of dairy farms being converted to both vineyards and sheep and beef farms (depending in part on their location). The farmer interviewed commented on farm sales:

- *In late 2023 there were about five or six farms on the market. Farms are going to drystock farming, so there might be more for sale in this area and a few runoffs in this area that don't seem to be moving. Some people that want to sell their runoffs but there's not much buying activity at the moment.*

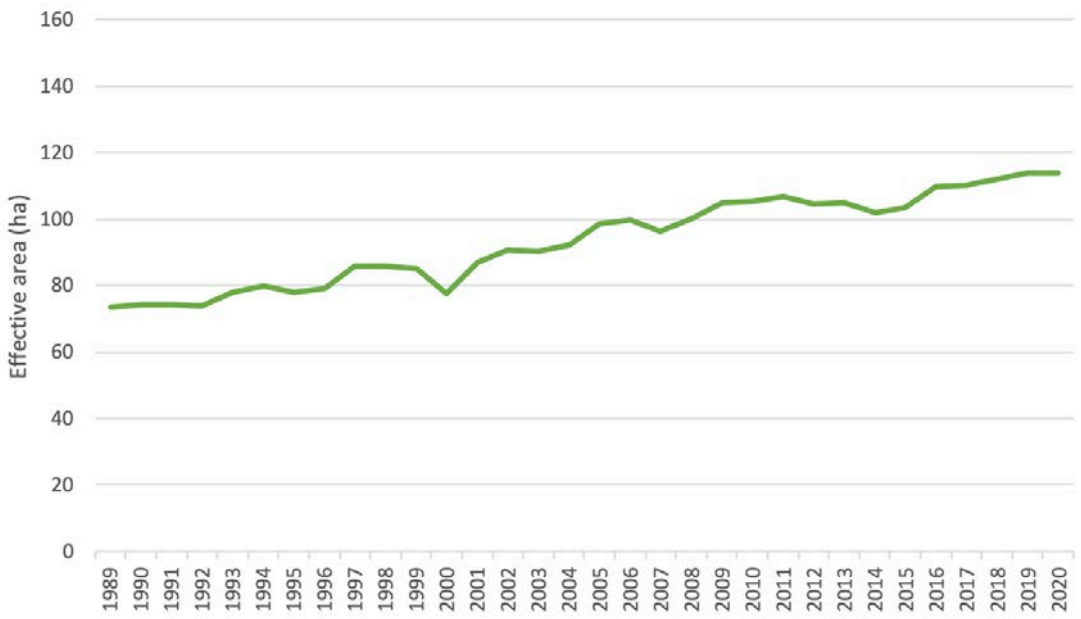


Figure 39: Average dairy farm size in Marlborough 1989-2020
Source data: DairyNZ

133 Stats NZ data does not include a house or laneways, while the LUCAS NZ land use data does.
134 The Mackenzie District in Canterbury has had the highest average herd size for the last four seasons with 1,102 cows, followed by Ashburton in North Canterbury with 843 cows (Dairy Statistics, 2022-23).

Production land is not all equal. Its versatility varies markedly across the landscape and a farm can contain land that falls into more than one Land Use Capability (LUC) Class (refer to Section 2.4 for more information). Typically, across New Zealand LUC Class 1-4 is preferred for dairy farming. However, in Marlborough dairying has a wide distribution across the LUC Classes, although as already noted, it is not unusual for dairy farmers in Marlborough to have native bush or forestry within their farm.

4.2.6 Farm Ownership, Sharemilking, and Labour

Dairy farms have a range of ownership structures and management arrangements. An owner-operator either owns, or leases, both the herd and the land. A farm owner may also use a contract milker to manage a farm. A contract milker is self-employed, usually providing labour, shed costs, electricity and vehicles, and is paid on a negotiated set price per kgMS (milksolids) produced. In contrast, a herd-owning sharemilker, or '50/50' sharemilker, owns the dairy herd and generally any equipment (other than the milking plant) needed to farm the property but not the milking land (generally referred to as the milking platform[135]). In practice, they may receive between 45 per cent and 55 per cent of the milk revenue. Variable or lower order sharemilkers are paid based on a set percentage of milk revenue[136].

Changes to farm operating structures over the past decade have seen the proportion of sharemilkers decrease in New Zealand from 34 per cent of total herds in 2013-14 to 29 per cent in 2022-23 (Dairy Statistics, 2022-23). The proportion of sharemilkers in Marlborough is both far less (19%) and relatively unchanged from a decade ago, possibly influenced by smaller herd sizes and traditional family farms in the region. Over time a lack of sharemilking opportunities can become an issue for farm succession as it is a pathway for earning cash to eventually buy land. Equity shares are an alternative pathway but one that tends to be slower, particularly if their growth rate is less than mortgage interest rates (Moran (Ed.), 2024).

Over recent years the average number of people employed on dairy farms in the Top of the South sample has decreased from 2.81 FTEs[137] in 2017-18 to 2.24 FTEs in 2021-22 (the average for NZ is about 1 FTE per 150 cows). In 2021-22, average annual expenditure on wages for dairy farms (owner-operators) in the Top of the South sample was $108,612 per farm, which was a decrease from that in 2018-19 (Table 24). However, in the 2017-18 production season (when expenditure on feed was high) average expenditure on wages was $102,700. On a per hectare and a per kg milksolids basis, expenditure on wages in the Top of the South has generally been higher than it is for New Zealand (this circumstance is in contrast with Taranaki). DairyNZ forecasts are that wage expenses in New Zealand have continued increasing over 2023-24 and 2024-25.

135 The milking platform is the land that is used for cows while they are in milk and is distinct from any support land, which is often referred to as a 'run-off block'.

136 The sharemilker is usually responsible for milk harvesting expenses, labour, stock-related expenses, and general farm work while the owner is usually responsible for expenses related to maintaining the property and may have little to do with farm management. A variable-order sharemilking agreement involves the farm owner retaining ownership of the herd and bearing more of the farm costs, such as animal health and breeding. It often sees the owner retain some involvement in management of the farm. The amount of farm work required by the sharemilker is determined by the individual agreement, with responsibility ranging from herd management only to carrying out all farm work (Dairy Statistics 2022-23).

137 In Dairybase this metric includes paid farm employees' hours, unpaid farm labour hours (usually family), and unpaid management as a proportion of the working year (2,400 hours). It includes items such as calf rearing and relief milking and paid farm managers but excludes any specific contract work such as cultivation or fencing etc.

Table 24: Dairy farm (owner-operator) median annual wage expenses from 2018-19 to 2022-23

Region	2018-19	2019-20	2020-21	2021-22	2022-23	Change 2022-23 from 2018-19	Latest baseline year available as share of FWE
FTEs incl. unpaid labour (per farm) Top of the South	2.80	2.75	2.27	2.24	2.08	-	-
Wages (per farm) Top of the South	$116,425	$101,408	$102,508	$108,612	$87,049	-	12%
Wages ($/kg MS sold) Top of the South	$0.72	$0.61	$0.74	$0.85	$0.84	-	12%
Wages ($/eff. ha) Top of the South	$793	$683	$801	$862	$879	-	12%
Wages ($/eff. ha) West Coast & Top of the South	$480	$516	$534	$455	$523	+9%	12%
Wages ($/eff. ha) Lower North Island	$699	$730	$707	$799	$983	+41%	17%
Wages ($/eff. ha) Canterbury	$1,051	$1,085	$1,157	$1,171	$1,272	+21%	16%
Wages ($/eff. ha) New Zealand	$686	$715	$750	$779	$837	+22%	13%

Source data: DairyNZ Econ Tracker
Note: FWE stands for Farm Working Expenses, which were reported in Tables 20 and 21.

4.2.7 Fertiliser and Supplementary Feed

The largest operating expense for dairy farmers is supplying sufficient feed, either through the use of fertiliser and supplementary feed (including off-farm grazing). In New Zealand feed for dairy cows is generally either pasture or non-pasture (Newman & Davidson, 2019). Pasture feed includes grazed pasture, hay and silage made from pasture, forage herbs (e.g., chicory, plantain), and lucerne. Non-pasture feed includes crops (e.g. fodder beet, kale, rape, turnips, and swedes), harvested supplements (maize grain, maize silage, barley, wheat, oats and cereal whole silage), and imported supplements (e.g., palm kernel extract, tapioca, soybean meal, cottonseed, brewers grain and other supplements (PROLIQ[138], molasses and waste manufacturing products like biscuits, chips, waste vegetables and fruit).

Farmers make decisions to supplement the feed that can be produced on-farm at both strategic and tactical levels. Strategic decisions are long-term and relate to the farmer's choice of farm system (refer to Section 4.2.3) while tactical decisions are made daily in response to seasonal conditions. Strategic decisions involve an annual feed budget and are based on various factors including stocking rate, pasture grown, and system goals (e.g. spring/autumn calving or milking frequency) (Kay, 2017). Tactical decisions for each stage of lactation consider factors such as pasture residuals, average pasture cover, round (or rotation) length, costs, and forecast payouts (Kay, 2017).

138 PROLIQ is a liquid stock food produced from lactose manufacture. https://proliq.nz/nz/en/about.html

The area extending from Marlborough to Southland relies more heavily on crops and supplementary feed than the rest of New Zealand over the winter months[139]. Combined non-pasture feeds in Marlborough-Canterbury increased from 9.2 per cent of total feed eaten in 1990 to 17.3 per cent in 2019 (Newman & Davidson, 2019). Marlborough's dairy grazing appears to occur in south Marlborough and (to a lesser extent) in Nelson / Tasman but this pattern may change with the gradual decrease in dairy farms in the region.

Not all feed is produced on a dairy farm's milking platform. Land used for dairy support can occur 1) as a run-off block that is owned or leased by a dairy farmer, 2) as a dedicated dairy support farm or 3) as dairy grazing within a drystock farm. The feed produced on this land is in addition to any supplementary feed imported onto the milking platform. As a basic rule of thumb, roughly 0.4 effective hectares of dairy support land is needed for each effective hectare of dairy platform land in New Zealand (M. Newman, pers. comm., 2024).

Table 25 details the contributions of feed used from various sources from 2017-18 to 2021-22. The farmer interviewed wintered most of their cows off the milking platform: "half on a farm locally and they are just on grass and baleage. Another quarter go to a drystock farm in south Marlborough where they're on kale and baleage. A few cows stay on-farm as well".

Table 25: Median values for feed used for dairy farms in the Top of the South from 2017-18 to 2021-22

Feed source (t/DM/eff.ha unless otherwise stated)	2017-18	2018-19	2019-20	2020-21	2021-22
Pasture and crop harvested on-farm	11.31	11.41	11.51	11.58	10.78
Supplementary feed eaten (purchased + support block + feed inventory)	2.42	2.65	1.94	1.80	1.93
Off-farm grazing	1.25	1.27	1.37	1.05	1.18
Cows per effective hectare	2.95	2.95	2.89	2.83	2.86

Note: Off-farm grazing is defined as mixed age dry cows that are grazed off the milking platform.

With the exception of 2018-19, the average spend on feed per effective hectare of dairy farmers in the Top of the South sample has tended to be slightly less in recent years than that for New Zealand (Table 26). As a five-year average from 2018-19 to 2022-23, average net feed expenses in the Top of the South was 22.2 per cent of Farm Working Expenses (New Zealand was 24.1%). However, there can be considerable variability between production seasons. For example, in 2018-19 average net feed expenses in the Top of the South were 24.0 per cent of Farm Working Expenses and in 2020-21 the average was 18.6 per cent.

A dairy farm's physical performance considers factors such as days in milk, cow condition, reproductive performance, soil fertility, and fertiliser use. It is the combination of the physical performance of the farm (reflected through milksolids production), the cost of production and milk prices that drives the financial results DairyNZ, 2019). Each production season, a farm's physical performance is influenced by seasonal weather patterns. For example, in 2018-19 Marlborough-Canterbury had a dry winter and a particularly wet spring compared to the previous decade (DairyNZ, 2019).

139 Newman & Davidson (2019) summarised the dairy industry's use of supplementary feed since 1990 by region. However, the information for Marlborough is not detailed here because it is grouped with Canterbury, which is a far larger dairying region.

Table 26: Dairy farm (owner-operator) median annual expenditure on net feed (made, purchased, and cropped) from 2018-19 to 2022-23

Region (eff. ha unless otherwise stated)	2018-19	2019-20	2020-21	2021-22	2022-23	Change 2022-23 from 2018-19	Latest baseline year available as share of FWE
Top of the South (per farm)	$163,130	$157,389	$120,346	$167,407	$124,391	-	25%
Top of the South	$1,112	$1,060	$940	$1,328	$1,256	-	25%
West Coast & Top of the South	$662	$730	$717	$887	$897	+35%	20%
Lower North Island	$943	$1,033	$1,066	$1,291	$1,247	+32%	21%
Canterbury	$1,161	$1,179	$1,357	$1,564	$1,698	+46%	21%
New Zealand	$1,053	$1,133	$1,214	$1,510	$1,641	+56%	26%

Source data: DairyNZ Econ Tracker
Note: FWE stands for Farm Working Expenses, which were reported in Table 15.

In general, dairy farmers across New Zealand usually purchase and apply fertiliser (including nitrogen) strategically across their pasture and crop, rather than using it more tactically as in sheep and beef farming (refer to Section 4.1.8). This fertiliser use is in addition to spreading stored farm dairy effluent, which is collected primarily from the farm dairy (and includes the milking shed).

Average annual expenditure on fertiliser (including nitrogen) for dairy farms (owner-operators) in the Top of the South in 2021-22 was just over $119,000 per farm, an increase of 16 per cent from 2018-19 (which was a season when the price of fertiliser increased 10.4%). Much of this increase is a result of inflationary pressures but it was offset by a 14 per cent decrease in average farm size (within the sample) over this time. The average spend per hectare for dairy farming in the Top of the South has been generally higher than for New Zealand (Table 27). As a four-year average from 2018-19 to 2021-22, fertiliser expenditure in the Top of the South was 14.3 per cent of Farm Working Expenses.

Table 27: Dairy farm (owner-operator) median annual expenses for fertiliser (including nitrogen) from 2018-19 to 2022-23

Region (eff. ha unless otherwise stated)	2018-19	2019-20	2020-21	2021-22	2022-23	Change since 2018-19	Latest baseline year available as share of FWE
Top of the South (per farm)	$87,297	$95,591	$96,518	$$119,269	$82,245	-	16%
Top of the South	$595	$644	$754	$946	$830	-	16%
West Coast & Top of the South	$588	$709	$655	$851	$801	+36%	18%
Lower North Island	$424	$384	$414	$524	$533	+26%	9%
Canterbury	$646	$690	$648	$827	$901	+39%	11%
New Zealand	$499	$519	$525	$663	$700	+40%	11%

Source data: DairyNZ Econ Tracker
Note: FWE stands for Farm Working Expenses, which were reported in Table 15.

The dairy industry use nitrogen surplus as an indicator of how efficiently nitrogen is being used[140]. Nitrogen surplus is the sum of the nitrogen inputs used for production on the farm (e.g., fertiliser, imported feed, irrigation water) minus the total nitrogen removed from the farm as products (e.g., milk, crops, exported effluent, supplements sold or stored). The lower the nitrogen surplus result, the more efficiently nitrogen is being used in the system.

However, the farmer interviewed commented that it can be difficult concept for people to fully grasp:

- *My understanding is nitrogen surplus is made up of all your fertiliser inputs and supplementary feed less the nitrogen exported off farm as milk and meat. To improve it you need to fine tune your inputs, and perhaps cow numbers, but the weather from season to season can have a big influence as well. For example, a drought may mean you have to input more supplementary feed to maintain your normal milk production. This will have a negative effect on your nitrogen loss as your inputs have increased, but your outputs have stayed the same or got smaller.*

They also noted that a constraint on the use of nitrogen fertiliser may result in an increase in supplementary feed (i.e., a substitution of one input with another):

- *If dairy farms are pushed to cut their nitrogen use too much (to reduce losses of excess nitrogen to fresh water) then it may force farmers to import more grain and palm kernel from Canterbury. This feed has to be trucked up and the transport will increase greenhouse gas emissions.*

4.2.8 Environmental Management

As discussed above, dairy farming involves high input and high intensity production systems. The main contaminants of concern on dairy farms, in general terms, are nitrogen, phosphorus, suspended sediment, and faecal microbes (as indicated by *E. coli*). Water abstraction on dairy farms is mainly used for livestock drinking, irrigation to grow pasture and crops, and dairy shed wash down (i.e., farm dairy effluent).

The need for continuous improvement in environmental management is not new for the dairy industry. In 2003 the industry launched the Dairying and Clean Streams Accord, which was followed a decade later by the Sustainable Dairying: Water Accord[141]. Since 2013, further initiatives have included guidance on good management practices (DairyNZ, 2016) and development of the Dairying Tomorrow Strategy (DairyNZ, 2017). Much of this improvement has been driven via the value chain as public concern about fresh water eventually translated into milk processor requirements[142].

In addition to environmental standards and stock exclusion regulations that now apply to farming across New Zealand, the proposed Marlborough Environment Plan includes specific policy direction and zone rules to manage dairy farming to help protect water quality. These policies and rules consider the related topics of land use conversions, farm dairy effluent, and nutrient management.

In Marlborough a land use consent is required to establish and operate a new dairy farm, as well as to expand an existing dairy farm where there is an increase in the area or intensity of the farming operation resulting in an additional area of dairy shed. For new dairy farms, a risk assessment must be undertaken and

---

140 Nitrogen surplus does not account for the environmental conditions of a farm or nitrogen fixed by clover, which are important factors in nitrogen leaching risks. Nitrogen surplus differs from nitrogen conversion efficiency (NCE), which is the proportion of nitrogen brought onto the farm that is converted into product. It is calculated as the sum of products divided by the sum of inputs and reported as a percentage. The larger the result the better the conversion efficiency. https://support.overseer.org.nz/hc/en-us/sections/25293326710041-Understanding-N-P-Results

141 https://www.dairynz.co.nz/regulation/policy/sustainable-dairying-water-accord/

142 For example, Fonterra's Tiaki campaign https://www.fonterra.com/nz/en/campaign/tiaki.html

adverse effects minimised. The latter focuses on actions preventing stock access to waterbodies, providing buffers for riparian margins, building appropriate storage for dairy effluent, and nutrient management plans for effluent, animal discharges and fertilisers.

Dairy effluent storage requirements have minimum expectations in the proposed Marlborough Environment Plan including 1) 3 months effluent storage capacity and 2) setback distances for storage systems from water bodies and flood zones. The discharge of dairy effluent to land is enabled through permitted activity rules, with the risk of adverse effects managed through conditions including appropriate discharge rates and soil conditions for the activity to be undertaken. The activity requires a consent in soil sensitive areas, groundwater protection zones, and within specified distances of waterbodies and boundaries. The direct discharge of any animal effluent to fresh or coastal waterbodies is to be avoided. The total cumulative nitrogen loading from all discharges on the areal extent of land to be used for the discharge must not exceed 200 kg N/ha/year (excluding N from direct animal inputs)[143].

New Zealand's dairy industry continues to develop and support 'Good Farming Practice Principles' for dairying farming. These principles are a set of minimum criteria that all dairy farmers are expected to be either meeting, or working towards meeting, over time. They are generally cheaper to implement than those that rely on advancing technology and infrastructure, but there is no criterion to be low cost. Fencing and planting waterways and critical source areas, and providing stock crossings, for example, are not inexpensive. Some incur opportunity costs, such as taking land out of production where it has elevated environmental risk.

- *There are opportunities to increase scale, but it can be more expensive buying out your neighbour, they always want 'top dollar'. And because you've got gullies with rivers, you can only go so big. The cows have to walk reasonable distances as it is, so it's hard to expand too much further.*
- *There is Te Horiere Project catchment group. Before that there was a farmer catchment group probably ten or fifteen years ago, around the time of all the fencing was coming in[144]. It was really good but dropped away as the rules and people changed.*

Most dairy farmers in Marlborough have numerous streams and multiple stock crossings that are connected to the farms network of lanes and races[145]. There are examples of dairy farmers who have put in riparian planting, such as one or two rows of flaxes, and mixed in cabbage trees, Rimu and other natives. Such plantings may be three to five metres depending on the topography. Also, some have taken off the corners of paddocks (i.e., 10-metre by 20-metre areas) and put in more substantial planting to create shade for the cows. There are also riverbank plantings of poplar poles to manage bank erosion, especially since floods in recent years.

The farmer interviewed described their situation:

- *We usually get a flood almost yearly, or once every two years we'll get a decent flood that goes over the banks. We've got a terraced farm along the banks of the river and most of the paddocks will go under – it's only for a day or two but obviously we have to pull the cows out of there and make sure they're safe. We're trying to stabilise the riverbank as much as we can, but we've had to move the fences back five or ten metres the last couple of years. It definitely takes out a bit of land.*

143 This requirement is more stringent than the 190 kg N/ha/yr synthetic nitrogen cap in the Resource Management (National Environmental Standards for Freshwater) Regulations 2020.

144 https://www.dairynz.co.nz/regulation/policy/sustainable-dairying-water-accord/

145 More information is available at: https://www.dairynz.co.nz/milking/tracks/

When asked if there are opportunities for farmers to get together to talk and learn from each other locally, a farmer interviewed said:

- *Yes, there is, but one of the things is that there's too much talk. Like when Te Hoiere Project was starting up, it took two years before any funding to come through from Central Government. You can't talk for two years and just not do anything.*
- *The main thing is the DairyNZ discussion groups – they're probably the biggest thing for us. There is also the Beef and Lamb equivalent. There's a bit of a difference between dairy and sheep and beef because we've done all this stock exclusion years ago[146], whereas they're playing catch-up. Sheep and beef farmers have got massive financial pressure as well at the moment.*

The farmer also commented that there is a bit of "put it on the shelf and get it out when you have to", with regard to local farmers' use of Fonterra Farm Environment Plans[147]. Their final comment was:

- *One of the big things that has helped us dairy farmers is already having all the waterways fenced off, and obviously people were doing riparian planting. We've put in dung beetles as well as part of the Te Hoiere Project. Many farmers are trying to improve their environmental footprint as best they can. The solutions need to be collaborative, rather than legislative.*

Based on the results of similar research for other regions[148], each dairy farmer in Marlborough can be expected to have their own set of circumstances and so their experience of the impacts of future freshwater management is likely to be specific to them. This said, there are a range of risk factors that may influence such impacts on a farm business. Such factors include (in no particular order):

- Levels of debt and/or cashflow, and so ability to borrow for investment;
- Farmer age and stage in farming career;
- A farmer's management skill;
- A farm's size and any opportunities (or not) for economies of scale;
- Age, design, location, and capacity of existing farm infrastructure;
- A farm's waterways (including wetlands) as well as its topography and soil drainage;
- Level of compliance with existing policy requirements; and
- The duration and timing of consents.

Dairy farming in Marlborough, however, clearly has important features that set it apart from the industry in other regions of the South Island, particularly Canterbury, Otago and Southland. These features means that any impacts from freshwater management may well differ from elsewhere at both farm business and industry scales.

146 https://www.dairynz.co.nz/regulation/policy/sustainable-dairying-water-accord/

147 This comment reinforces similar research for Taranaki (Moran *et al.*, 2024) where farmers interviewed were of the view that farm environment plans tended to sit in the background. They had put in place some of the actions, such as pond calculations and water metres. In that research farmers made a connection between implementing actions and the timing of their consents.

148 For example, Newman (2019); Moran, McDonald, & McKay (2022a); Ross, Cooper, & Chikazhe (2023); and Moran, McDonald, & McKay (2024).

5 Horticulture

This chapter focuses on fruit and vegetable growing. It draws on an interview with a sector expert as well as publicly available information from Stats NZ, the United Fresh publication series Fresh Facts, and a literature review. Detailed data for each of the numerous industries within horticulture in Marlborough was not available in the same way as it was for agriculture. As well, many industries within the sector are now only represented by a handful of growers in the region, making this chapter simultaneously multi-dimensional and individually specific. Viticulture (the cultivation of grapes for wine production) is covered in the next chapter.

5.1 Introduction

Horticulture is a complex sector that encompasses a broad range of crops, growing systems, product groups, and industries, many of which can occur either outdoors and/or indoors[149]. A range of factors influence whether a location (and within that a specific site) is suitable for horticultural use, and this suitability often depends on the crop to be grown. Having growers of the same type of crop in different regions, as well as growers using different crop varieties, extends the growing seasons of various fresh fruit and vegetables for consumers.

On this topic, the technical expert interviewed gave the following explanation:

- *Growing conditions vary across New Zealand. Some regions are more well suited to growing particular crops commercially than others and regions may supply markets with the same crop at different times of the year. For instance, peonies can be grown in Marlborough because it retains frost. The first cherries are available from Hawkes Bay, then Nelson/Marlborough, and finally from Central Otago. Marlborough's horticultural profile in terms of soils and climate has some similarities with Tasman and Central Otago.*

Marlborough, and particularly the Blenheim area, has long been known for its orchards and market gardens, which have primarily supplied produce to the domestic market. A long-time local vegetable grower observed that the quality of the region's fresh water for growing vegetable crops is "second to none and so is its land". The region's horticultural growing hub is located on the lower Wairau Plains, although there are instances of growers in other localities. For example, Waikawa Marae (Picton) have their own māra (garden) and Okiwi Market Gardens (Rai Valley). The growing hub is much smaller than in Nelson but its more central location gives it some importance for freight around the country.

This chapter gives an overview of the range of outdoor and indoor crops grown and their extent in Marlborough. It then outlines the historical context for the horticultural sector in the region. Finally, the chapter turns to freshwater considerations and Good Agricultural Practices (GAP) programmes. The chapter uses as many examples as possible but does not consider any specific type of growing operation in-depth because there are now few examples of each type.

149 In addition, specific product groups represent the interests of commercial growers and there are also broader representations such as Vegetables New Zealand https://www.freshvegetables.co.nz/ and the New Zealand Treegrowers Association; https://treecrops.org.nz/about-treecrops/ Horticulture New Zealand was formed in 2005 from a merger of the New Zealand Fruitgrowers' Federation, the New Zealand Vegetable and Potato Growers Federation, and New Zealand Berryfruit Growers' Federation (https://www.hortnz.co.nz/about-us/). The New Zealand Horticulture Export Authority provides information on product groups such as summerfruit, chestnuts, and walnuts (https://www.hea.co.nz/).

While a crop's total land area is a useful metric, it does not always fully reflect an industry's economic importance because various horticultural crops have differing growing conditions (Roberts, 2022). Some crops tend to take up more land than others and, even within a crop type, the amount of land needed for economic or commercial viability can also depend on the type of growing system, which can be either outdoors or indoors (e.g., strawberries). For example, the Upright Fruiting Offshoots (UFO) method of growing is higher density compared with traditional cherry tree orchards and can influence fruit quality, yields, and production efficiencies (including labour). Similarly, hydroponic operations can achieve high levels of production on a small land area footprint. Some crops may cover a small area but represent a large share of an industry nationally, particularly at certain times of year.

Horticulture is a labour-intensive sector and provides a considerable amount of employment, although levels tend to vary by crop and growing system as well as across a year. Most horticultural businesses are owner-operators and face high workloads. As noted in Chapter 3, the Stats NZ Business Frame records its data 'as of February' so is not necessarily a good fit for horticulture with seasonality changes. For example, the peak season for strawberries and cherries[150] is Christmas and both the crops are largely finished in January.

5.2 Outdoor Crops

In Marlborough, as in other regions around New Zealand, both the number of horticultural growers and the area where fruit and vegetable crops are grown have reduced dramatically since the 1990s[151]. This trend can be attributed to a combination of circumstances, including growth in the power of supermarkets, business succession, competition for land with vineyards, increased urbanisation on horticultural soils, and challenging growing seasons (Roberts, 2022)[152]. Few commercial growers now remain in the region and outdoor crops largely focus on cherries, apples, sweetcorn[153], garlic, and pinenuts. Most of the production from many these crops supply consumers outside of the region[154]. Land scarcity is now an issue for ownership, to lease, or access for short-term crop rotation.

Table 28 uses Stats NZ Agricultural Production Survey data to show the broad range of vegetable, fruit and nut crops that have been grown in Marlborough over the past 20 years as well as other largely ornamental crops (e.g., flowers, foliage, nursery). The crops included in Table 28 are only those for which a specific planted area was recorded in one of the five time periods surveyed (i.e., a result other than zero, suppressed, or confidential). It is possible that other crops were grown in the region that are not identified here but the data were always shown as either suppressed or confidential (e.g., kiwifruit, blackcurrants). A blank blue cell in the table is used where the category was not included in the survey in that year.

150 For example, one cherry orchard provides employment for eight professional pickers at the peak of the season. The grower noted that this was a change from "the old days of dozens of schoolchildren working the orchard".

151 Across the regions, there is a strong shift to fewer, larger fruit farming operations with more employees (MBIE, 2017).

152 For example, Marlborough had a "particularly tough growing season" in 2021-22 with flooding in July and further heavy rainfall in September and October which affected pollination, resulting in the lowest fruit yield in decades and a shortage of cherries in the region (Hellstrom, 2022). It was followed in 2022-23 by the wettest summer growers had experienced in more than 20 years (Fisher, 2023) and then a drought in 2023-24. Seasonal conditions can influence future yields. For instance, the amount of blossom for an orchard crop can depend in part on the conditions in spring the previous year.

153 Sweetcorn and process peas are considered as vegetable crops in a resource management context but their environmental profile is not dissimilar to arable crops (e.g., maize and field peas) (L. Roberts, pers. comm., 2025).

154 For example, the bulk of the Caythorpe crop is sold through wholesale markets in the North Island, and a small amount sold direct to consumers through its website (Hardy, 2022).

Table 28: Area (ha) of horticultural crops grown outdoors (either harvested area or planted area) in Marlborough

Horticultural Crop	2002	2007	2012	2017	2022
Asparagus	C	C	C	1	0
Carrots	60	C	C	92	51
Cauliflower	C	C	C	1	1
Broccoli	C	C	-	7	1
Garlic (not specifically identified after 2002)	178				
Onions	15	0	C	33	22
Peas (fresh and process)	761	676	552	132	6
Green beans	116	C	190	52	25
Sweetcorn	842	778	601	637	322
Potatoes	C	C	2	1	6
Pumpkin	C	C	19	6	0
Leafy vegetables (e.g., spinach, silverbeet, bok choy)	C		C	81	1
Lettuce	C	C	C	0	0
Tomatoes (fresh and process)	4	C	C	0	0
Cooking herbs	C	C	C	1	0
Other vegetables or herbs		174	90	78	0
Apples	211	25	18	21	16
Pears (does not include nashi)	32	16	7	1	0
Peaches	15	2	1	2	0
Apricots	30	10	8	4	0
Nectarines	C	2	C	1	0
Cherries	108	49	56	36	31
Plums	10	4	3	2	3
Feijoas	5	11	8	7	1
Table grapes	28	C	-	0	0
Blueberries	C	2	C	2	2
Boysenberries	C	C	C	1	0
Raspberries	C	C	C	1	1
Strawberries	C	C	C	2	0
Lemons	3	C	-	0	0
Melon (water or rock)	0	0	-	0	1
Olives	449	240	134	50	16
Chestnuts	9	C	C	0	0
Hazelnuts		17	16	3	3
Walnuts	43	9	15	2	5
Other fruit, nut, & edible tree crops[155]	12	39	C	688	439
Flowers & foliage	17	12		4	5
Nursery crops	59	21		9	21
Hops		0		4	S
All other outdoor horticultural crops	47	C		21	19

155 In 2002 this category was split as 'other fruit' and 'other nuts'. In 2007 there was only 'other fruit'.

In showing the changes in the range of crops and the area where they were grown in Marlborough over time, Table 28 highlights the decrease in horticultural production since at least 2002. As a result, Marlborough has become more dependent on other growing areas around the country especially for fresh vegetables and fruit. In 2022 the total outdoor area used to grow vegetables and cooking herbs was 470 hectares. By contrast, the total outdoor area used in 2002 was at least 1,976 hectares – around four times the extent of 2022. The decrease appears to have impacted most outdoor crops (the few exceptions include garlic and pine nuts). The primary market for most vegetable crops is domestic, but growers in New Zealand also produce export crops (e.g., onions) within their rotations for both practical (soil health) and economic reasons (Roberts, 2022).

As a crop, Marlborough's peas[156] have long made a notable contribution to total New Zealand production (e.g., McLintock, 1966). In 2012 process peas and sweetcorn were still important crops in Marlborough (Dymond (Ed.), 2014). The region remained until recently one of four main localities in New Zealand that produced processed vegetables, particularly sweetcorn and peas but also potatoes (the others being Canterbury, Hawkes Bay/Gisborne, Rangitīkei/Manawatu)[157]. When Talleys moved its Marlborough pea processing operations to Ashburton in 2016, the crop was no longer a viable option in the region[158] (Figure 40). In 2022 322 hectares of sweetcorn was grown, a reduction in area of around 62 per cent from 2002.

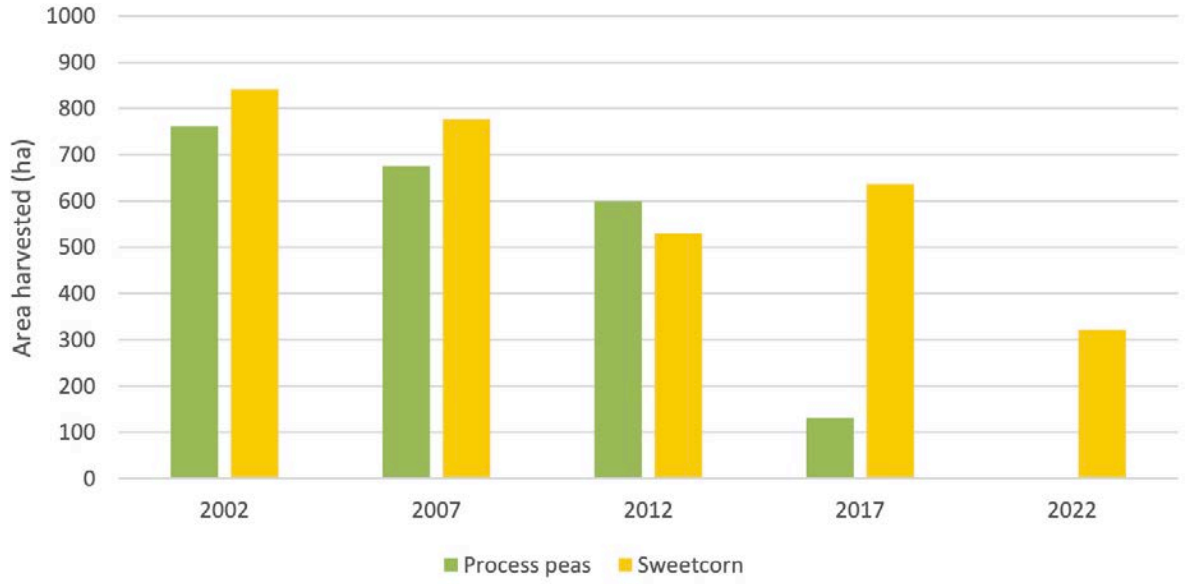


Figure 40: Harvested areas of process peas and sweetcorn in Marlborough from 2002 to 2022
Source data: Stats NZ Agricultural Production Statistics

156 Process peas (or garden peas) are canned or frozen for human consumption. Field / seed peas are grown for both human consumption and livestock feed. Arable farmers can use field peas as a break crop for disease control and soil fertility improvements in cereal rotations.

157 Process Vegetables NZ is the industry body that represents the commercial growers of carrots, sweet corn, peas, beans and beetroot (potatoes are represented by Potatoes NZ Inc). Other minor process crops include kumara, cauliflower and broccoli. *https://www.processvegetables.co.nz/about/*

158 While peas are a valuable part of a crop rotation yields can be temperamental for various reasons (e.g., past herbicide use, weed competition, soil temperature). As well, process peas are one of the most perishable vegetable crops, making it difficult to provide an even flow of raw material of the desired maturity into the processing factory over the planned harvest period. The time limit between start of harvest for a truckload of peas and the end of processing is limited to a maximum of 2.5 to 3.5 hours, depending on temperature. *https://www.agronomysociety.org.nz/files/SP6_14._Processing_peas.pdf*

In 1994, 300 hectares of potatoes and 200 hectares of squash were grown in Marlborough (Stats NZ APS 2002). However, since the Agricultural Production Survey began in 2002 the areas planted in these two crops have been minimal. The area planted in pumpkins peaked in 2012 at 19 hectares but is now largely absent as a crop in the region. In 2017 81 hectares of leafy vegetables (e.g., spinach, silver beet) were grown, as Talleys switched from growing peas to kale on its Seaview farm (near Seddon)[159]. By 2022 there was just one hectare of leafy vegetables[160]. Some minor crops, such as asparagus (grown between at least 2014[161] and 2017) also no longer appear to be evident. Talleys are the main vegetable processor in Marlborough and the plant was recently upgraded with a new boiler fuelled by wood pellets (a renewable waste stream from local timber processing)[162].

Most of the vegetable growers that remain are small businesses. For example, Alistair and Kathryn Dawson are the owners of Spudz N Greens through which they sell fresh produce (e.g., potatoes, brassicas, leafy vegetables, and onions) directly to customers in and around Blenheim[163]. The Dawsons' grow around 30 different crops on three hectares of on fertile silt loam soils that is irrigated with overhead sprinklers (Fisher, 2023). They don't employ staff. "We have some automation, including for preparing the ground, planting seedlings and planting and harvesting potatoes, but our other harvests are by hand" (Fisher, 2023). The production system is designed to maximise the growing area and protect the soil from unnecessary compaction (Fisher, 2023). Challenges to the viability of the business include land use change and inflation, particularly the cost of fertiliser, pest control products, diesel, and the overall cost of living, which affects demand (Fisher, 2023).

In a recent industry magazine article titled "Broccoli may be Blenheim's favourite vegetable" (Fisher, 2023), the Dawsons' commented:

> *If we don't have broccoli to harvest, orders drop off. Potatoes are not as popular as they used to be and with the number of diseases now affecting them, are becoming quite costly to grow… People's money can only stretch so far. We try to keep our prices competitive with those at the supermarket, but the reality is it's getting more expensive to grow vegetables… We are working around the planting of new vines on one block of land we lease… Pest and disease control is getting harder and more costly, especially for small growers like us who have no influence in the industry. Many existing products are being discontinued and new ones are not coming on to replace them.*
>
> ***Edited excerpt from in NZ Grower February 2023***

From 2002 to 2022, the planted area of pipfruit[164] in the region decreased by more than 93 per cent from 243 hectares to 16 hectares[165]. For apples, which is largely an export crop, this decline can be partially explained by uncertainty in the 2000s caused by factors such as the ending of the Apple and Pear Marketing Board's monopoly in 2001 and fluctuating harvests and returns. Some of the apples grown in the region have been used to produce cider by Blenheim-based brewers such as Moa Brewing Company (although almost all of its product is now contracted to McCashin's Brewery in Stoke, Nelson[166]) and the Marlborough Cider Company.

---

159 This property is currently in the process of converting to viticulture use.

160 *https://www.stuff.co.nz/business/farming/86006468/talleys-add-kale-to-healthy-menu-choices*

161 *https://www.facebook.com/exploremarlborough/videos/picking-marlborough-asparagus/1002262886465827/*

162 *https://www.talleys.co.nz/news/carbon-reduction-builds-up-a-head-of-steam-at-talleys-marlborough-plant*

163 *https://spudzngreens.com/*

164 Pipfruit is the common name for pome fruit, such as apples and pears. Commercial pipfruit growers are represented by New Zealand Apples and Pears: https://www.applesandpears.nz/

165 Following a poor apple harvest in 2004-05, the value of New Zealand's apple exports climbed from around $350 million in 2012 to $900 million in 2020. The value of New Zealand's pears has sat fairly consistently between $8 million and $11 million since 2009, with the exception of a drop in 2012.

166 *https://businessdesk.co.nz/article/the-life/moa-is-back-from-the-brink-of-extinction*

Marlborough is a secondary region for summerfruit (the main producing regions being Hawkes Bay and Central Otago)[167] and very little of the region's output is processed commercially. Yet from 2002 to 2022 the planted area of summerfruit[168] area decreased from at least 163 hectares to 34 hectares. The combination of the Global Financial Crisis and weather conditions in the three years following (e.g., a string of frosts and a hailstorm) reduced market prices and yields respectively, proving challenging for growers. Until recently, apricots (as well as nectarines and peaches) were largely grown by Primac Horticulture (Renwick), Birch Grove Orchard (Spring Creek), and Pauls Road Orchard (Rapaura)[169]. Little (if any) apricots, nectarines, or peaches are grown commercially now in Marlborough. Several varieties of plums (as well as quinces) are still grown by Windsong Orchard.

As with other types of summerfruit, the area used to grow cherry trees has also decreased markedly and in 2022 the extent was just 29 per cent of that twenty years earlier. Not all this reduction in area has necessarily resulted in less production where new growing systems are being adopted. For example, by 2013 Kiwi Cherries (Rapaura) had reduced the orchard area from 11 hectares to 2.5 hectares with no loss of crop by shifting to a 2D growing system (e.g., UFO) where trees are espaliered on crop support structures, such as trellises, that place cherries within easy reach of pickers[170]. The use of plastic cherry covering also saved fruit from more extensive weather damage. The need for rain protection for cherries depends in part on the crop variety and growing system used (Hardy, 2022)[171].

Other examples of cherry growers include Cherrybank Orchard (Spring Creek) and Caythorpe Family Estate (Springlands). Cherrybank Orchard is a nine to ten hectare property (including the packhouse) that has around 8,000 trees with at least three main varieties[172]. Through the three-week harvest the orchard employs between 70 and 80 workers – roughly half are locals and half are on working holiday visas (Hardy, 2022). Caythorpe Family Estate includes a four hectare cherry orchard[173] along with a large vineyard and land used for stock and hay (Hardy, 2022). In a good year the cherry crop can return five times the value of grapes on a per hectare basis (Hardy, 2022)[174]. Like Kiwi Cherries, both growers are in the process of converting some or all of their plantings to a 2D growing system and installing rain protection between the rows of trees (Hardy, 2022). The growers anticipate that the new growing system will set the orchards up for mechanisation in the future (Hardy, 2022).

---

167 The Wairau (a large, early variety of apricot developed by the Marlborough Research Centre) was able to fetch premium prices by entering the market before apricots from many other regions *https://www.stuff.co.nz/marlborough-express/6165432/Late-apricot-harvest-under-way*

168 Summerfruit is the term used in New Zealand to collectively describe what used to be known as stone fruit: apricots, peaches, plums, nectarines, and cherries. Summerfruit New Zealand is the industry body that represents the commercial summerfruit growers *https://www.summerfruitnz.co.nz/*

169 *https://www.stuff.co.nz/marlborough-express/business/8153010/Weather-blamed-for-poor-apricot-season*. Apricots are one of the earliest flowering fruit tree species and so can be particularly vulnerable to frosts.

170 *https://www.stuff.co.nz/marlborough-express/editors-picks/9372248/Cherries-ahead-of-schedule*

171 Rain leaves water sitting around the stem of the cherries, which leads to split fruit with a limited shelf life, and it is also taken up through the trees' roots making the cherries softer and prone to splitting. Cherry varieties such as Stella are softer and so more at risk than others. Common forms of weather protection in Marlborough are netting and shade cloth.

172 *https://www.mggroup.co.nz/news/news/passing-on-the/*

173 Caythorpe Family Estate was featured on Country Calendar *https://www.tvnz.co.nz/shows/country-calendar/episodes/s2024-e20*

174 Average returns for the cherries are approximately $10 to $15 per kilogram (Hardy, 2022). Conservative estimates put full production of the UFO system at 20 tonnes of fruit per hectare, depending on factors such as pollination which can be fickle in Marlborough if there is not enough winter chilling for fruit buds to become viable (Hardy, 2022).

With the exception of cherries and (to a far lesser extent) apricots, most summerfruit crops grown in New Zealand are consumed domestically[175]. However, only small volumes of Marlborough's cherries are exported. A grower's decisions around whether to supply domestic or export markets in any given year is complex but important considerations are a specific crop's quality (including shelf life) and its timing (both in relation to other producing regions and demand from export markets)[176]. For instance, Kiwi Cherries trialled exports to Japan in the 2010-11 growing season[177] because 1) cold conditions in early spring meant the trees were about 10 days behind schedule, and 2) a large number of trees in Hawke's Bay had matured and increased domestic supply[178].

The expert interviewed commented that:

- *Like Central Otago, Marlborough was well-known for its stone fruit, particularly apricots – it's the chill factor, lovely hot and dry in the summer so you get that temperature difference[179], which contributes to sweetness and firmness. In the past a wide range of crops were grown but it is now limited. There are now just two small growers of apricots focused on farm gate sales. There used to be lots of apples as well. Although there still appears to be a wide range of crops, in many cases there are only one or two growers of each crop. There are roughly six cherry orchards remaining.*

Examples of growers of other outdoor fruit crops include Windsong Orchard, Cherryland, Old Road Estate, and Mangarua Figs Marlborough. The crops grown can include berries, figs, feijoas, and table grapes. The feijoa growers' co-operative, Future Fruit, shifted from Nelson in 2013 when they purchased a summerfruit orchard's packing shed[180]. Most of the co-operative's fruit was sold for processing into cider and wine, and juice and puree for flavouring food. Few citrus fruits are grown in the region other than lemons.

As is described in Section 5.3, the olive industry began in Marlborough in the late 1980s. However, from 2002 to 2007 the area of olives planted in the region halved in the five years from 449 hectares to 240 hectares. By 2009 there were about 25 growers and profitability in olive growing was described around this time as marginal (Pitts, 2011). In 2024 the planted area of olives in Marlborough was 16 hectares, making it one of the smallest olive growing regions in New Zealand. The Olive Press Marlborough, which was established as a community asset in 2020, produces monthly newsletters on local olive growing[181] and Olives New Zealand published a useful overview of the industry nationally in 2019 (Olives NZ, 2019). The Marlborough Returned Services Association produces olive oil from local olives, such as those grown in the Burleigh Memorial Olive Grove near the Taylor River.

---

175 Apricot exports from New Zealand decreased by 70% to $1.1 million in 2022, largely because of an 81% decrease in exports to Australia, the primary market for this country's apricots. The value of apricots exported to other markets has also declined over this reporting period. The average value for apricots in 2022 was $5,179/tonne. By comparison, the value of cherries in the same year was $20,805/tonne. *https://www.hea.co.nz/2012-05-11-03-05-28/summerfruit-trade*

176 A useful profile of the summerfruit exports is available at https://hea.co.nz/2012-05-11-03-05-28/summerfruit-trade

176 Since 2010 exporting cherries to Japan has become easier because the fruit was no longer required to have methyl bromide fumigation.

178 *https://www.stuff.co.nz/marlborough-express/business/rural/4187000/Warmer-weather-welcome*

179 The difference between daytime and night-time temperatures is the diurnal temperature range.

180 *https://www.stuff.co.nz/marlborough-express/editors-picks/8813684/Bumper-crop* More information on feijoas is available at *https://www.feijoa.org.nz/* and *https://www.hortnz.co.nz/assets/News-Events/Magazines/The-Orchardist-April-2022.pdf*

181 *https://www.olivepressmarlborough.co.nz/news* The olive press operated at Riverlands (and possible other locations) for around 20 years. It moved to its current site in 2020 following the sale of the physical press and the loss of the Riverlands shed location. The press went from private ownership to shareholding.

This excerpt illustrates the importance of water during flowering in the olive grove:

> *A profusion of little white flowers is a great start to the season and always looks very hopeful. Following pollination, the petals drop to reveal a developing fruit bud the tree will then perform a 'sieve' function only keeping the healthiest and strongest to develop and grow into olives. Only 2% of flowers will actually develop into olives. Water is also crucial at this time. The tree is busy with a lot of demands on it and that all requires a good nutrient distribution system, hence fluids coursing through the feeding systems. If you irrigate make sure your trees are well watered. If you rely on the heavens then keep your fingers crossed but persistent rain at flowering will wash away that crucial pollen.*
>
> ***Edited excerpt from Olive Press Newsletter November 2024***

Pinoli Premium Pine Nuts, New Zealand's first commercial grower of pine nuts, have at least 550,000 trees planted on 540 hectares of land across two main blocks. Processing pine nuts (technically a seed kernel) is complex[182] and a solar-powered processing facility was built in 2013. In 2023 Andy Wilshire, co-owner of Pinoli, predicted that "We have some new growers, so very shortly, we will have about 800 hectares of pine nut plantations. And from that, we can produce two per cent of the world's Mediterranean pine nut crop because our growing conditions and productivity are so good here."

> *Unlike nut trees such as almond, stone pines don't require irrigation. Sheep graze beneath the trees; no chemicals or herbicides are used on the trees or cones. As pine nuts are an orchard crop, not a forestry crop, trees grow for many decades (100 years) and are not clear-felled like radiata pine. There is no slash nor wilding pine issue. Pickers use a metal crook to knock the green pinecones from branches of younger trees, while larger trees with thicker trunks get a jostle from a mechanised tree-shaker.*
>
> ***Excerpt from Pining for Success (Rawson, 2023)[183]***

Different varieties of chestnuts, hazelnuts, and walnuts are grown in Marlborough for the nuts as well as speciality oils and other value-added products (e.g., chestnut flour)[184]. An example of a nut grower is Uncle Joes Marlborough (Grovetown). Walnuts, in particular, have a long history in the region[185]. Hazelnuts have been grown commercially in New Zealand since the 1980s[186]. The most suitable sites (e.g. not too dry) tend to be outside traditional horticultural areas but issues with yields have constrained industry growth. Chestnuts, walnuts, and hazelnuts are small industries in New Zealand and mostly consist of boutique or hobby growers. While chestnut trees can be grown across much of the country, most walnut and hazelnuts trees tend to be found in Canterbury and Otago. Almonds were also grown in the region but the trees were removed after the property sold.

---

182 First, the green cones are sun-dried to open the scales before the cone is broken in the factory. Then the pine nut kernel is separated from within the tough seed shell without damaging it, a delicate mechanical dance of wetting, drying and shaking. The kernels are then polished, washed and dried again before being sorted and packaged.

183 *https://ourwayoflife.co.nz/pining-for-success-pinoli-takes-home-top-honours-at-the-2023-outstanding-nz-food-producer-awards/*

184 Nut trees (including pine nuts) that are managed as a food crop are currently excluded from Emissions Trading Scheme. *https://www.mpi.govt.nz/forestry/forestry-in-the-emissions-trading-scheme/about-forestry-in-the-emissions-trading-scheme-ets/how-forest-land-is-defined-in-the-ets/*

185 Beverley (2023) records that there used to be an old Blenheim saying "plant a walnut tree and pay your rates".

186 More information is available at https://hazelnut-growers.org.nz/resources/ and https://nzcc.org.nz/app/nzcc

The decrease in berries grown outdoors in Marlborough between 2017 and 2022 is largely as a result of Jones Berry Farm closing (discussed in Section 5.3). However, it has been offset by an increase in berries being grown hydroponically indoors (refer to Section 5.2). Blueberries are grown at Windsong Orchard[187] (Renwick) and Marlborough Blueberries (Woodbourne) grow blueberries and raspberries.

In 2002, there were 17 hectares of flowers grown (including 2 ha of calla lilies and 7 ha of peonies). In 2022 the area of flowers and foliage grown was 5 hectares. During this time specialist flower growers have included the Marlborough Lavender Company, The Pot Shed (growing gerberas), the Protea Patch (proteas, leucadendrons and other hardy, low maintenance plants), Alison's Peonies, and Verve Flowers. Local florists also supply some of their own flowers. There is also the Turf Farm, which grows instant lawn.

The industry expert interviewed noted:

- *Much of the vegetables and herbs produced in Marlborough are consumed locally (i.e., in Marlborough or the Top of the South) or supplement supply elsewhere. There are three growers of vegetables that supply nationally. Around 80% of the NZ grown garlic comes from Marlborough. While some is grown elsewhere the main packhouses are based in this region. Thymebank supplies the lower North Island and whole of the South Island as does Kinzetts tomatoes. The cherries are predominantly for the domestic market and are generally finished around Christmas. Marlborough is down to a handful of growers and they all supply the domestic market, so that's concerning, but the bigger issue is the vulnerabilities it creates for the region – that lack of diversity.*

5.3 Indoor Crops

Greenhouses (i.e., covered cropping) are indoor growing systems that, often in combination with specific growing techniques (e.g., CO_2 enrichment, soil-less cultivation, and heating) help to extend the availability of seasonal fresh produce to meet consumer demand (HortNZ, 2023). There are an estimated 310 hectares (3.1 million m^2) of food-producing greenhouses in New Zealand used to grow more than 90 per cent of the fresh tomatoes, capsicums, and cucumbers, as well as numerous other crops (HortNZ, 2023). Horticulture New Zealand has estimated there were six growers in Marlborough with commercial greenhouses (HortNZ, 2023) and none are large-scale for New Zealand (i.e., more than 5 hectares). However, scale differs in the South Island context: the smallest 'medium' size grower is around 5,500 m^2 and the largest indoor vegetable growing operations are between two and five hectares (L. Roberts, pers. comm., 2025).

Table 29 uses Stats NZ Agricultural Production Survey data to show the range of vegetable and herbs that have been grown indoors in Marlborough since 2002 as well as other largely ornamental crops (e.g., flowers, foliage, nursery). Indoor crops have seen similar trends over recent years to those for outdoor crops. In 2022 the total area reported for all indoor horticultural crops grown in Marlborough was 30,350 m^2 (roughly 3 ha), which was a 68 per cent decrease from the 94,247 m^2 reported in 2017 (25,086 m^2 of this area was nursery crops). Crops such as capsicum and mushrooms do not appear in the regional data over this 20-year period. For comparison, the total covered area for horticultural crops in 2002 was 65,909 m^2.

187 More information on blueberries is available at https://blueberriesnz.co.nz/who-we-are/

The accuracy of some data in Table 29 may be uncertain as locally supplied area estimates for 2025 are as follows: tomatoes 20,000 to 30,000 m^2, leafy greens and herbs 12,000 m^2, cucumbers and raspberries 3,000 m^2, and strawberries 15,000 m^2. It is also unclear how strawberries grown indoors are reported in the Stats NZ Agricultural Production Survey

Table 29: Area (m^2) of horticultural crops grown indoors and ornamental crops in Marlborough

Horticultural Crop	2002	2007	2012	2017	2022
Cucumber	5,700	C	-	55	110
Lettuce / salad greens		C	C	13,909	3,588
Tomatoes	C	C	C	18,602	18,877
Cooking herbs		C	C	11,580	3,256
All other vegetables and herbs		C	-	17,984	3,748
Flower bulb, corm, and tubers	C	C		3,587	0
Flowers & foliage for cut production		0		1,236	0
Nursery crops	1,632	C		25,086	771
All other indoor crops not previously specified				2,208	0

Table 29 (above) identifies that more than half of the area of indoor crops in Marlborough is used for tomatoes. With around two hectares of glasshouses, a major producer of this crop in Marlborough is Kinzett Tomatoes[188]. The business uses hydroponics and concentrates on winter production when there are higher prices. It also has diversified over time by growing cherries (since 1983) and wine grapes[189]. The seasonal fluctuations in tomato prices are highlighted in Figure 41. However, even the higher prices in winter may not be sufficient to cover the increasing costs of production facing growers (Cohen, 2022). TomatoesNZ recently published a document focused on the four main issues currently facing tomato growers: decarbonising (notably greenhouse heating), increasing costs of production, regulations that allow businesses the flexibility to foster growth, and biosecurity risks (e.g., those related to online sales of seeds) (Cohen, 2022). These issues are likely to be in common with many other industries in the horticultural sector.

188 A video of the business is available at *https://www.youtube.com/watch?v=1IECo_oQYvE* and a description of the growing system as it was in 2012 at *https://www.ruraldelivery.net.nz/posts/Kinzett-Cherries-Tomatoes-and-Grapes-2017-04-05-22-11-06Z#:~:text=The%20Kinzett%20family%20have%20over,grape%20growing%20and%20cherry%20growing*

189 Third-generation grower Paul Kinzett was recognised by Lincoln University Alumni as an early adopter and developer of innovative production and management systems for high-value greenhouse tomato and cherry crops. An example was the growing of dwarf cherry trees in pots and transferring into a greenhouse for fruiting to provide the Japanese market with high quality cherries (Nichols, 2020).

Figure 41: Monthly tomato price fluctuations from January 2020 to August 2022
Source: New Zealand Grower October 2022

Other hydroponic growers in Marlborough include Thymebank (Springlands), Golden Mile Produce (Spring Creek), and Hedgerows Hydroponic Strawberry Farm (Springlands). An important reason that the hydroponic system is used is because it is far more water-efficient than soil-grown crops.

- Thymebank is located on just under three hectares of land (with a hydroponic area of 6,000 m^2) and produces fresh herb and salad greens (around 20,000 lettuces a week). The produce is packed on site and supplied to wholesalers, retailers, food service nationally (MBIE, 2017).
- Golden Mile Produce is also just under three hectares of land and grow 14 seasonal fruit and vegetable crops throughout the year (Woodworth, 2024), such as strawberries, raspberries, potatoes, asian greens, courgettes, and melons. The strawberries are produced from 30,000

plants that are grown using a nutrient film technique[190] and occupy about two-thirds of the 3,300 m^2 indoor space (Woodworth, 2024). The produce is sold on site through Sal's Shed as well as via local supermarkets, restaurants, and markets. Golden Mile Produce also hosts the Olive Press while it is in use for eight weeks during winter (refer to Section 5.1).

- Hedgerows Hydroponic Strawberry Farm is on a one-hectare property and grows 70,000 plants in glasshouses covering just under 5,000 m^2 (in 2002 12,000 plants were grown in a polyplastic house)[191]. The business also produces products such as iceblocks, icecream, and protein shakes and sells through local outlets including its farm shop and markets[192].

Okiwi Market Gardens (Okiwi Bay, north of Rai Valley) grows crops (e.g., spring onions and salad greens) indoors and outdoors. They specialise in nutritionally dense, low carbohydrate vegetables that are sold at local outlets (e.g., in Rai Valley and Pelorus Bridge).

The total area of 'other indoor horticultural crops' (e.g., cut flowers, cut foliage, nursery plants) peaked in 2017 at 32,117 m^2, with 78 per cent of this area being nursery crops. Examples of nurseries in Marlborough include Marlborough Nursery, Morgans Road Nursery, Gray Floral Nursery and Garden Centre, Landscape Marlborough. Ormond Nursery (Grovetown) has specialised in propagating grafted grape plants for vineyards for 40 years and is one of four members of NZ Viticultural Nursery Association[193]. There are also nurseries that propagating and growing native trees, such as Wild about Natives.

Image 37: Hydroponic and spray-free lettuces grown indoors

190 Videos on this specific growing operation are currently available on Facebook. More information on nutrient film strawberries can be found at *https://hydroponicsystems.eu/guide-of-hydroponic-strawberry-farming/*

191 *https://www.stuff.co.nz/business/122872520/new-strawberry-farm-owners-promise-to-make-previous-owners-proud*

192 *https://www.pressreader.com/new-zealand/marlborough-express/20220909/281517934955417*; *https://www.stuff.co.nz/business/122872520/new-strawberry-farm-owners-promise-to-make-previous-owners-proud*

193 *https://www.vina.co.nz/#features*

5.4 Historical Context[194]

Horticulture has a long history in and around Blenheim. Its close connections to the local community, through income, employment, and the supply of a wide range of fresh fruit and vegetables, are an important part of the region's character. For example, the tradition of 'pick your own' fruit has been a popular activity over generations. The growing hub's main features have been the capacity for a broad range of high-quality crops to be grown and a dependence on water availability to maintain crop quality and yields.

From the late nineteenth century Blenheim had a small but steady community of Chinese market gardeners who cropped on small pieces of leased land within the city boundary (e.g., by the Taylor River between Monro and Dillon Streets, and on Hutcheson Street by Pollard Park) (Kee & Lam, 2012). As well as supplying the locals, the Chinese gardeners also shipped vegetables across Cook Strait to Wellington (Kee & Lam, 2012). Another notable early grower, particularly of greenhouse tomatoes, was Hedley Kinzett on Old Renwick Road (Springlands) who established a multi-generational business that still exists today in the same location.

Between 1908 and 1910, Marlborough's first large-scale commercial orchard subdivision occurred known as the Wairau Orchard Lands (Wardle, 1991) (in the vicinity of what is now the Vines Village). Around 600 acres (243 ha) of land on Rapaura Road was cleared of scrub, ploughed, and fenced as 28 blocks ranging from 10 to 33 acres (Wardle, 1991). By the end of World War I apples were being exported, mainly to the United Kingdom (Wardle, 1991) (e.g., 5,000 cases of apples in 1922 (Beverley, 2023)). Each orchard block was independently run with its own packing shed and in competition with each other and without tractors, mobile spray units, or automatic irrigation systems, orcharding was time consuming and labour intensive (Wardle, 1991). The rows between trees were not planted down in grass until the 1950s when irrigation made this possible (Wardle, 1991). Longstanding family orchardists who planted trees in the original subdivision included the Ivorys, Doggetts, Glennies, Craggs, Emmanuels, Shipleys, Harpers, and Saunders.

Image 38: Apple-growing in the Marlbrough Provnce: Gathering the fruit in a large orchard. Originally published in the Auckland Weekly News 15 May 1919.
Source: Auckland Libraries Heritage Collections (AWNS-19190515-32-02) - photographer A J McCusker

194 Figures for 1989 and earlier may include horticultural activities in Kaikōura.

By the early 1960s, there were upward of 500 acres (200 ha) of orchards and 90 per cent of the area was concentrated on the stony soils of the Rapaura area (Beggs, 1962). Apples made up about 80 per cent of the total crop (have grown markedly over the previous decade), the remainder being mainly pears, peaches, and cherries (Beggs, 1962). Up until around 1970, the Ivorys were Marlborough's only commercial producer of cherries and in the late 1960s, together with a Blenheim engineer Gordon Cuddon, they developed an irrigation system using over-tree sprinklers for apple trees and under-tree sprinklers for cherry trees (Wardle, 1991). An increase in plantings of cherries in the 1970s led to an oversupply of domestic markets and new export markets were developed (Wardle, 1991).

In the 1960s the market garden area producing fresh vegetables and berry fruits was static to declining, but the area in vegetable crops grown for processing had increased markedly (Beggs, 1962). Blenheim was also the earliest producer of glasshouse tomatoes each year in the South Island (Beggs, 1962). Specific consignments exported from Blenheim to London during the 1960s included 33 trays of Wiggins peaches by one grower and 400 lb of asparagus by another (Beverley, 2023)[195].

Pipfruit, mainly apples, continued its steady growth into the 1970s as existing orchards gradually expanded. Pipfruit was held in cool stores at the New Zealand Apple and Pear Marketing Board's depot at Spring Creek for inspection and subsequent distribution either within New Zealand or export (Duckworth *et al.*, 1976). At the industry's peak in the 1990s there were 189 orchards in the region growing apples. An over-supply of apples globally together with the rapid expansion of viticulture in Marlborough contributed to the decline of apple-growing (Harper, 2011).

Table 30 shows the extent of pipfruit and summerfruit in the 1970s. In total there were 49 registered orchards at the time and all but three were less than 20 hectares in size. Increased planting of cherries meant summerfruit occupied almost three times the area in 1973 as it did in 1968. Cherries were exported to Japan up until the mid-1990s when growers stopped the trade because the fumigation process that the Japanese required was spoiling the fruit[196]. There were few market gardens as such, with most vegetables grown as part of a farm rotation, but the output was sizeable. A wide variety of vegetable and flower seed was being produced (mostly for export)[197] (Marlborough County Council, 1982).

Table 30: Plantings and production for Pipfruit and Summerfruit in 1975

Crop	Total trees	Area (ha)	Share of New Zealand area	Production (6-year average) Bushels
Apples	80,697	201	3.9%	227,000
Pears	2,114	5	1.0%	5,000
Apricots	2,906	7	1.2%	N.A.
Peaches	5,031	14	1.4%	7,500
Plums (Japanese)	1,691	5	1.4%	2,000
Cherries	25,300	57	50.8%	9,000

Source: Duckworth et al., (1976) (original data source: Ministry of Agriculture and Fisheries)[198]

195 The United Kingdom was New Zealand's most important export market until the former joined the European Economic Community (also known as the European Common Market) in 1973.

196 https://www.rnz.co.nz/news/rural/64097/marlborough-cherries-being-sent-to-japan; https://caythorpe.nz/pages/our-story

197 McKay (2008) gives a useful overview of the development and importance of New Zealand's vegetable seed industry.

198 Duckworth *et al.* (1976: p146) noted that "European plums and nectarines are of little significance at present, although some of the newer nectarine varieties are attracting attention."

Table 31 gives the extent of vegetable growing in Marlborough in the mid-1970s. Around this time a few growers, such as Murray Bishell (Caythorpe Family Estate), were starting to use irrigation on process vegetable crops[199]. Practically all glasshouse properties were used for tomato production although cucumbers and beans were also grown, mainly as catch crops (Duckworth *et al*., 1976). The area of glasshouse crops in 1975 was 3.1 hectares as well as two glasshouses for cut flower production (chrysanthemums and carnations) (Duckworth *et al*., 1976). Lasting examples of early indoor vegetable growers are Thymebank, which has now been operating for at least 35 years, followed by the Marlborough Salad Factory (now Golden Mile Produce) (L. Roberts, pers. comm., 2025).

Table 31: Vegetable area planted and production 1974/75

Crop	**Total trees**	**Area (ha)**	**Share of New Zealand area**
Crop	Planted area	Share of New Zealand area	Weight (tonnes)
Asparagus	6.0	0.7%	23
Cabbages	3.0	0.2%	105
Carrots	3.0	0.2%	70
Cauliflowers	5.0	0.3%	79
Celery	0.5	0.4%	15
Lettuces	3.0	0.3%	63
Onions	10.0	0.6%	173
Parsnips	0.5	0.1%	9
Peas	711.0	8.4%	2,558
Sweet corn	12.0	0.5%	94
Tomatoes	3.0	0.3%	76
Pumpkins	39.0	N.A.	1,010

Source: Duckworth et al., (1976) (original data source: Ministry of Agriculture and Fisheries)

Not included in Table 31 (above) is garlic: about 80 hectares was planted for the 1975/76 growing season the area planted varied from year to year (Duckworth *et al*., 1976). The Murphy family started growing garlic and shallots in the early 1960s and other growers soon followed. In the 1970s almost all of New Zealand's garlic production was based around Blenheim and most of the crop was exported to the Pacific Islands and Australia as "local demand is increasing, but it is still rather limited" (Duckworth *et al*., 1976: p149). Around this time there were at least 20 commercial growers of garlic in Marlborough[200].

The area of berry fruit commercially grown in the 1970s was around nine hectares, and largely focused on boysenberries, strawberries, and raspberries. A long-term grower in the region was Jones Berry Fruits, which was established on Old Renwick Road in 1972 and operated for 45 years until 2017 growing the berry fruits as well as cherries. Jones Berry Fruits originally grew strawberries in soil but later changed to a basic hydroponic system of long tubes (filled with coconut fibre) on boards supported by poles, which

199 https://caythorpe.nz/pages/our-story. Market gardeners and farmers in the lower Wairau area east of State Highway 1 have used irrigation since the 1950s although its scale was somewhat limited by the technology available (Davidson & Wilson, 2011). A common form of irrigation supply at the time was to drill a well to the appropriate depth and use the resulting natural artesian flow to fill ditches from which the water was pumped for irrigation anywhere on the farm (Davidson & Wilson, 2011).

200 https://www.garlic.co.nz/pages/about

anecdotally reduced the crop's flavour. The boysenberries were grown along wires to keep them off the ground. At the point of farm succession and with aging infrastructure, the property was sold in 2019 for development as part of the Summerset Blenheim Retirement Village.

Commercial olive growing in New Zealand began in the late 1980s with the import of 250 trees from Israel to Blenheim, which were soon followed by European varieties from the International Olive Collection in Spain as well as cultivars from Australia (Grzelewski, 2009; Olives NZ, 2019)[201]. Nurseries in and around Grovetown and Renwick formed the basis of the New Zealand olive industry. Up until 2005 the bulk of New Zealand's olive oil was grown in the region and although the output was high quality the yield was low and the extent of plantings declined with the rapid expansion of vineyards. By 2019 there were a total of 7,873 commercial olive trees in Marlborough (the total for New Zealand was 400,000 trees) (Olives NZ, 2019).

Another mediterranean crop developed in the region was pine nuts, despite scientific research questioning its industry potential in New Zealand (e.g., Ledgard, 1995). Pinoli began planting Italian Stone Pine (Pinus pinea L.) on its first block near Renwick in the Wairau Valley in 1998 and on the second bock near Cape Campbell in the Awatere Valley in 2011. As with other orchard crops it was a longer-term investment, as it takes a tree six years to produce its first cones and the crop is harvestable in eight to 10 years[202]. Stone pine has the best mineral profile of seven pinus species grown in New Zealand and the environment in Marlborough is conducive to growing quality products (Vanhanen & Savage, 2013)[203].

During the 1990s, changes in the wholesale fresh produce market, as a result of changes in government policy and developments in the supermarket and grocery store industry, increased pressure on fruit and vegetable growers. Up until the late 1980s the standard way for grocery retailers to acquire the fruits and vegetables they wanted to on-sell was to buy produce at wholesale markets, and typically at auction (United Fresh New Zealand, 2021). Since then, closer economic ties with Australia and deregulation, together with supermarkets demands for consistency and economies of scale[204] led to a mix of private treaty and direct grower supply. In Marlborough, the full wholesale vegetable market ended as supermarkets required growers to use a central distribution hub in Christchurch.

Over the summer of 2003/04 a paddock-by-paddock study of Spring Creek, Lower Wairau, and Dillons Point was undertaken to determine the crops being grown, estimate their water use, and future trends (Neal, 2004). The total area covered just over 6,600 hectares (79% of which was farmed) and held some of the best soils, especially for cropping, vegetable production, and small seeds[205]. Horticultural crops

---

201 A 1985 government report (authored by Nick Ursin) identified the potential for commercial olive growing as a possible additional land use. In 1996, the government supported the creation of *Olives New Zealand*, an association of olive growers, millers, distributors and experts. The Australian & New Zealand Olivegrower & Processor publication is also a key source of industry information for the Australasian region.

202 Pinus pinea trees hold three years' worth of cones on the tree simultaneously, but when the trees are shaken, only the mature fall. Generally, a tree will produce a heavy (mast) crop every three years. There are, on average, 120 kernels per cone. *https://ourwayoflife.co.nz/pining-for-success-pinoli-takes-home-top-honours-at-the-2023-outstanding-nz-food-producer-awards/*

203 The authors compared their results to published data from six different countries. Marlborough's sunshine hours are comparable to those of the Mediterranean and cited features of its loess were 'fertility, low organic matter and high cation exchange capacity, which enables efficient absorption of nutrients by the trees".

204 In its submission on the Commerce Commission's Market Study into the Grocery Sector, United Fresh New Zealand noted as a driver of these changes, "the realisation by some supermarket operators that the auction system was no longer in a position to be a reliable supplier of volume, quality, and price to the consistency level modern consumers had grown accustomed to, as their direct connection with the land disappeared by way of generational change. A supporting driver here was the level of economies of scale supermarkets had reached in terms of their fresh produce volume requirements and the need for the above-mentioned consistency." *https://comcom.govt.nz/__data/assets/pdf_file/0032/265784/United-Fresh-New-Zealand-Inc.-Submission-on-Market-study-into-grocery-sector-draft-report-24-August-2021.pdf*

205 The main soil types in the study area were Kaiapoi silt loams and heavier Motukarara soils. These soils are generally deep, extending below two metres and particularly the Motukarara soils have a characteristic of very high soil moisture holding capacities and potentially poor drainage during the winter months.

included vegetables, apples, olives, and flowers, and covered 192 hectares (just under 3% of the total area). Viticulture was already one-quarter of the total area and it was anticipated at the time that "large tracts of land that could well change land use" in the future (Neal, 2004).

In a media interview[206] in 2003, Murray Neal (Marlborough Fruit Growers' Association president) explained that:

> *Many orchards had been pulled down, ploughed up and burned this winter. Every year for the last five years there has been a significant removal, which was disappointing for those who stayed in the industry because the infrastructure reduced as the number of orchards decreased. It was not necessarily the value of the crop that made people turn to grapes, but the value of the land. The offers are just too good. People would be silly not to take the values being offered. It is setting people up for life. Marlborough's warming winters have added injury to insult for orchardists, who need winter chilling at temperatures below 5˚C to initiate fruit buds. However, fruit grew exceptionally well in Marlborough and would eventually make a comeback.*

5.5 Freshwater Considerations

The broad range of indoor and outdoor crops in Tables 28 and 29 (Sections 5.2 and 5.3) and their various production systems highlight just some of the complexity within horticulture. This complexity makes it challenging to characterise the sector for freshwater management. Each crop has its own lifecycle and demands for nutrients, temperature, and water (that all vary at different growth stages), as well as needs for space. Other than some berry fruits (e.g., strawberries), fruit and nut crops tend to be perennials while vegetables are largely annuals that are usually grown in grower-specific crop rotations. The tables also show the flexibility needed by horticultural growers over time to respond to shifts in market demand.

Whether a crop is annual or perennial influences cultivation and so risk of sediment losses, demand for fertiliser and water inputs, as well as any opportunities for change within a production system. For example, vegetable crops generally have high fertiliser inputs because their sparse root systems in the early stages of growth are inefficient at recovering applied fertiliser (Menneer, Ledgard, & Gillingham, 2004)[207]. Annuals can be particularly vulnerable to water restrictions because they are shallow rooting, whereas insufficient water for perennial crops can threaten their root stock survival. If a crop's demand for fertiliser and water is unable to be met, particularly at critical times, then it is likely to reduce its eventual marketable yield (one that is a grown to certain standards and specifications).

Each grower's situation is unique, with their own mix of crops, growing systems, and size of operation. This uniqueness means that the experience of the impacts of freshwater management will vary from one grower to another. Possible impacts have been tested in research for other regions for both vegetable and orchard growing operations. Research examples include:

- Vegetable cropping and orcharding in the Bay of Plenty (Meneer *et al*., 2004);
- An extensive rotation of vegetables (potatoes, onions, carrots, and squash) with some arable crops, a more intensive rotation of vegetables (squash, broccoli, lettuce, and onions) with some arable crops, and a traditional market garden in Pukekohe (Waikato) (2014);

206 *https://www.nzherald.co.nz/nz/marlborough-orchards-go-as-grapes-take-over/G6SPVJNLMG4US55C54VZCSQIZM/*

207 Horticulture New Zealand has published a useful manual on the nutrition of 15 vegetable crops (Reid & Morton, 2019). There are also tools, such as the "Don't Muddy the Water" Erosion Calculator (a mobile phone application).

- Reductions in the use of nitrogen fertiliser were modelled on 12 to 13-year carrot, parsnip, and tulip rotations in Southland (Moran *et al*., 2017);

- A wider range of actions for nitrogen and phosphorus, sediment, and irrigation restrictions were modelled for pipfruit, kiwifruit, summerfruit (mostly peaches), grapes, and vegetables (squash, brown onions, peas, beans, and sweetcorn) on the Heretaunga Plains in the Hawkes Bay (Archer & Brookes, 2018); and

- Reductions in water availability were modelled for vegetables (winter brassicas and lettuces), pipfruit, mixed orchard, traditional cherries, and UFO cherries in Otago (Roberts & Robertson, 2023). Also considered in this research were the impacts on growing operations of short-term consents for water takes and root stock survival water for orchard crops.

Research is also underway in other regions, such as Manawatū-Whanganui. The Otago research is likely to be particularly relevant to horticulture in Marlborough because of the many similarities in climate and crops grown (Roberts, pers. comm., 2024). An additional consideration is the rapidly increasing costs of food production, particularly fertiliser, transportation, and labour. For example, the price of specialist compound fertilisers commonly used by vegetable growers and growers of other high value crops more than doubled in price between 2020 and 2022 (Boom, 2022).

Access to water and irrigation are important aspects of any horticultural operation (Roberts, 2022)[208]. Water gives the flexibility that many growers need in their production systems to achieve a marketable yield on an ongoing basis. The importance of water was illustrated by a recent study[209] that assessed the potential for horticulture in Ward. The study found that if irrigation water was available then an area of up to 2,000 hectares may be suitable for horticultural crops such as apples, kiwifruit, wine grapes, blueberries, avocados, hazelnuts and walnuts, hops[210], hemp and cannabidiol cannabis, and olives (Ward & Clothier, 2020). Irrigation is used to maintain optimum soil moisture levels for crops to thrive and most growing operations will have irrigation systems in place that best meet the needs of their specific crops[211] (Roberts, 2022).

Many of the horticultural operations that remain in Marlborough are relatively low intensity, particularly those focused on orchard crops, or their nutrient losses are managed through a greenhouse code of practice[212]. The main factors influencing nitrate leaching in intensively managed outdoor vegetable cropping systems (i.e., market gardening) are high nitrogen use (fertiliser and manure), frequent cultivation, relatively short periods of plant growth, low nutrient use efficiency by many vegetable crops, and crop residues remaining after harvest (Di and Cameron, 2002a). The Sustainable Vegetable Systems Project is improving knowledge, practices, and technologies, including development of a nitrogen balance tool to support growers' decisions around fertiliser use[213].

---

208 Even when access to water exists for irrigation there can be challenges. For example, in 2019 water takes to fight large fires in Waimea and Moutere areas of Tasman District compounded the impacts of an existing drought for vegetable growers.

209 B+LNZ commissioned the research (as a desktop exercise) as a follow-on from a post-Kaikōura Earthquake Farming Project. At the time, a Flaxbourne Community Irrigation Scheme was a possibility and sheep and beef farmers were interested in options for diversifying. The viability of this irrigation scheme in the future is partly dependent on the outcomes of the NPSFM 2020 process.

210 The authors noted (p19) that "Ward is significantly windier than both Motueka and Blenheim, so significant wind protection, or mitigation, would be needed for hops to be feasible. We consider that the Ward area is marginal for hop growing, primarily because of its windiness."

211 Just as underwatering can negatively impact a plant's growth, so can overwatering. Overwatering can cause leaching of nutrients and anaerobic soil activity that limits root growth.

212 *https://www.hortnz.co.nz/assets/Compliance/CoP-Managing-GH-Nutrient-Discharges-2nd-edition.pdf*

213 *https://potatoesnz.co.nz/innovation/sustainable-vegetable-systems-svs-tool/*

5.6 Good Agricultural Practice (GAP)

A grower aims to get a sufficient yield from their plantings that the market will accept and is profitable. If a grower's produce does not meet its primary market then there are few secondary markets available in New Zealand. Over 90 per cent of New Zealand's commercial fruit and vegetable growers use Good Agricultural Practice (GAP) programmes[214] to certify that their fruit and vegetables are produced safely and sustainably, and meet market and regulatory requirements. NZGAP is used for the domestic market and GLOBALG.A.P. for overseas markets and, in many cases, customers require the applicable GAP certification. GAP certified growers have three main distribution channels: retail, foodservice and exports (Deloittes, 2018).

The expert interviewed commented that:

- *Gaining Good Agricultural Practice (GAP) accreditation is a business choice. It gives recognition from the Ministry for Primary Industries of food safety standards and the decision is usually driven by the market(s) that a grower wants to supply. Only accredited growers are able to supply food processors, supermarkets, or restaurants[215]. In Marlborough there are now fewer than ten GAP accredited growers, such as Cherrybank Orchard, Caythorpe Family Estate, Murphy's New Zealand, Garlico, and Thymebank.*

The GAP programmes are designed as a modular approach, such as for food safety, employment law, and environmental regulation, through a single certification and audit process. Growers use GAP in relation to fresh water and climate change. For example, the Environment Management System add-on was developed in 2017 for Farm Environment Plans and contains over 60 practices for managing nutrients, soils, and irrigation based on industry codes of practice and research[216]. This add-on to NZGAP has been tested and rolled out to approximately 40,000 hectares of horticulture land in New Zealand.

In relation to nutrients, GAP requires growers to takes a holistic approach: from a businesses' environmental policies to staff training, soil testing and crop budgets, fertiliser recommendations, to the control of each fertiliser application in each paddock (right product, right rate, right time, right place) for each crop. This process requires checks and balances throughout a grower's decision-making. More information about how growers use practices and tools to help improve the quality of fresh water, particularly in relation to crop rotations, is available in a HortNZ storymap[217].

214 NZGAP was established in 1998 and GLOBALG.A.P. was established in 2007 (originally called EUREGAP, founded in 1997). *https://www.hortnz.co.nz/compliance/gap-schemes/*

215 Some horticultural growers also sell produce directly via websites, farm gate shops or stalls, and weekly farmers markets (e.g., the Marlborough Farmers' Market, which was established in 2001, and the Nelson Farmers Market). Farm gate sales can include opportunities for 'pick your own' fruit. Boutique-scale growers are less likely to have GAP accreditation but they are still required to have Council food safety certification. Consumers are in a better position to make their own assessments about a grower's practices when buying directly from a grower than via a 3rd party.

216 The Environmental Management System presents a toolbox of good and best practices, asks a grower to assess their risks at a property and paddock scale, and consider each practice and its appropriateness to manage those risks over time. The results of 9 Otago growers' responses to the questions posed are reported in Roberts & Robertson (2023).

217 *https://storymaps.arcgis.com/stories/c55248b6c960475eb9913f95dab89680*

6 Viticulture

This chapter draws on a set of online interviews with ten people involved in winegrowing in Marlborough. The interviews were edited for clarity, conciseness, and anonymity. They were then collated by topic and presented as bullet points (in blue italics) throughout the section (each bullet point being from a separate interviewee).

This research is supported with Sustainable Winegrowing New Zealand (SWNZ™)[218] data specific to Marlborough for the 2022-23 production season supplied by New Zealand Winegrowers. Established in 1995, SWNZ is a sustainability programme that certifies all parts of the wine production chain and included 96 per cent of New Zealand's vineyard producing area. It does not, however, gather financial or employment information.

6.1 Introduction

This section surveys viticulture in Marlborough, which celebrated 50 years as an industry in 2023[219]. It first discusses the winegrowing region's main characteristics, which all tend to be closely connected. That section is followed by an overview of current water use within the vineyards and an analysis of the impacts of possible changes in water availability.

The interviewees were largely self-selected, with the support of Wine Marlborough. Nine are winegrowers[220], a mix of both owner/operators and employees, and the tenth works closely with winegrowers in a research capacity. All of the interviewees had a depth of experience in the industry and in Marlborough. The winegrowers interviewed tend to be involved with medium and large vineyards[221] that are mostly well-established, and as a set they cover a broad range of perspectives and locations. While the interviewees were asked to consider more than their own circumstances, winegrowers of vineyards with a planted area less than 20 hectares were not directly represented.

6.2 Main Characteristics

There are eleven winegrowing regions in New Zealand and each one region has a specific nature. This section discusses seven characteristics of the Marlborough wine-growing region: scale and dominance, Marlborough Sauvignon Blanc, diversity within and between vineyards, water use, people, profitability, and land values. These characteristics will influence how options to further manage fresh water may impact the industry.

218 https://www.nzwine.com/en/sustainability/swnz

219 For conciseness, the history of the viticulture industry in Marlborough is not summarised in this chapter because it is well surveyed in other easily accessible publications from various perspectives. For example: https://www.marlboroughwinenz.com/history and the land use change chapter of the 2008 State of the Environment Report (MDC, 2008).

220 The use of this term in this report does not distinguish between growers who own a vineyard and those who also produce wine but don't own vineyard land. The term wine company is also used for winegrowers.

221 In the context of this report, a medium-sized 'vineyard' is considered to be one that has a total planted area of between 50 and 200 hectares, a large vineyard has over 200 hectares and a small vineyard has between 20 and 50 hectares. These size categories are intended to be specific to Marlborough and may be less relevant in other winegrowing regions.

Image 39: Looking from Marlborough Ridge south towards the Wither Hills

6.2.1 Scale and Dominance

The most obvious characteristic of the Marlborough winegrowing region is its scale. Using the SWNZ data, in 2023 there were 1,118 vineyards and 47 physical wineries[222] in the region – an additional 49 vineyards from the previous year (+5%)[223]. Within these vineyards the planted area of vines totalled 30,113 hectares - an annual increase of 987 hectares (+3%) (note that the planted vineyard area may be more than the producing area).

The SWNZ data is broadly consistent with the Marlborough Land Use Map 2023, which estimates a total vineyard area at a whole property scale of just under 41,000 hectares and the total planted area (i.e., within a property) of 32,500 hectares. Image 40 shows the estimated extent of vineyards as a land use and highlights some of the diversity in situations. Some of the increase in total planted area will have occurred within existing vineyards as winegrowers progressively develop their operations.

222 The 47 physical wineries make some or all of the wines of the 163 wine companies in Marlborough (M. Pickens, pers. comm., January 2024).

223 In this context, a vineyard is a business that may consist of more than one property. In general, there are three basic business models in viticulture: vineyards that produce all (or substantially all) of their fruit into finished wine (i.e., are a vineyard and a winery), vineyards that produce a small amount of finished wine but supply the majority of their fruit as contract to a winery, and vineyards that only act as a grower for a winery (Wilkinson, 2022).

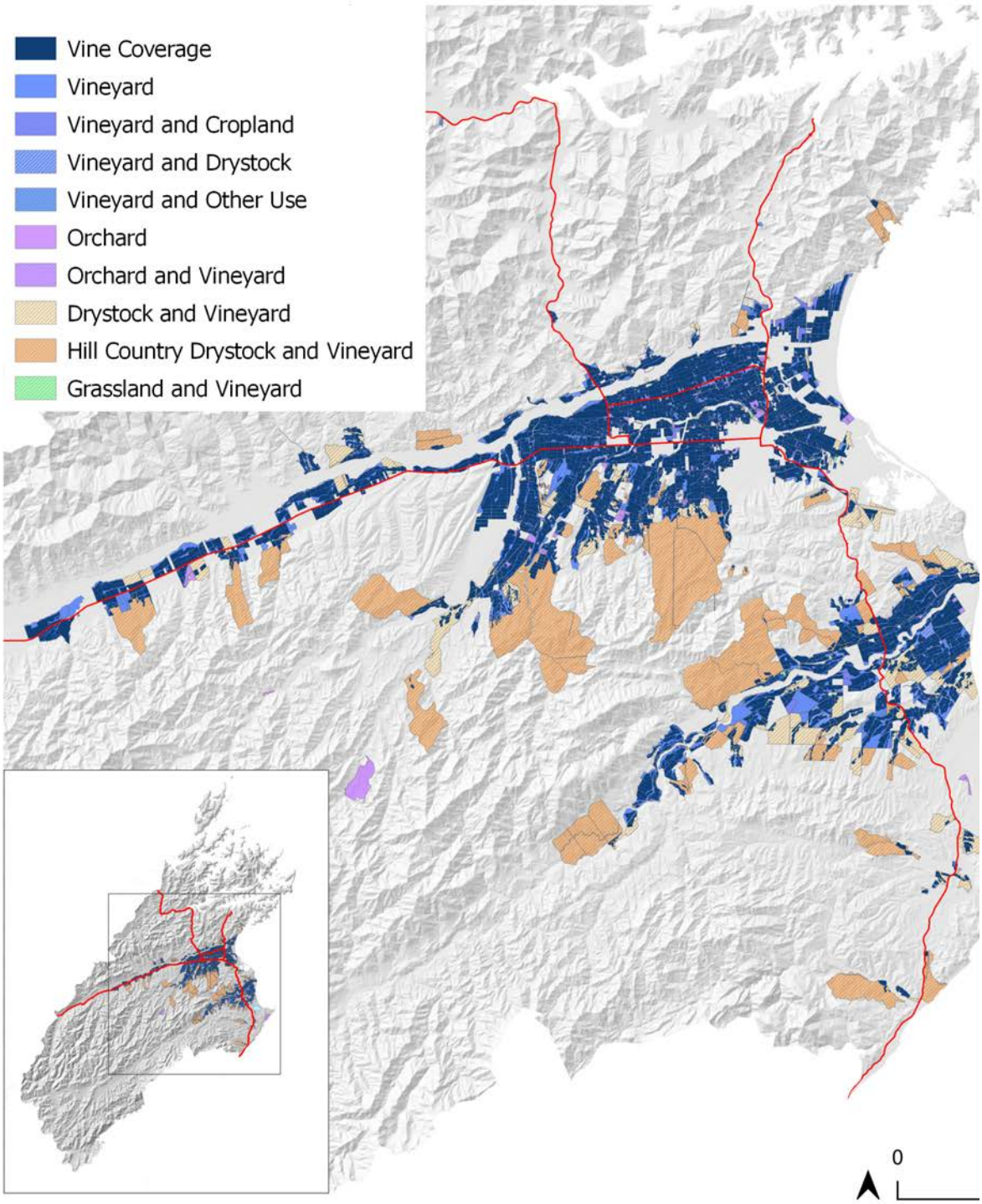


Image 40: Estimated distribution of viticulture and horticulture in Marlborough in 2023
Note: Vine coverage is the extent of vines plantings within a vineyard.
Source: Marlborough Land Use Map 2023

Similar to other rural industries, the number of vineyards and their planted area are both important measures for understanding the nature of the industry and the possible impacts of policy. Together, Figures 42 and 43 show contrasting distributions of total planted land and the number of vineyards in the region across a range of five vineyard size categories. For example, 58 per cent of the total planted land sits within vineyards over 50 hectares in size, while 87 per cent of the vineyards hold less than 50 hectares of planted land. In 2022-23, the average vineyard size was just under 27 hectares. One grower commented that "There is a difference within the industry between the high tonnage big companies that dominate the landscape and smaller companies that are more focused on quality than tonnage."

Other comments on this topic in the interviews were:

- *The industry is very intense in terms of the amount of land it takes up for the region. There're not many regions that I'm aware of that are as tightly planted as Marlborough. Visitors to Marlborough for the first time are blown away by how much of the land, particularly the flat land, is occupied with grapevines.*
- *In New Zealand roughly a quarter of vineyards are under five hectares, but their share of total area is less because there are many 100-hectare, 200-hectare, 400-hectare vineyards around in Marlborough. There'll be plenty smaller than that, but 50 hectares is not uncommon at all.*

The proportion of planted area on a fully developed vineyard partly depends on its configuration and topography. For example, one winegrower had 80 per cent of their property planted in vines but commented that if it had been a rectangular block with long rows then the planted area would have been at least 90 per cent.

- *If you took 100 hectares of land you probably have ten hectares in headland – which is around the circumference, or areas adjoining waterways, so you've got to have setbacks from those, storage dams, terrace side lands, it all adds up. We've got up to ten hectares of amenity plantings on the property, storage dams are probably two hectares, plus headlands.*

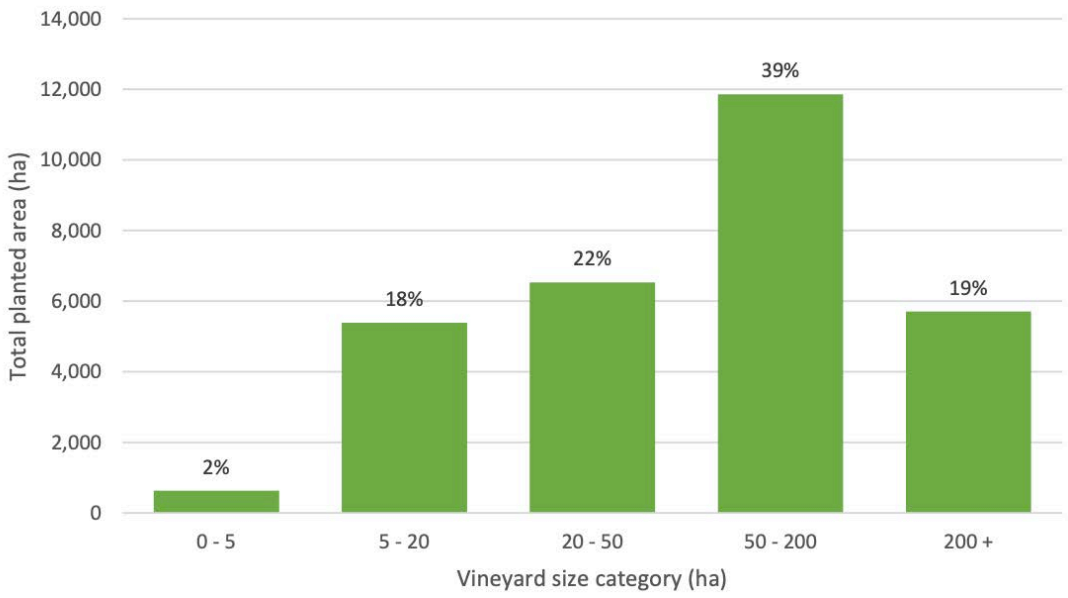


Figure 42: Distribution of total planted area in Marlborough by vineyard size category in 2023
Source data: SWNZ

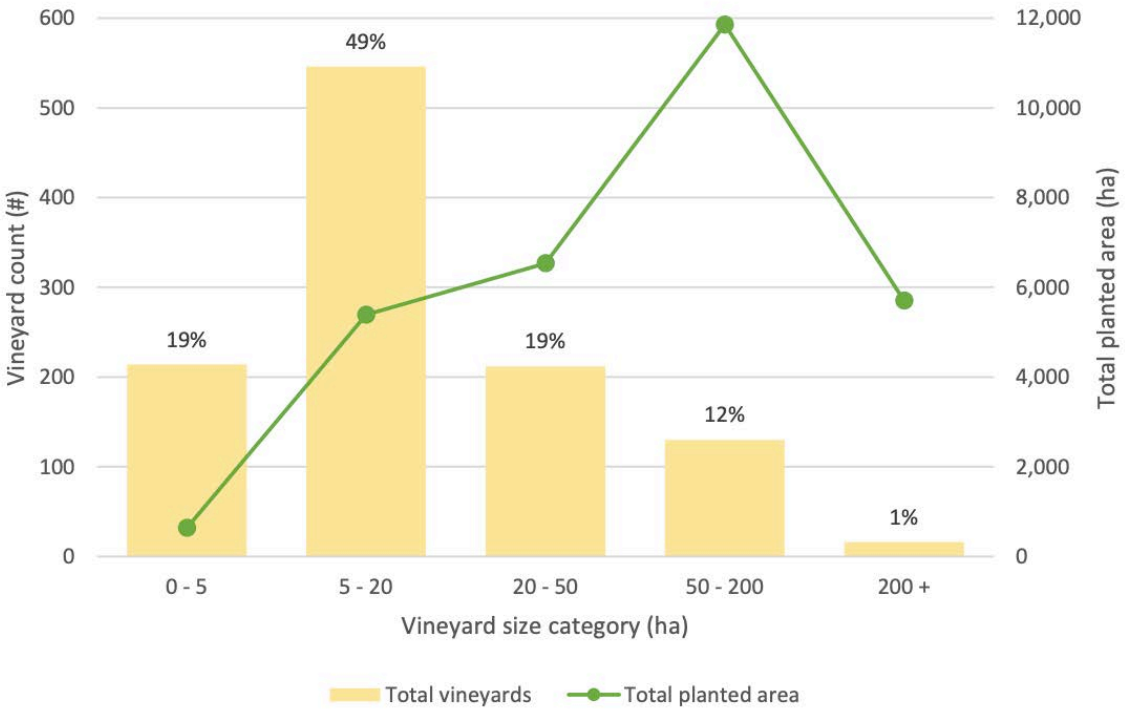


Figure 43: Comparison number of vineyards and total planted area in Marlborough in 2023
Source data: SWNZ

In addition to the extent of land management, a vineyard's size is also measured using its crop yield or output (i.e., the total volume of grapes produced a year). On average for the region, there is a decreasing relationship between vineyard size (planted area) and yield with 15.0 t/ha on the smallest vineyards (0-5 ha) to 13.5 t/ha for the largest vineyards (200+ ha). As a vineyard's yield is partly influenced by its mix of varietals, the higher yield on smaller vineyards may indicate a focus solely on Sauvignon Blanc.

Winegrowing in Marlborough occurs at such a scale that it is an important driver of the regional economy, and its scale translates into 'dominance' in relation to (at least) three key aspects. As a land use, vineyards tend to be located on flatter land across the region and many are in the vicinity of the more populated areas and main roads. Consequently, they are visually apparent in the landscape and gain public attention. As a wine growing region, Marlborough is central to the New Zealand industry as a whole. As a wine, Marlborough Sauvignon Blanc is dominant around the world, particularly as Sauvignon Blanc is a relatively underutilised varietal. Other than in New Zealand, the grape is largely limited to Chile, South Africa and, to a lesser extent, France (Sancerre).

The scale of the industry is reflected in the variability between individual vineyards, which is discussed further in this section. It also creates a depth of knowledge, skills, and opportunities for those in the industry to learn from each other. Marlborough also benefits from the Bragato Research Institute, Plant and Food Research, Nelson Marlborough Institute of Technology, and Marlborough Research Centre Trust all having a science led approach to viticulture in the region.

- *There are good people in the region and it is easy to get things done. I've been a winegrower for over 30 years but I'm still learning every day. There are people here that you can ring, even pub talk – there are plenty of very knowledgeable winegrowers. New growers need to be more aware of that.*

- *That's one thing in this industry - whether you're growing, making, or sell wine, it really is inclusive. Most people really want to help, and they really want to see you succeed. It's a breath of fresh air and it makes you feel really positive about the industry, that sort of inclusiveness. It's really cool!*

Scale also means that viticulture is collectively a large user of water in the region in relation to takes. However, on a per hectare basis, the industry's use is low compared to other land uses and the value of its production from that use is high. A change in irrigation activity from farming to winegrowing usually results in a marked reduction in water allocation because water use for grape vines is generally less than for intensive pasture or arable crops.

6.2.2 Marlborough Sauvignon Blanc

The region's second characteristic is the success of the unique wine style of Marlborough Sauvignon Blanc, which is a critical factor in the industry's scale. Although winegrowers grow other varietals (e.g., Pinot Gris, Pinot Noir, and Chardonnay), Marlborough is Sauvignon Blanc-centric and it consists of about 88 per cent of the region's grape production (M. Pickens, pers. comm., February 2025). Varietals, such as Pinot Noir and Chardonnay, are grown more globally so there is more competition in the market, and other winegrowing regions in New Zealand tend to have more emphasis on those varietals, (e.g., the Bordeaux varietals in Hawkes Bay, Pinot Noir in Central Otago). Sauvignon Blanc is less distinctive in winegrowing regions in the North Island where a vine's natural character is more difficult to see.

The stylistic traits of Marlborough Sauvignon Blanc that are recognised internationally are attributed to the terroir of the region. Some winemakers need grapes with those stylistic traits for their products, while others lean more towards those of specific subregions within Marlborough. Vegetative growth, which is reliant on sufficient water, is also seen by many as being important to the region's wine style.

- *Marlborough Sauvignon Blanc has unique, distinctive characteristics that are not easily reproduced anywhere else in the world. We've got a very specific terroir uniqueness.*
- *For the lower Wairau, it's certainly a lot riper. It's got a lot of what you call 'thiols'[224], the strong, punchy aromatics, so it's where you get that sort of boxwood, blackcurrant leaf, passionfruit, more tropical characteristics. Whereas, in lower Awatere you get more of the greener characters of lemongrass, tomato stalk, some capsicum, grassy notes, and some citrus characteristics as well.*
- *Marlborough is well suited to Sauvignon Blanc, but we can also grow Chardonnay, Pinot Noir – most varieties grow well here except the very late ripening red varieties as we don't have the heat. With Chardonnay it is more the style of the winemaker than the region. Pinot Noir is more specific to the region, but it is grown more widely. With Sauvignon Blanc we've found a unique style and thankfully the world likes it, so we have a market of our own.*
- *It's the unique flavour, the size and scale and the proportion of the region that sets it apart from the rest of the winegrowing regions (e.g., Hawkes Bay, Wairarapa, Nelson, Central Otago, North Canterbury). It's also internationally labelled on that terroir. It's New Zealand's most recognisable wine region.*

224 Thiols are a group of volatile sulphur compounds that are elevated in Marlborough Sauvignon Blanc. They give these wines passionfruit, grapefruit and tropical fruit aromatics and can balance or play off the more common green characteristics. Thiols and beyond: the science of Sauvignon Blanc (wineanorak.com)

6.2.3 Vineyard Diversity

A third characteristic of viticulture in Marlborough is the diversity between vineyards. At first glance winegrowing may appear fairly uniform, being Sauvignon Blanc-centric, but with over 1,000 vineyards across more than 30,000 hectares of land there is considerable potential for a range of production systems[225]. As a result, there is a proliferation of possible vineyard 'types', with each vineyard varying by size and development stage, number of properties and their location, soil types, mix of varietals (including choice of rootstock), management practices, irrigation system, water sources, water storage capacity, frost protection, and inclusion (or not) of other enterprises. Each of these elements will influence the impacts of possible changes in water availability.

Image 41: Looking south across the Awatere Valley with the foothills of the Inland Kaikōura Range in distance

Geographically, vineyards are located across Marlborough from Blind River, by the Pacific Ocean in the southern Awatere, to inland of the Wairau Valley township (40 km west of Blenheim), and from Ward[226] in the south of Marlborough through to Rārangi and across to Havelock in the north. Coastal properties may have more windrun than further inland while frost is less common than in regions further south, often occurring in pockets across the landscape, and are usually less severe than the more continental climate of Central Otago.

Marlborough's two principal winegrowing subregions are the Wairau Valley (includes Southern Valleys and the upper and lower Wairau) and South Marlborough including the Awatere Valley. Each subregion is markedly different in terms of their landform and utility for grapes. As well, the influence of microclimates within these subregions on vineyard practices should not be underestimated or discounted (Agrilink, 2023).

- *As a winegrowing region, Marlborough tends to have an east/west rainfall gradient – heavier on the coast and lighter inland. A 'nor'west' weather system tends to bring rain to the upper catchments (e.g., Branch, upper Wairau, Rainbow, Pine Valley) but are intermittent. The more constant pattern has been coastal – particularly during La Niña cycles.*

225 Bramley, Trought, & Praat (2011) used a Marlborough case study to examine variability within a 6 ha vineyard planted with Sauvignon Blanc. They found yield variation was roughly twofold, despite substantial variation in vine vigour which was associated with variation in the land (soil, topography) underlying the vineyard.

226 The Marlborough winegrowing region extends further south to Kekerengu in the Hurunui District (north Canterbury).

- *Marlborough is one of the windiest parts of the country so some vineyards face issues in terms of high sodicity in the sub-soils, compacted clays, and high wind run that affected all sorts of things like the ability to spray, irrigation was highly inefficient and when vine roots got down into the sodic soils they really struggled. There has been a goldrush there in the last twenty or thirty years, and less suitable sites have been planted.*

The large size of many vineyards in the region means they are likely to capture a range of soil types, slope classes and aspects, as well as sources of water. As well, medium-sized vineyards and large vineyards own and/or lease multiple properties, and their mix of environmental conditions can be particularly complex. The location of a vineyard's landholdings does not always easily convert into its fruit supply. A business may have most of its vineyards in one sub-region but source a considerable share of its grapes from vineyards in other sub-regions. Some vineyards include a range of properties, often between catchments, to spread risk and gain a range of varietals and flavour profiles. One winegrower commented that "You might grow Pinot Noir in one block because of a certain soil type, Sauvignon Blanc somewhere else, or it might just be that you were able to get that land as much as anything – it became available when you had the cash flow to do it."

In addition to the variability in environmental conditions, vineyards have different degrees of interdependency. A winegrower commented that if a vineyard has some scale, then its viticultural programme is likely to consist of blocks they own and others from whom they source their fruit supply. As an example, one medium sized vineyard is supplied fruit from at least 20 other winegrowers in addition to their own production. In another example, a vineyard sources roughly 30 per cent of its fruit supply from winegrowers outside of the region.

Figure 44 shows the distribution of soil types across the Marlborough winegrowing region (data on water sources are presented in the next section). Although not all winegrowers reported their soil types, roughly 30 per cent of vineyard soils are light or very light and another 30 per cent are heavy or clay based soils. Lighter soils are usually freer draining and need more irrigation. Medium-loam soils are the most common and receive average irrigation in the mid-range of all soil types (Agrilink, 2023)[227].

- *Even within a 100-hectare vineyard there's a massive diversity of soil types. We've got one block that I irrigated last season for two hours, or four hours when it needed a top up, but then we've got some that I water four hours every day within a kilometre radius. So, we need to be very aware that what we talk about for one vineyard is different to another – for each block it's different.*
- *Each winegrowing region in New Zealand has differing proportions of more ideal soil types, such as those in the lower Wairau. For example, a relatively large proportion of the Gisborne winegrowing region has very productive soils. There, Sauvignon Blanc is able to be grown without irrigation because of the clay soils and fairly consistent rainfall through spring and partway through summer. In contrast, parts of Marlborough are hot and dry, and coastal locations are open to those dry nor'westerlies we get straight off the Tasman Sea. They're more like 1,200 to 1,300 mms a year versus roughly 600 to 700 mm here."*

227 It is not fully understood how well the SWNZ soil type question is interpreted and completed by winegrowers, so the predominance of 'medium – loam' soils should not be taken as a certainty (Agrilink, 2023).

- *A real challenge is to water to specific soil types. We operate in river valleys: our vineyard rows tend to run north to south, but our soil strata are more east to west, having been laid down by the river. In a broadacre situation with centre pivots you can alter your irrigation accordingly to soil types. In viticulture it is more difficult. It's the ability to use technology where it's appropriate, but you also need to understand your property and the soil types and the variation within each of those irrigation blocks to optimise water use (get the best result for your business).*

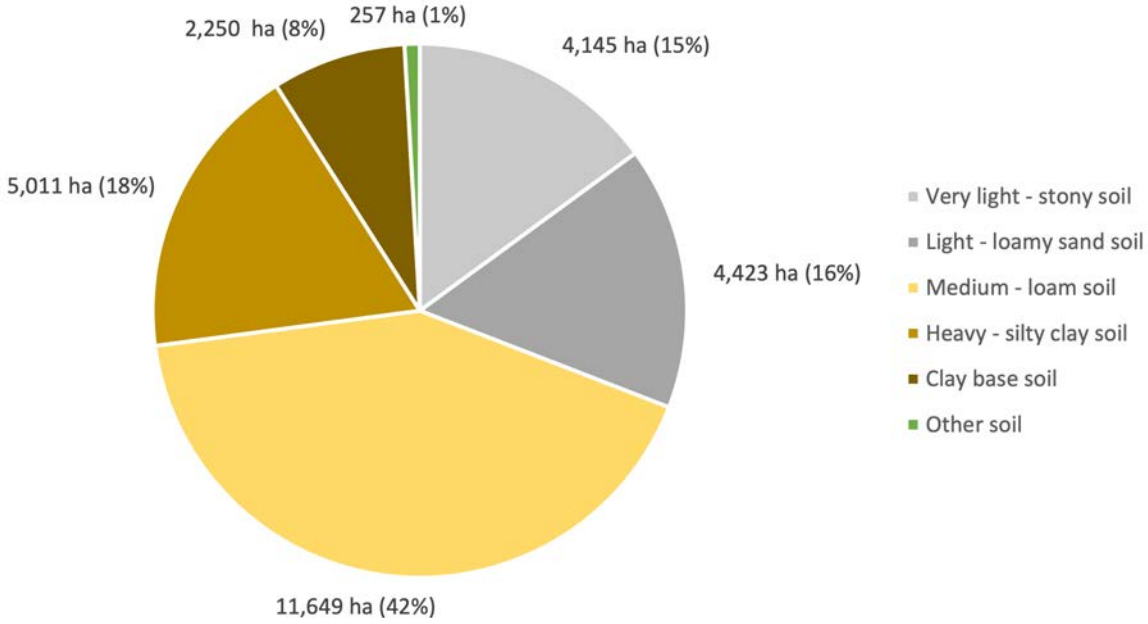


Figure 44: Vineyard planted area in Marlborough by soil type in 2023
Source data: SWNZ
Note: Not all winegrowers reported their soil types so the area totals 92% of the total planted area.

In the interviews, winegrowers repeatedly commented on the diversity in soil drainage conditions within the Marlborough wine growing region (in general terms, soil drainage is influenced by soil type and slope). Some vineyards are extremely well drained while others are imperfectly drained and may have some localised areas of artificial drainage (not wholesale gridded drainage). One winegrower described the wet areas in their vineyards as being confined to shallow depressions in the middle of a normally dry area where water sits (or perches) after rain. Another referred to areas of 'winter wetness' where surface water sits on the soil surface for some time after a considerable amount of rain (e.g., 150+ mms):

- *We have installed Novaflo pipe with punched holes laid with drainage stone or chip. The drainage installed is to shift this surface ponding to avoid soils becoming water-logged for extended periods. Arable crops and grapevines do not tolerate wet feet and will die.*

A third winegrower described their soils as fertile silt loam that are moderately free draining with a naturally occurring hard pan at a depth of around 1-1.5 metres. “In general, the soils have a reasonably high moisture holding capacity and we have some pockets of artificial drainage.”

Variability in environmental conditions creates a set of individual circumstances for each vineyard, which then influences their production systems and management approach. Table 32 compares the planted areas, water storage, need for frost protection across four of the winegrowers interviewed (the remaining winegrowers were far more complex). Notably, two of these winegrowers also include drystock farming enterprises within their operation.

Table 32: Comparison of four medium sized vineyards (ordered in decreasing planted area from left to right)

Total property area between 150 and 200 hectares: 81% planted in vines and 19% is used for grazing (cattle fattening). The vineyard is 87% planted and 13% in headlands, yards etc. The grazing land is not suitable for vines because floodable and one-third of it has k-line irrigation. Vines are mixed age, ranging from less than one year to 30 years and five years into a replanting programme. No winery but make a very small amount of wine. No water storage but installing sub-surface dripline irrigation and soil moisture probes as replanting. Do not use water frost protection.	Total property area between 150 and 200 hectares: 80% planted in vines (excluding headlands etc). Vines ages range from one year to 20 years, being developed as progressive plantings. No winery. An earth-lined dam was built for water storage and upgraded because of seepage issues following Kaikōura earthquake. Do not use water for frost protection.	Total property area between 150 and 200 hectares: 36% planted in vines (over two landholdings) and 74% used for grazing (sheep). Vines range from two to 14 years in age. No winery. Recently built a water storage dam. Cost roughly $10 per m^3 to construct including headworks. Annual maintenance costs for dam roughly $10,000 just to upgrade things like monitoring. Anticipated lifespan of dam is 50 years with a bit of maintenance in between, possibly longer. The dam’s capacity was over-specified to provide more water security in the future because of climate change. Do not use water for frost protection.	Total property area is less than 50 hectares: almost all planted in vines (including headlands etc) and a small amount of grazing even though it is suitable for vines. The vineyard was developed in two blocks. Vine ages range from one year to 30 years developed in two stages. Started replanting (replacing other varieties with Sauvignon Blanc) but now delayed for five years because of cost and still producing 15 tonne per hectare. No winery. Water scheme also provides water to neighbouring blocks. No water storage – was considering it and have an area that may be suitable but unaffordable. Do not use water for frost protection.

6.2.4 Water Use

A fourth main characteristic of the Marlborough winegrowing region is its water use, which is strongly connected to a vineyard's location and soil type, and has the following three aspects. First, conversions to viticulture have changed water use in the region and increased the total amount of land that is irrigated. Second, Sauvignon Blanc is known as a 'thirsty' varietal and needs relatively more water than other grape varietals to achieve the yields for a vineyard to operate successfully. Third, the allocation of water per hectare and by crop type within the region is well-established. Consequently, the approach appears to be a generally accepted concept and monitoring information over time is available. Water use as a topic is returned to in Section 6.6 and discussed there in more detail.

- *Water is a contentious issue in Marlborough – when you've got a system in the Wairau River that has an average flow of around 20 cubic metres, and the Awatere River is somewhere in the order of six or seven, it means that every drop that falls in that catchment is sacred.*

- *Many larger companies produce around 15-16 tonnes a hectare on average. When I first arrived in Marlborough, Sauvignon Blanc was cropping at 12 tonnes a hectare, but we weren't using enough water. More water increased yield so the two are linear up to a point, but it also depends on soils. If you are on deep silt loam soils that have high water holding capacities (e.g., 200-300 mm/m), these are extremely productive soils, some used to be dairy farms. Some vineyards do not need irrigation and happily produce 25 tonnes per hectare. Others are in old riverbeds that are extremely gravelly, and you could put on 12 litres per vine per day and the vines will still be stressed. A sound business model fits consumer's varietal expectation for Sauvignon Blanc. Highly stressed vines on 'drafty soils' where water has been 'grinched' does not fit and the winegrower will eventually go broke.*

- *Broadly speaking there isn't the trade-off between quantity and quality for Sauvignon Blanc when you compare it to other grape varieties where there's a very direct correlation. Sauvignon Blanc is one that breaks all the traditional rules. There is an upper limit, quality and quantity don't just keep going up, there is a point where it will drop off – where quality will drop off with quantity. With other varieties that's not the case.*

- *We never had an excessive amount of water. Since 1990 we've had limits on the amount of water we had available and we've learnt to be more efficient with water. We used to irrigate 70 or 80 hectares with one irrigator and put more water on grass and arable crops than we do now on 145 hectares of viticulture. So, we've relinquished a portion of our water allocation but were happy to go through the fair and reasonable use test given that we've got storage, good delivery systems and know how much water is being put on – we've got real time monitoring. I look at where we're at today versus 30 years ago in terms of our efficiency, our monitoring, and our ability to provide information to third parties.*

- *The property was originally traditional sheep and cereal cropping and partly irrigated using broadacre irrigation. We progressively irrigated the whole property and changed to intensive cropping and then a long transition into viticulture. We were looking at opportunities, and viticulture was an efficient user of water – effectively we use about a third of the water for irrigating than we would have for pasture to feed sheep under a very traditional regime. It is typically two thirds or half of what we would use if we were growing intensive arable crops. So, we've been able to use that water resource across more hectares over time.*

A vineyard's sources of water can be complex, especially where there are multiple properties, and sources tend to vary by location. Figures 45 and 46 show that half of all vineyards have a bore as a water source but they represent less than half of the planted area. One winegrower commented that one of their properties "has three sources of water. There are two separate bores/two separate schemes and the backup was the Southern Valleys Scheme. The Southern Valleys Scheme is the most unreliable source (because of cut-offs) and has the lowest flow compared to the ground water supply."

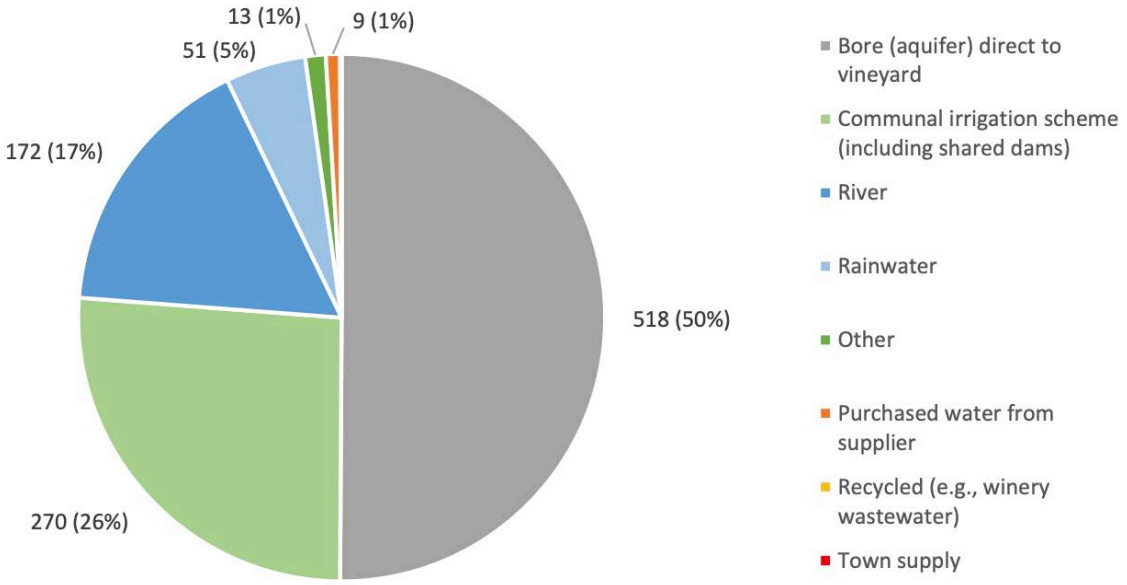


Figure 45: Water sources by vineyard in Marlborough in 2023
Source data: SWNZ
Note: The results are for the 79% of winegrowers who reported their water sources data.

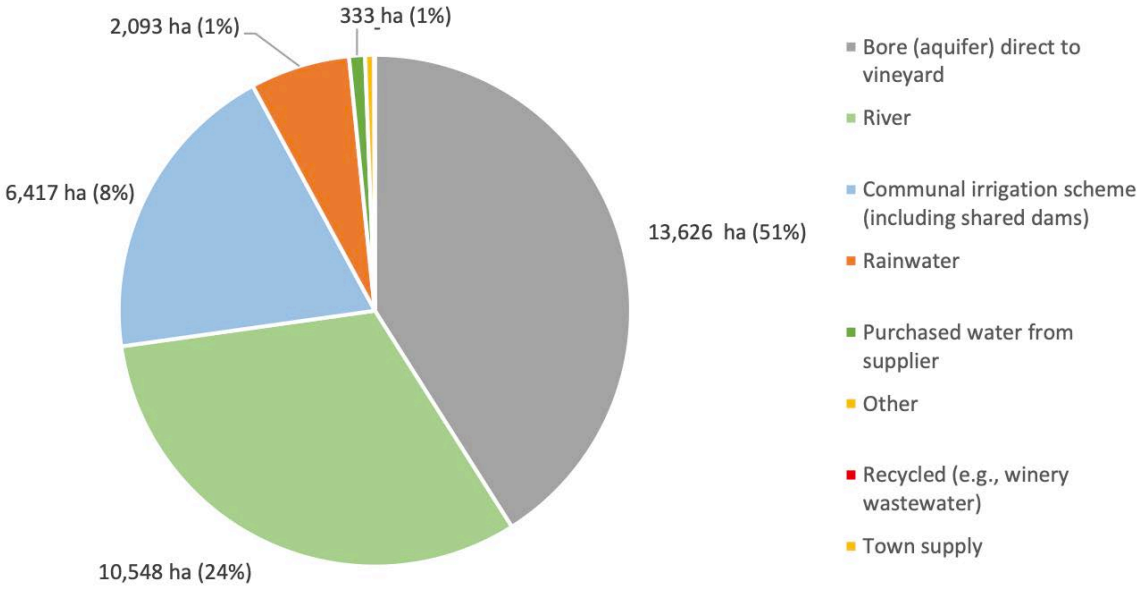


Figure 46: Water sources by planted area in Marlborough among vineyards that irrigate in Marlborough in 2023
Source data: SWNZ
Note: Vineyards can have multiple water sources so the total area for water sources may be higher than the total planted area for the winegrowers who reported their data (and so add up to more than 100%).

6.3 People

Viticulture typically is an industry that involves many people throughout each stage of the winemaking process. People are employed permanently and seasonally either directly in the vineyards, cellars, and bottling, or indirectly to support the industry as contractors (e.g., Grapeworx[228]), hospitality, and professional services. Within a vineyard, different grape varieties have different demands for labour and some winegrowers may choose to use more labour than others (Table 33). For example, while almost all of the harvest is done mechanically (Dryden & Weeks, 2021), a few vineyards still hand harvest some or all of their grapes.

- *Sauvignon Blanc typically has lower labour costs. It's a very straight grower so a lot of tasks are quicker and easier, such as wire lifting, and you can mechanise more. With Pinot Noir you typically have to drop off any green bunches, so there's extra passes to go through. The higher the value of Pinot Noir you are selling, the more passes you need to go through, so your inputs for growing are much higher. Chardonnay doesn't need to be as high, but you don't get the huge crops like with the Sauvignon Blanc.*

Table 33: Examples of employment on three medium-sized vineyards

We employ four to five people plus me. So, we're labour heavy on purpose because we do a lot of work in-house. However, we do use a contractor as well. For example, we had up to 150 people on site for wire-dropping and they completed 100 hectares in two hours. It's hard finding good people, but once you've found good people it makes such a difference.	We employ one person on the larger block and use a contractor for all the vine work, and then on the smaller block we have a contractor do everything, including tractor work (our machinery won't work on that block). So, it is a bit of a mix. It's a better way, rather than investing in new machinery – it's a business decision rather than anything else.	I'm a one-man band. I try to do most of the work myself and am extremely busy. I use contractors sometimes, such as for jobs like wire lifting and post driving, but not for tractor work. I have employed people in the past but found it quite restrictive and difficult to employ people full time. Contractors are easier and it works well.

The industry has a strong multi-cultural element. For example, one winegrower observed that many of the itinerant workforce at harvest are Hispanic or Latinex (particularly in the cellars), and another winegrower thought many of the Spanish-speaking people in the industry are immigrating to New Zealand. Many people work through the Recognised Seasonal Employer (RSE) scheme[229]. Marlborough is dependent on the RSE scheme, accounting for between one-third to half of the RSE viticulture labour force in New Zealand. People come to the region from Vanuatu principally, but also Samoa, Tonga, Fiji and many other pacific countries for seven to nine months within an 11-month period, depending on their country of origin. They must be paid at least the living wage (in the past it was just the minimum wage) and guaranteed 120 hours over a four week period. Some winegrowers or contract labour providers have purpose built accommodation for their RSE workforce.

228 *https://grapeworx.co.nz/*

229 The Recognised Seasonal Employer Scheme was introduced in 2007 and is administered by New Zealand Immigration. The scheme allows businesses in horticulture and viticulture to recruit people from overseas for seasonal work when there are insufficient New Zealanders to fill roles. Many RSE organisations are also members of the New Zealand Ethical Employers Association. *https://www.immigration.govt.nz/about-us/research-and-statistics/research-reports/recognised-seasonal-employer-rse-scheme*

- *Most are RSE workers, so from the Pacific islands or Asian countries doing the manual labour. Operators, tractor operators and other general vineyard people, are usually New Zealanders. But then you've got a whole mosaic of French, Italian, Spanish, German, American, Canadian, Argentinian, Uruguayans, Chilean, Australian – people from all over the world. It can be transient, but the length of time people stay is quite variable. A lot of people have been here for 15 to 20 years.*

- *For us, the biggest labour cost is RSE labour. They are living in the community while they work, but the benefit to the islands is more than worth it. We have a good balance of international companies and New Zealand companies. It doesn't really matter who owns the companies, as most of the labour is local. The only time you're importing labour is contractors and winery staff that are here for the experience and a good time, and typically they inject most of what they earn back into the economy.*

- *We have a big chunk of permanent workforce, we use a lot of contract labour and some of that labour supply is typically reliant on the RSE schemes, which are fantastic. We'll employ fixed term staff for summer and vintage and things like that, when we've got our peak demands, but most of our staff are permanent staff. We don't really have casuals.*

- *Essentially, RSE are remittance workers - an export earner for their home country. Their wages depend on what they're doing (a pruner earns more) and they just get into it – their work ethic is amazing. They consider their time as a contribution they can make to their home communities. They average about three 'tours of duty' and it tends to follow a pattern. The first tour pays for the house, the second pays for the school, and the third helps pay for the hospital.*

6.3.1 Mechanisation

The winegrowers interviewed had quite differing views around the present use and future potential of mechanisation and automisation/robotics in Marlborough. There is movement towards mechanisation on vineyards where possible in response to rising labour expenses (refer to Section 6.4), including: multi-row sprayers, vine trimmers, trialling robotic vineyard machinery, high resolution digital imaging, and lasers for bird control (MPI, 2024). However, technological issues (e.g., need for LIDAR and rural internet, skilled operators) and some resistance from winegrowers may mean that the reality is some way off. A recent increase in the use of vine stripping machines appears to be stabilising as some winegrowers have observed machine stripping causing some damage to canes (MPI 2024).

Several winegrowers indicated that they mechanise as much as possible as a cost-saving and to not be so reliant on labour "because that is getting tighter and harder". One winegrower identified their biggest cost as being for winter pruning: "It is a real expense, but to do the job well it is hard to replace what a person can do." Technologies identified as having potential were artificial intelligence (e.g., for section control), automatic wire lifters, which have been used in Australia for at least 20 years, and autonomous tractors (Oxins), which are currently being trialled in the region.

- *There are efficiencies to be had but when it comes to the hard work in the vineyard (e.g., the pruning cuts, lifting wires, bud rubbing) it takes decision-making. Bud rubbing you can get away with because there are new grafting techniques where the vines don't grow water shoots, and pruning techniques can change to some extent to mechanise part of it. Twenty years ago, it cost about $2.50 to prune a vine and because the canes had to be pulled out of the trellis. The invention of the Klima[230] dropped the 'pulling out' costs from $1 to 10c. Those sorts of innovations make a material difference. Total pruning cost in Marlborough is down to perhaps a dollar a vine – but with 60+ million vines, that's a lot of money.*

- *Mechanisation is what everyone is working towards. Yes, it's hard for pruning because we have cane pruning rather than spur pruning, but that is one period of time. Probably the biggest target will be to minimise contractor labour. Labour is our Achilles heel. It's just getting bigger, and the cost is astronomical, so anywhere that we can modify what we're doing to save us on a pass, that will be the game changer for Marlborough – minimising labour costs.*

Image 42: An autonomous vineyard tractor (AVT) with a cropsy camera (used for computer vision data capture)

230 https://www.klima.co.nz/

6.4 Profitability

Sauvignon Blanc's relative profitability is largely in its tonnage: the value of the crop (per tonne) is lower in comparison to some other grape varieties but the crop has a higher yield (per hectare). As with rurally-based industries, profitability is a key driver of land values, which are discussed in the next section.

Table 34 presents summary results from the Ministry for Primary Industries' Marlborough Vineyard Model, which is a notional vineyard of mixed grape varietals produced annually using data from 50 vineyards (MPI, 2024). Since 2012 Colliers have provided a valuation of this vineyard model, based on the assumption that it is centrally located within the Wairau Valley (Gifford, Powell, & Hill, 2024)[231]. The valuation is of the land planted in grapes, the grape vines, posts and wires, and headlands, and is based on the variety mix and productive performance of the vineyard model.

Table 34: Summary of Marlborough Vineyard Model

Marlborough	2020	2021	2022	2023	2024
Producing Plant Area (ha)	30	30	30	30	30
Total Yield (t)	413	281	454	418	321
Average Return (per tonne)	$2,020	$2,110	$2,365	$2,475	$2,210
Net Cash Income (per ha)	$27,930	$19,770	$35,790	$34,520	$23,620
Vineyard Working expenses (per ha)	$12,730	$13,435	$14,665	$15,955	$16,860
Economic Vineyard Surplus (per ha)	$11,910	$4,535	$19,425	$16,765	$4,755
Land Value (per ha)	$120,000	$125,000	$165,000	$180,000	$170,000
Vineyard Value (per ha)	$233,000	$238,000	$293,000	$316,000	$283,000

Source: Gifford, Powell, & Hill, 2024

As with other rural industries, winegrowers are facing considerable inflationary pressures. In 2023-24 total vineyard operating expenses (includes cash and non-cash expenses) for the Marlborough Vineyard Model reached $18,860 per producing hectare (+6% from 2022-23), pushed up by expenses such as labour, fertiliser, electricity, irrigation, and repairs and maintenance (MPI, 2024). Total expenses for the Marlborough Vineyard Model increased by just under 60 per cent between 2015 and 2024 (MPI, 2024). By contrast, average grape prices were 22 per cent higher in 2024 than 2015 (MPI, 2024).

One of the winegrowers interviewed noted that:

- *In the last three to four years, we've had inflation in all of our inputs and labour has gone up exponentially, which is about half of our operating expenses. Ten years ago, our vineyard operating expenses were probably sitting at around $10,000 per hectare, now (2023) they're typically going to be $14-15,000 per hectare. It's no different to pastoral farmers, we've all seen marked lifts in our costs.*

231 Of the 50 vineyards, 13 are located in the Awatere Valley and 37 in the Wairau Valley. They include 30 contract growers and 20 winery operated vineyards in the survey group. The vineyard size distribution is: 9 of 0-10 ha, 9 of 10-20 ha, 10 of 20-50 ha, and 22 that are 50 ha or larger. In the Model, Sauvignon Blanc is the dominant grape variety (84% of the producing area), followed by Pinot Noir (8%), while Chardonnay and Pinot Gris (4% each).

Another winegrower was of the view that those companies managing their vineyards well, such as by maintaining and monitoring irrigation (e.g., sensors) and nutrition (e.g., soil and tissue tests), may have higher costs per hectare but better long-term productivity, and so profitability. There was also the view that some winegrowers may be changing their cost focus from a per hectare measure to one based on per tonne of grapes (i.e., output).

Changes in costs are just one reason that profitability in growing grapes or wine making continually fluctuates. For the most recent production seasons (at least up until 2023 harvest) grape growing has tended to be more profitable. Demand for grapes has resulted in large increases in their prices, and so a vineyard's revenue. Profitability in winemaking is more set, depending on the type of market and markets segments, particularly when supplying large customers such as supermarkets. The increase in growing price has narrowed some of a winery's potential profitability.

- *I'd say it's 50/50 but a little more in the growers' favour at the moment to what they're making versus what a winery is. We bottle wine through Wineworks[232] – we don't have a bottling facility ourselves. Most of our wine is bottled in Marlborough. There are small quantities sold as bulk wine to overseas parties.*
- *We bottle everything that is consumed in New Zealand and everything that is consumed internationally is bottled overseas. There are obviously some exceptions in both directions, but if 70% to 80% of our wine is exported, then we're internationally bottling 70% to 80% of our wine.*

Several winegrowers commented on how the fortunes of viticulture in Marlborough appear to strongly influence retail sales of good and services in Blenheim from vehicles and boats to clothing.

- *Growing Sauvignon Blanc in Marlborough on the right soil is very profitable. While in Central Otago the bulk wine price might be sitting around $8 a litre, based on a yield of 6 tonnes per hectare, in Marlborough it may be $4 a litre but is based on 15 tonnes per hectare. The grape price ranges from $2,000 to $2,500 a tonne, and the region is growing roughly 400,000 tonnes. It is that productivity that makes Marlborough work – you can grow enough to make a fairly substantial return and people are making a really good income. You are talking roughly $40,000 a hectare gross, but $50,000 (25 tonnes/ha at $2,000 a tonne) is not unheard of in some parts, especially in the Wairau. Some growers have that revenue year on year and their costs are around $10,000 to $13,000 per hectare, so they're making good money.*
- *An accountant will tell you a good year is when your bank account is full and your yields are high, but that doesn't mean you made the best quality wine. The idea that 'a struggling vine makes great wine' is not the case for Sauvignon Blanc. Some of the best wines are made from the more productive vineyards – but it is very site-specific. The year-on-year swing between yield and quality, a good year and a bad year, is far less than in Central Otago. In Marlborough a bad year is not really the ones that affect quality because changes in quality are more subtle. The aim is to maintain style and the driver is yield. Average yield in 2021, which was a year of poor 'fruit set', was probably close to 10.5 to 11 tonnes a hectare, but in 2022 it went closer to 18 tonnes. The way growers become more profitable is to make their vineyard more productive.*

232 https://www.wineworks.co.nz/

- *We command high prices and are very much into lower cropping. Profit is not the sole driver for us. While we need to be economically viable and make money, our reputation not only comes from the wine we make but also from the grapes we sell. We are keen to make sure the grapes are always of a high quality that can be made into an exceptional wine, so we can justify where we are. It's definitely aiming at the high end of the market, and we try to be as individual as possible.*

Wine companies can process grapes outside of the region in which it is grown depending on factors such as supply availability, facility capacity, and specialties. For example, a company may buy grapes from growers in Central Otago to process in a winery in Marlborough or send grapes between Marlborough and Hawkes Bay. Although New Zealand Wine does not collect data on the flows of grapes between regions for processing, there is this interdependency. Consequently, changes that impact Marlborough could impact other winegrowing regions, and vice versa.

- *If a freshwater management affects yields in Marlborough, then it will also reduce demand for grapes grown outside of the region that are used in "Marlborough" blends. That production has to be reduced at the same proportion or be used for other purposes e.g., Hawkes Bay or Nelson Sauvignon Blanc. To label anything by its terroir, it has to be 85% sourced from there so you are limited to what you can bring in from outside the region. The loss of revenue will also have flow on to other regions because many companies have vineyard operations beyond Marlborough.*
- *You can charge more for Chardonnay wine, but people will never pay more for grapes because they are harder to sell on the market. If you can't buy it from one person, then someone else will sell it to you. For Sauvignon Blanc, there is still the 'grab-on' from wineries to try to secure production, so it's keeping the price of grapes up – which is a good thing. It is basically directly related to return.*
- *Sauvignon Blanc doesn't have the same level of inputs – the amount of work you have to do to the vines. Sauvignon Blanc is far less crop-sensitive to the amount of crop than Chardonnay and Pinot Noir – you can crop it higher, and if you're selling to a company that wants homogeny, you're fine. If you're selling to a company that likes individuality, you crop it lower and carry the best crop, but you'll be paid more for the fruit and that will be reflected in the bottle price.*
- *We can't keep on pushing yields up. There is a ceiling on what we can realistically produce and ripen. If we overcrop our vines and carry a big crop but get poorer growing conditions, lower heat units, that extend the ripening phase further into April then it is higher risk – shortening days, slower ripening, increased risk from Botrytis disease and the risk of frost. It is a balancing act.*
- *Production is partly driven by a wine company. When a company allows a grower to grow more than their next-door neighbour, the neighbour will look over the fence and ask why they can't too. It is kind of the inverse of most farming. They are not trying to grow the absolute most volume they can, or they shouldn't be, generally speaking, to produce quality wine. We're not potato farmers, we're not corn farmers, we're not trying to maximise yield per hectare, we're trying to create the best quality primary product, grapes, to create a better secondary product, wine.*

6.5 Land Values

Viticultural land values are driven by global demand for Marlborough Sauvignon Blanc wine, which stylistically is specific to this winegrowing region and difficult to mimic. Consequently, there is a limited amount of viticultural land in Marlborough and its market value is high in comparison to other rural land uses. This said, the range of market values is broad and that of a specific property at a particular time depends on multiple factors. Most factors are connected to potential profitability (e.g., water, soils, slope, aspect) and are tied up in a property's location, with the more valuable vineyards tending to be in the lower Wairau, particularly around Rapaura. A property's water security (a combination of access and storage) is inextricably linked to its land value. Its soils, topography, and aspect also influence the grape varietals and proportion of planted area that can be achieved on a property.

One experienced winegrower estimated that for someone buying a vineyard just to grow grapes, a minimum economic unit would be an eight-hectare block, giving seven hectares of that planted in Sauvignon Blanc. Another winegrower noted that a vineyard's value is linked to its water supply and, to a certain extent, other infrastructure, and the scale of the property. These interviewees estimated average prices in 2023 to be at least $200,000 planted but noted there are always exceptions, citing an example at the time of a six-hectare vineyard near Rapaura Road priced at around $400,000 per hectare. A third winegrower estimated prices to be "north of $250,000 per canopy hectare for fully developed productive land".

By 2021-22 demand for vineyards was being driven by wine companies keen to increase grape supply quickly and choosing to purchasing existing vineyards rather than developing green field sites (New Zealand Winegrowers, 2022). In 2022-2023 increased interest rates, high inflation, and potential climatic risks (heightened by Cyclone Gabrielle) were influencing buyer interest and expected to do so for some time (New Zealand Winegrowers, 2023). More recent sales in 2023-24 have been of smaller scale blocks with either older vineyard improvements or unfavourable varieties that need redevelopment (Gifford, Powell, & Hill, 2024).

Image 43: New vineyard block being developed in the lower Awatere Valley in January 2023

Figure 47 is a reproduction of Colliers' long-term trend of vineyard sale prices from the start of 2015 to mid-2024 (Gifford, Powell, & Hill, 2024). The data is presented on a vineyard and headlands per planted hectare basis, excluding any non-viticulture land and assets (dwellings, curtilage value etc), for the various sub-regions across Marlborough along with the assessed Marlborough Vineyard Model value (refer to the previous section) and average Sauvignon Blanc grape price for Marlborough. In 2023-24 the assessed value of the Marlborough Vineyard Model equated to $9,530,000.

Figure 47: Marlborough Vineyard Model Value ($ per planted hectare) and vineyard sales data, 2015-2024
Source: Reproduced from Colliers Marlborough Viticulture Property Market Report (Gifford, Powell, & Hill, 2024)

In addition to the high cost of land, conversion to viticulture is a considerable capital investment and it is a transition that occurs over several years. One winegrower estimated that it is costing them around $60,000 per hectare to convert land into a vineyard. They chose to retain their land base rather than sell off blocks to fund development, so they have progressively borrowed and developed based on cashflow. Having just finished the transition, they are now starting to redevelop some of the original plantings, which are reaching the end of their productive life. However, the cost per hectare for conversion is influenced on the size of the area being converted, with small blocks likely being more expensive per hectare than large blocks (all other things being equal).

Other interview comments on this topic were:

- *In the last three years land prices have gone from affordable to unobtainable. Prices have almost doubled. Eight years ago, they were in the early $100,000s to $130,000/140,000 per hectare for Awatere and late $190,000s, early $200,000s in the Wairau. Now, it is early to mid-$400,000s/$450,000 per hectare unless it is the lower Wairau. So, you've seen that side of debt loading for sure. There is also major capital investment in many companies from a winery perspective as well.*

- *Marlborough debt levels are probably quite low. As vineyards reach the maturity phase of 20 to 25 years old they are replanting, and some re-investment is needed. Some vineyards are being pulled out entirely, and in others only certain vines are being replaced so that production is maintained. For us, the replacement model gave us the better internal rate of return over the life of the vineyard than ripping out and starting again. As people are retiring, they are either selling the vineyard down through the generations or, if there is no interest, then it is just as likely to be leased as sold.*

- *We've been in the game for a long time and are in a secure position. We have enough equity in the business that the banks are happy as long as we continue to have cashflow coming in. Much of our land was bought at a low price, which makes a huge difference. If I was buying land now, yes, you'd be looking for high yields to make it worthwhile. Thankfully, we're not in that position and our priorities are based around profit definitely, but also the environment. For us it's very much the whole package.*

- *I've seen a generation of change from smaller family-owned businesses, to becoming more corporatised and large family holdings. That then creates a whole lot of issues around succession going into the future. We are talking big numbers in terms of these asset values, and that's been a generational change over the last twenty to thirty years – it's been substantial. There are parallels with the changes in land values for dairy farming, pastoral farming, kiwifruit, pip fruit. There has been a major lift in values to varying degrees for all land based assets and these businesses.*

Vineyards rely on their water supply, which is tied into the land value. Water security is expected to be an increasing issue when buying or refinancing vineyards. Several winegrowers anticipate that there may be increasing pressure from banks to invest in water storage, especially those vineyards that do not have access to groundwater, such as those that rely solely on Southern Valleys Irrigation Scheme. One winegrower expressed surprise that water storage is not already mandated for new vineyards and described it as a personal 'bottom line'. The distinction between new vineyards and established vineyards is important.

- *Water storage is not the silver bullet and necessarily the best solution, but a new vineyard should put in enough to deal with irrigation needs. It is a different proposition for long established vineyards where it is a major change. If it is a new vineyard proposition in front of you, you can make the investment decision based on all of the costs. It's no different to going into an area where you might need overhead water for reliable frost protection versus frost fans. You might take the cheaper option and put in frost fans and live with occasional frost losses because it was too cold for the frost fans.*

As a business, vineyards have a range of ownership and management structures, from owner-operators to international companies that are based overseas. As already mentioned, some vineyards own and/or lease vineyards but a few also include blocks in other winegrowing regions around New Zealand. In some cases, a company may include a winery and several wine brands, and with those wine brands come vineyards. However, a wine brand is not necessarily connected to a specific vineyard. There may be more pressure on larger companies for environmental reporting, particularly if they are publicly listed. A company in overseas ownership may need to meet more than one set of standards.

A constraint for overseas-owned companies is land ownership and they may be more likely to have a mixed business model of owned and leased vineyards. In some cases, the vineyards are dry land-leased or bare land-leased, and the company owns all of the improvements. In other cases, vineyards are developed land leases based on a partnership between the company and the landowner who develops and owns the vineyard. If a business becomes uneconomic it is possible that the vines may be leased rather than removed as long as production can be maintained.

- *There are not just the corporates, but there are lot of growers in Marlborough - a lot of individual small families; some vineyards are now three generations deep.*
- *Our model is different to lots of other people as we are a grower, and we grow for many other companies. But it won't work if those who are growing for a larger company that wants homogeny and things a particular way.*
- *Generally speaking, it would be rare for someone to start up a vineyard if they are not already involved in the industry or have a fortune that they are bringing to the table.*
- *An international company is still run on the ground by people who live in Marlborough. We aren't any less invested than if we were working down the road for a company that is New Zealand owned. The company supports local start-ups and invest in new technologies that might not be happening otherwise.*
- *Land prices have gone up with new people coming in, and the investment opportunity in Marlborough has become a lot more lucrative. As the investment value in Marlborough goes up, the average wage in Marlborough goes up, and the economy is further ahead.*

6.6 Current Water Use

As noted earlier in this report, water use occurs in two main ways: 1) water is taken and used as an input in economic activities and 2) it is used to absorb and/or transport substances lost from these activities. This section briefly discusses water quality in relation to vineyards and wineries but is primarily about water takes. It covers the topics of irrigation efficiency, frost protection, water storage, and consent duration before turning to the possible impacts of reductions in water availability in the next section. One winegrower interviewed observed that "the biggest constraint for Marlborough is probably not land area but water availability, so we have to be clever about how we use it."

Being a perennial crop with limited soil disturbance and use of fertilisers, winegrowing typically has low losses of excess nutrients and sediment in comparison to more intensive land uses[233]. Nutrient use in viticulture is highly controlled by Sustainable Winegrowing New Zealand (SWNZ) and most nitrogen applied to grapevines is fixed in the grapes and vine (Wilkinson, 2022). Monitoring of nitrate leaching under vineyard soils on the Wairau Plains showed less than 4 kg/ha/year of nitrate being leached (Green *et al.*, 2014). Subsequent modelling indicated that the average nitrate leaching for Marlborough's vineyards across 31 soil types is 9 kg /ha/year on, with soil (particularly its carbon to nitrogen ratio) playing a dominant role (Clothier and Green, 2017).

233 Typical seasonal phosphorus application is through fertigation systems. A commonly used product is Kristalon Yellow, which is high in phosphorus and applied in spring to promote root movement and set up vines for the season. A Kristalon White product, which has less phosphorus and more nitrogen, may also be applied a little later in the season. Both products are applied at around 5 kg per planted hectare and leave negligible trace in soils because the nutrients are almost fully taken up by the plant while drip-line application prevents surface run-off.

A more critical water quality issue for winegrowers in Marlborough than nutrient losses is the adverse effects of high turbidity caused by suspended sediment in water takes for irrigation in the Awatere Valley. This issue is discussed in relation to water storage further on in this section.

Many winegrowers are working to enhance biodiversity vineyard areas and surrounds, some of which have benefit to the quality of fresh water. SWNZ data for 2022 and 2023 indicates that roughly 40 per cent of Marlborough's winegrowers[234] have indigenous plantings, created habitats for indigenous wildlife (e.g., wetlands, woodland, pollinator strips, riparian margins), and have taken specific management steps (e.g., reduced mowing and herbicide or pesticide applications).

Almost all the total water used in viticulture annually is for vineyard irrigation, which includes sprinkler frost protection[235]. The remaining water used is for vineyard spray tank water and in wineries. Variability in total irrigation water use between years within a winegrowing region depends, in part, on the amount and timing of seasonal rainfall. In 2022-23, 27,000 hectares of the total planted vineyard area was irrigated (89%) and total irrigation water used amounted to just under 30 million cubic metres[236] (just over 1,100 m^3 annually per irrigated hectare). It was a year of relatively low irrigation water use and high production that made the vintage the lowest water intensity of any in the previous decade (Agrilink, 2023). On average, the proportion of planted area irrigated increases with vineyard size, ranging from 69 per cent for 0-5 hectare vineyards up to 95 per cent for 200+ hectare vineyards (Figure 48).

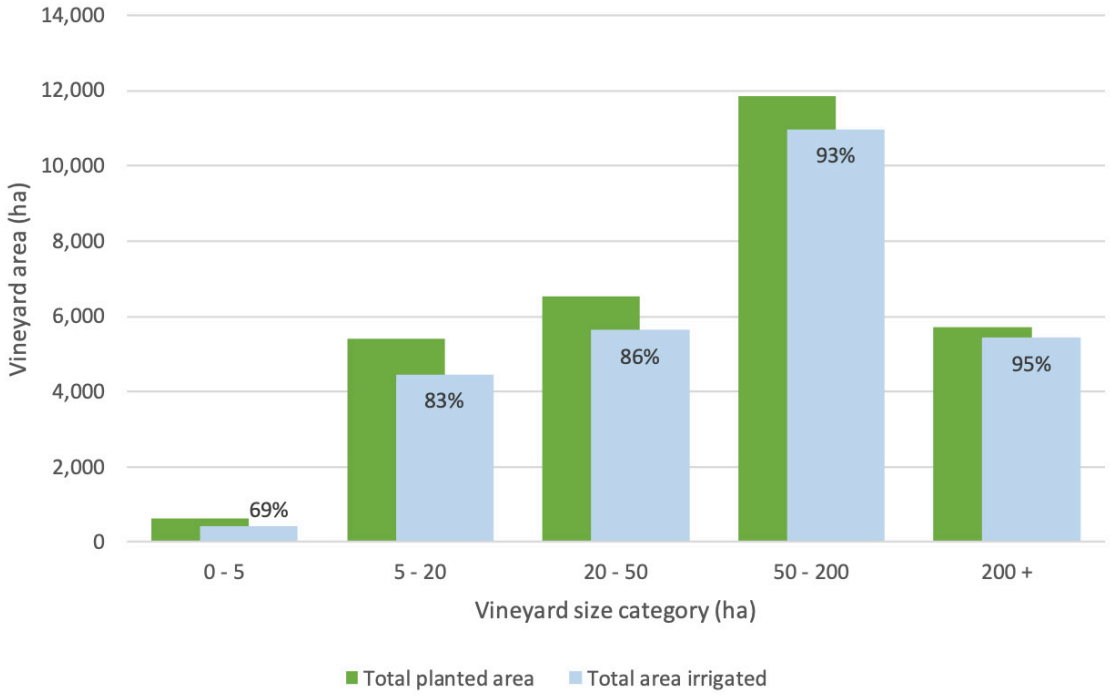


Figure 48: Comparison of planted area and irrigated area by vineyard size category in 2022-23
Source data: SWNZ

Patterns of seasonal rainfall affect both the supply of, and demand for, irrigation water – as well as the environmental effects of the water used. These patterns, and so water supply and demand, are becoming more variable with climate change.

234 It may not be the same 40% of winegrowers in each case.
235 Irrigation water use is estimated as 98% of total vineyard water use in Marlborough since 2014 (Agrilink, 2023).
236 By comparison, total winery water use in Marlborough was just under 735,000 m^3.

As an example, total rainfall for July 2023 to June 2024 was 374.4 mm, which was 58 per cent of the long-term average (643.8 mm) and the third lowest July to June total on record since 1930–31 (Raw, 2024). This extremely dry 12-month period was preceded by the eight wettest July to June period on record in 2022-23 (Raw, 2024). In an interview, a winegrower commented in later 2023 that, "The last few years were La Niña, which is wetter here. This year (2023-24) is El Niño and we are worried about droughts. Last time we had a drought was leading up to Christmas 2017 and the Southern Valleys Scheme off was basically cut off. But by January 2nd 2018 it started raining and didn't stop – we didn't need water after that anyway."

Other growers' comments on this topic were:

- *Growers are gradually having to deal with less supply or more unreliable supply. In the Wairau Catchment a 1960s diversion system for flood protection may be contributing to declining levels in the aquifer. Vineyards in the Southern Valleys, where there is less groundwater, went dry during an El Niño in the late 1990s. The Southern Valleys Irrigation Scheme is no longer sufficient, depending on the size of the property. In the Awatere most takes are surface flow – if there's water in the river you can take it, but it often looks like a chocolate milkshake.*
- *The longest we've had our water cut off is three to four weeks and our vineyards are well equipped to cope. We moderate our crops by having less canopy and less fruit. With Chardonnay and Pinot Noir you can get away with very little water. It's the make-up of the fruit, the cell structure, and they do better and have better flavour if they are slightly stressed. If you put stress on Sauvignon Blanc, you lose flavour and character, so you have to keep the water up. The makeup of my vineyard means I can shuffle water around to keep Sauvignon Blanc ticking away and restrict Pinot Noir and Chardonnay.*
- *Climate change is going to be extreme. We're going to need more water sometimes, and not at others. Our annual irrigation volumes will go up and down a lot more – we've had two lower volume irrigation years, but you look back at the two before that and they were the driest since the 1970s. It will get worse.*
- *If you just look at more heat as a simple example, at some point it will become unfavourable for Sauvignon Blanc. In some sub-regions of France they've switched to other varieties because it is basically too hot. You could see the same happen with water availability as it is ratcheted back, at some point we may not be able to grow Sauvignon Blanc as successfully in the future (50 to 100 years). Change is gradual but there will be a threshold where we look at other grape varieties, or other crops. Water will help us move that threshold date back.*

6.6.1 Irrigation Efficiency[237]

Irrigation efficiency largely depends on the physical infrastructure and technical management within a vineyard, with the latter being provided either within the business or by a contracting service. Some winegrowers appear to still have room to improve the efficiency of their irrigation, while others have already made a lot of progress (e.g., using vine sensors and software to understand their water needs and help with scheduling) and have few measures left to turn to. This said, one winegrower was of the view that although many winegrowers in Marlborough have tried different irrigation strategies over the years, for 'middle of the road' Sauvignon Blanc production there may be few differences between vineyards.

237 In 2005, HortResearch produced a Marlborough Crop Water Use Efficiency Report that served as a discussion document for stakeholders at the Marlborough Crop Water Use Efficiency Review Meeting (Green, Greven, & Clothier, 2005. Key factors controlling vine water use identified at the time were: prevailing microclimate, vine total leaf area, and available soil water.

- *Our vineyards were developed in the early 2000s. The thinking then was to divide a water take into days and irrigation infrastructure was designed for that continuous rate. It is a flawed system for things like evaporative loss and mechanical downtime. As our permits are rolling over onto the monthly IrriCalc schedule, we are unable to physically use all of our water in some places because our main lines are not big enough. We are constrained by the existing infrastructure and, as it is beginning to limit us, we are moving to improve our system capacity.*

- *If you were in Marlborough twenty years ago and you asked most growers, "What was your irrigation strategy?" they'd say two hours a day, and that would be that, set the controller and go away for Christmas break. That's changing, and it is important to realise that a lot of work is being done to make sure water is being used sensibly. New technologies all take time and resources to introduce.*

- *We use a soil moisture monitoring service. Neutron probes tell us where the water is in the soil profiles, whether it is deep down or shallow. It tells me how I should be irrigating. If the top is drying out and the bottom's still wet and then I'm going into a dry spell, I'll fill up that top portion of the soil so I'm not depleting the lower portion of the soil profile. We are very active in reducing our water use. I wouldn't want to go much less. A lot of people are quite surprised at how little we do use.*

- *Our irrigation is all above ground - we're putting in some subsurface in the town block because it's set up for it. We put soil moisture probes in four or five years ago and it was a game changer. We used to do 12-hour waterings (just because that's what we always did) but found a lot of that water just fell out the bottom. Now we water for a shorter time and use the soil moisture probes to work out when to turn it off.*

- *All our irrigation is 200 mm above ground, including the new vines I've just planted. I think more work is needed on subsurface irrigation, just to be a bit more confident in it. We have probes and work off those to a degree, but I need more of them. We used to irrigate in ten-hour blocks, but we've certainly reduced that now. I go with the old school: if it's going to rain, we won't irrigate. I know technology is better and we can be more specific than we are. We use pretty much all the water that we're allocated, not because we can, but because we need it.*

Several methods are used on almost all vineyards (estimated to be between 84% and 89%) to optimise the application of water (Figure 49). The most common are largely those that are lower cost: measuring rainfall and/or soil moisture (can be measured simply with a spade and a visual assessment), monitoring weather forecasts, and maintaining irrigation systems. On some vineyards, particularly the more sizeable ones, use is also made of irrigation zone maps (48%), consultant reports (23%), and vine moisture measurements (11%).

As well, some winegrowers actively look to improve their water efficiency practices or initiatives. While at least nine out of ten vineyards have a leak detection and repair programme, benchmarking reports of water use over time are reviewed for roughly a quarter, and about one in ten have recently installed new equipment that has resulted in further water efficiencies.

- *We have a lot of soil moisture probes across our blocks to indicate whether irrigation is needed. There'll be a lot of situations where people are growing without that sort of input. We are also moving into sub-surface irrigation. Same production but less water because you're not losing as much to evaporation, you're not watering weeds, you're getting water to where you want it.*

- *Having reliable pumping infrastructure is also really important. If you miss irrigation shifts because of unreliable pumps, pipes, or valves then you've put yourself into deficit and it's more difficult to get back to where you want to be than had you just maintained the right amount of water at the right time.*

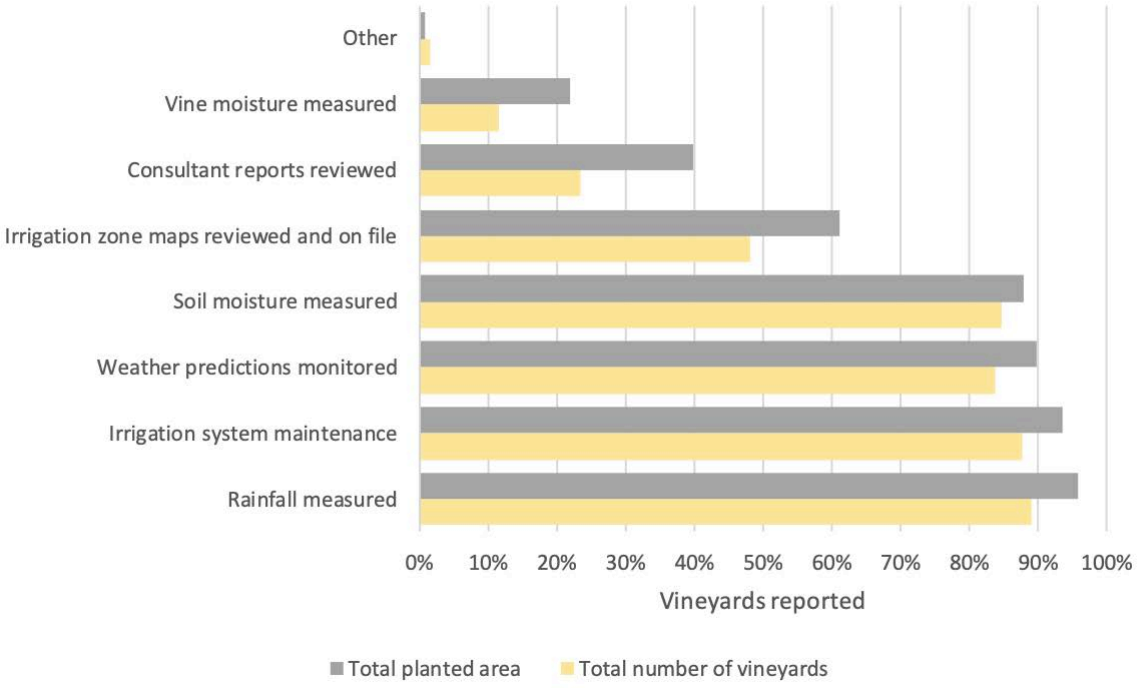


Figure 49: Use of methods to optimise water application in Marlborough vineyards in 2023.
Source data: SWNZ.

An extremely efficient form of irrigation is sub-surface dripline, which is seen as a viable option for vineyards in some locations with varying levels of cost. Ideally, it is installed at a depth of 300 mm (with drippers around 600 mm apart), although it can range from 50 mm to 500 mm depending on the conditions. It is more difficult to install in soils with high-alluvial deposits (i.e., stony soils) soils that are hard to penetrate. The driplines can occasionally become blocked when used in finer soils, which shows in the soil as a soak mark. Anecdotally, winegrowers are successfully using sub-surface irrigation over quite large areas in localities such as the Awatere. Although the technology has been around for a while, its wider uptake by winegrowers in Marlborough has been more recent (i.e., within the last five years).

One of the winegrowers interviewed explained their experience:

- *Our new subsurface irrigation may turn out to be lower cost. We don't need a wire as the dripline is mole ploughed straight into the ground, so the setup cost is cheaper. We should have less repairs and maintenance because being in the ground it doesn't break with machinery, sheep can't trip on it, it is not damaged during harvesting, and hares don't eat it. The capillary action is supposed to stop stones becoming an issue and it is copper impregnated so it shouldn't get root ingress into the drippers.*

Image 44: Croptide vine sensors measuring sap flow for irrigation data

Several winegrowers commented that a reliance on a daily take may be a less efficient use of water than a maximum take per week, as allowing deeper irrigation can mean less water use overall. One winegrower raised the use of Irricalc[238] to allocate water as a possible constraint on their ability to improve efficiency in the future. Another described it as a reasonably generic approach that essentially uses 'bell-shaped' curves to allocate water for irrigation within a year. While they supported reducing overallocation, they viewed Irricalc as not necessarily a good fit for a locality's typical environmental conditions. The winegrower used the Awatere and the Wairau as two examples to highlight their point:

1. Vineyards in the Awatere have a longer season with a smaller peak. During the early and late season shoulders they potentially will not have enough water to irrigate in the way that is optimal for the vines, but if they irrigated optimally then they use less than the total IrriCalc allocation.

2. Vineyards in the Wairau typically are irrigated earlier than the IrriCalc calculation is giving any decent amount of water, and then finished and harvested before that allocation runs out. It does not 'sync' well with a typical growing season in some vineyards.

The winegrower concluded that "Irricalc is not particularly granular in its assessment of the soil type and what you're growing. There are vineyards that aren't that far apart that have hugely different irrigation needs but effectively get the same distribution of allocation."

238 IrriCalc is an agricultural water balance model operated by Aqualinc Research that simulates the day-to-day operation of an irrigation system to avoid crop yield loss due to water stress (Collins *et al.*, 2022). Irrigation water application is defined by a rule-based approach on a daily basis in response to modelled soil water balance status, which determines the timing of irrigation and the amount to be applied.

6.6.2 Frost Protection

Frost is a potential hazard in many of New Zealand's winegrowing regions, both early and late in the growing season. While spring frosts can damage developing grape buds, autumn frosts can lead to premature leaf fall (Trought, Howell, & Cherry, 1999). For example, a frost in Marlborough in late March 1992 followed by rain resulted in dead, wet leaves that caused major problems with machine harvesters and excessive plant resides in the fruit (Trought *et al.*, 1999). Frost damage not only puts at risk the current season's crop, but also because of the perennial nature of grapevines, can influence the productivity of vines for several seasons in the future (Trought *et al.*, 1999).

Frost protection begins during vineyard development with winegrowers assessing the frost sensitivity of a particular site. For those sites where there is sensitivity, attention then turns to the use of frost-fighting methods along with the remediation of any damaged vines (Trought *et al.*, 1999). The two main frost fighting methods are frost fans and overhead sprinklers. Frost fans draw down warmer air from the inversion layer and are generally effective for frosts down to -2 degrees Celsius. Overhead sprinklers rely on the latent heat of fusion[239] and are effective for frosts down to a depth of -6 degrees Celsius. As sprinkler water needs to be applied continually during a frost, large volumes of water may be needed and some vineyards rely on water storage to supply water[240]. The two methods can be run in conjunction with one another.

The predominant frost fighting method In Marlborough is frost fans with sprinkler frost protection being less common than it is further south, accounting for just under three per cent of total irrigation water in 2023 (compared to 31% for Central Otago in 2022). However, sprinklers still are important for Marlborough vineyards in certain situations. A winegrower noted that "Water is incredibly effective for frosts, but it does make everything soggy." Although there is some uncertainty around the data, water use for frost protection could equate to an additional 3.3 litres per litre of wine and the second largest use of water in the winemaking process (Agrilink, 2023).

- *Some winegrowers use frost protection. It tends to be more on the outskirts of the wine growing region. In the central Wairau Valley, there are frost machines but not 'flippers'. It seems that it is more the Waihopai, potentially upper Awatere – the extremities. The cost as well as repairs and maintenance are so high you'd need to have the lower temperatures to justify it. The other issue is the noise where there is housing density. For a frost machine to get a consent you need to have a separation distance[241] from a residential property or signed off from the neighbour to be closer.*

Figure 50 shows the average use of water for frost protection compared to total irrigation water in 2022-23 for vineyards in each of the five size categories. The vineyards in the four more sizeable categories (those with a planted area of 5 ha or more) used between two and three per cent of their total irrigation water to protect vines against frost damage. Where water for frost protection was applied, the averages for these vineyard categories ranged from 56 to 98 mm (based on the area irrigated). In contrast, the vineyards in the smallest vineyard category (0-5 ha planted area) used 12 per cent of their total irrigation water for frost protection (on average) and applied this water at a higher rate (127 mm).

---

239 Sprinklers are used to cover the plant in a mist of water that then freezes. As the ice forms it releases heat that keeps a thin layer of water around the plant, which protects it from frost. More information is available at: *https://wineanorak.com/2020/03/30/frost-protection-using-sprinklers-how-it-really-works/*

240 As an example, Waterforce indicated that in Central Otago most sprinkler systems deliver one mm of water per hour and that the average use per frost event is for six hours (Wilkinson & Ford, 2023). In the region, these systems are designed with water storage that allows for sufficient storage to apply frost protection water for five events.

241 The proposed Marlborough Environment Plan (Vol 2 Rural Env Ch 3 - Controlled activity Rule Standards - 3.4.1. Erection and use of a frost fan) includes setbacks of between 300 m and 500 m as well as noise limits.

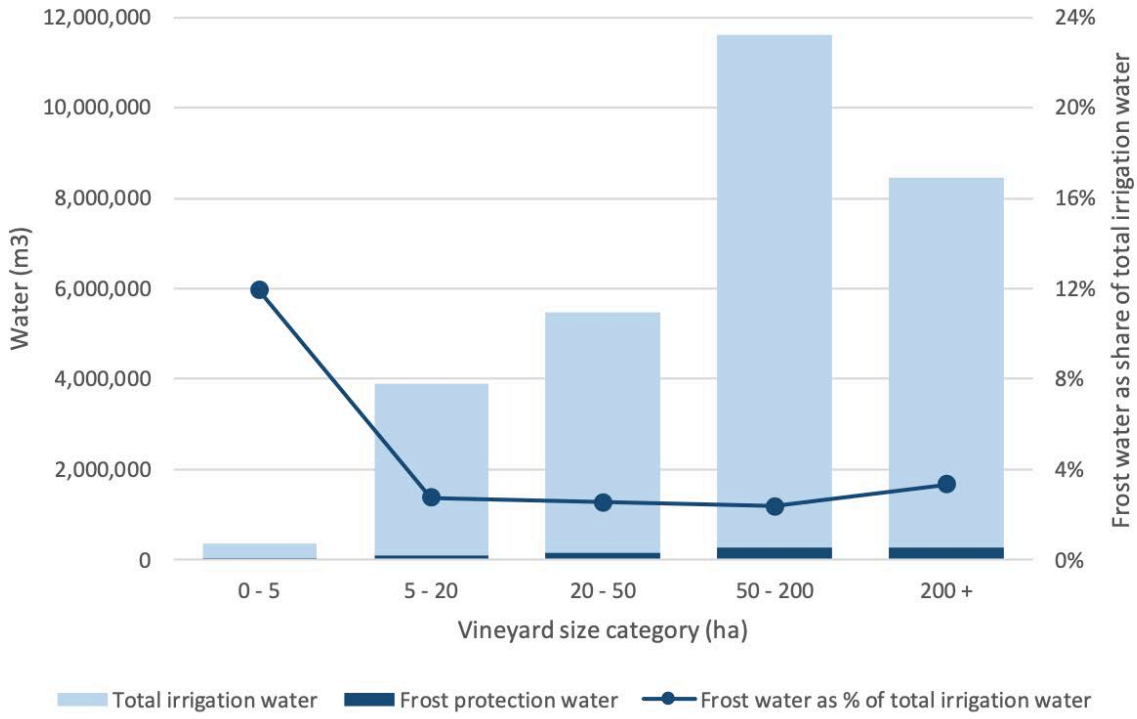


Figure 50: Average use of water for frost protection by vineyard size category in 2022-23
Source data: SWNZ

In those areas where frosts are a more regular event, it was observed that their frequency and severity may be altering over time. One winegrower commented: "We always get frost. Twenty years ago, we used to get down to –6˚, but now the hardest frost we get is –3˚, so water easily protects for that." However, they do not necessarily see a future without frosts, viewing climate change as being more about extreme weather events (e.g., floods or drought). "Last year in Marlborough and the year before we barely had any frosts through the winter period. This year, we've had an absolute cracker, and we've had weeks of them."

Where sprinkler frost protection infrastructure is already set up, a shift away from it comes at a cost, either to install an alternative method or as a loss in production from frost damage to vines and grapes. The impacts of such a change may be quite variable between very small vineyards and other vineyards. The topic of frost protection is covered in some depth in the Viticulture Chapter (Section 7.5.2) of the report titled Otago's Rural Businesses and Environmental Actions for Fresh Water (Wilkinson & Ford, 2023).

6.6.3 Water Storage

The existence of water storage on a vineyard strongly depends on individual circumstances, including the purpose of the storage (e.g., frost protection, managing suspended sediment, irrigation), the stage and size of the vineyard, access to capital for investment, access to alternative water sources, and opportunities within a property's natural landform. One of the winegrowers interviewed observed that "Since 2000, the situation has been changing. Water storage used to be a lot less common as typically, winegrowers tended to get a generous consent for the property being developed and good security around accessing that water."

Image 45: A newly installed water storage dam in the Southern Valleys, Marlborough

In 2022-23, 200 (18%) of Marlborough's vineyards reported having some water storage capacity (Figure 51), which was up from 179 vineyards in 2021-22 (noting some of the increase may be an improvement in reporting). This increase of 21 vineyards was spread fairly consistently across all five vineyard size categories. From 2021-22 to 2022-23, the proportion of irrigated area with water storage reported increased by one per cent to 44 per cent. The proportion of vineyards with both irrigation and water storage increases with the size category of the vineyard (ranging from 8% to 60%) while the average storage volume per hectare is greatest for vineyards between 20 and 200 hectares (Figure 52).

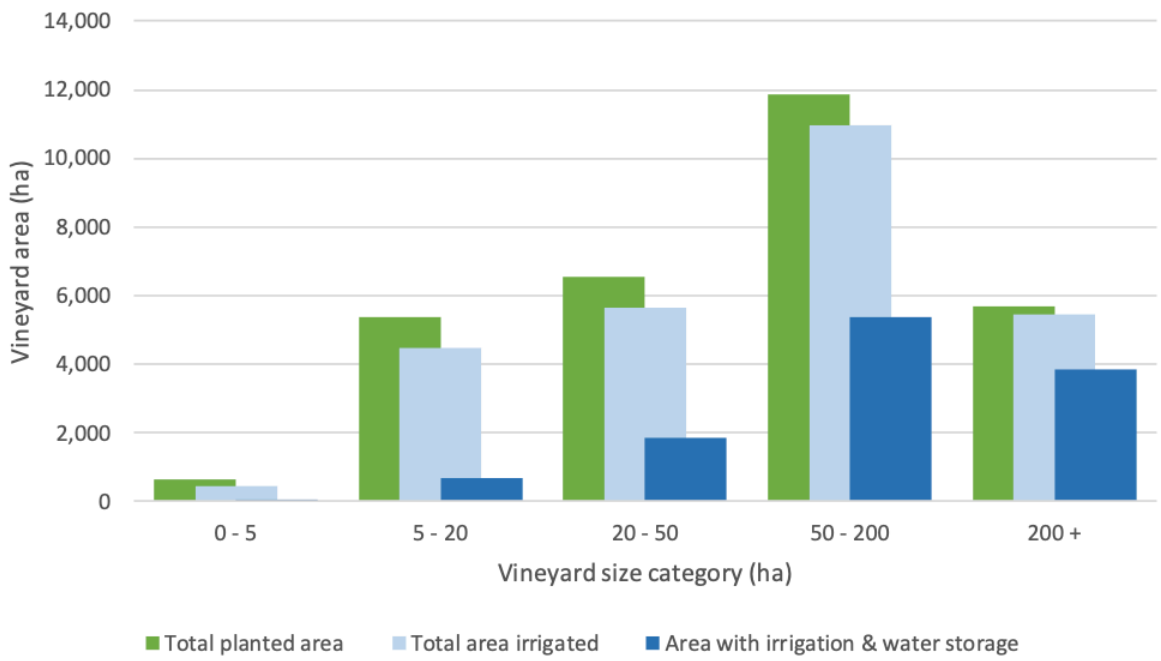


Figure 51: Distribution of total area with irrigation and water storage in 2022-23
Source data: SWNZ

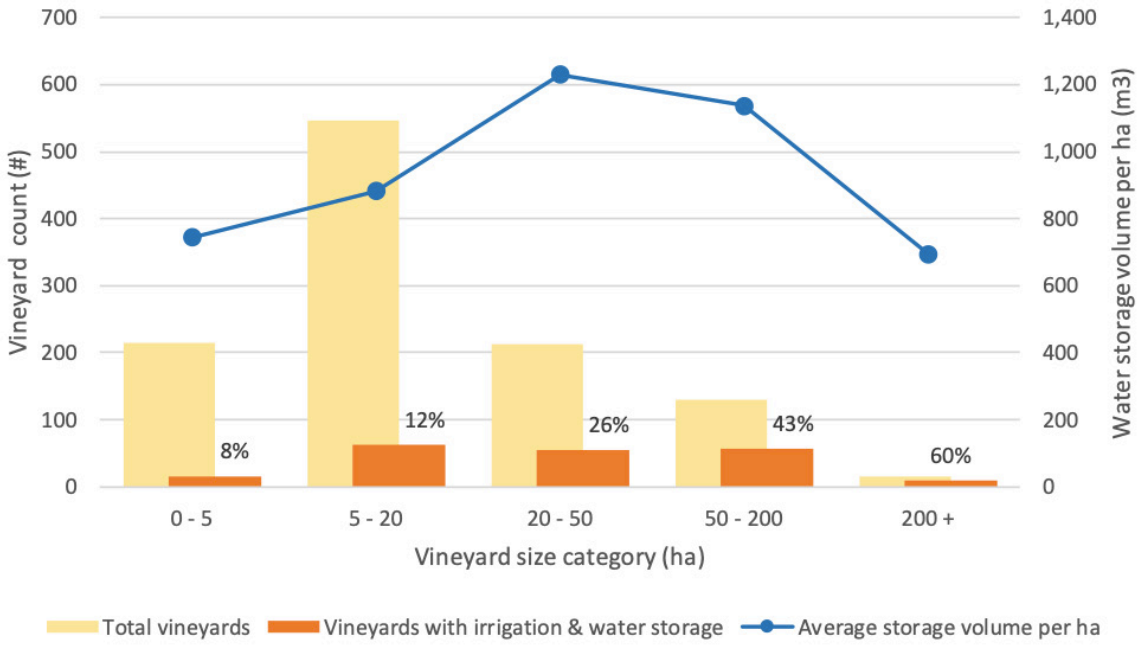


Figure 52: Distribution of vineyards with irrigation and water storage in 2022-23
Source data: SWNZ

The winegrowers interviewed expressed a wide range of views on water storage:

- *Most of our vineyards have alternative water sources, some have backup water storage. They are old vineyards so have a multitude of wells on them and are also connected to the Southern Valleys Irrigation Scheme. My main vineyard has Class A water rights out of rivers, and I have the flexibility to pump water between dams.*
- *You lose water consistently. There have been cases where, because a dam is nowhere near big enough, water is being pumped out into the vineyard while water is being pumped from the river into the dam to keep the cistern full. In other words, pumps are being run twice. In the Awatere, the dams are possibly more efficient simply because they've needed to be bigger. The Awatere Valley is slightly cooler but windier, so evapotranspiration is likely to be similar to the Wairau.*
- *Water storage gives you security but not necessarily efficiency. We work to minimise and optimise our water use. It comes down to technology, infrastructure, and irrigation method.*
- *Water storage may not buy you security. It used to be people were building dams to say, "When our well goes dry or when our water goes off because we're Class B, then we've got 15 or 20 or 30 days of irrigation." Now, the mainstream thought is, "I want to do all my seasonal irrigation out of a dam that I only fill in the winter." And so, there is a continuum of value and thought processes around management of water, as well as capital investment.*
- *In most situations a storage dam takes away productive area. We don't really have a shortage of water over a year, arguably it's a water storage shortage within seasons. Building individual reservoirs can be an inefficient use of capital and there is evapotranspiration and pumping the water twice. You only need to look at the small hydro-electricity production facility by Lake Argyll (Upper Wairau Valley). You can see the effect on the river when they release water, and it helps the Southern Valleys Scheme.*

Newer vineyards are being developed with water storage, while it often needs to be retrofitted (usually with a loss of planted area) for established vineyards. Vineyards with multiple properties have a mix of water storage situations, although some have none. Older vineyards are often located in the lower Wairau on the most highly productive (and so highest value) land and rely on groundwater, which has been a secure water supply historically. Taking this land out of production for water storage has a greater cost per hectare, although the vineyard might be in a better position to afford the capital investment than those in other localities. Water storage is more common in the Awatere Valley and suitable land may be more available for new storage. However, these dams tend to be used more as a 'cistern' to manage the quality and flow of the water than for its longer-term use.

- *Useful rainfall recharges the aquifer without affecting water quality. However, five mm of rain in the upper Awatere can make the entire river system unpumpable (due to its turbidity). There may not be any rainfall on the coast and even though there's flow in the river, you can't pump it. Generally, the dams for water storage are bigger in the Awatere than in the Wairau because you don't have the recharge available.*

- *The water scheme we draw from (Blind River Irrigation Ltd.) does not have sufficient filtration. Rain in the headwaters dirties the river and, by the time it comes clean enough to be able to draw from again, the volume has dropped and your ability to draw water is cut short. It's not easy. If there was government investment in infrastructure to give the ability to draw water earlier, even though it's dirty, it would lower the risk for everyone.*

- *The Awatere River is notorious for having high turbidity. An inland thunderstorm can create a plume of silt that makes the river unavailable for several days in summer, but we've had no rain downstream. We could tolerate some turbidity with broadacre irrigation for cropping, but pumping sediment loaded water through a drip line is not a good combination. We need really good filtration and to be smart when we're pumping from the river and be prepared to stop. Fortunately, much better monitoring of the river means we can see when there's a spike in the river flows and go and have a look. We use any spare capacity from our direct irrigation take from the Awatere River to fill our storage dam for when the river take is unavailable. In those instances, we can pump straight out of storage, keep our vineyard watered until we can go back to direct irrigation.*

- *Relying on the Awatere River is insecure without Class A water rights and/or water storage because it is subject to river levels and flows and also gets very dirty. It's a very difficult river to consistently extract water from. The infiltration galleries are more complex and less secure than a bore to an aquifer. They need constant maintenance and can be damaged from floods. The water from the river is very abrasive and can damage pumps, block up drip lines and just wears everything out quickly.*

- *The Awatere Water Users Group[242] has 40 plus members that irrigate from the river and we have worked for over ten years on an Awatere Riverbed Activity Guidelines Document. If you are having to do works in the river to maintain a diversion or a surface take or an infiltration gallery, then there are good management protocols about how you should do those river works to avoid disturbance to nesting birds, freshwater fish, managing turbidity in water, as well as interference effects to downstream water users.*

242 Awatere Water Users Group: https://www.irrigationnz.co.nz/water-measurement/Category?Action=View&Category_id=82

Several winegrowers interviewed also noted that they had recently been through the dam reclassification process with Marlborough District Council under the Building (Dam Safety) Regulations 2022[243]. One winegrower expressed surprise that their storage dams do not meet the new height and capacity thresholds of a classifiable dam, and so is no longer legally considered as such.

Image 46: Poorly bedded sandstone and sandy siltstone in the Awatere Valley

6.6.4 Permit Duration

Viticulture is a capital-intensive industry (Wilkinson & Ford, 2023). Large investments are needed to develop or purchase vineyards. There is also a sizeable annual cost in maintaining that investment, meaning investor confidence is necessary to gain finance. As well, establishing a new vineyard is a considerable undertaking and may take seven or eight years from time of the land purchase to reach full crop production (Wilkinson, 2022). Consequently, the duration of permits for water is a factor in decision-making.

One winegrower proposed that in the future permit duration for water is aligned with the minimum land arrangements that wine companies work to, which was 25 years for the Sauvignon Blanc production cycle. Another winegrower was of the view that the lifespan of a Sauvignon Blanc vineyard, when well-managed, was 30 years, but between 20 and 30 years was "workable" for the duration of permits.

243 https://www.legislation.govt.nz/regulation/public/2022/0133/latest/whole.html

- *With 30 years it means the permits are coming up as you are looking at replanting your vineyard, so you can think whether there is a different way of setting up your vineyard to suit your water allowance. Ten years is a bureaucratic headache and the uncertainty is scary, especially if you were growing Sauvignon Blanc when your production is designed around a certain amount of water. If you know you've got signalled that in ten years' time your water will be cut (because that's the way things are going), you've got time to build up reserves and come up with a plan, as opposed to five years. Trying to do anything in five years is not an easy thing.*

Another winegrower had, over the course of 40 years, always worked with ten-year water permits. Despite the shorter permit duration, they had confidence in their ability to renew their permits because their use of the water is "fair and efficient", and they made sure their abstraction met the permit conditions on riverbed activities.

Other comments in the interviews on this topic were:

- *The last time we applied for a permit we asked for 30 years and got 20 years, and I have friends who asked for 20 years and got ten years. The Council should have a standard permit term for viticulture, be it they take a happy medium of 15 or 20 years. If it is less than ten years, then it's not worth having. You wouldn't replant and it's too much risk if you are developing a new vineyard. There is so much paperwork and expense - certainty and consistency of permit term is very important.*
- *Water permit timeframes are important but so is having conditions that don't change. I understand that we are all learning and things just can't stay the same for ten or 20 years but some 'tweaks' are not minor.*
- *Shorter permit timeframes for adaptive management makes sense, but it is a lot of paperwork too often. I think a standard timeframe is fairer and will bring down the cost.*
- *Without water we can't farm. It becomes extremely challenging, and the tenure of permits is critical. All our permits are for ten years so there is a fairness aspect. A critical issue is almost rewarding people for more efficient use of their water. It is difficult because how do you define what it looks like and then penalising people for inefficient use is fraught. How does water storage fit in? It is a massive cost, but it gives security to the business as well.*
- *When I went for my water permit 15 years ago there was even talk then of the water being overallocated. If there's not enough water in the aquifers and the amount of permitted water needs to be reduced, then part of me feels that maybe so much shouldn't have been allocated. The first thing they'll say is that there's not enough water there for everyone – well six new pumps shouldn't have been put right next-door to my pump.*
- *What I'm worried about is the permit reduction, you know, the amount of water that you use. I would hope that they don't take that off growers because there is so much variation. Especially with climate change, we certainly don't want a reduction in the amount of daily use – we just can't.*

6.7 Reductions in Water Availability

This section is based on the interview responses to two types of questions. First, the winegrowers were asked to comment on their options and possible impacts if a vineyard was faced with reductions in water availability. Second, they were asked to identify which factors may mean a vineyard may be more at risk than others of such impacts in the future. These questions were challenging for the interviewees because of their inherent uncertainty and complexity.

While each vineyard has individual circumstances, the winegrowers' responses to the questions indicate a possible continuum of impacts from reducing water availability roughly based on the degree of change: improvements in irrigation efficiency (including water storage), changes in flavour profile (less vegetative growth), reductions in crop yield, shifts in grape varietals[244], and finally possibly a change in ownership and/or land use. A complicating factor is climate change, which is predicted to make both water supply and demand more variable.

- *I'm not sure what I can do to reduce water – perhaps more probes, but they get expensive. It's a fine line. We have five soil types on a small vineyard, and it makes it very hard. I think for a lot of the people I speak to in my circles, a lot of irrigation is gut feeling – rightly or wrongly. We seem to be doing alright. Reducing the yield is a tough one because it is a business. I'd have to see more research on what we can achieve.*
- *My guess would be that the first land use change you would see is not a shift away from grapes but a switch in varieties away from Sauvignon Blanc. In the long term, you're probably talking about red grapes, the likes of what Hawkes Bay is doing now, the Syrahs first, more Pinot, then eventually your Cabernets. You're just basically going up the heat spectrum of wine producing regions across the globe. And typically, as you get hotter, you get more red.*
- *If we crop lower per hectare then hopefully, we'll get paid more. I am not sure whether some technologies can work everywhere, but only time will tell, and technologies may become the way to go. We certainly use a lot less water than we used to growing broadacre crops and process crops. We're pretty efficient compared to other land uses and that's something we should be proud of.*

The impacts for a vineyard of reducing water availability tend to depend on the time of year and alternative water sources (including water storage capacity). One winegrower described the irrigation 'bell curve' in Marlborough that follows the growing season: "You usually want a good amount of water on for flowering so you're possibly starting irrigation in October. It then ramps up through November to December. From December through to the start of February is typically when you want the most water and then you can start easing off. With Sauvignon Blanc you can keep watering until the start of March."

Another winegrower described current water restrictions as follows: "The driest period of the year is usually before harvest (late March-April) and water takes may be restricted from December onwards, depending on conditions and the 'classes' of water a winegrower can access. For example, the Awatere River has A, B and C class water: C class is restricted first, which is typically water pumped to storage,

244 By mid-century, in the Marlborough region, the four cultivars tested (Sauvignon Blanc, Merlot, Pinot Noir, and Grenache) would flower 3 to 7 days earlier and reach sugar ripeness 7 to 15 days earlier depending on the greenhouse gas emission pathway (Ausseil, Law, Parker, Teixeira, & Sood, 2021). For winegrowers to maintain the same timing of key phenological stages would require shifting planting of cultivars to more southern parts of the country or implement adaptation strategies (Ausseil *et al*., 2021)..

then B class, and finally A class. A winegrower's water allocation is more likely to include A class water if they were one of the earlier vineyards to be irrigated. The length of time that vines can survive without irrigation depends on multiple factors, including the watering regime up to that point, the stage a vineyard is at leading up to harvest, any rainfall, and the age of the vines."

- *An older, well-established vine will be well rooted and have a greater bank of water to draw off, whereas a younger vine will only have a much smaller root mass and consequently a smaller bank of moisture to draw off. The young vine will have a lower crop load as opposed to the older vine, but if you stress a young vine, you can kill it. It's getting the balance right.*

Where vines fail and need replanting it can take four to five years to return to full production, assuming new rootstock is available (Wilkinson & Ford, 2023).

6.7.1 Improving Irrigation Efficiency

Although vineyards generally use less water than most other land uses on a per hectare basis, there is a range in their efficiency. As previously mentioned, efficiency depends on technology, infrastructure, and irrigation method. Some winegrowers have already made improvements while others still potentially have gains to be made and actions tend to either be 'remedial' or 'retrofitting'. Those vineyards with older infrastructure may be less efficient in terms of water use.

- *Unfortunately, I have some blocks on a very stony soil, and 100 metres away it is swampy. And it's all irrigated at the same time, which makes it very difficult. So, I'm going to get on top of that with more zones. At the moment I make a conscious effort to manually turn irrigation on the blocks that are stonier than the others. The trouble is with our irrigation scheme we have to open ten hectares to make it work, otherwise it will just cut out on high pressure.*

If a vineyard's water efficiency needs to improve, then for some measures, when it occurs will influence the impacts. As a perennial crop, vineyards operate on a long rotation (some winegrowers still have vines in the ground dating back to the early 1980s). The length of vine rotation depends on factors such as the varietal's productive life, and changes in vineyard management (often based on improved knowledge about a property) or the replacement or upgrade of infrastructure. For example, a winegrower may choose to move a block of Pinot Noir from the valley floor to a hillside which may be a better proposition, while Sauvignon Blanc is better suited to flat land.

- *Changing underground infrastructure is obviously complex, especially when much of it is under the vineyard. The best time is when we redevelop blocks and are going back to a bare field because we can design what we want. But that doesn't happen in vineyards all at one time either. Typically, it will take several years to redevelop a whole vineyard.*

Several winegrowers identified the use of daily take limits on consents as possibly acting as a constraint on efficiency for those winegrowers who do not have water storage.

- *As an example, a winegrower has a take of 100 m^3 per day that they are encouraged to use daily, but for some soil types it is more beneficial to soak them at intervals of two to three days rather than watering daily. However, there is not this flexibility to use the allocation within a week, even though it may save some water and gain more benefit.*
- *The daily take limit doesn't affect us so much because our storage dams mean we can use the water how we like. There is a benefit in having flexibility for how you use the water, rather than just the volume you can water from a daily take. It applies not just to mature vineyards, but new developments as well. If you're just doing the same thing every day, and your water's only going down 200-300 mm then you're basically training the vines to stay within that range. You're making a rod for your own back really.*

6.7.2 Increasing Soil Carbon

In addition to technologies that directly relate to water efficiency, winegrowers showed interest in the relationship between soil health, water conservation, and water use. In particular, it was noted that increasing organic matter, and so soil carbon, can improve the water holding capacity of soil. Specific practices mentioned were cover crops and composting grape marc or pomace (pressed skins, pulp, seeds and stems).

- *More and more, we are concentrating on soil health and giving it a bigger reserve of soil carbon with cover cropping and all the techniques you can use every day. Soil carbon mitigates some of the issues around dry, wet etc., and just makes your vines healthier. When they're healthier they can mitigate the stresses that the environment throws at them. You are dealt a hand, but you can change it and leave the land in a better position. That needs to be taken into account when we're talking about water – the amount of water going in and its quality coming out – we can help the whole system.*
- *There's definitely an appetite for improving the soils. We are trialling compost from the mussel extracts out in Picton and we did quite an extensive under vine mulch. The difference was pretty good – it keeps the moisture in and reduces the weeds. If it works, hey, I'll do another ten hectares next year. Very expensive, but it's kind of that feel-good trying to do the right thing as well, provided the prices remain the same for the fruit – or more.*

As in other regions, some winegrowers try to maintain vegetation between the rows of grapevines and there are a few who also see value in the use of cover crops. Cover crops tend to be oat dominated but also may include mustards, buckwheat, phacelias, borage, peas, and radish. It is compatible with sheep grazing: most cover crops are sowed in spring and 'crimped' in summer, autumn cover crops are usually sheep friendly and grazed towards the end of winter (Wilkinson, 2022). Regenerative agriculture is not necessarily well understood in viticulture, but there is still considerable support for this type of production system (Wilson, 2022). There are also several instances of organic vineyards in the region.

- *The use of cover crops is something we're starting to do and I'm trialling some wool matting I was given under vine this year and expect it will reduce water use. Last year we put wool from our own ewes under some struggling vines and it seemed to work. Also, I like having green crop for soil microbes too.*

Grape marc, a solid agricultural waste from winemaking, is occasionally spread directly onto vineyards during harvest to build the soil's organic matter. However, leachate from grape marc can have adverse environmental effects for water and needs to be stored and spread with care (e.g., using concrete pads and collecting and processing leachate). One winegrower suggested that, although only a few wineries are equipped to make use of their grape marc, it appears that those that do think that it is worth the effort. Another had experience with grape marc:

- *We've done a fair bit of that, spreading under vine. Yes, the leachate can be toxic when stored and not handled correctly, but you can do it with minimal storage. You still have to get it on the ground, then into your wagon, then spread it – which we've done, and we've done it efficiently and effectively. It helps the soil compaction under vine, organic matter etc., etc.*

Image 47: Use of cover crops between vine rows in December 2021

6.7.3 Changing Rootstock

When winegrowers replace their vines, in some cases they will change their rootstock while others may just change the varietal clone grown on the rootstock. An option suggested by a winegrower to sustain grape yield and vine vigour under a more constrained water allocation (up to -10% in water availability) was to match rootstock to soil type. In theory, there are opportunities to achieve this as vineyards are established or as they are re-developed, either as planned or the result of trunk disease. However, whether these opportunities exist in reality will depend on whether it is possible to source sufficient supply, which is challenging. Further, matching rootstock to soil types at an industry wide level would be extremely complex given that soil types within a single vineyard block soil types can be very fragmented.

Another winegrower noted that in the 1990s the focus was on low vigour rootstocks because it was thought to improve quality, which turned out not to be the case. At the time, winegrowers in the main, were yet to fully understand the interactions between soil water availability, plant water use, and essentially the terroir. Much of the winegrowing region now relies on a single rootstock (#3309) because it is easy to graft and so is more readily available. In some cases, winegrowers may have used this rootstock in less suitable sites (e.g., on 'drafty' soils).

A winegrower explained "there are now deep-rooted rootstocks bred from material native to dry climates, such as the Arizona Desert or the Permian basin of Texas and they have a genetic tendency to be more efficient with water. In other words, the vines can cope with high levels of stress while providing a decent amount of vigour. Some companies in the Awatere may be turning to rootstocks like #SO4 and #1103 Paulsen, which are known as 'high vigour stocks', producing similar vigour and yield but at higher levels of soil moisture tension."

When other winegrowers were asked if they were changing the type of rootstock as they redevelop their vineyards, the responses were as follows:

- *Changing root stock won't work for everyone. Much of the population of vines are more than likely going to need to be replanted over the next ten to 15 years. They are reaching the end of their productive life so there's potential to change. Otherwise, if it's a freshly planted vine it's not economically viable to just rip out every plant based just on having to replace rootstock.*
- *We've always used quite a deep rooting rootstock – it's what we've always been interested in anyway, so for us it's not a big change.*
- *As we replace vines we are going for a different type. We had issues with productivity in a block of Pinot Noir, so we've been replacing the vines with Sauvignon Blanc. We are pulling out the whole plant and putting in a new one that is on a different rootstock, but materially it wouldn't be deeper rooting.*
- *Sort of. There is an availability issue from the nurseries so we are beginning to change and experiment with these, so-called, drought resistant, more water-efficient rootstocks, but we can only source a small percentage a year until the nurseries can catch up. We have contracts for three years from now where we get a couple of thousand vines, but it's not much in the scheme of things and it will take time to convert.*
- *Changing rootstocks costs around $75,000 a hectare because you have to pull out most of your infrastructure and restart. We are being forced to change because of trunk disease, which is why we've done 20 hectares so far.*

Along similar lines, a winegrower highlighted the industry's investment in improving resilience to risks from climate, pests, disease and changing markets via the seven-year Sauvignon Blanc Grapevine Improvement Programme[245]. The programme's goal is to create 12,000 new variants of New Zealand Sauvignon Blanc, and select for traits such as yield, resistance to fungal infection, frost tolerance and water use efficiency.

The winegrower explained: "Most of New Zealand's Sauvignon Blanc vines are the same genetic individual, which relates to the way grapes are propagated. It means vines can be managed in an efficient and predictable way but also that they are all at risk from pests, disease, or environmental change. There have not been the crop selection and genetic improvements that have occurred with crops such as apples and kiwifruit, and the main barrier to grapevine improvement in New Zealand is a lack of available diversity."

6.7.4 Less Vegetative Growth

If vineyards had to reduce water use (without water storage) then focusing on reproductive growth (i.e., buds and grapes) rather than excessive vegetative growth (i.e., leaf canopy) was proposed as a possible option before looking to change grape varietal, or a reduce planted area. The winegrowers interviewed had a broad range of views on the importance of a vine's vegetative growth, particularly for the stylistic Marlborough Sauvignon Blanc. There was general agreement amongst the winegrowers that less leaf canopy would mean a change in the wine being produced and some raised concerns about needing to avoid vine stress.

- *Once we are past veraison then as long as a vine has maintenance water, we are not so worried about maintaining vegetative growth. We're trying to grow fruit, not leaves, and to ripen fruit we want reproductive growth – to slow down vegetative growth is not an issue for us. It means changing the way you are growing, minimising canopies to not burn up water and focusing on organic matter in the soil to retain the water that is there. It is more of a mindset change. Other people buy our fruit for its structure, but we don't grow for many large companies because they are not interested in the flavour profile that we grow. They are usually very much driven by conventionals.*
- *You can get away with less water but it is detrimental to the characteristic and style of our wines. A lack of water will cause a dramatic change in stylistic output. There's a lot you can do in wine making, but much is pre-determined by the fruit. If fruit is physiologically changed then it forces you down a path and you just can't make the same wine as before. Also, a water deficit affects the total canopy, which influences vine fertility for the coming season. The health and size of the canopy at harvest determines the carbohydrate that can be taken back down into the root system for the next budburst. There may be a long-term degradation of the vine. Grape quality and quantity would taper off at a similar rate.*
- *Reducing vegetative growth changes the flavour characteristics. If a canopy is less vegetative it is more focused on the ripening, and so it's all about timing. Moderating water post-veraison (where grapes go from hard to soft), is the trigger for berries to start ripening. It can affect this year's crop and next year's crop potential as well as it needs canopy to develop enough cane to lay down to grow a healthy crop. So, you've got two years going on at once. If you stress a vine this year leading up to harvest, it will adversely affect next year's production. Just as with livestock, we have to look after our plants.*

245 https://bri.co.nz/research/grapevine-improvement/#:~:text=Bragato%20Research%20Institute%20and%20its,new%20diversity%20in%20Sauvignon%20Blanc

- *Some newer winegrowers may need to be more aware. If their vineyard is too vigorous, then the fact is they're probably overwatering, but they just don't know. Some time spent with them, ensuring they're aware of the consequences can go a long way. Underwatering or reduced watering is also an issue. The bud is the following year's fruit, and you need leaves and reserve within that bud otherwise you will pay for it. It is detrimental to have excessive leaf loss post-harvest as you need that little bit of vigour.*

- *I've got some experience with vine stress. We had water issues with our older block for a couple of years, and we've rectified it. Last year was the first year since and it's going to take us another couple of years to get back just because of the years of water stress. It was extreme water stress though, which does have an ongoing effect, without question.*

- *I know from just eating grapes just before harvest, that vines that are dry and don't have a vigorous canopy, are like sugar water. They just taste completely different to a healthy or vigorous vine. And I wouldn't buy that.*

- *Typical Marlborough Sauvignon Blanc production has more vegetative growth than other varieties and this contributes to the Marlborough characteristic, but you can do the same thing with vegetative growth elsewhere and not get the same characteristics. In saying that, excessive vegetative growth can have a negative impact on other production factors like disease pressure and inputs like trimming and leaf plucking, so it is certainly not a case of trying to encourage maximum growth. There is surely some opportunity to reduce vegetative growth on some vineyards, but it isn't massive.*

- *I tried to lower the vineyard canopy a few years ago. We came off a year with Botrytis (because of a big, strong canopy we didn't have enough airflow or light) so I really brought back the water, didn't water specific blocks, and I got it wrong. There were other things that happened – a frost and a bad flowering – but I didn't water at the right time and lost a substantial amount of money because of that one action. I think we only broke even that year.*

One winegrower mentioned a current research project on the effects of irrigation, comparing normally treated vines with deficit irrigated vines (i.e., not irrigating until it is essential for the long-term reproductivity of the vine): "The wines produced are day and night different – and not in a good way."

Another winegrower focuses on growing vines with smaller, pale to medium green leaves, rather than large, deep green, highly chlorophylled leaves. Nitrogen is used to promote leaf growth and it was observed that ground applied nitrogen, either calcium nitrate or urea, is highly water soluble and only some is taken up by the vine's root system before leaching through the soil or being burnt off. The vines also need more water to support more leaf. They recommended the use of more stable forms of nitrogen that are root productive and commented that they "can get away with one trim per year where many growers conventionally need three to four trims. You don't need to be cutting that much leaf off, and if you are, then you're growing too much leaf, you're focusing on the wrong part of the plant."

- *If winegrowers start going in this direction, then they will alter the flavour of Marlborough Sauvignon Blanc. You lose that grassy, hugely punchy, vibrancy, greenness. What you get is a lot more textured wine. As a result, larger wine companies love the nitrogen because what the nitrogen will also give you is thiols, and the thiols are one of the big flavour components of Marlborough Sauvignon Blanc.*

6.7.5 Yield Reductions

The alternative to less vegetative growth is reduction in yield. Almost all of the winegrowers viewed the relationship between water use and yield as quite linear, particularly for Sauvignon Blanc, but some noted there is a natural limit: "you can reach a point where you've got too much water and you're not really adding or taking away anything by going down a little bit."

Other interview comments were:

- *Not only will you reduce yield, but you may not maintain the quality. Sauvignon Blanc is like the 'anti-grape', so what you consider normal with growing grapes for wine doesn't really apply. The vine doesn't respond well to water stress, the wine style doesn't want any characteristics of stress, and the vine typically gets watered quite close to harvest. If you are starting to put your Sauvignon Blanc vines into water stress, then not only will you see less yield, but you'll see a wine that doesn't hit the same price point. Or carry that regional characteristic that our industry is grown on.*

- *We've learnt to be more efficient with our watering since we've been using a moisture monitoring service – we are putting on less water than we used to. So, to go leaner again, we would start to see an impact on our canopies. It can have a negative effect on your ability to ripen your grapes if vines are moisture stressed. The yield and quality of grapes harvested can be compromised if they're overstressed – they become quite flaccid, and it affects the flavour profile.*

One winegrower observed that "some vineyards are basically near the top of that slope with their current consent, so any reductions in water availability will mean they fall down that linear yield reduction, but others may have some room to give before they begin to slide." Another winegrower's situation highlighted this point:

- *To a degree, we have pre-empted any changes in allocation by choosing a more 'cost-effective and beneficial to the vines' process. We are 20 hectares into a replant programme that we started about five years ago. We have installed sub-surface dripline on eight hectares so far and found strong benefits. We are already very efficient with our water use as we water to our soil type via soil moisture probes to optimising our delivery of water to when it's needed. We are also watering less often but deeper, so longer periods per block – so, we're creating a deeper water source for our vines. We only really use irrigation during the peak period, which for us is December to March. We're also increasing our soil carbon, which increases the soil water holding capacity. Once we have all our subsurface driplines in there's not much more we can do.*

When asked what might happen if they had to reduce their water take by 10 to 20 per cent in March, the winegrowers interviewed had a range of responses and some seemed to think it may be more manageable than others. For example:

- *For us, I think we would be fine because of the way we structure our watering. If we knew it was coming, then we would start irrigating for longer periods earlier on to try and drive water down further where it's not going to evaporate, so then it would be slow-release water later on. So, if we did have to dry out the top there would still be feeder water from below. We already start irrigating more in the early part of the season. Ten per cent would certainly tighten it up but it wouldn't be catastrophic. It would make me be a lot more cautious and considered.*

One winegrower interviewed cited research carried out on a vineyard in Marlborough, which has a relatively dry block planted in Sauvignon Blanc grapes. The research tested how far a vineyard could go in terms of reduced irrigation without negatively affecting output in both wine quantity and quality (Mercer, Dryden, Neal, & Green, 2016). The trial was run for three years (production seasons) under reduced application treatments but was then fully irrigated in the fourth year and, as a result, it found that production reverted to its normal level. The winegrower noted the finding that while the vines adapted to the reduced irrigation and produced a crop, there were serious consequences on the vines and the fruit. "In essence, it is saying that the reduction in water was very detrimental to their actual vines, as opposed to the fruit – the actual vines declined."

Winegrowers were asked what they might do if faced with sizeable, permanent reductions in their water take (e.g., -20%) because of drier and hotter conditions with climate change (i.e., drought). Possible options identified were increasing storage capacity to store water earlier for later use, a more water efficient grapevine, installation of sub-surface irrigation, drought-tolerant rootstocks, change in grape varietal, reducing planted area, and moderating crop yield. On the last point, a winegrower noted that (at present) it may not be every year, but it might be one year in ten that there is a 20-30% hit in yield because of drought. All of these possibilities would involve long-term structural change and sizeable investment by winegrowers. For instance, using more water efficient grapevines, drought-tolerant rootstocks and changing grape varietals means considerable upheaval of the current Marlborough wine industry.

To a certain extent, a winegrower's future options depend on whether they were already using newer technologies for water use efficiency, such as soil moisture probes and pressure bomb tests, which are labour intensive, rather than manual weekly readings.

6.7.6 Impact Risk

Launched in 1995, Sustainable Wine New Zealand is widely recognised as a world-leading sustainability programme and it was the first to be established for a wine industry at a national scale (Wilkinson, 2023). At least 97 per cent of all viticultural land across New Zealand operates under a regime of sustainable wine growing standards and audits. In addition, Sustainable Wine New Zealand provides members with information on changes to agrichemical regulations and advises on best practices in viticulture.

Each vineyard in Marlborough has its own individual profile relating to its use of fresh water and so its risks of being impacted by policy options for fresh water. Most are likely to have several factors that are important in one way or another. This said, it is likely that some vineyards use of fresh water may present more risk of impacts than others. While freshwater policy brings this risk into sharper focus for some vineyards, it is also likely to exist with the increasing effects of a changing climate. When asked who might face change, one winegrower simply concluded, "everyone".

The main factors identified by winegrowers that may contribute to this risk profile are soil drainage, water security, stage and location of a vineyard, vineyards with streams, vineyard size, and a winegrower's knowledge and experience around efficient water use. Those vineyards most at risk are likely to be those facing a series of factors, which can be associated with particular localities.

- *The vineyards in the Wairau's Southern Valleys, vineyards reliant on the Southern Valleys Irrigation Scheme and those who have a well in any of those valleys, depend on water takes late in the summer in dry years. Also, any on the geologically recent Wairau River bed. It is essentially just river stone – great conditions for growing grapes, but they need irrigation to survive. As you travel up the Wairau Valley into the newer plantings – basically the vineyards between State Highway 63 and the river have very free draining soils. Vineyards in the Awatere Valley depend on river take, water availability and the river. I see those as the three main risk areas, which encompasses most of the winegrowing region when you add them all up – large swathes of Marlborough. The older vineyards are more secure in their water because they have higher water holding capacity soils. The good land was taken first. They are less likely to need water storage but if they do then retrofitting will be very costly.*

Many winegrowers identified soil type, regardless of management or infrastructure, as a characteristic of vineyards more at risk of being impacted. One winegrower summed it up as those vineyards that are "new and on the fringes" of the winegrowing region.

- *One thing that is critical to any discussion around water in Marlborough is soil type. I think we just need to be really conscious that we have to go back to our soil types as there is huge variation. I'm really cautious about making comments without talking about our specific site, our specific soil types.*

- *How efficiently you use the water you've got comes down to mindset and soil type. If a blanket approach is taken to allocating water, then if you've got stony soil and not enough water then you're going to be in a more challenging space. Playing the devil's advocate though, "You bought that land, you understand the benefits and the challenges that land gives you". But there's that balance that needs to be taken into this conversation.*

- *Some of the areas being planted now are pushing the boundaries of where we should be growing. They are going into the lighter soils or heavy soils, onto the hillsides, closer to valleys and gullies. Where a stream runs through a vineyard it will be gutting for those who didn't plant far enough back. Those new vineyards in 'fringe areas' (i.e., less traditional) may be the ones hardest hit because they're not in the best situations.*

- *Water takes and discharge go hand in hand. Vineyards on 'bony' soils are prime candidates for water use and leaching. Those soils that suit some varietals tend to be less desirable for Sauvignon Blanc. They create a thinner canopy and riper, cooked characteristics compared to other soil types. Probably some vineyards that are geared towards higher production have soil types that aren't suited to that. The inputs and manipulation that needs to happen to be able to get those yield characteristics mean that they are the ones that will run into problems with some of the impacts of Freshwater Farm Plans.*

- *It simply comes down to the soils with the least water-holding capacity needing the most irrigating to keep up with the plant's demand. There is obviously a way to produce grapes with less water, but then that will affect your economic model. You'll have a direct relationship with yield in those blocks.*

- *Probably those that are on lighter soils and properties without storage, or the ability to create a storage facility. Ironically, some of the smaller holdings, because they may not have the economic capacity to provide for all of the above. Increasing costs really have a big impact if you are a smaller operation – you don't have economies of scale. We are continuing to see our industry becoming larger and more corporatised.*

Alongside soils, the length of streams was also identified, as they will need to be managed within a vineyard's Freshwater Farm Plan, which is an additional cost. In general terms, the more streams within a vineyard the more management that will be needed. Although some winegrowers saw little direct benefit of Freshwater Farm Plans to their businesses, one winegrower described the benefit as "being able to continue to operate". Another winegrower suggested that Freshwater Farm Plans may be easier for smaller vineyards: "You are basically documenting your practise rather than having lots of actions because there are probably few things you can do. The very small vineyards may come under the five-hectare minimum threshold."

- *We are in an extremely fortunate situation with the SWNZ accreditation process. Our existing systems in SWNZ could help implement these farm plans within our businesses. We supply data annually and are audited every three years. It's an ingrained process. There is an opportunity to incorporate our freshwater farm plans to actually achieve what is wanted and SWNZ is capturing a huge amount of the data already.*

Finally, two winegrowers raised the risk of not being sustainable and the topic of a social licence, one mentioned costs and benefits to the vineyard owner, and another talked about the importance of education within viticulture.

- *We live in a broader community and need to start behaving more like it. The social aspect is becoming critical – environmental management is put in place for everyone and is part of the cost of farming. Essentially, it is part of your social licence to operate. Things have to be done sustainably, and yes it costs, but if it is not, then the industry is going to slide, and we'll find it much harder to sell our wine. Businesses that are squeezing everything out of their vineyard are probably vulnerable.*
- *There're so many considerations, but it comes down to the cost benefit ratio for the vineyard owner. The real challenge is finding the benefit in changes, and for most people if you don't have to change and you get a similar result then you won't change. And rightly so.*
- *Some new people coming into the industry need to be more educated about water use. If someone plants a new vineyard, the first thing they do is give it four hours every day and it doesn't need that – just a little education from the viticultural side of it.*

7 Plantation Forestry

This chapter is primarily based on publicly available data for the Nelson-Marlborough wood supply region[246] and information gained from a literature review specific to Marlborough. It also draws on the results of an interview with a long-standing representative of the forestry sector with local knowledge. The chapter was reviewed by this representative and others from the sector for completeness and accuracy.

Marlborough's forestry sector consists predominantly of commercial plantation forestry and, to a lesser extent, farm forestry. In general terms, plantation forests or production forests are those that are regularly harvested for the purpose of selling the wood or logs; they differ from permanent forests, which are not intended to be clear-felled for at least 50 years (but can be partially logged) (MPI, 2022).

This description is slightly broader than the interpretation in the Resource Management (National Environmental Standards for Commercial Forestry) Regulations 2017. In that context, **plantation forest** and **plantation forestry** is a forest deliberately established for commercial purposes that is at least one hectare of continuous forest cover of forest species that has been planted and has or will be harvested or replanted (includes forestry infrastructure but has some exclusions e.g., shelter belts, orchards).

Within this report, farm forestry is discussed in relation to sheep and beef farming as well as dairy farming[247] (Sections 4.1 and 4.2 of Chapter 4). With overlapping membership, the Marlborough branches of the Farm Forestry Association and the New Zealand Tree Crops Association combined in the late 1980s to form the Marlborough Tree Growers Association (Hosking, 1999). There are currently about 30 affiliated members from the Farm Forestry Association (C. Dawkins, pers. comm., 2024)[248]. A range of resources describe farm forestry in Marlborough, including the following articles:

- In tune with their landscape: South Island Husqvarna Farm Forester of the Year (Anon, 2008)[249]
- Queen Charlotte Sound conference 2014 field day (Ledgard, 2014)
- Gerard's Pelorus Sounds farm Hopai and Elie Bays (Gerard, 2014)
- Rebuilding after the Onamalutu fire earlier this year (Bradshaw, 2015)
- Milling blackwood in the Marlborough Sounds (Millen, 2017)

These articles highlight the interest in farm forestry in the region, including speciality timbers, as well as many of its unique challenges within the Marlborough Sounds. Field trips to Marlborough Ridge, the Throne, and the Pyramid during the 2014 Blenheim Conference are described in Bateson (2014).

The sector is part of the Nelson-Marlborough wood supply region – one of nine such regions across New Zealand. Using Statistics New Zealand Agricultural Production Statistics for 2022, the total area of exotic tree plantations intended for harvest in Marlborough was just over 85,000 hectares or 19 per cent of total land used for 'agriculture' (discussed in Section 3.1.2), which is sizeable when compared

246 The Ministry for Primary Industry, New Zealand Forest Owners Association, and the New Zealand Farm Forestry Association collectively produce the annual National Exotic Forest Description. This publication groups New Zealand's 66 territorial authorities into nine wood supply regions that have broadly similar growth patterns for radiata pine, representing wood supply and processing catchments. The Nelson-Marlborough wood supply region consists of Nelson City, Tasman District, and Marlborough District. Wood supply and wood availability are terms that tend to be used interchangeably within the forestry sector. The National Exotic Forest Description defines planted production forests are 'An area of trees not less than one hectare in size, planted and managed with the intention of producing wood or wood fibre'.

247 Many dairy farms in Marlborough also contain a farm forestry enterprise as well as native bush. Farm forestry averages 8% of dairy farms in the region and varies between catchments by 4% to 11%.

248 A useful overview of the changing fortunes of the NZ Farm Foresters Association is available in *https://www.nzffa.org.nz/system/assets/6138/Major_Issues_facing_NZFFA.pdf*

249 A useful branch member video accompanies this article: *https://www.nzffa.org.nz/members/branches/marlborough-branch/branch-member-videos/chris-dawkins-the-pyramid-waihopai-valley-marlborough-branch/*

with other regions in New Zealand's South Island (Figure 53). Overall, forestry accounts for a larger share of economic activity in Marlborough than in many other regions, as well as a considerable amount of employment (e.g., Nixon *et al.*, 2017).

Image 48: Plantation forest in the Waihopai Valley with arable cropping in foreground

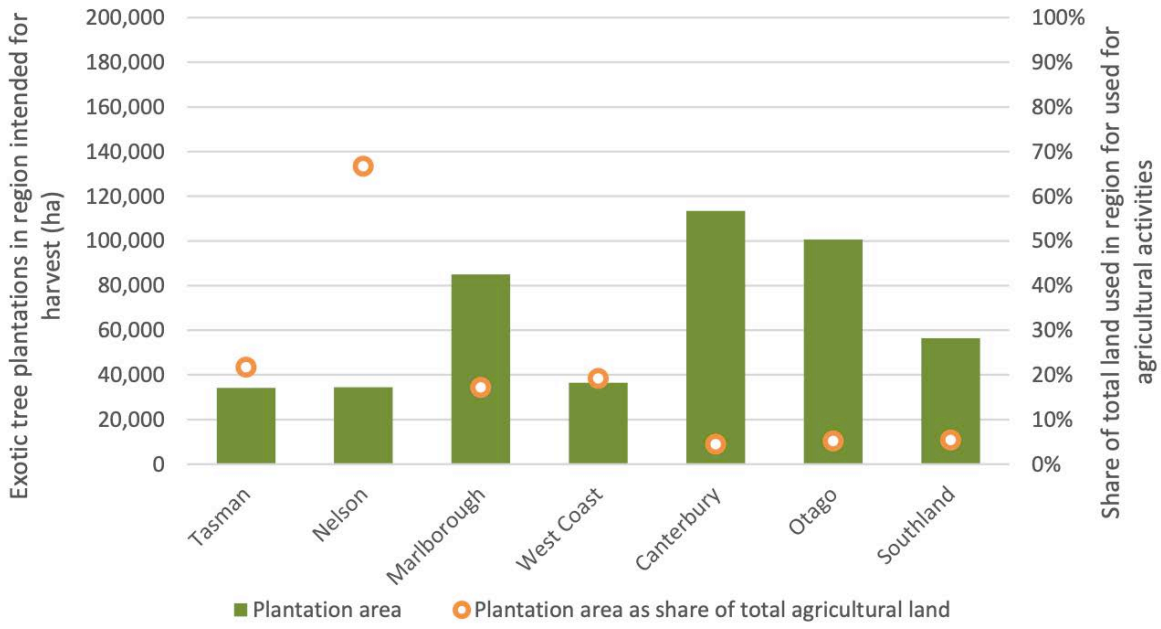


Figure 53: Distribution of Exotic Forestry by region in the South Island
Source data: Stats NZ Agricultural Production Statistics 2022

Although plantation forests are present in all of Marlborough's FMUs, they are mostly located in the Wairau, Te Hoiere / Pelorus, and the Marlborough Sounds Complex (Image 37)[250]. The total area of exotic forestry properties in 2020 is estimated to have been 86,772 hectares, of which 70,600 hectares was plantation forestry and a further 6,734 hectares of plantings occurred on agricultural properties.

250 Within LUC Classes 1 to 7, plantation forestry is not normally suitable to areas that are alternatively very wet or low rainfall areas (<500 mm/year), or have shallow soils (< 45 cm) (Rutledge *et al.*, 2010).

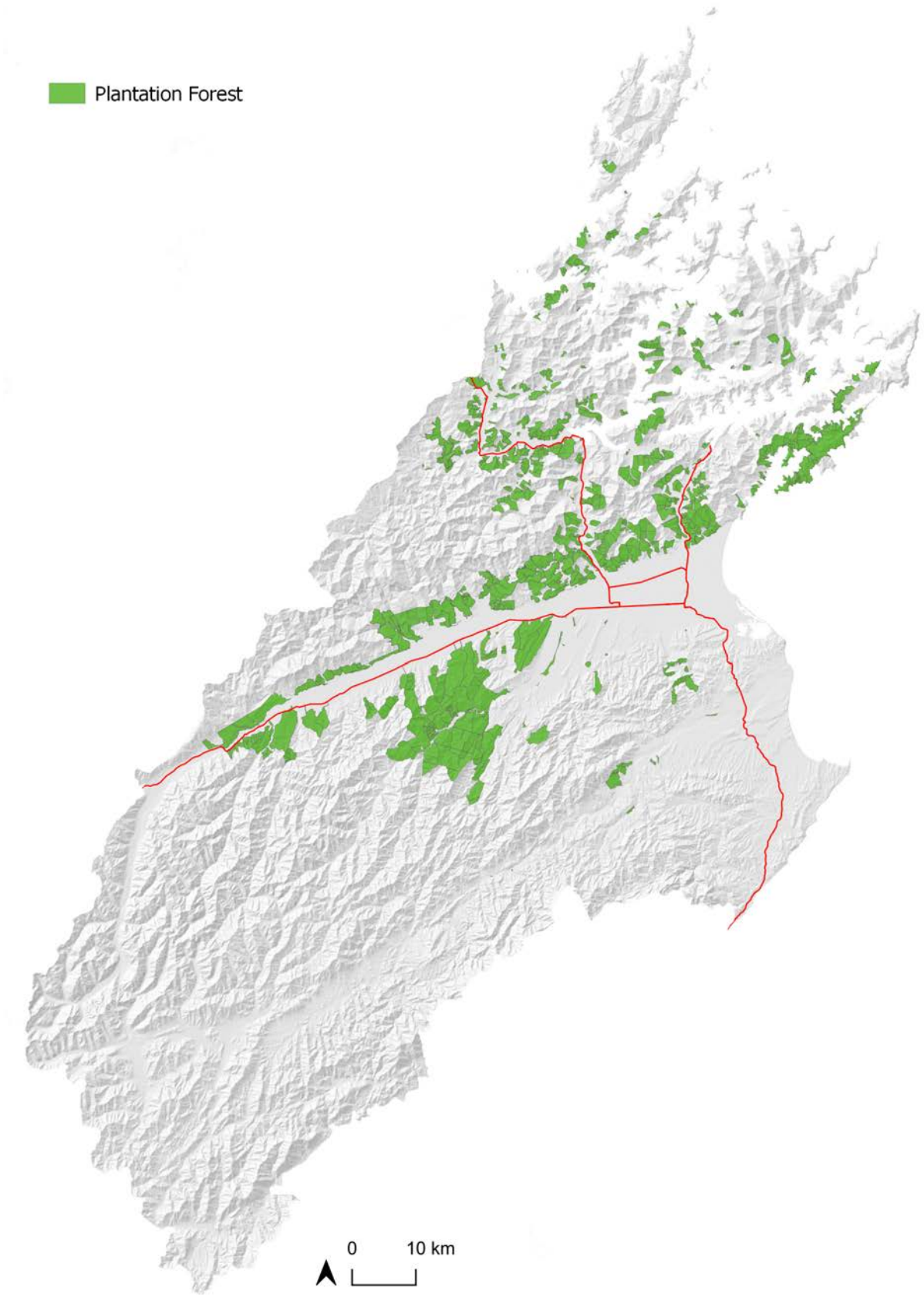


Image 37: Estimated distribution of plantation forestry in Marlborough in 2023 (the map does not show farm forestry)
Source: Marlborough Land Use Map 2023

7.1 Main Characteristics

Similar to other parts of New Zealand, an important characteristic of the Nelson-Marlborough wood supply region is that large tracts of forests were established during the 1990s and followed by limited new plantings over the next two decades (Marshall & Brown, 2021b). This period of rapid afforestation has resulted in an uneven distribution of the age classes across the forest estate and record harvests during the 2020s as the plantings in the 1990s reached maturity. There are indications that Marlborough has a comparative advantage[251] in forestry and logging (e.g., Mandolin Associates 2013), meaning that the sector contributes proportionally more to the regional economy than in many other regions. However, this advantage is still to be maximised in value added processing. Marlborough earns less from wood product manufacturing than Nelson-Tasman, indicating much of the value-add is flowing out of Marlborough (Mandolin Associates 2013).

A characteristic specific to Marlborough is the higher level of small-scale ownership, and possibly private ownership, within the forest estate as well as a probable tendency towards smaller plantations (Table 35). In 2020, large-scale owners[252] held 47 per cent of the forest resources in Marlborough while small-scale owners held 53 per cent (Marshall & Brown, 2021b), which was almost unchanged from the early 2000s[253]. This split is more similar to Canterbury, where large-scale owners held 48 per cent[254] (Marshall & Brown, 2021a) than Nelson where they held 71 per cent (Marshall & Brown, 2021b). This characteristic is returned to as a topic in Section 7.4.

Table 35: Distribution of planted production forests by size and ownership in Marlborough in 2022

Forest size	Number of forest entities	Total area (ha)	Share of forest estate
1,000 to 10,000+ ha	15	51,787	69.7%
40 to 1,000 ha	171	21,374	28.8%
Less than 40 ha	45	1,124	1.5%
Total	231*	74,285	100.0%

Source data: Te Uru Rākau New Zealand, 2024 (based on National Exotic Forest Description 2022 for Marlborough)
*Note: * Large-forest entities are likely to own forests in more than one size category, so the total number of forest entities is expected to be less. Also, a forest entity may represent many individual owners with shares in a forest.*

251 Comparative advantage refers to an industry's ability to produce goods and services at a lower opportunity cost than its competition (not necessarily at a greater volume or better quality). In the context of this report, the comparison is between an industry in Marlborough and the industry in New Zealand. In other words, it shows the extent to which it is advantageous for an industry to be operating in Marlborough.

252 Large-scale owners are those with 3,000 hectares or more of forest in the region of interest, with more than three age classes, and not a part of a syndicate (Marshall & Brown, 2021b). In some regions, particularly those few large-scale owners, forest owners with just under 3,000 hectares may also be included.

253 In 2006 owners of small forests held 52% of the forest estate, followed by Nelson Forests (rebranded as part of OneFortyOne since March 2020) who owned 26% (BERL, 2007 as cited in Mandolin Associates, 2013). At the time, the fragmentation of roughly three-quarters of the forestry holdings was seen as a possible issue for achieving advantageous positions in international markets. OneFortyOne purchased Nelson Forests Limited and Kaituna Sawmill in Renwick in 2018.

254 In Canterbury most of the small-scale owners are located on the high productivity foothill compared to large-scale owners who mostly own forests on the lower productive plains (Marshall & Brown, 2021a).

Relevant comments from the interview were:

- *Typically, a higher proportion of the land in commercial forestry in Marlborough has been privately owned, which may be different to some other regions. There are many smaller woodlot owners and a handful of large corporate owners. Many of forest owners are farmers and vice versa. The level of private ownership can have implications for harvest. When investors have waited 27 or 28 years to harvest, often for their retirement fund, they want to achieve the highest price they can.*

- *The topography here is very different to other regions. Compared with locations like the central North Island or with Southland, Marlborough's topography is normally more incised and steeper. And then of course the Marlborough Sounds brings with it a whole different set of social, community, environmental and health and safety considerations as well.*

This ownership relates to the forest itself; the land where the forest is planted may be either owned or leased by the forest owner. A forest's ownership can be separate from its management. Forest management companies either only manage forests they own (e.g., Tasman Pine, OneFortyOne) or also manage forests on behalf of clients. Such companies usually operate in several catchments and regions.

Comments from the interview in relation to ownership and management were:

- *Alongside ownership, a forest needs to be actively managed and there are at least ten forest management companies in Marlborough, ranging in size from very small to quite large. While most forest owners will have their forests professionally managed, there is a period of time during the rotation that some smaller forest owners may be less inclined to engage professional management.*

- *Most smaller woodlots have owner-operators that tend to be locals, and the larger plantations are managed either by or for foreign-owned companies. Some international companies have more requirements put on them by external agencies and markets in terms of accreditation and the environment. They understand that they need to do certain things (e.g., water monitoring) to differentiate their products.*

A second characteristic is the combination of 1) a unique set of conditions that the forestry sector faces in the Marlborough Sounds and 2) the regulatory response to such conditions[255]. There is limited land in the Marlborough Sounds that is suitable for infrastructure, such as access roads and skid sites, and the Coastal Marine Area[256] contains highly sensitive receiving environments. Consequently, there is a long history of commercial forestry activities in the Marlborough Sounds being managed through resource consents (P. Hawes, pers. comm., 2024).

255 Rules control activities occurring within each zone, including the planting, harvesting and replanting of commercial forestry and the processing of the commercial forestry crop (as an industrial activity).

256 In general terms, a Coastal Marine Area is the foreshore, seabed, and coastal water, as well as the air space above the water. The seaward boundary is the outer limits of the territorial sea, and the landward boundary is the line of mean high water springs. Where that line crosses a river, the landward boundary is the lesser of (i) 1 kilometre upstream from the mouth of the river; or (ii) the point upstream that is calculated by multiplying the width of the river mouth by 5. Under the Resource Management Act 1991, the Minister of Conservation is responsible for matters relating to the Coastal Marine Area.

Commercial forestry largely occurs within the proposed Marlborough Environment Plan's Coastal Environment Zone (the Marlborough Sounds) and the Rural Environment Zone (the rural environment in Marlborough). There are rules for afforestation, harvesting, replanting within 200 metres of the coastal marine area[257], and excavation and filling to construct or upgrade forestry roads, forestry tracks or skid sites in the Coastal Environment Zone mean that all of these activities require a restricted discretionary resource consent. This approach builds on the previous rules for the Marlborough Sounds in the Marlborough Sounds Resource Management Plan[258] and the Marlborough County District Scheme prior to that. In contrast, forestry activities in South Marlborough are predominantly managed through the aforementioned National Environmental Standard for Commercial Forestry. The Council does exercise additional stringency in certain landscapes and regulates water yield effects in vulnerable catchments.

Interview comments in relation to the Marlborough Sounds were:

- *Marlborough is the only region in New Zealand where logs are transported by barge. The roading network in the Marlborough Sounds is particularly vulnerable to adverse weather events and so barging within the Sounds is a highly valued means of transport. Access roads are still needed to reach the points where it is possible to barge from.*
- *It is more costly to operate in the Marlborough Sounds and it is not just the transport. Consents are needed for ramps and log storage sites within the Coastal Marine Area. It means working with several government agencies and harvest planning normally starts years out. Initial contact is with the local staff, but decisions are made at a national level. It can be quite challenging at times, especially if people are not familiar with the area, as blanket requirements may not be appropriate and it takes time to get a response.*

Other characteristics include windthrow and forestry's connections with viticulture. Windthrow[259] can occur at any time of the year in Marlborough but is more common after heavy rains. As examples, a southwest storm event in October 2004 caused severe damage to 75 hectares of forest in Marlborough (and 1,138 ha in Nelson), and an easterly storm in July 2008 damaged 113 hectares in Marlborough (Moore, Manley, & Park, 2011). While the hazard presented by wind cannot be controlled, the impact of this hazard on forest and thus the resulting expected loss can be managed (Moore, Manley, & Park, 2011).

257 This setback is more restrictive than the National Environment Standards Standards for Commercial Forestry 2017, which requires a 30 m setback for replanting from the coastal marine area.

258 Planting and harvesting were discretionary activities and these were continued into the proposed Marlborough Environment Plan but the activity status was then amended to restricted discretionary when the Resource Management (National Environmental Standards for Plantation Forestry) Regulations 2017 came into force in May 2018 (in 2023 amendments the title was changed to Resource Management (National Environmental Standards for Commercial Forestry) Regulations 2017). In that context, **commercial forest** or **commercial forestry** means exotic continuous-cover forestry or plantation forestry.

259 Windthrow is the damage that storms and high wind cause to trees. Windthrow can cause broken or uprooted trees, which may fall and become lodged on other trees and are very dangerous to work with. *https://www.mpi.govt.nz/dmsdocument/129-Dealing-with-trees-damaged-by-storms*

The interviewee's comment on this aspect of forestry was:

- *Windthrow depends on the direction of the wind, so is an issue right across Marlborough. You can certainly see with one storm that it might have impacted one area more than another area, but there's no area of the region that is not vulnerable to windthrow. This vulnerability may increase with the effects of climate change.*

Many farm shelterbelts and woodlots in the Wairau and Awatere catchments have been removed as pastoral farmland was cleared for vineyards[260]. However, the forestry sector also supplies timber for use in vineyards. Marlborough is the base of the New Zealand Dryland Forests Innovation, which is a research and development project into genetically improved naturally durable hardwoods (e.g., eucalypts) that are suited to New Zealand's dryland regions. The project is currently conducting a regional case study to evaluate how such forests could contribute to sustainability and reduce greenhouse gas emissions in Marlborough's wine industry[261].

Image 49: Cleared shelters belts in the lower Awatere Valley in 2023

260 https://www.nzffa.org.nz/system/assets/1353/NZFFA-conference-programme-2014.pdf
261 https://nzdfi.org.nz/

7.2 Historical Context

As a sector, commercial plantation forestry in Marlborough largely dates from the 1960s[262]. Before this time forestry tended to revolve around the logging and milling of native bush as well as exotics (primarily radiata pine and macrocarpa) planted as shelterbelts and in large woodlots for harvest (Sutherland, 2011)[263]. In New Zealand there were two main factors that constrained the wider use of trees on "poor and otherwise unproductive" farmland: 1) the effect of death duties on such assets and 2) the low stumpage[264] paid by sawmillers to the Government (Hosking, 1999).

There were three notable precursors to the development of plantation forestry:

1. In the early 1900s, the Government established the Dumgree Plantation using prison labour on 881 acres of land on part of a sheep run in the Awatere Valley (https://heritage.tasmanlibraries.govt.nz/nodes/view/7599 and Sutherland, 2011).
2. Farnham Forest was established from 1934 over 136 hectares in the Marlborough Sounds (Urlich & Handley, 2020). This forest was planted at Snake Point in Bay of Many Coves by renowned British aviator and sailor Sir Francis Chichester (Wardle, 2011).
3. From 1940 establishment of the Rai State Forest began in the Te Hoiere / Pelorus catchment with 272 hectares had been planted by 1950[265] (Urlich & Handley, 2020).

By the end of the 19th Century, much of the South Island's tracts of native bush and forest had been cleared by felling and burning for pastoral farming and to supply timber for the building of towns and settlements as well as machinery used in the gold rushes (Fleet, 1984). A contemporaneous estimate[266] of the rate of loss in Marlborough by Dr James Hector was 37.5 per cent between 1830 and 1873, most of which occurred after 1868[267]. By the early 1880s, 14 sawmills were operating (down from 16 mills in the mid-1870s) with an output of 18.6 million feet of timber (Fleet, 1984). However, the impact of early sawmilling activities on local forests was limited and concentrated on the lower fertile river flats (Duckworth *et al*., 1976). The main timber trees included rimu, miro, mataī, tōtara, and kahikatea (Fleet, 1984; Duckworth *et al*., 1976)[268].

---

262 For example, Sutherland (2011: p217) states that "By the 100th anniversary of the province, little exotic planting had occurred." A NIWA report (Handley, Gibbs, Swales, Olsen, Ovenden, & Bradley, 2017) and subsequent journal paper (Urlich & Handley, 2020) presented evidence of early radiata pine forestry (plantings and harvest) in the Marlborough Sounds. This evidence has been challenged by operators within the forestry sector (e.g., Hemphill, 2021).

263 Many of the region's "Notable Trees" (as identified in Schedule 3 of the proposed Marlborough Environment Plan) are remnants of these plantings.

264 Stumpage is the price a buyer pays for the right to harvest a forest owner's timber. The buyer is responsible for all harvesting operations and sale of the logs. The advantage is the forest owner knows what they will get per tonne for their logs. The disadvantage is that the buyer may pay the owner less because they are accepting the log grade mix, volume and market risks. https://www.canopy.govt.nz/harvest-forest/harvest-land/sell-standing-timber/ .

265 The first rotation was harvested around 1979, with the trees going to Burleigh Mill in Blenheim (Urlich & Handley, 2020). Roughly half of Rai Forest land was included in the Settlement redress to Te Ātiawa o Te Waka-a-Māui and the other half was included in the Settlement redress to Ngāti Tama ki Te Tau Ihu (*https://cms.onefortyone.com/app/uploads/2021/06/2021-Management-Plan.pdf*)

266 Dr. James Hector was Director of the Geological Survey during the 1860s and later Chancellor of the New Zealand University.

267 Large-scale sawmilling began in the valleys of the Sounds County in the late 1860s but this activity had given way to pastoral farming by the turn of the 20th century (McLintock, 1966).

268 Sutherland (2011) offers more detail: The most notable early native forest was Big Bush at Grovetown where kahikatea, mataī, maire, and tawa were felled and milled for housing. Substantial native logging occurred in the Kaituna, Rai, and Wakamarina Valleys and in parts of the Marlborough Sounds (e.g., Clova Bay, Tennyson Inlet, and Anakoha Bay) operated into the 1970s.

To address a forecast shortfall in the domestic supply of timber, the Government promoted the growth of forestry in New Zealand during the 1960s, by amending the taxation system and introducing the Farm Forestry Act 1962 (later named the Forestry Encouragement Act) (Hosking, 1999). Under this Act and its subsequent amendments, loans and grants were available for the purpose of establishing or managing a farm woodlot[269]. Other drivers included increasing recognition of the need for soil conversation[270] and to control weed species such as broom as well as the diversification of farming production systems.

The forestry sector's early development was marked by the formation in 1957, of the Marlborough Branch of the Farm Forestry Association[271], "mainly by farmers in the Wairau, Awatere, and East Coast areas who realised they had little timber for firewood, building and fencing" (Hosking, 1999, p. 59). In the late 1960s, local government bodies became interested in planting pine trees on large tracts of unproductive land to promote soil stabilisation and to generate funds from logging. In 1970 they created the Marlborough Forest Corporation to establish and manage these forests[272]. It was quickly followed in 1971 with the establishment of the Marlborough Forest Owners Association, which was the first such group in New Zealand and included members from Nelson/Tasman (TOSWC website)[273].

In the mid-1970s, the exotic forestry estate in Marlborough totalled around 14,500 hectares with 85 per cent having been planted since 1960, and over 60 per cent since 1970 (Duckworth *et al.*, 1976) (Figure 54). At the time, the estate consisted largely of radiata pine, Douglas fir, and Corsican pine, and just over 9,400 hectares (65%) was privately owned[274]. These plantings were characterised by a substantial number of small companies and landowners operating mainly under the Forestry Encouragement Grant Scheme (Planning Tribunal, 1980). The Rai State Forest was around 3,000 hectares and the Wairau State Forest just over 2,100 hectares. There were 11 sawmills operating (four of which produced 75% of Marlborough's sawn timber production) and milling was becoming increasingly mechanised and capital-intensive (Duckworth *et al.*, 1976). Unprocessed logs were exported (through Picton) to Japan and sawn timber to Christchurch[275].

---

269 *https://www.nzlii.org/nz/legis/hist_act/ffa19621962n20200/* Farm blocks of up to around 100 hectares were planted in Rai, Te Hoiere / Pelorus, Kaituna and Cullens Creek Catchments, and land preparation for afforestation included burning off scrub (Urlich & Handley, 2020).

270 By the 1950s, soil erosion was an issue on hill country in the Rai, Te Hoiere / Pelorus, Kaituna and Cullens Creek catchments under pastoral farming (Urlich & Handley, 2020). In the 1970s, the re-establishment of forest cover was seen as having "a major role in water and soil conservation" (Duckworth *et al.*, 1976, p. 119).

271 *https://www.nzffa.org.nz/members/branches/marlborough-branch/*

272 *https://www.nzlii.org/nz/legis/hist_act/mfca19701970n17456/.* A detailed history of the Marlborough Forestry Corporation is available in Sutherland (2009).

273 In 2000, it became the Marlborough Forest Industry Association when its membership widened to also include forest processors and support industries. A brief history of this Association is available in Sutherland (2011: p220). In 2022, it expanded again to cover Nelson and Tasman regions and changed its name to the Top of the South Wood Council for consistency with seven other wood councils around the country.

274 Duckworth *et al.*, 1976, p. 186 reported: "There was a tremendous upsurge in planting in the Sounds and inland north Marlborough in the last 5 years compared with the previous fifty. During the period 1971-1975, 77% of the exotic resource was planted. The relatively small areas of exotic resource in South Marlborough, which are principally shelter belts, continue to be established at a steady rate."

275 The utilization of timber in the 1970s was inefficient (Duckworth *et al.*, 1976). Only part of the tree was suitable for sawlogs and the remainder was left in the forest. Sawmills were only able to convert half of the sawlog into sawn timber and the residue was sold as firewood or burnt.

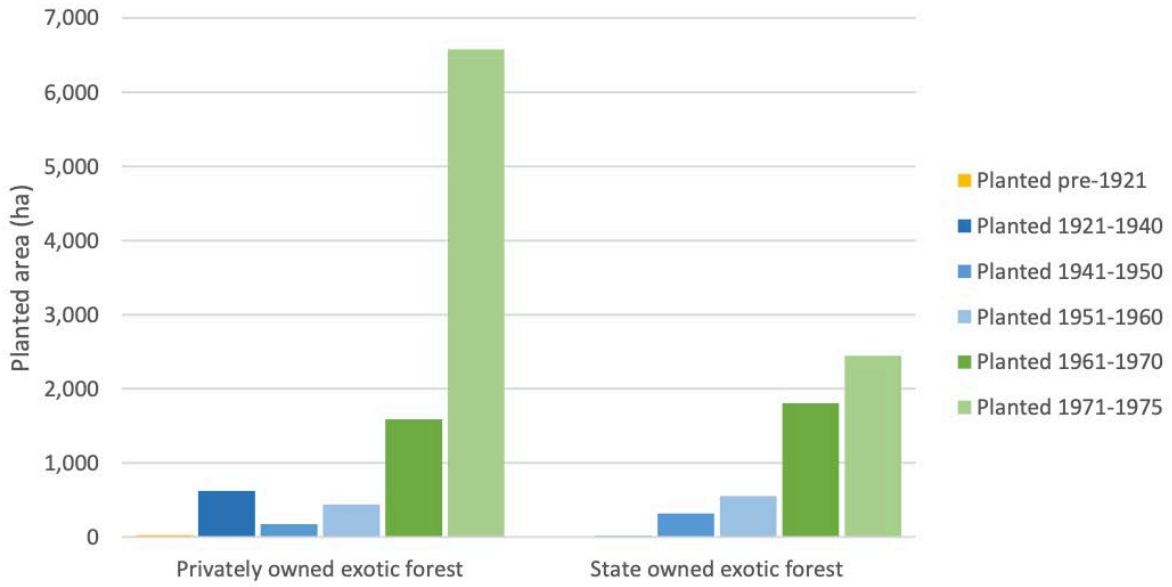


Figure 54: Age class distribution of exotic forest plantations in Marlborough in 1975
Source data: Duckworth et al. (1976)

Considerable potential was seen in the 1970s for forestry, particularly in the area north of the Wairau River on land that had been cleared of native land cover for pastoral farming but was reverting (Duckworth, 1976). While this potential included land in the Marlborough Sounds it was noted at the time that with any afforestation *"It is vital to ensure that forest developers are aware of the special needs of the Sounds"* (Duckworth *et al.*, 1976: p187). Afforestation in south Marlborough was seen as less likely because of existing erosion issues, as well as slow growth rates (as a result of low rainfall) and high transport costs. However, just as this growth in forestry was occurring, the adverse effects from the clear-felling of Farnham Forest (Wardle, 2011[276]) and the possible effects on the Brown River and Havelock Estuary from impending pine harvest of the Rai Forest (Bargh, 1977 in Swales *et al.*, 2021) were becoming evident[277].

> *If access to afforestation areas is unacceptable or if extraction would necessitate a reclamation for stockpiling which could ruin a beautiful or well used bay; then the Nature Conservation Council deems it very desirable that the problems should be given some thought before the trees are planted. Otherwise, the County's and Park Board's hand could be forced in thirty years' time by the presence of mature timber which has to be harvested.*
>
> ***Sir Holmes Miller (Deputy Chairman of the Nature Conservation Council)***

276 https://www.stuff.co.nz/marlborough-express/news/4635533/Pressure-comes-off-foresters

277 Understanding and managing the environmental effects of forestry in the Marlborough Sounds has been an ongoing endeavour since this time. For instance, Phillips, Pruden, & Coker (1996) considered the impacts of a storm in 1994 in relation to forest harvesting, planning, restocking, and environmental risk. In the 1970s there was a campaign to keep the Sounds "free of pines" and a field trip for the 1980 New Zealand Farm Forestry Association Conference (held in Blenheim) included "boat travel in the Sounds so that delegates could see the reasons for the debate between land owners wishing to plant trees, mussel farmers, and tourism (Hosking, 1999: p60-61). Forestry-related topics in Northern Marlborough and the Marlborough Sounds also dominated the Ecological Society Conference in 1979 (Anon, 1980).

In 1982, Marlborough Country introduced rules for commercial forestry, particularly in the Marlborough Sounds (Rural B Zone), under the Marlborough Division District Scheme.

> *Exotic Forests will play an important part in the area's future economy. There are considerable areas of land to the north of the Wairau River (and more limited areas to the south of it) which are suited to its use. Because of the complexity of conflicts likely to arise forestry is restricted to the conditional use category in the Sounds. However, in the Rural A Zones outside the Sounds where existing and presently proposed roading is adequate it is permitted as a predominant use but subject to special conditions designed to avoid conflict with other forms of land use, to economise in the services of the District and to preserve the amenities. While these limitations will prima facie have the effect of reducing the areas available to be utilised for commercial forestry, it will be open to Council in the context of a conditional use application to allow commercial forestry in any part of a Rural Zone on being satisfied that it is proper to do so.*
>
> ***Excerpt from Marlborough Division District Scheme***

At this time, the planted area in Marlborough was estimated to be 25,000 hectares, of which 70 per cent was planted on the Northbank[278] (i.e., north-west of the Wairau River) and 25 per cent in the Marlborough Sounds (Ashworth-Morrison Cooper, 1982). New plantings were located between Kaituna and Goulter, Koromiko and Waikakaho Valleys, and Queen Charlotte Forest (Tory Channel) (Sutherland, 2011). While "very little useable timber" had been harvested in the past, wood volumes were projected at the time to reach over 1.2 million cubic metres by 2011, with impacts on the region's transport, employment, and environment (Ashworth-Morrison Cooper, 1982).

In the mid-1980s, the New Zealand Forest Service was dis-established and in the early 1990s state-owned plantation forests were privatised[279] (O'Loughlin, 2006). State privatisation included the sale of forestry assets through Crown Forest Licenses, established via the Crown Forest Assets Act 1989. These licenses were an exclusive right of ownership to the forest trees but not the land itself, which was retained by the Crown. Although these reforms brought immediate job losses, eventually the profitability of the country's forestry sector improved and it was buoyant through the 1990s. The late 1980s and 1990s were characterised by rapid afforestation in New Zealand.

In Marlborough, new forestry plantings occurred on hill country in the Rai, Te Hoiere / Pelorus, Kaituna and Cullens Creek Catchments and the Marlborough Sounds, as a result of tax concessions and returns for forestry compared to pastoral farming being more favourable at the time (MDC, 1992; Sutherland, 2000). By 2000, the forest area in the Nelson-Marlborough wood supply region was just over 177,000 hectares (MAF, 2000). As a point of reference, in 1999, the harvest was 1.3 million m^3 of logs, the base cut forecast for 2000 was 1.4 million m^3, and the wood supply was forecast at the time to double over the next decade.

---

278 These plantings were part of the Northbank Catchment Control Scheme, which sought to reduce sediment.

279 In 1990 Jim Sutton (Minister for Forestry) noted that, using taxpayer funds, the state plantation forest resource in New Zealand stood at 550,000 hectares and the private sector had planted a similar area (Sutton, 1990). He went on to explain *"Forestry is no longer an infant industry; thanks to the taxpayers and the entrepreneurs we now have mature plantation and processing industries in New Zealand. Over the next ten years wood supply will double; if the country is to derive maximum benefit from this increase, critical decisions on its use have to be made now to give sufficient lead time to establish the necessary processing plants."*

By the 1990s, continuous harvesting was occurring in Marlborough as plantations matured. In 1991, the Nelson-Marlborough wood supply region was estimated to have a total plantation forest resource of about 130,000 hectares: 90,000 hectares in Nelson (including all of the Rai Forest) and 40,000 hectares in Marlborough (Aldwell & Manley, 1994). The forests varied considerably in size and were scattered throughout the wood supply region, including through the Marlborough Sounds (Aldwell & Manley, 1994). These forests were supporting local sawmilling industries and a medium density fibreboard (MDF) plant (located in Nelson), as well as material for export as either logs or chips (Aldwell & Manley, 1994).

With the introduction of the Resource Management Act 1991, Marlborough District Council explored issues and options for forestry and farming in the Marlborough Sounds (MDC, 1992). The regulatory regime for commercial forestry under the Marlborough Division District Scheme continued under the Marlborough Sounds Resource Management Plan, which became operative in 2003 (P. Hawes, pers. comm., 2024). In addition, resource consent was required for land disturbance associated with forestry earthworks, but not harvesting or for replanting to retire erosion-prone areas (Urlich, 2020).

Through three Treaty of Waitangi Settlements in 2014, forestry land became one mechanism of redress with the land being returned to tangata whenua ownership. Ownership of the forest asset was also transferred to tangata whenua through the cessation of the Crown Forest Licenses, occurring either when the trees are felled or 35 years after the transfer from the Crown, whichever is sooner. This process has led to considerable iwi ownership of forest resources and the underlying land throughout Marlborough in areas such as Queen Charlotte Sound, and Rai and Wairau Valleys.

Also in 2014, a 'Wood Sector' group was formed to adopt the Smart+Connected approach, Marlborough's regional economic and community development programme[280]. This group includes representatives of the forestry sector, local landowners, transportation service providers, the Marlborough Chamber of Commerce and local government entities. Its priorities are to: 1) enhance the sector's reputation (e.g., environmental stewardship, employment opportunities, community partnership), and 2) increase processing and value add opportunities in Marlborough to reduce the reliance on the export of logs. Workers in the sector are employed in forest production operations (e.g., establishment, silviculture[281], and harvesting) while others are involved in wood product manufacturing (Yao, Hock, Harrison, Hall, Baillie, & Evanson, 2017).

280 *https://www.marlborough.govt.nz/your-council/marlborough-smart-and-connected/collaboration-innovation-and-transformation-groups/industry-group-forestry-and-wood-sector*

281 There are 4 main silviculture regimes – unpruned with no thinning, pruned with no thinning, pruned and thinned, and unpruned and thinned. There are 3 broad grades of timber – industrial, structural and appearance.

7.3 Marlborough Forestry Estate[282]

Marlborough's plantation forestry estate[283] in 2023 was at least 75,000 hectares, with an estimated standing volume of wood of 26.6 million m^3. This area represents an expansion of just over 2,000 hectares (2.8%) since 2019[284]. Over the 4-year period, Marlborough's share of planted area in the Nelson-Marlborough wood supply region has increased slightly from 43.6 per cent to 44.7 per cent (all species). The estate is predominantly radiata pine, with minor areas of Douglas fir[285], cypress species, softwoods other than cypress (e.g., redwoods), and eucalypts (National Exotic Forest Description, 2023)[286].

In 2022, the indigenous species with the most volume delivered to mills in the Nelson Marlborough wood supply region were tōtara, rimu, silver beech, and red beech (Canopy, 2024). However, although no data was available, it is thought to be largely supplied from Nelson and Tasman (e.g., Maruia, Murchison, and Golden Bay) (A. Mackenzie, pers. comm., 2025).

There are four main silviculture regimes: unpruned with no thinning, pruned with no thinning, unpruned and thinned, and pruned and thinned (Table 36). Pruning, in particular, is costly and decisions are influenced by factors such as 1) the location of the site in relation to labour supply, processing, and markets, 2) the site's terrain (i.e., steepness) and 3) soil fertility, which affects growth and stiffness of trees. Radiata pine is normally planted at about 1,000 to 1,250 stems per hectare. If pruned or thinned then final stocking rates change to 200 to 400 stems per hectare for pruned regimes and 400 to 500 stems per hectare for structural regimes[287]. In Marlborough, around 41 per cent of the area in radiata pine is managed under a pruned regime but no production thinning was being undertaken (Marshall & Brown, 2021b)[288].

Table 36: Four main silviculture regimes in plantation forestry

Unpruned with no thinning Also known as 'plant and leave' or 'millennium' regime. Produces industrial grades that are mulched into pulp and paper or exported for the construction industry. There is a large demand from China for this type of timber.	**Pruned with no thinning** Used for growing narrow appearance grade logs for the domestic market. Pruning is the removal of a tree's lower limbs to produce higher value wood free from knots.
Unpruned and thinned Produces structural grade timber. Thinning to a lower stocking rate encourages greater diameter logs. Demand is from China, Korea, Japan and the domestic market.	**Pruned and thinned** Produces structural and appearance grade timber. This timber is mainly used for the domestic market with a small demand from Japan.

Source information: https://www.canopy.govt.nz/market-forest/what-silviculture-regime/

282 General information on P. radiata forests and clearwood production is available in Bunn (1981) and Bier (1985).

283 Marlborough's total forestry estate includes commercial forests, private non-commercial forests, and conservation forests (Mandolin Associates, 2013).

284 Marlborough's production forest estate in 2019 was around 73,000 hectares, with a standing volume of 21.1 million m^3 , and the area-weighted average age of the forest was 17.8 years (MPI, 2019).

285 The National Exotic Forest Description (2023) estimated the area of Douglas-fir in Marlborough as 1,095 hectares, down from 1,320 hectares in 2020. Once harvested, most areas that were in Douglas-fir are being replanted with radiata pine (the planting of Douglas fir now requires a resource consent). The age-class distribution of Douglas-fir in Marlborough is uneven, and the target rotation age is 35 years.

286 Forecasts of wood availability from New Zealand plantations have been undertaken regularly since 1969 (Manley & Lane, 2013). An article tracing the background to the National Exotic Forest Description is available at: *https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/may-2015/the-importance-of-the-national-exotic-forest-description-for-small-scale-forest-owners/*

287 The information on silviculture in this paragraph is sourced from https://www.canopy.govt.nz/market-forest/what-silviculture-regime/

288 It is anticipated that the pruned log type in the Nelson and Marlborough wood supply region will almost disappear by 2045 (Marshall & Brown, 2021b).

A forestry rotation has three main phases: 1) planting to canopy closure, 2) canopy closure to forest maturity, and 3) harvesting and post-harvest (Baillie & Neary, 2015). Figure 55 shows Marlborough's production forest estate distributed by age class in 2023. Radiata pine grown for timber framing at 400-600 stems per hectare will usually reach an optimum harvest volume in 24 to 30 years, and 30 to 35 years for clearwood[289]. In 2021, the average rotation age for radiata pine was 27 years based on the results of the large forest owners harvest intention survey for the Nelson-Marlborough wood supply region (Marshall & Brown, 2021b).

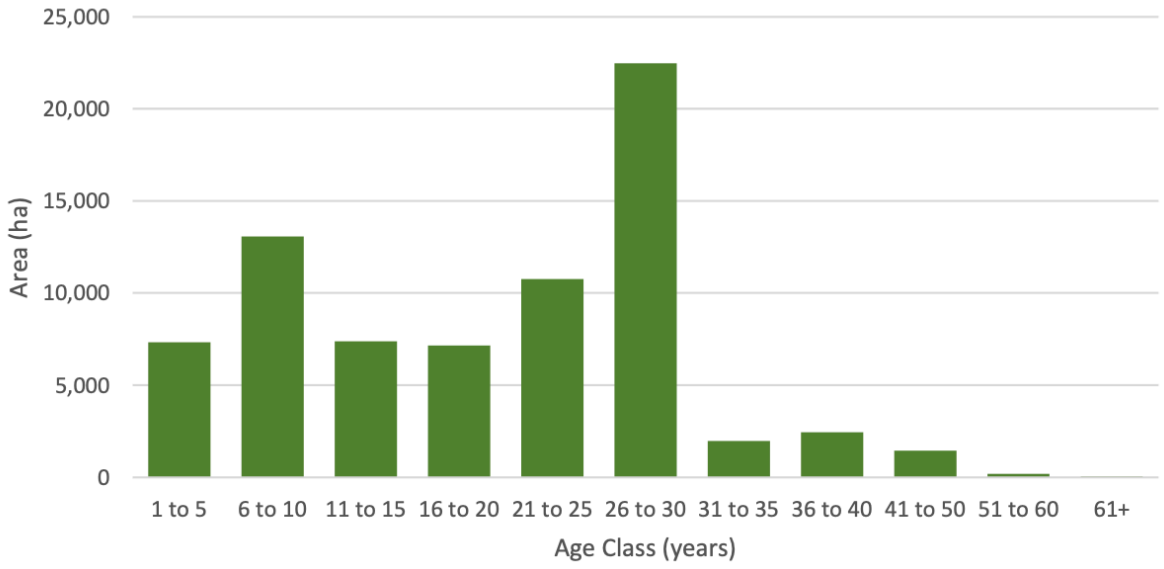


Figure 55: Distribution of forest area (all species) by age in Marlborough, as at 1 April 2023
Source data: National Exotic Forest Description 2024

The area of harvested exotic forest in Marlborough awaiting restocking in 2022 was around 2,300 hectares (Stats NZ Agricultural Production Statistics)[290]. In addition, Marlborough is estimated to have had around 330 hectares of afforestation in 2022 (Manley, 2024) but it is unclear as to whether it may be for carbon forestry. As of December 2023, $3.4 million in funding has been approved from the One Billion Trees fund for direct landowner and partnership grants in the region and a total of 1,107 hectares were planted in the region (Canopy, 2024).

- *The rate of forest establishment in 2023 around the country was on par with 2001 rates. Occasionally in Marlborough there are sheep and beef farms converting to carbon forestry. There were a few examples in South Marlborough of afforestation rather than just re-establishment but none in the Wairau Valley. There have been one or two small woodlots removed on properties to expand vineyard plantings. The rate of afforestation is certainly much less than the public perception.*

289 https://www.nzffa.org.nz/farm-forestry-model/species-selection-tool/. Clearwood is knot and blemish-free wood that is used to produce furnishing, finishing, and decorative timbers. It is produced by pruning the trees while still young and thinning the stand to encourage fast growth and a good sheath.
290 The area in Nelson and Tasman combined was just over 2,400 ha.

7.4 Wood Availability

Based on the exotic forest estate discussed in the previous section, the 2021 wood availability forecast for Marlborough showed the region's peak supply of logs was expected to occur in the mid-2020s, which will complete the harvest of areas planted during the early to mid-1990s (Marshall & Brown, 2021b). At the time just under 3,464 hectares of forest planted before 1990 remained in the Nelson-Marlborough wood supply region (Marshall & Brown, 2021b).

In a scenario that maintains a 27-year average rotation age, wood availability in Marlborough was expected to peak at 2 million m^3 per year between 2023 and 2027, decrease to below 1 million m^3 per year by 2031, before rebounding to 1.5 million m^3 per year by 2040. By comparison, Nelson was forecast to have a more stable harvest over this time period, ranging from 1.6 million m^3 per year to 2 million m^3 per year.

Figure 56 shows the forecast availability of logs by large and small-scale forest owners between 2021 and 2050 for Marlborough[291]. The forecast uses survey results to include the harvesting intentions of the region's large-scale owners[292], while small-scale owners are simply assumed to harvest their forest holdings at 27 years (Marshall & Brown, 2021b). The graph shows modelling results for a wood availability scenario that assumes that large-scale owners harvest according to their stated intentions from 2021 to 2031 then at a non-declining yield (i.e., once established it will not decrease) from 2031 (Scenario 3 in Marshall & Brown, 2021b). Prevailing market conditions (e.g., log prices) and logistical constraints (e.g., availability of harvest crews and transport capacity[293]) are an important determinants of actual harvests, and so woodflows, in any given year.

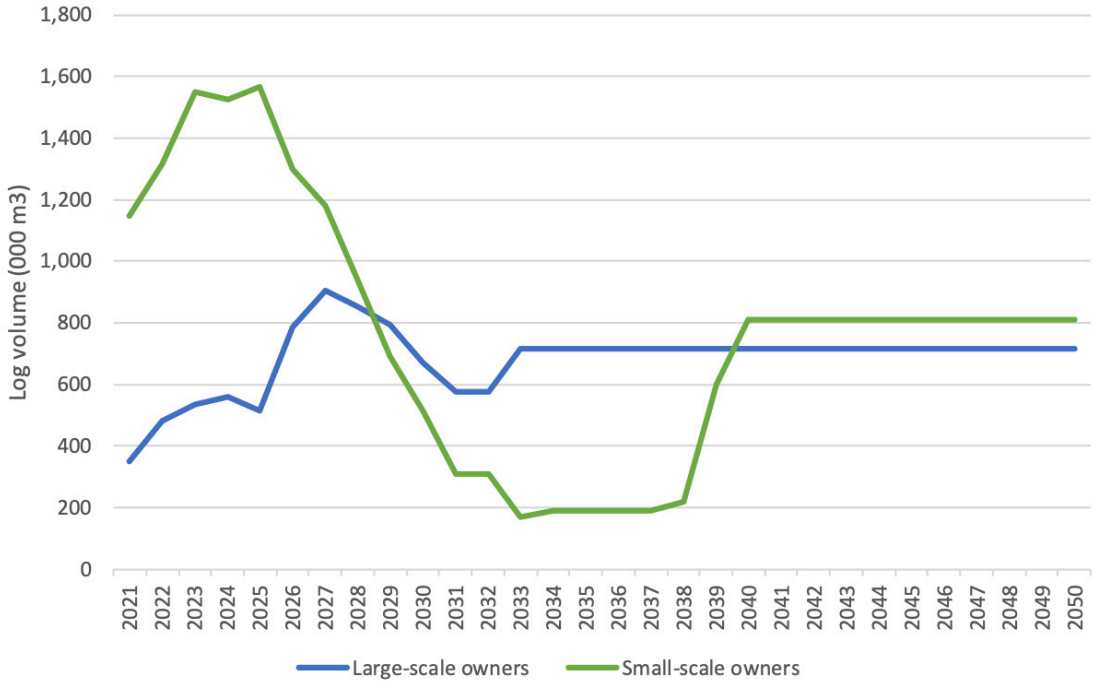


Figure 56: Wood Availability Forecast in Marlborough by log grade with a target rotation of 27 years
Source data: Marshall & Brown, 2021b

291 An average radiata pine tree yields 2.4 m^3 of wood at harvest, one hectare of 28 year-old radiata pine contains between 650 and 800 m^3 of wood, and one hectare grows up to 28 m^3 of wood each year (FOA, 2019).

292 As noted in Section 7.2 in wood availability forecasts large-scale owners are defined as exotic plantation owners with: 1) 3 000 ha or more of forest in the region of interest; and 2) more than three age classes; and 3) not a part of a syndicate. In some regions, particularly those with only a few large-scale owners, some forest owners with just under 3 000 ha are also included (Marshall & Brown, 2021b).

293 Aldwell & Manley (1994) discussed the changes needed to the size and composition of the transport sector to meet the demand from a rapidly increasing wood harvest in the Nelson-Marlborough wood supply region in the 1990s.

Tables 37 and 38 give the number of forest owners and forest area in the Nelson-Marlborough wood supply region in 2023 (MPI. 2024). Canterbury and New Zealand as a whole are also included in these tables for comparison. In 2023, there were just under 300 forest owners in Marlborough (and roughly 1,800 in New Zealand) holding more than 40 hectares of forests (MPI, 2024a). Almost all forest owners (94%) held between 40 and 499 hectares of forest, making up 18 per cent of the total exotic plantation forest estate. In contrast, a handful of owners (6%) held 500 or more hectares and accounted for 67 per cent of the total estate.

Table 37: Number of forest owners by national size class, as at 1 April 2023

Wood Supply Region	40-99 ha	100-499 ha	500-999 ha	1,000-9,999 ha	10,000+ ha
Nelson and Marlborough	167	102	8	8	2
Canterbury	71	78	3	7	1
New Zealand	894	694	83	70	28

Source data: MPI (2024)

Table 38: Forest area by forest owner national size class, as at 1 April 2023

Wood Supply Region	<40 ha[294]	40-99 ha	100-499 ha	500-999 ha	1,000-9,999 ha	10,000+ ha	Total ha
Nelson and Marlborough	25,136	10,543	19,006	5,584	22,681	85,022	167,972
Canterbury	32,834	4,545	14,500	2,054	20,259	20,508	94,700
New Zealand	281,940	57,815	148,507	68,166	341,923	890,448	1,788,799

Source data: MPI (2024)

As noted in Section 7.1, in the wood supply forecasts for Marlborough large-scale owners were estimated to hold 47 per cent of the forest estate, and small-scale owners 53 per cent (contrasting with Nelson where the split is 71% and 29%). The forecast increase in wood availability is largely driven by the small-scale owner forest resource, particularly in Marlborough, but there is less certainty around the NEFD age-class distribution and area for small-scale owners. This uncertainty will impact the wood availability from the Nelson and Marlborough region, particularly in the short term.

The University of Canterbury carried out a national mapping study in 2019 of small-scale forest ownership (defined in the study as owners who did not provide harvest intentions for wood availability forecasts). It showed that the area of exotic forest of just under 36,000 that is assumed to be held by small-scale owners was overstated by 2,000 hectares, likely because of uncertainty in the data for forest owners with

294 The number of owners with fewer than 40 hectares of forest in New Zealand is difficult to estimate, but is likely to be over 10,000. It is estimated these owners represent around one per cent of total forest area (MPI, 2024a).

less the 40 hectares (Manley, Morgenroth, & Xu, 2021). Marlborough (like Nelson) has a relatively high proportion of small-scale forestry on steep sites (average slope in Marlborough is 31 degrees) and the majority is within 60 km of a port (Manley *et al.*, 2021).

Owners of small-scale forests (e.g., a woodlot) who are looking to harvest, such as for a retirement fund, may be more likely to delay harvest if prices drop so at to maximise returns. Consequently, log prices in the market can have an immediate and direct impact on a range of economic activities (e.g., harvest crews, log transport, earthworks).

- *Fluctuations in the market are seen quickly on the ground locally and there may be less resilience than in other regions. Larger corporates or those managing harvests over 100 hectares are more able to ride it out but smaller operators, and certainly smaller forest owners, tend to hesitate before they harvest because they want to maximise their return. When people have already waited 27 or 28 years, they will want to get the most out of their investment.*
- *There are many variables to weigh up. If too many owners choose not to harvest when log prices decline, then some contractors may go out of business. Their machinery is upwards of $1 million apiece and the interest costs on that investment are high. Larger forest owners tend to be more aware of the issue and some will put harvest crews into their forests for short periods if it means keeping them in work. Everyone has 5 to 10-year harvest plans in place and it is not easy to find a harvest crew because a forest owner wants to harvest early. It just doesn't work like that.*
- *With smaller woodlots some of the profit stays in the local community and they're likely to engage in local projects as well. Overseas companies have triple bottom line reporting that they have to meet, and so will undertake activities that are above and beyond what some of the smaller companies are able or mandated to do.*
- *We haven't worked with a harvesting crew outside of the Top of the South. Many of them are located in Marlborough and you need to consider their travel time from a health and safety point of view. They are usually travelling a long way anyway to their work sites each day, so it is best to avoid increasing that where possible. Also, harvesting crews are members of our local community, and they support sports teams and other activities, so local is preferable as much as possible.*

There are three broad grades of timber – industrial, structural and appearance. Industrial grade timber usually comes from the top one-third of logs or from logs that have not been pruned or thinned[295]. This grade of timber is used for things like construction boxing and pallets. Structural grade timber usually come from the middle-third and lower-third parts of the log. This is the timber grade used in construction for things like framing and roof trusses. Appearance grade timber usually comes from the bottom one-third of a log, which commonly has been pruned. It is used for things like furniture and weatherboards because of its clean, knot free appearance.

In 2023, just over 383,000 m^3 of logs (35% of the total wood supply) went to sawmills in Marlborough, contributing to 3.4% of New Zealand's total log volume processed domestically (Canopy, 2024). A mix of major and small wood processing plants in the Nelson Marlborough wood supply region produced just over 328,000 m^3 of sawn timber and just under 402,000 m^3 of panels (9% and 29.5% of New Zealand's total production respectively) (MPI, 2024a). At least six other wood processors produce around 20,000 m^3 of beams, posts and poles per annum.

295 *https://www.canopy.govt.nz/market-forest/what-silviculture-regime/*

Image 50: Looking down on Waimahara Wharf in Shakespeare Bay with Picton Township in the distance

In Marlborough timber processing predominantly occurs at One Forty One site at Kaituna Sawmill (near Renwick). In 2021 One Forty One announced three major projects (with a value of $11 million) to increase the sawmill's drying and treating capacity. These projects are intended to allow greater value to be extracted from its logs and reduce road transport. Two small sawmills in Marlborough offering a range of products are Dashwood Treated Timber and Posts Ltd (established in 1963), and Rapaura Timber 2015 Ltd[296]. Heagney Bros Ltd in Blenheim are a transport company that also supplies firewood. The Timberlink New Zealand Ltd sawmill in Blenheim closed in 2020 with the loss of 75 jobs[297].

For the log export market, softwood logs are usually sold on volume based on the Japanese Agricultural Standard (JAS) (Ellis, Sanders, & Pont, 1996)[298]. In 2024, just under 709,000 m^3 (JAS) were exported from Port Marlborough (Shakespeare Bay, Picton), and although this volume was a decrease from 2023 and 2022 it was still above pre-COVID-19 levels (Figure 57). A log debarking facility is scheduled to be established at the Port in 2024, which will eliminate the need for chemical fumigation for exporting logs to countries allowing debarked logs (Canopy, 2024).

296 https://www.dashwoodtimber.co.nz/ and https://www.rapauratimber.co.nz/

297 Although Timberlink had invested over $10 million to upgrade the Blenheim site, the reasons the company cited for the closure were "ongoing high log costs, the strong NZ dollar, and low prices in export, especially Asia" as well as COVID-19. https://www.stuff.co.nz/business/122704945/blenheim-sawmill-with-75-staff-to-close-by-end-of-the-year

298 It is customary for harvesting and cartage contractors to be paid on tonnes, but port services contractors are paid on volume (m^3 JAS) (Ellis, 2016). Volume in JAS is derived from two formulae, one for logs of less than 6 m in length and the other for logs of 6 m and longer (Ellis *et al*., 1996). Although JAS volume estimates on logs of average dimensions are close to true cubic, large errors can occur with increase in log taper and decrease in small-end diameter (Ellis *et al*., 1996).

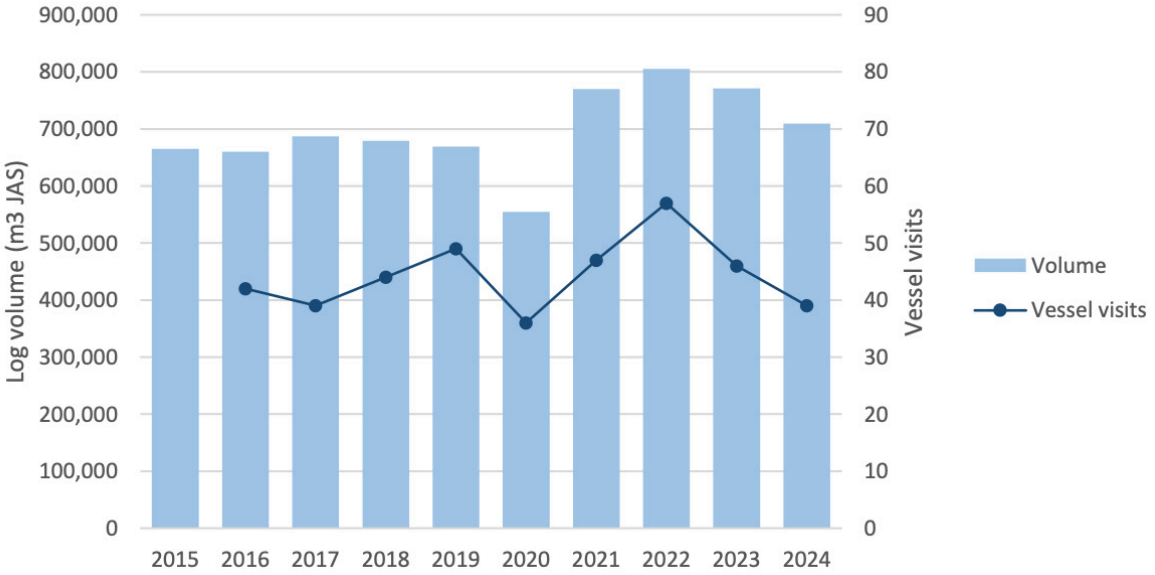


Figure 57: Annual log exports (volume and number of vessel visits) from Port Marlborough (Shakespeare Bay)
Source data: Port Marlborough Annual Report 2024

7.5 Harvesting

Plantation forests can have dual roles of economic production and protection of vulnerable land from soil erosion and landsliding. However, the risks of such effects increase when a forest is harvested (Philips, Marden, & Basher, 2012)[299].

Landsliding and the mobilising of slash and debris from slopes into and through stream networks can have disastrous effects both within and beyond the forest boundary (Philips *et al.*, 2012). Whether that risk is fully realised is usually related to the incidence of storms in the few years following forest removal, often referred to as the "window of vulnerability" (Philips *et al.*, 2012). The period of maximum susceptibility is up to six years following tree removal though this will vary depending on factors that include site conditions, tree species, and planting density (Philips *et al.*, 2012). Sediment yield also increases in the years after harvesting but then drops to pre-harvest levels (Philips *et al.*, 2012)[300]. Reforestation of a site is used to control soil erosion and sediment loss. As is discussed below, the incidence of storms is expected to increase with climate change.

Forestry slash (any tree waste left behind after commercial forestry activities[301]), particularly at harvest, has long been recognised as an issue and slash is actively managed by foresters. Leaving a small proportion of the slash on-site is beneficial for the insect life and soil health, and in some circumstances it can be used to help manage erosion and sediment loss. However, and as noted above, the longer that the bulk of the slash is left on-site the more opportunity there is for it to be transported downstream.

---

299 Baillie & Neary (2015) provide a review of literature on water quality in New Zealand's planted forests throughout the planted forestry cycle from afforestation through to harvesting.

300 In a recent study for three regions (Marlborough, Tasman, and Tolaga Bay), Philips, Betts, Smith & Tsyplenkov (2024) found that maximum number and density of landslides was on land harvested up to four years beforehand. They also occurred in areas with trees up to harvest age of about 30 years and on areas with different vegetation covers (e.g., indigenous forests, pasture, scrub). Fewer landslides were associated with forest infrastructure (e.g., roads, landings) than on clearcut slopes. Some landslides were connected to streamlines, and so were able to deliver sediment and woody debris.

301 As defined in the Resource Management (National Environmental Standards for Commercial Forestry) Regulations 2017. *https://environment.govt.nz/acts-and-regulations/regulations/national-environmental-standards-for-commercial-forestry/*

- *The weather, specifically rainfall, is the biggest determinant of increased sediment rates. So, if you've just harvested a forest, and you have a massive adverse weather event, the likelihood of there being adverse environmental effects are higher. If you've just harvested a block and the weather afterwards is fine, then you're going to have less environmental effects.*

Some larger companies are turning their slash into a waste residues stream (e.g., chipping it) but the cost is a constraint, particularly for small forest owners. There is a high level of interest in new technology coming on stream but to be viable at scale in Marlborough there needs to be a market, which is either missing or some distance[302]. A recent local initiative was the Marlborough Forestry 'Hackathon'[303], the first such event in New Zealand. This 6-hour collaborative engineering event was designed to explore potential uses for slash.

Soil erosion, as well as suspended sediment in waterbodies and their resulting sedimentation, can also have negative adverse effects. Sediment from catchments with forestry development is one factor that has driven changes in the benthos of Pelorus Sound (other factors include over-fishing of shellfish stocks, contact fishing methods, aquaculture) (NIWA, 2021). The use of coastal setbacks, such as the 200 metre setback for replanting in the proposed Marlborough Environment Plan, are one way of addressing this issue. Setbacks can reduce the harvestable area and log volume as well as increase the cost of harvesting, all contributing to a decrease in revenue and employment opportunities (Yao *et al*, 2017). The area of planted forests in the Marlborough Sounds accounts for about one-quarter of this land use in the region (Yao *et al*., 2017).

Marlborough District Council is currently mapping debris flow and debris flood susceptibility to further understanding of landslide hazards in North Marlborough[304]. In addition, there are five forestry-related studies within the multi-partner Te Hoiere / Pelorus Catchment Restoration Project[305]:

1. A study to understand current sediment levels in streams within specific forests prior to harvesting. These levels will be the baseline for future monitoring and management efforts and inform similar studies for other land uses in the catchment.

2. A post-harvest riparian native planting project to establish and test options to identify either the most successful – in terms of biodiversity and stream health outcomes – or the factors that contribute to restoration success.

3. A land transition study to identify owners who may want to transition areas of their property to another land use; understand where it may lead to better environmental and economic outcomes; and create an industry-led roadmap, including funding and resources available.

4. A research project aimed at investigating the exclusion of introduced ungulates (deer, pigs and goats) from forests and the potential restorative effects on indigenous flora and fauna, aquatic health, and for carbon sequestration.

5. An access toolkit and forest database for researchers and monitoring teams to better engage with forestry owners throughout the catchment.

---

302 The efficiency of developing new technologies, including the case for public investment in them, can be more obvious once damage costs and remediation costs are considered. An example is how the economics of Scion's new technology for processing forestry slash on site changed following Cyclone Gabrielle. https://www.scionresearch.com/about-us/news-and-events/news/2023-news-and-media-releases/scion-supports-sustainable-forestry-land-use-inquiry-for-tairwhiti-and-wairoa2

303 https://totswoodcouncil.org.nz/marlborough-forestry-hackathon/

304 https://www.marlborough.govt.nz/environment/land/science-projects/project-erosion

305 https://www.marlborough.govt.nz/environment/te-hoiere-pelorus-catchment-restoration-project;https://totswoodcouncil.org.nz/te-hoiere-project/

Image 51: Planted and cleared forestry blocks In the Taylor Pass between the Wairau and Awatere Valleys

Where forests are in close proximity, some of their infrastructure may be shared (e.g., an access road, boundary skid sites). In such situations, forest management companies will usually communicate and occasionally coordinate their harvest plans with each other, particularly from a health and safety viewpoint but also environmentally. If a skid site, where logs are brought to, can be shared then it minimises earthworks, which results in less soil disturbance and also reduces costs. The extent to which harvest plans can be co-ordinated depends, in the first instance, on the harvest intentions of the forest owners. This topic was discussed in relation to Marlborough in Section 7.4.

In the interview it was identified that forestry sector is planning for climate change by aiming to ensure that the mitigation work that takes place for surface water run-off is capable of withstanding either a one in fifty-year or one in a hundred-year rainfall event. However, for each of the four selected locations (Blenheim, Rangitahi / Molesworth, Picton and Rai Valley) rainfall depths are projected to increase for both return periods (Macara, 2021). Increasing rainfall intensity is likely to have impacts on soil erosion, sedimentation, and saturation of soils as well as landslides (Macara, 2021). The results of a rapid assessment of land damage in the North Island from Cyclone Gabrielle in 2023 highlighted the effects that extreme events can have (McMillan, Dymond, Jolly, Shepherd, & Sutherland, 2023).

A further interview comment was:

- *With intense rainfall there is a correlation between forestry infrastructure and slips but, as winter 2022 showed[306], mid-slope failures of hillsides can also occur on other land uses. The government directed what category of land that a forest could be established on. It is unsurprising that the higher the gradient, the greater the chance that things can mobilise downhill, but forests are quite effective in capturing high rainfall within them[307].*

306 Winter 2022 was likely the wettest in Marlborough in a century. https://www.marlborough.govt.nz/your-council/latest-news-notices-and-media-releases/media-releases?item=id:2n7tvh97o1cxbygu5qy4

307 The results from the assessment of land damage from Cyclone Gabrielle were mixed (McMillan *et al.*, 2023). In the southern Hawke's Bay – northern Wairarapa hill country, indigenous forest and exotic forest were observed to be effective in reducing landslide probability (90% and 80% respectively). In northern Hawke's Bay, exotic forestry was moderately effective (60%) but largely ineffective in the Gisborne coastal hill country (by comparison, indigenous forest was 90% and 50%). Possible reasons for reduced effectiveness in those locations included: forestry management such as non-thinning, multiple rotations of forestry, and thin soils caused by a long erosion history. However, field investigations were recommended.

7.6 Other Ecosystem Services

In addition to wood supply, New Zealand's plantation forests supply other goods and services that affect people's wellbeing, such as carbon sequestration, native species habitat, manuka honey, livestock grazing, under canopy crops (e.g., truffles, ginseng), and recreation where there is public access[308] (e.g., hunting of wild game such as pigs, deer, goats). However, it is unclear to what extent each of these activities occurs in Marlborough and their supply will vary across a rotation.

In its overview report on New Zealand's biodiversity, the Department of Conservation noted that plantation forestry is an example of a modified landscape that can offer some habitat for indigenous species, including those that are threatened. However, it was also noted that the felling of trees is associated with smaller bat colony sizes, and may displace native vegetation and harbour weeds. In 2018 there were 4,718 hectares of native vegetation within Marlborough's plantation forests that are certified by the Forest Stewardship Council[309] (FOA, 2019).

- *Forestry is a crop, so over its life cycle there are very different aspects to it, not just the fauna. Biodiversity also depends on the situation, the location. In South Marlborough there isn't as much growing in the under canopy (depending on the stocking rate) as in north Marlborough, such as the Wakamarina, the Rai, and the Opouri valleys. Even in our plantation forests, the biodiversity, the passive ecosystem benefits from those forests are substantial. It's not just the flora and fauna above ground, there's also a myriad of indigenous species, such as fungi, that live underground,*

- *And then there is carbon forestry. There is the idea of mosaics and using a plantation forest to transition to a native forest for some people is an effective way to go. And that's through active management and going through and you using your pines as your nursery crop basically.*

An ecosystem disservice linked with forestry is the spread of wilding conifers[310], which has been rapid across parts of New Zealand since the 1970s. However, the issue is complex. It is often a reasonably foreseeable but unintended consequence of past afforestation programs to control erosion, old amenity plantings, and shelter belts, rather than being the result of modern commercial forestry, which is usually harvested as it reaches maturity. The spread of various wilding conifer species is a particular issue in the Marlborough Sounds (FOA, 2019) as well as the Upper Wairau and Waihopai Catchments, the Upper Awatere Catchment, and Rangitahi / Molesworth Station.

> *Many south Marlborough catchments include areas seeded or planted with introduced conifer species for erosion control purposes in the 1960s-1970s. With 55,000 hectares planted, the Branch/Leatham catchment has been subject to more erosion control plantings than any other New Zealand catchment. While much is known about individual catchments the data has not been aggregated for south Marlborough. In 2004 1,000 hectares of the Marlborough Sounds had wildings at high densities (>50 stems per ha), while wildings at low densities (<1 wilding per ha) covered 24,000 hectares.*
>
> ***Froude (2011)***

308 In addition to private access, right of way easements provide public access to forests that used to be Crown land.

309 The Forest Stewardship Council is an international non-government organisation that was founded in 1994 to promote responsible forest management. Their forest management certification recognises achievement of nationally and internationally agreed standards. https://anz.fsc.org/new-zealand-forest-management

310 Under the National Environmental Standards for Commercial Forestry, wilding conifer means a self-established conifer species tree resulting from seed spread from commercial forestry, shelter belts, amenity planting, or an already established wilding conifer species tree population.

Lodgepole or contorta pine (Pinus contorta) is commonly recognised as the most vigorous invasive conifer, and although rarely planted today, it remains the dominant species in many areas where wildings are a problem (Ledgard 2001). There are now some spread risk issues emerging with Douglas fir impacting on the hill and high country and the wilding spread in the Marlborough Sounds is mainly Radiata pine (Alan Johnson, pers. comm., 2025). The planting of Douglas fir is now prohibited by the proposed Marlborough Environment Plan (rules 3.3.9 and 3.3.11 for Woodlot planting, Conservation planting, exotic continuous-cover forestry planting and carbon sequestration forestry planting). Another wilding conifer species found in the Marlborough Sounds is Maritime pine (Pinus pinaster) (A. MacKenzie, pers. comm., 2025).

The spread of wilding radiata pine overseas occurs in climatic zones and indigenous vegetation types that are not represented in New Zealand. A key factor in many of those environments is regular fires, which allow prolific seed release from radiata pine's serotinous (closed) cones. Without fire, radiata pine cones only open and release seed during sustained spells (e.g., 1-3 months) of dry weather where daytime temperatures frequently exceed 30 °C. Such conditions are rare in New Zealand's maritime climate (Bloomberg, 2014). In New Zealand, radiata wilding spread is limited to warmer sites, and its seedlings are more palatable than most other invasive conifer species, so there is a lower risk of spreading where there is controlled grazing pressure from livestock (Bloomberg, 2014).

The interviewee's comment on wilding conifer spread was:

- *To help deal with legacy issues and minimise wilding seed spread originating from commercial forests, the forest industry advocates for the removal, either through harvesting or poisoning, or all mature pine trees from forests prior to the establishment of the next rotation of trees. The potential for permanent carbon forestry as a seed source in Marlborough is an unknown quantity at this stage, although is covered by and subject to the regulations of the National Environmental Standards for Commercial Forestry (as is all commercial forestry).*

From a policy perspective, the issue is managed through the permitted standards for both afforestation and replanting in the National Environmental Standards for Commercial Forestry and its wilding tree risk calculator. On the ground, the spread of wildings in the region has primarily been managed at a landscape scale through the National Wilding Conifer Control Programme[311], which has focused in the Upper Clarence Catchments on Rangitahi / Molesworth Station, the Upper Awatere and Waihopai Catchments, as well as other high-country areas. However, recent cuts in the government funding of this programme may result in losses of the gains that have been made.

More visible to the public are the local wilding pine programmes run by the Marlborough Sounds Restoration Trust[312] and the South Marlborough Landscape Restoration Trust[313] to protect natural character and biodiversity. Marlborough District Council provides the two trusts with some operational funding. The Marlborough Sounds Restoration Trust employs professional contractors while the South Marlborough Landscape Restoration Trust relies on volunteers and landowner support.

311 https://www.wildingpines.nz/about-wilding-pines
312 https://www.soundsrestoration.org.nz/
313 https://www.marlboroughrestoration.org.nz/

Seedlings and young trees are either hand-pulled or felled using a pruning saw, while mature trees are generally poisoned by injecting holes into their trunks, and injecting a small amount of herbicide into each hole. Occasionally trees in difficult-to-access areas, or where they are widely spaced, will be treated from helicopter by herbicide application onto the bark of the trees. Poisoning rather than felling mature trees leaves the surrounding regenerating native vegetation undisturbed and lessens secondary pine re-growth. Poisoning is also preferable to the use of chainsaws on steep slopes for the health and safety of forestry crews and reduction of fire risk.

Image 52: Wilding pine control Endeavour Inlet, Queen Charlotte Sound

7.7 Wildfire Risk

As noted earlier in this report, Marlborough tends to be dry during much of the year and parts of the region currently have one of the most severe fire climates in New Zealand (along with central Canterbury and Hawke's Bay). Wildfire events can have severe implications for plantation forestry (Langer *et al.*, 2021). For example, in 2015, three major forest fires in Marlborough contributed to the greatest loss of plantation forest (over 3,000 ha) since the 1955 Balmoral Forest fire (3,155 ha) (Langer *et al.*, 2021). The mass planting of exotic trees for carbon sequestration may alter water availability or heighten fire risk (DOC, 2020).

Wildfire risk in New Zealand is influenced by the prevailing climatic conditions, particularly whether the country is in a La Niña or El Niño phase[314]. Marlborough / Nelson experienced a decrease in both the number of wildfires and area burnt during the 2019-20, 2020-21 and 2021-22 wildfire seasons due to a La Niña phase (Gross, 2024). However, the wildfire risk increased in Marlborough in the 2023-24 wildfire season during an El Niño phase[315]. The risk can also vary between localities. During the 2024 drought south Marlborough had a more extreme fire risk than north Marlborough, which is where much of the plantation forestry is located (south and north is divided by the Wairau River)[316].

Part of a forest's infrastructure is its fire breaks. The National Environmental Standards for Commercial Forestry 2017 requires setbacks for new plantings (i.e., afforestation) from building and adjoining property boundaries. The proposed Marlborough Environment Plan also has fire safety setbacks in the Rural Environment Zone for buildings on neighbouring land from existing commercial forestry or carbon sequestration forestry (proposed Rule 3.2.1.7).

In addition, firefighting equipment (e.g., a water container with a pump and a hose) is kept on work sites at all times in a plantation forest and is towed around. The equipment is determined by the nature of the work (e.g. planting, thinning, harvesting etc) and any machine entering a forest is also required to carry mandatory firefighting equipment. On steep hillsides an alternative option is to rely on a helicopter and monsoon bucket with water drawn out of a river, such as the Wairau. Water points are identified on the site set up and emergency response plans. Some forests will have waterbodies within them, or otherwise others will be identified. As the fire risk is elevated[317] an increasing amount of water is required and earlier cut-off times during the day that certain activities must be halted by. It can get to a point where work has to finish on-site by midday.

- *The forest industry works closely with FENZ, runs annual pre-season fire meetings and has developed (in collaboration with FENZ) an approved Nelson/Marlborough set of guidelines for forestry operations during the fire season[318]. These guidelines are adhered to and escalated throughout the day, based on the daily fire indices that are broadcast every morning.*

- *If extreme fire risk stays around too long and workers are on reduced wages then after a while they start to look for work elsewhere, because the situation is unsustainable. It can impact local employment and the available workforce for forestry. It was only a few months ago that we had a huge rainfall event, and a lot of the workers were on reduced wages then as well because the log prices were low and the cost of the infrastructure was so high.*

---

314 El Niño and La Niña are the warm and cool phases respectively of a natural climate pattern across the tropical Pacific known as the El Niño-Southern Oscillation. On the east coast of New Zealand a La Niña phase generally results in moister conditions while El Niño conditions are drier.

315 *https://www.fireandemergency.nz/assets/Documents/Seasonal-Fire-Danger-Outlook/January_2024_Fire_Danger_Outlook_FINAL.pdf*

316 In the future Marlborough will be divided into a north zone, a south zone, and public conservation land. The zones are based on climatic conditions, geographical features, land use, and territorial authority. Also considered are previous analyses of the wildfire threat. Descriptions and maps of each zone are available at *https://www.fireandemergency.nz/assets/Documents/fire-plan/2024-Fire-Plans/Marlborough-Fire-Plan-2024-2027-draft.pdf*

317 The NZ Forest Owners Association's Forest fire risk management guidelines (2018) have trigger point tables and fire prevention actions at different fire danger levels. Fire and Emergency supports these guidelines. *https://www.fireandemergency.nz/assets/Documents/fire-plan/2024-Fire-Plans/Marlborough-Fire-Plan-2024-2027-draft.pdf*

318 This document is titled: Nelson / Marlborough Forest Industry Working Group Fire Prevention Guidelines for Forestry Operations.

7.8 Impact Risk

The forestry sector's use of fresh water will influence how it is impacted by policy options in the future. Across a Pinus radiata rotation, the use of nutrients (nitrogen and phosphorus) in commercial forestry is usually low. At the most, one fertiliser application in a 27-year cycle, and in many cases, now not used at all. Faecal microbes (which are indicated by *E. coli*) largely just occur where fauna is present. Although irrigation is used for seedlings in nurseries, new plantings for commercial plantation forestry in Marlborough rely on precipitation rather than irrigation for water. While forestry can be used to combat erosion, the main issues for the sector in relation to water are losses of sediment and slash between harvest and re-planting, particularly when there are adverse weather events. Also relevant for new plantings is a catchment's hydrology, with some catchments already being subject to regulatory controls to protect water yields.

The owners and managers of Marlborough's commercial forests each have their own business situation and so individual risk profile for how they may be impacted by future policy. This profile is based on a range of factors. In the first instance there is likely to be a distinction between the large forest owners and small forest owners. While all forest owners are seeking to maximise their return on what is a long-term investment, the scale of their holdings and the parties involved will influence their priorities, timeframes, and management opportunities. In some cases, a forest owner may represent many shareholders with varying situations.

The interviewee commented:

- *Harvest plans can go out for years and if it is constrained then it can impact not just shareholders' returns but also the harvesting crew, the transport, all of the subsidiary industries that support the sector. A forest owner may end up with a hole in their harvesting in future years and moving machines between sites and catchments is a high cost exercise.*

A second factor is the number and length of streams within a forest block, which is one of first considerations for forest managers when harvest planning, and the degree to which the block is steeply incised or includes easier gradients. As highlighted in Section 2.1, Marlborough has a considerable share of moderately steep and steep land, particularly compared to Tasman.

Another factor is the nature of the forest establishment (e.g., its age, design, size, location, and growth patterns, windthrow) as well as others within a catchment, particularly where plantings are of a similar age. This factor is also influenced by the level of management over time. A forest's physical limitations will partly determine if alternatives exist for a forest's earthworks or site access.

Finally, there is the generational length of a forestry rotation. Rotation length means that decision-making within the sector is generally on a long time horizon. For example, legacy plantings still exist that extend right up to a stream bank while some more recent plantings may include riparian indigenous bush-covered setbacks.

Some factors are the result of a forest owner or manager's knowledge of the Marlborough and its forestry sector. The interviewee noted that "At present there is something of a 'changing of the guard' in the region and new entrants into the sector are not always as familiar with the geography of different sites and localities."

References

Agnew, R, & Raw, V. (2021). *Marlborough meteorological services.* A Plant & Food Research report for Marlborough Research Centre Trust.

Agrilink (2023). Water use on vineyards and in wineries in the Marlborough region over 10 years. An Agrilink NZ report for Marlborough District Council and Sustainable Winegrowing New Zealand.

Aldwell, P., & Manley, B. (1993). Impacts of forestry sector growth on the Nelson and Marlborough transport industry. *New Zealand Journal of Forestry,* 38(4), 31-37. New Zealand Institute of Forestry.

Anon (1980). Resumes of Conferences Papers. *New Zealand Journal of Ecology, 3*. https://newzealandecology.org/nzje/1483.pdf

Anon (2008). In tune with their landscape: South Island Husqvarna Farm Forester of the Year. New Zealand Tree Grower, August. https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/august-2008/in-tune-with-their-landscape-south-island-husqvarna-farm-forester-of-the-year/

Anon (2023). *Freshwater Monitoring Annual Report 2023*. Avon Valley Catchment Group.

Archer, L. & Brookes, J. (2018): *Modelling nutrient restrictions and nutrient losses for Horticulture in the TANK catchment – An economic analysis.* An AgFirst report for Hawke's Bay Regional Council. https://www.hbrc.govt.nz/assets/Document-Library/TANK/TANK-Key-Reports/Modelling-Water-Restrictions-and-Nutrient-Losses-for-Horticulture-AgFirst-2018.pdf

Ashworth-Morrison Cooper (1982). Primary Production Potential: Technical Appendix 1. A report for Marlborough United Council & the Ministry of Works & Development.

Atkinson, J., Crampton, P., Salmond, C. (2021). *NZDep2018 analysis of census 2018 variables.* University of Otago.

Ausseil, A-G. E., Law, R. M., Parker, A. K., Teixeira, E. I., & Sood, A. (2021). Projected Wine Grape Cultivar Shifts Due to Climate Change in New Zealand. *Frontiers in Plant Science, 12.*

Australian Productivity Commission. (2013). On efficiency and effectiveness: some definitions. Productivity Commission Staff Research Note, Australian Productivity Commission Canberra.

Aviss, M. (2023). Summary Report on the *Results of the Significant Natural Areas Project 2022 – 2023.* Marlborough District Council.

Baillie, B. R. & Neary, D. G. (2015). Water quality in New Zealand's planted forests: a review. *New Zealand Journal of Forestry Science, 45.* https://nzjforestryscience.springeropen.com/articles/10.1186/s40490-015-0040-0

Bateson, J. (2014). The last full conference day: Marlborough Ridge, The Throne and The Pyramid. *New Zealand Tree Grower, August.* https://www.nzffa.org.nz/system/assets/1712/Tree_Grower_Aug_2014_low_res.pdf

Beggs, J. P. (1962). Farming in Marlborough. *Proceedings of the New Zealand Grasslands Association, 24,* 126-132.

Beverley, A. (2023). *The First Hundred: The story of the borough of Blenheim 1869-1969.* https://www.marlboroughonline.co.nz/marlborough/information/history/the-first-hundred/

Bloombery, M. (2014). *Preliminary investigation into wilding spread of radiata pine in South Marlborough.* Lincoln University.

Boffa Miskell. (2015). *Marlborough Landscape Study. Section B: Introduction to the Marlborough Landscape* (Report No. C15018) [Boffa Miskell report for Marlborough District Council]. Boffa Miskell.

Bradshaw, K. (2015). Rebuilding after the Onamalutu fire earlier this year. New Zealand Tree Grower, August. https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/august-2015/rebuilding-after-the-onamalutu-fire-earlier-this-year/

Bramley, R. G. V., Trought, M. C. T., & Praat, J-P. (2011). Vineyard variability in Marlborough, New Zealand: characterising variation in vineyard performance and options for the implementation of Precision Viticulture. *Australian Journal of Grape and Wine Research, 17,* 72–78.

Burtt, A. (2019). Sheep and Beef Cattle Farming. In E. Moran, L. Pearson, M. Couldrey and K. Eyre (Eds.), *The Southland Economic Project: Agriculture and Forestry* (Technical Report No. 2019-04) (pp. 70-87). Environment Southland.

Bywater, A. C., & Moot, D. J. (2011). Dryland Sheep Systems in Canterbury and Marlborough. *Proceedings of the Congress of the International Farm Management Association, Methven, New Zealand, 18.*

Canopy. (2024). *Regional Fact Sheet – Te Tauihu-o-Te-Waka / Marlborough.* Te Uru Rākau New Zealand Forest Service. https://www.canopy.govt.nz/assets/content-blocks/downloads/Marlborough-fact-sheet.pdf

Chappell, P. R. (2016). *The Climate and Weather of Taranaki.* NIWA.

Chrystal, J., Fisher, A., & Burtt, A. (2023). Sheep and Beef Cattle Farming. In E. Moran, (Ed.), *Otago's rural businesses and environmental actions for fresh water* [EM Consulting report for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Clothier, B. and Green, S. (2017). *The Leaching and Runoff of Nutrients from Vineyards.* (Occasional Report No. 30). Massey University.

Collins, D., Dark, A., Zammit, C., & Bright, J. (2022). *Effects of climate change on irrigation supply and demand. A national scale analysis.* (Technical Paper No. 2022/07) [Prepared by NIWA for Ministry for Primary Industries]. NIWA.

Crush, J. R. and Rowarth, J. S. (2007). The role of C4 grasses in New Zealand pastoral systems. *New Zealand Journal of Agricultural Research, 50.*

DairyNZ (1999-2023). *New Zealand Dairy Statistics.* Livestock Improvement Corporation Limited & DairyNZ Limited. *https://www.lic.co.nz/about/research-publications/dairy-statistics/*

DairyNZ (2011-2023). DairyNZ Economic Survey. DairyNZ Limited. *https://www.dairynz.co.nz/resources/?page=1&topics=Economic%2520Survey*

DairyNZ (2019). Economic Survey 2018-19. DairyNZ Limited.

Dasgupta, P. (2021). *The Economics of Biodiversity: The Dasgupta Review.* HM Treasury, London.

Davidson, P. & Wilson, S. (2011). Groundwaters of Marlborough. Marlborough District Council.

Dawkins, C., & Dawkins, J. (2008). The Pyramid: a typical Marlborough family farm. *Proceedings of the New Zealand Grassland Association, 70.*

Department of Conservation (2020). *Biodiversity in Aotearoa an overview of state, trends and pressures 2020.* Department of Conservation. *https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020-biodiversity-report.pdf*

Destination Marlborough. (2022). *Marlborough Destination Management Plan 2022-32.* A report by Destination Marlborough for Marlborough District Council. *https://rtnz.org.nz/wp-content/uploads/2022/10/Dest-Marlborough-MP-Full-Doc.pdf*

Di, H.J., & Cameron, K. C. (2002). Nitrate leaching in temperate agroecosystems: Sources, factors and mitigating strategies. *Nutrient Cycling in Agroecosystems, 46.*

Dryden, G., & Weeks, A. (2021). *Marlborough Wine Industry Growth Forecast 2020: Vineyard Area Expansion, Future Challenges and Opportunities.* A Fruition Horticulture report prepared for Wine Marlborough.

Duckworth, L. C., Fletcher, A. S., Higham, J.R.S., & Pope, L.K. (1976). *Marlborough: A survey of present resources and future potential* [Business Development Centre, University of Otago report for Marlborough Regional Development Council]. University of Otago.

Dymond, J. (Ed.) (2014) *Ecosystem Services in New Zealand.* Manaaki Whenua Landcare Research. *https://www.landcareresearch.co.nz/publications/ecosystem-services-in-new-zealand/*

Ellis, J. (2016). Variability in JAS/tonne values. *New Zealand Journal of Forestry, 60(4).* *https://nzif.org.nz/nzif-journal/publications/downloadfulltext/22873*

Ellis, J.C., Sanders, D.H., & Pont, D. (1996). AS log volume estimates of New Zealand radiata pine and Douglas-fir logs. *New Zealand Forestry, (May).*

Executive Finesse (2011). *The Economic Value of Water in the Marlborough Region.* A client report for Marlborough District Council.

Fisher, E. (2023). Broccoli may be Blenheim's favourite vegetable. *New Zealand Grower, 78*(1) *https://www.hortnz.co.nz/assets/News-Events/Magazines/NZ-Grower-February-2023-pages.pdf*

Fisher, A. and Burtt, A. (2022). Chapter 3: Sheep and Beef Cattle Farming. In E. Moran (Ed.), *Farmers and Growers in Otago* (pp. 29-69) [EM Consulting report for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Fleet, H. (1984). *New Zealand's Forests*. Heinemann.

Forest Owners Association (2019). *Facts & Figures 2018/19.* New Zealand Plantation Forest Industry. Ministry for Primary Industries. https://www.nzfoa.org.nz/images/Facts_and_Figures_2018-2019_Web.pdf

Foster, A. (1998). Sounds Complicated. *New Zealand Geographic, 37.* https://www.nzgeo.com/stories/sounds-complicated/

Froude, V. (2011). *Wilding Conifers in New Zealand: Beyond the status report.* A Pacific Eco-Logic Ltd. report for the Ministry of Agriculture and Forestry.

Gerard, M. (2014). Gerard's Pelorus Sounds farm Hopai and Elie Bays. New Zealand Tree Grower, August. https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/august-2014/gerards-pelorus-sounds-farm-hopai-and-elie-bays/

Gibbs, H. S., & Vucetich, C. G. (1962). Soils of Marlborough. *Proceedings of the New Zealand Grasslands Association, 24,* 8-17. https://doi.org/10.33584/jnzg.1962.24

Grigg, D. W., Grigg, J. M., & Lucas, R. J. (2008). Maximising subterranean clover in Marlborough's hill country is key to weaning 80% of sale lambs prime. *Proceedings of the New Zealand Grassland Association, 70,* 25–29. https://doi.org/10.33584/jnzg.2008.70.2727

Green, S. R., Greven, M., & Clothier, B. (2005). *Marlborough Crop Water Use Efficiency Report – 2005* [HortResearch report for Marlborough District Council]. HortResearch.

Green, S., Agnew, R., & Greven, M. (2014). Monitoring nitrate loss under vineyard soils on the Wairau Plains, Marlborough [Plant & Food Research report for Marlborough District Council]. Plant & Food Research.

Gross, S., Aguilar-Arguello, S., Woods, D., & Clifford, V. (2024.) *2021/2022 New Zealand Wildfire Summary.* Fire and Emergency New Zealand.

Grzelewski, D. (2009). Hard pressed: Olive oil gains traction. *New Zealand Geographic, 95.*

Handley, S., Gibbs, M., Swales, A., Olsen, G., Ovenden, R., & Bradley, A. (2017). *A 1,000 year history of seabed change in Pelorus Sound/Te Hoiere, Marlborough*. A NIWA client report for Marlborough District Council, Ministry of Primary Industries and the Marine Farming Association Industries.

Hardy, A. (2022). Innovating for the perfect cherry, every time. Horticulture New Zealand. https://www.hortnz.co.nz/news-events-and-media/media-releases/innovating-for-the-perfect-cherry-every-time/

Hellstrom, K. (2022). Summerfruit season summary. *The Orchardist, 95*(3). https://www.hortnz.co.nz/assets/News-Events/Magazines/The-Orchardist-April-2022.pdf

Hemphill, D. (2021). Pine forests in Pelorus Sound from 1900 to 1970. *New Zealand Tree Grower* (May 2021). NZ Farm Forestry - Pine forests in Pelorus Sound from 1900 to 1970

Hewitt, A. E. (2010). *New Zealand Soil Classification.* Manaaki Whenua Press.

Horticulture New Zealand (2023). Submission on Managing the Use and Development of Highly Productive Land. *https://www.hortnz.co.nz/assets/Environment/National-Env-Policy/Land/23.10.30_HortNZ-FINAL-Submission-on-NPSHPL-Amendments.pdf*

Hosking, J. (1999). Farm Forestry – *The First 50 Years.* New Zealand Farm Forestry.

Infometrics (2012). *Economic Profile: Marlborough*. A client report for Marlborough District Council.

Kay, J. (2017). TechNote 10: Response to Supplements. In *FeedRight Tech Notes: Dairy Cow Nutrition in NZ,* Ministry for Primary Industries and DairyNZ.

Kee, L, & Lam, R. (2012). Sons of the Soil: Chinese Market Gardeners in New Zealand. Dominion Federation of New Zealand Chinese Commercial Growers Inc.

Krugman, P. (22 May 2023) Working from home and realizing what matters. Opinion Column, *New York Times.*

Langer, E., Wegner, S., Pearce, G., Palmer, P., Melia, N., & Luff, N. (2021). *Adapting and mitigating wildfire risk due to climate change: extending knowledge and best practice.* A Scion report for the Ministry of Primary Industries. *https://www.scionresearch.com/?a=80922*

Leathwick, J., Morgan, F., Wilson, G., Rutledge, D., McLeod, M., & Johnston, K. (2002). *Land Environments of New Zealand: A Technical Guide.* Ministry for the Environment.

Ledgard, N. (1995). "Pine Nuts in New Zealand." *The Tree Cropper, 3.*

Ledgard, N. (2001). The spread of Lodgepole pine (Pinus contorta, Dougl.) in New Zealand. *Journal of Forest Ecology and Management, 141.*

Ledgard, N. (2014). Queen Charlotte Sound conference 2014 field day. New Zealand Tree Grower, November. *https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/november-2014/queen-charlotte-sound-conference-2014-field-day/*

Lee, W.W. (1983). Potential and Problems of Developing Summer Dry Hill Country in Marlborough. *Proceedings of the New Zealand Grasslands Association, 44.*

Lynn, I., Manderson, A., Page, M., Harmsworth, G., Eyles, G., Douglas, G., MacKay, A., & Newsome, P. (2009). *Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land* (3rd ed.). AgResearch, Landcare Research, GNS Science.

Macara, G., Woolley, J-M., Morrish, D., Sood, A., Stuart, S., Eager, C., Zammit, C., Wadhwa, S., & Fauchereau, N. (2021). *Climate change projections and impacts for Marlborough* (Client Report No. 2021031 WN) [NIWA report for Marlborough District Council]. NIWA.

Mackay, J. (2008). The development of the New Zealand seed industry and future opportunities. *Journal of New Zealand Grasslands, 14. https://www.nzgajournal.org.nz/index.php/rps/article/view/3179/2803*

Makhlouf, G. (2018). *Natural Capital and the Living Standards Framework* [Speech delivered by the Secretary to the Treasury on 8 March 2018]. The Treasury. https://www.treasury.govt.nz/publications/speech/natural-capital-and-living-standards-framework

Mandolin Associates (2013). Forestry, Logging and Wood Products. An output from the *Industry and Innovation Stocktake Project,* Marlborough District Council.

Manley, B., & Lane, P. (2013). Wood availability forecasting in New Zealand: Meeting the challenges. *New Zealand Journal of Forestry, 58*(3), 25-33. https://nzif.org.nz/nzif-journal/publications/article/22769

Manley, B., Morgenroth, J., Xu, C. (2021). Map of the small-scale forest estate of New Zealand. *New Zealand Journal of Forestry, 66*(1). https://nzif.org.nz/nzif-journal/publications/article/23100

Manley, B. (2023). *Afforestation and Deforestation Intentions Survey 2023.* MPI Technical Paper No: 2024/14. Afforestation and Deforestation Intentions Survey 2023 Final Report

Marlborough County Council (1982). *The Marlborough County District Planning Scheme.* Marlborough County Council. https://www.marlborough.govt.nz/repository/libraries/id:2ifzri1o01cxbymxkvwz/hierarchy/documents/your-council/environmental-policy-and-plans/prev-rmp-docs-list/county-of-marl/mdds1982/Marlborough_Division_DS_Operative_14_May_1982_Part1.pdf

Marlborough District Council (1992). *Issues and Options for Forestry and Farming in the Marlborough Sounds.* Marlborough District Council.

Marlborough District Council (2008). "Chapter 3: Land Use Change". In *2008 State of the Environment Marlborough* (Section Two). Marlborough District Council.

Marlborough District Council. (2010). *Soil State in the Marlborough Region, 2002 – 2005.* Report by Environmental Science and Monitoring Group. Marlborough District Council. https://www.marlborough.govt.nz/repository/libraries/id:2ifzri1o01cxbymxkvwz/hierarchy/documents/environment/state-of-the-environment-reporting-2008-section-2-list/SOE_2008_Sec2_Land_Use_Change.pdf

Marlborough District Council. (2015). *State of the Environment: Our Land, Our Water, Our Place – Atmosphere.* Marlborough District Council. https://www.marlborough.govt.nz/repository/libraries/id:2ifzri1o01cxbymxkvwz/hierarchy/documents/environment/state-of-the-environment-reporting-list/C_State_of_the_Environment_Atmosphere_Pages_45_54.pdf

Marlborough District Council. (2022). *Marlborough Economic Wellbeing Strategy 2022 – 2032.* https://www.marlborough.govt.nz/repository/libraries/id:2ifzri1o01cxbymxkvwz/hierarchy/documents/your-council/marlborough-smart-and-connected/Marlborough_Economic_Wellbeing_Strategy_2022-2032.pdf

Marshall, H., & Brown, J. (2021a). *Wood Availability Forecast – Canterbury 2021* [Margules Groome report for Ministry for Primary Industries]. Margules Groome.

Marshall, H., & Brown, J. (2021b). *Wood Availability Forecast – Nelson and Marlborough 2021* [Margules Groome report for Ministry for Primary Industries]. Margules Groome.

McLintock, A. H. (Ed.). (1966). *An Encyclopaedia of New Zealand*. R. E. Owen, Government Printer.

McMillan, A., Dymond, J., Jolly, B., Shepherd, J., & Sutherland A. (2023). *Rapid assessment of land damage – Cyclone Gabrielle* [Manaaki Whenua – Landcare Research report for Ministry for the Environment]. Manaaki Whenua – Landcare Research. *https://environment.govt.nz/assets/Rapid-assessment-of-land-damage-Cyclone-Gabrielle-Manaaki-Whenua-Landcare-Research-report.pdf*

Mercer, J., Dryden, G., Neal, M., and Green, S. (2016) *Maximising irrigation savings in grape vines and the effect on yield and wine quality.* Sustainable Farming Fund.

Millen, P. (2017). Milling blackwood in the Marlborough Sounds. New Zealand Tree Grower, February. *https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/february-2017/milling-blackwood-in-the-marlborough-sounds/*

Ministry of Agriculture and Forestry. (2000). *National Exotic Forest Description: National and Regional Wood Supply Forecasts 2000. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=7be29e1123d7fd09181fa656a41cd6916e1c3568*

Ministry of Business, Innovation & Employment. (2017). *The Investor's Guide to The New Zealand Produce Industry 2017. https://www.mbie.govt.nz/assets/ec91c182a5/investors-guide-to-the-new-zealand-produce-industry-2017.pdf*

Ministry of Business, Innovation & Employment. (2020). Regional fact sheet: Marlborough. *https://www.mbie.govt.nz/dmsdocument/11448-regional-factsheet-marlborough-pdf*

Ministry of Business, Innovation & Employment. (2024). *Regional Economic Activity Webtool. https://webrear.mbie.govt.nz/summary/new-zealand?accessedvia=new-zealand&areatype=ta&bailiwick=WyJ0YXNtYW4iLHRydWUsdHJ1ZSx0cnVlXQ%3D%3D*

Ministry for Primary Industries. (2019). *National Exotic Forest Description as at 1 April 2019. https://www.mpi.govt.nz/dmsdocument/34425-2019-nefd-report-pdf*

Ministry for Primary Industries. (2022). *Managing exotic afforestation incentives: A discussion document on proposals to change forestry settings in the New Zealand Emissions Trading Scheme. https://www.mpi.govt.nz/dmsdocument/50206-Managing-exotic-afforestation-incentives-Proposals-to-change-forestry-settings-in-the-NZ-Emissions-Trading-Scheme*

Ministry for Primary Industries. (2023). *National Exotic Forest Description as at 1 April 2022. https://www.canopy.govt.nz/assets/content-blocks/downloads/NEFD-2022.pdf*

Ministry for Primary Industries. (2024). *Vineyard Monitoring Report Marlborough 2024. https://www.mpi.govt.nz/dmsdocument/65616-2024-Marlborough-vineyard-monitoring-report*

Ministry for Primary Industries. (2024a). *National Exotic Forest Description as at 1 April 2023. https://www.mpi.govt.nz/dmsdocument/55996-2022-NEFD-Report*

Moore, J., Manley, B., Park, D. (2011). *Quantification and management of the risk of wind damage to New Zealand's Planted Forests* (MAF Technical report 2011.41). Ministry of Agriculture and Forestry.

Moran, E., Pearson, L., & Couldrey, M. (Eds.) (2017). *The Southland Economic Project - Agriculture and Forestry Report.* Environment Southland.

Moran, E. (Ed.) (2022b). *Farmers and Growers in Otago.* [EM Consulting report for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Moran, E. (Ed.) (2023). *Otago's rural businesses and environmental actions for fresh water.* [EM Consulting report for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Moran, E., McDonald, N., & McKay, D. (2022a). *Farm Debt, Farm Viability and Freshwater Management in Pastoral Southland: A Report from the Farm Debt Working Group.* Environment Southland.

Moran, E., McDonald, G., & Mckay, D. (2024). *The Taranaki Economy and Freshwater Management.* Taranaki Regional Council.

Neal, M. (2004). Wairau Plain Land Use and Crop Water Use Trends. A Primac Horticulture report for Marlborough District Council. *https://www.marlborough.govt.nz/repository/libraries/id:1w1mps0ir17q9sgxanf9/hierarchy/Documents/Environment/Land/NealMurrayWairauPlainLandUseandCropWaterTrends.pdf*

Newman, M. (2019). Dairy. In E. Moran, L. Pearson, M. Couldrey and K. Eyre (Eds.), *The Southland Economic Project: Agriculture and Forestry* (Technical Report No. 2019-04) (pp. 70-87). Environment Southland.

Newman, M., & Davidson, R. (2019). Feed Consumed by NZ Dairy Cows: *An Update of Feed Volumes Consumed by New Zealand Dairy Cows Nationally and Regionally since 1990-91.* A report prepared for the Ministry of Primary Industries by DairyNZ Economics Group. *https://www.mpi.govt.nz/dmsdocument/46231-Feed-Consumed-by-NZ-Dairy-Cows*

New Zealand Winegrower. (2022). Vineyard Monitoring Report: Marlborough 2022. New Zealand Winegrowers and the Ministry for Primary Industries. *https://www.mpi.govt.nz/dmsdocument/54541-2022-Marlborough-vineyard-monitoring-report*

New Zealand Winegrowers. (2023). Vineyard Monitoring Report: Marlborough 2023. New Zealand Winegrowers and the Ministry for Primary Industries. *https://www.mpi.govt.nz/dmsdocument/59686-2023-Marlborough-vineyard-monitoring-report*

Nicholls, M. (2020). Out of season cherries. *The Orchardist, November.* *https://issuu.com/hortnz/docs/the_orchardist_nov2020/17*

Nixon, C., Gamperle, D., Pambudi, D., & Clough, P. (2017). *Plantation forestry statistics: Contribution of forestry to New Zealand* [NZIER report for New Zealand Forest Owners Association and New Zealand Farm Forestry Association]. NZIER.

Nixon, C., Kaye-Blake, B., Leroy de Morel, L., & Gämperle, D. (2021). *Economic impacts of the 2019 drought* [NZIER report to Ministry for Primary Industries]. NZIER.

O'Loughlin, C. (2006). *Institutional Restructuring, Reforms, and other changes within the forestry sector since 1986*. A report for FAO. https://www.fao.org/4/ai412e/AI412E08.htm

Olives NZ (2019). The New Zealand Olive Industry. Olives New Zealand. https://www.olivesnz.org.nz/wp-content/uploads/2019/05/Olives-New-Zealand-Overview-Paper-1.pdf

Pearson, L. (2024). *Marlborough Land Use Map: 2024 Base Map Update.* A report by Pearson Environmental Consulting Report for Marlborough District Council.

Phillips, C., Pruden, C., & Russell Coker, R. (1996). Forest harvesting in the Marlborough Sounds - Flying in the face of a storm? N.Z. *Forestry, May.*

Phillips, C., Marden, M., & Basher, L. (2012). Plantation Forest Harvesting and Landscape Response – What We Know and What We Need to Know. New Zealand Journal of Forestry, 56(4).

Philips, C., Betts, H., Smith, H.G., & Tsyplenkov, A. (2024). Exploring the post-harvest 'window of vulnerability' to landslides in New Zealand steepland plantation forests. *Ecological Engineering, 206.*

Pickford, K. (August 2022). Taking time out to tour guide. Winepress (Issue 332), Wine Marlborough.

Planning Tribunal (1979). *Marlborough Forest Owners Association Inc v Marlborough County Council.* NZTPA, 6.

Planning Tribunal (1980). *Marlborough Forest Owners Association Inc and Minister of Works and Development v Marlborough County Council.* NZTPA, 7.

Port Marlborough (2015 - 2024). Annual Report. Port Marlborough. https://portmarlborough.co.nz/about/publications/; https://portmarlborough.co.nz/wp-content/uploads/2024/10/PM-AR24_FINAL.pdf

Raw, V. (2024). Marlborough meteorological services. A Plant & Food Research report for the Marlborough Research Centre Trust.

Reid, J. B. & Morton, J. D. (2019). *Nutrient Management for Vegetable Crops in New Zealand.* Horticulture New Zealand. https://www.hortnz.co.nz/assets/Compliance/Nutrient-Management-for-Vegetable-Crops-in-NZ-Manual-Feb-2020.pdf

Ribaudo, M. O., Horan, R.D., & Smith, M.E. (1999). *Economics of Water Quality Protection From Nonpoint Sources: Theory and Practice.* (Agricultural Economic Report No. 782). Resource Economics Division, Economic Research Service, U.S. Department of Agriculture.

Roberts, L. (2022). Horticulture. In E. Moran (Ed.) *Farmers and Growers in Otago* (pp. 140-162) [EM Consulting report for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Ross, C., Cooper, D., & Chikazhe, T. (2023). Dairy Farming. In E. Moran (Ed.), *Otago's rural businesses and environmental actions for fresh water* (p.209-253) [Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Rutledge, D., Briggs, C., Lynn, I., & Price, R. (2010). *Land-Use Trends in Marlborough District: Consequences for Soil Resources* [Manaaki Whenua – Landcare Research report for Marlborough District Council]. Manaaki Whenua – Landcare Research. https://envirolink.govt.nz/assets/Envirolink/880-MLDC49-Land-use-trends-Marlborough-consequences-for-soil-resources.PDF

Scherp, E. (1962). "The impact of aerial top- dressing on a Marlborough hill country farm. *Proceedings of the New Zealand Grassland Association, 24.*

Smith, N. J., & McDonald, G.W. (2008). *Ecological Footprints of New Zealand and its Regions 2003/04.* New Zealand Centre for Ecological Economics Research Monograph Series, 14.

Sutherland, B. (2000). *The effects of changing resource use in the Marlborough Sounds.* Thesis, Department of Geography, University of Canterbury.

Sutherland, R. (2011). Forestry: Seeing the Wood for the Trees. In C. Brooks, L. McKendry & D. Olliver (Eds.), Marlborough – *Celebrating 150 Years.* Marlborough District Council; Marlborough Electric Power Trust.

Sutton, J. (1990). State Forest Assets Sale: Myths and Realities. *NZ Forestry, 4*. https://nzif.org.nz/nzif-journal/publications/downloadfulltext/20583

Swales, A., Gibbs, M., Handley, S., Olsen, G., Ovenden, R., Wadhwa, S., & Brown, J. (2021). *Sources of fine sediment and contribution to sedimentation in the inner Pelorus Sound/Te Hoiere* (Client Report No. 2021291HN) [NIWA report for Marlborough District Council]. NIWA.

Urlich, S. C. (2020). Opportunities to manage sediment from forestry more effectively in the Marlborough Sounds and contributing catchments. *New Zealand Journal of Forestry, 65*(2), 28-35.

Urlich, S. C., & Handley, S. J. (2020). History of pine forestry in the Pelorus/Te Hoiere catchment and the Marlborough Sounds. *New Zealand Journal of Forestry, 65*(3), 30-35. https://nzif.org.nz/nzif-journal/publications/downloadfulltext/23072

Vanhanen, L. P. & Savage, G. P. (2013). Mineral Analysis of Pine Nuts (Pinus spp.) Grown in New Zealand. *Foods, 2.*

Vergara, M.J., Harvey, E.P., McDonald, N.J., & Brown, C. (2019). *Development of Reference Economic Futures. Market Economics*. https://www.merit.org.nz/projects/development-of-reference-economic-futures/

Ward, F. L. (1962). Beef cattle and sheep on hill country farms. *New Zealand Grassland Association,* 24, 95-103. https://doi.org/10.33584/jnzg.1962.24.1146

Ward, R., & Clothier, B. (2020). *Evaluation of selected horticultural crops for Ward and surrounding areas* [Plant & Food Research report for Beef + Lamb New Zealand]. Plant & Food Research.

Wardle, P. (2011, February 10). Pressure comes off foresters. *The Marlborough Express*. https://www.stuff.co.nz/marlborough-express/news/4635533/Pressure-comes-off-foresters

Wilkinson, A. (2022). Viticulture. In E. Moran (Ed.), *Farmers and Growers in Otago* (pp.163-184) [EM Consulting for Otago Regional Council LWRP Economic Work Programme]. Otago Regional Council.

Wilkinson, A., & Ford, S. (2023). Viticulture. In E. Moran (Ed.), *Otago's rural businesses and environmental actions for fresh water* (pp. 292-318) EM Consulting report for Otago Regional Council LWRP Economic Work Programme. Otago Regional Council.

Wilson, J. (2022). *Regenerative Viticulture - the answer to a future-proofed New Zealand Wine Industry?* Kellogg Rural Leadership Programme.

Yao, R., Hock, B., Harrison, D., Hall, P., Baillie, B., & Evanson, T. (2017). *Analysis of setback options and harvesting implications for forestry in the Marlborough Sounds.* [Scion report for Marlborough District Council.

Yeoman, P. G. (1983). Marlborough Grassland Farming. *Proceedings of the New Zealand Grassland Association,* 44, 15-22. *https://doi.org/10.33584/jnzg.1983.44.1644*

Woodworth, W. (19 June 2024). Strawberry Fields Endeavour. *Marlborough News. https://issuu.com/marlboroughweekly/docs/mwk-ed1-zn-20240619-all*

MARLBOROUGH DISTRICT COUNCIL

Marlborough District Council
15 Seymour St
Blenheim 7201
New Zealand
mdc@marlborough.govt.nz
+64 3 520 7400

EM | CONSULTING

EM Consulting Ltd
30 Newcastle Street
Invercargill 9810
New Zealand
Emma@emconsulting.co.nz
+64 27 905 5616