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Journeaux Economics

Economic analysis of the Crown Pastoral Estate

Prepared for

Land Information New Zealand

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Executive Summary

This analysis assessed the current and potential economic value of Crown Pastoral Lease (CPL) land in the South Island high country. Two representative high-country farms were modelled to establish a pastoral baseline, using Farmax farm systems and long-term Beef + Lamb New Zealand (B+LNZ) data for comparison. Additional scenarios were then developed to test the economic effect of enabling secondary land uses, including forestry, horticulture, renewable energy, and tourism, under a set of average, indicative assumptions.

Baseline pastoral performance across the two case study farms showed an Economic Farm Surplus (EFS) of around $80/ha and a return on capital of 3.3–3.5%, notably higher than the B+LNZ South Island High Country average of $16/ha and 1.0% return. These results formed the "status quo" against which alternative uses were compared.

The analysis found that forestry profitability depends heavily on carbon income. Timber-only regimes for radiata pine or Douglas fir were generally uneconomic, but adding carbon at $60/NZU produced positive annuities of $569–$603/ha and increased whole-farm EFS by 15–17%. Native forestry remained negative at current carbon values, except in the scenario where an area was allowed to regenerate naturally. Including carbon in all forestry scenarios would require a change to allow lessees to receive the carbon credits (NZUs) rather than the landowner (The Crown).

All horticultural options tested, viticulture, pipfruit, and cherries, were profitable to varying degrees. Viticulture was marginal, while pipfruit using modern high-yielding varieties achieved annuities around $2,000/ha. Cherries were the most profitable horticultural option, with annuities close to $9,700/ha and potential whole-farm gains of 25–30%. However, land, water, and labour availability would significantly limit the scale of such development.

Renewable energy, modelled through a 10-hectare agrivoltaic solar installation, showed the strongest economic returns, with annuities of $14,000–$18,500/ha and whole-farm EFS increases of around 20–25%. Feasibility would depend on access to the national grid, flat to low slope, and high solar radiation zones, which are most likely in South Canterbury and Central Otago.

Tourism ventures produced more moderate but positive gains. Two scenarios were modelled noting there is a significant range of options and returns. Unguided hunting added approximately $20,000 per year to farm profit, while a small high-end lodge operation returned around $50,000 per year, depending on occupancy and capital outlay. These activities already occur on many pastoral leases, with scale, capability, and visitor experience quality being key drivers of success.

A GIS-based spatial analysis was undertaken to estimate where alternative land uses could feasibly occur across the Crown Pastoral Lease estate. This incorporated Land Use Capability (LUC), slope, and elevation data to identify land potentially suitable for horticulture, forestry, or solar energy. Of the total 1.34 million hectares analysed, approximately 58,600 hectares (4.4%) were classified as LUC 2–4, the most versatile

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land, and only around 23,500 hectares also had slopes of less than 7°, making them realistically convertible for intensive land uses such as horticulture or solar installations. For forestry, the analysis suggested up to 93,600 hectares of land below 500 metres above sea level could be suitable for radiata pine and around 257,000 hectares between 500–800 metres for Douglas fir, noting existing forest cover and regional restrictions would reduce this in practice. The GIS outputs provided an important spatial context for the economic modelling, confirming that while high-value alternative uses could generate strong returns, the proportion of the pastoral estate physically capable of supporting them is relatively limited.

At a system level, extrapolating the analysis across the Crown pastoral estate indicates substantial theoretical economic headroom. If 25–100% of the land with biophysical potential were converted to alternative uses, the total EFS could increase by between 13% (viticulture) and 1,700% (solar). These results are illustrative only; they assume all technical, market, and regulatory barriers are overcome, and do not account for price effects, infrastructure limits, or labour constraints.

While the study was primarily economic, it acknowledges that environmental and regulatory factors would strongly influence what is achievable in practice. Much of the high country has limited irrigation water, strict landscape and biodiversity protections, and slope or soil constraints that restrict large-scale development. Forestry species such as Douglas fir are prohibited in some regions due to wilding risks, and new irrigation or land conversion typically requires consent under regional plans. These factors mean the economic potential identified here represents an upper bound rather than a practical forecast.

Overall, the modelling suggests that while pastoral farming remains the foundation of high-country production, selected secondary uses, particularly carbon forestry, high-value horticulture, solar energy, and niche tourism (done well), could materially enhance economic returns on suitable sites. The realisable value, however, will depend on local conditions, operator capability, and the ability to navigate environmental, infrastructural, and regulatory constraints on a case-by-case basis.

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1.0 Background

Toitū Te Whenua Land Information New Zealand (LINZ) administers around two million hectares of Crown land, including approximately 1.2 million hectares of Crown pastoral land in the South Island high country (Figure 1).

Crown pastoral land is managed under the *Land Act 1948* and the *Crown Pastoral Land Act 1998 (CPLA)*. Administration of this land is the responsibility of the Commissioner of Crown Lands — a statutory officer within LINZ who reports to the Minister for Land Information (Hon Chris Penk).

The Commissioner oversees the management, leasing, and sale of Crown land on behalf of the Crown and ensures that Treaty settlement commitments involving Crown land are honoured.

Crown pastoral land is leased primarily for pastoral farming. Most leases run for 33 years and carry a perpetual right of renewal. Leaseholders have exclusive grazing rights but no ownership of the soil or vegetation, and no automatic right to freehold the land.

The Commissioner may grant consents for pastoral activities on Crown pastoral land, as well as permits for commercial recreation and easements for access or utilities. In recent years, some leaseholders have sought to undertake additional activities alongside pastoral farming, while government has also explored opportunities to better utilise Crown land — including for afforestation.

LINZ has been tasked with reviewing the *CPLA* and *Land Act* to ensure they remain fit for purpose. The review is considering:

- Enabling secondary uses alongside pastoral farming (for example, through a new secondary-use permit system).
- Updating provisions to improve certainty and efficiency in regulation and to modernise operational processes.

This report, commissioned by LINZ, assesses the current economic value of Crown pastoral leases and explores the potential economic value that could be realised if secondary uses were enabled.

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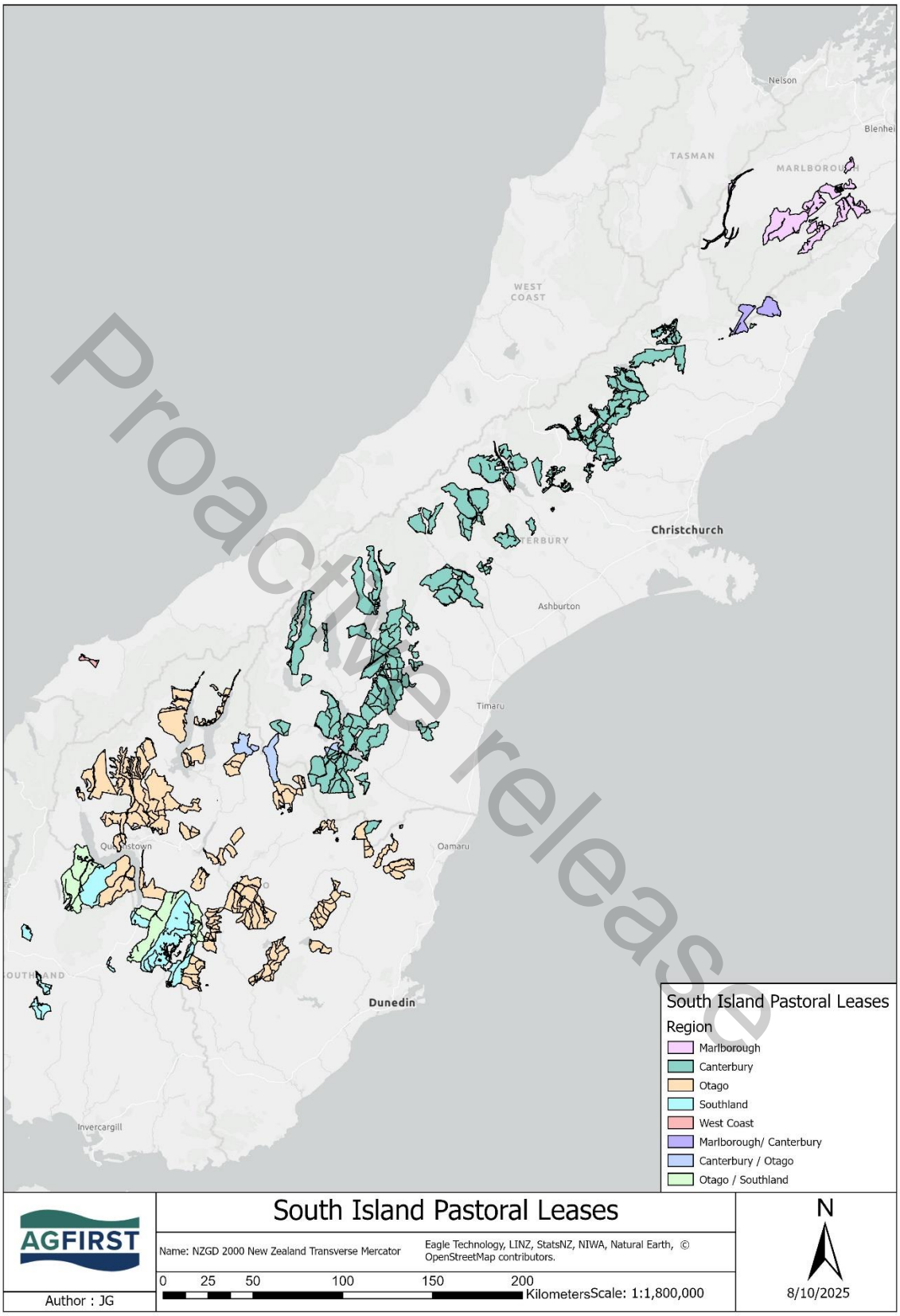
Figure 1: Crown Pastoral Lease Estate



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2.0 Methodology

The methodology used was:

- A baseline budget for 2 case study farms within the Pastoral Lease area was developed. This was based on income less expenditure down to an Economic Farm Surplus (EFS)[1] level, using a 5-year average schedule, plus the farm's actual expenditure. These were developed using the Farmax farm systems model[2], which is widely used in New Zealand.

  This gave a baseline figure as to the "status quo" situation, in the absence of any other land-based activity. A return on capital figure was also calculated based on this baseline figure.

- The financial returns from a variety of other land-based activities were calculated:
  - Forestry, covering radiata pine, Douglas fir, and natives, with & without carbon
  - Horticulture, covering viticulture, pipfruit, or cherries.
  - A Tourism activity involving either unguided hunting or a high-end touring/accommodation operation.
  - Renewable energy operation based on solar energy.

  The returns were calculated via a discounted cashflow for each option, with the NPV calculated then converted into an annuity which was added to the farm budget.

- These were then added to the case study farm budgets, with the base budgets adjusted as necessary, e.g. for land taken up by forestry or horticulture. For the purposes of the exercise, it was assumed that such activities are suitable for the case study farms.

  It is important to note that these analyses were based on average situations, which would vary widely depending on the location of the individual farm. The key premise was that "***if*** you can carry out these activities, then the results are as indicated". They are not, therefore, an exercise in due diligence.

- A GIS-based study was also undertaken to analyse the pastoral lease area as to such factors as: LUC, slope, elevation, land cover. This formed the basis of a discussion on the likelihood of extrapolating the above additional land-based activities across the pastoral lease area, to give an estimation as to how much forestry and horticulture may be possible.

  Note this assessment was based on the land area that may be suitable. Other factors, such as Council rules around afforestation, or water availability for

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[1] Defined as: net cash income plus change in livestock values less farm working expenses less depreciation less wages of management

[2] www.farmax.co.nz

horticulture, is outside the scope of this analysis, although were considered at a high-level (refer section10).

3.0 Case study farms

Two case study farms were used for the analysis:

(i) Farm A, 9,000 effective hectares, based in the Marlborough region, running 4,800 breeding ewes and 460 breeding cows.

(ii) Farm B, 6,825 effective hectares, based in Otago, running 7,495 breeding ewes, 135 breeding cows and 180 breeding hinds.

Both could be classified as Class 1 High Country farms as per the Beef + Lamb NZ Economic Service classification.

Financial analysis of the farms is shown in Table 1 below.

Table 1: Base financial analysis

	SU/ha	kg Product/ha*	EFS/ha	Return on capital**
Farm A	1.2	18.3	$79.86	3.5%
Farm B	2.0	36.1	$81.10	3.3%

** Includes meat + wool*

*** This was based on dividing the EFS by total capital, where the land and plant and machinery value was based on the B+ L NZ Economic Service Class 1 2024/25 values, and stock values were based on the 2025 IRD National Average Market Values*

This compares with the Beef + Lamb NZ Economic Service survey data (Table 2)

Table 2: B+L NZ Survey data (average 2019/20- 2023/24)

	SU/ha	EFS/ha	Return on Capital
Class 1 South Island High Country	1.5	$16.40	1.0%
Class 2 South Island Hill Country	4.6	$59.20	0.8%

It is important to note that the 2 case study farms are **not** representative of CPL farms in a statistical sense – they are used in this analysis as a means of representing the impacts of the various alternative land uses on profitability. The Beef + Lamb NZ data is based on a more statistical survey which Beef + Lamb NZ undertake on an annual basis and are therefore much more representative of this class of farm. As such. the two data sets shown in Tables 1 and 2 are not direct comparisons between CPL farms and B+L NZ Class 1 farms.

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4.0 Forestry

The financial returns from forestry vary considerably, depending, particularly, where on the farm the trees are planted and the costs to access and harvest them, and the distance to the nearest export port (for logs) or mill. A generalised estimate of the returns from forestry, for radiata pine, Douglas Fir, and natives, with and without carbon, were calculated by Groundtruth Ltd[3], for inland South Island hill country. As such they are generalized and will not be accurate at particular sites.

4.1 Forest area and location

A forest area of 100 hectares was assumed to be established 100 kilometres from wharf/mill gate. Modelling is based on radiata pine established on moderate hill country between 300 and 500m above sea level. Douglas fir was established at a similar location between 500 and 800m above sea level. Areas were assumed to be located in South Canterbury / North Otago. Table 3 outlines carbon sequestration based on forest type.

Table 3: Forest type and average carbon sequestration rate.

Forest Type	Description	Average sequestration tonnes CO2e/ha/year to average age			
		Region	Tonnes/Yr	Age	Total Tonnes
Radiata Pine	Structural or framing regime, plant 1000 SPH, thinned at age 9, clearfell at age 30	Otago	15	16	240
Douglas fir	Plant @ 1650 SPH. Thin at age 17 to 750 SPH. Clearfell age 40	All regions	16.8	26	436
Native Forest	Plant mix of native species, control pest weeds and animals. Permanent forest	All regions	6.5	50	323

The return for the differing species is outlined in Table 4 below.

Table 4: Equivalent annual annuity and NPV for three forest types and two carbon values

	Carbon value	Net Present Value ($/ha)	Equivalent annual annuity ($/ha/year)
Radiata Pine	0	-$175	-$11
	$60/NZU	$8,751	$569
Douglas Fir	0	-$1,168	-$68
	$60/NZU	$10,355	$603
Native Forest	0	-$7,688	-$905
	$60/NZU	-$2,932	-$470

[3] Peter Handford, Registered Forestry Consultant www.groundtruth.co.nz

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A separate scenario was run whereby an area was closed off to stock and native forest regenerated naturally. This would obviously negate the high cost of establishment, plus it was assumed that it would meet ETS requirements and hence carbon credits could be claimed. Note this can be a major assumption, as a key criterion for ETS registration is that the farmers need to prove area was not predominantly in "forest" (or "woody cover") prior to 1990 (much of the regenerating native vegetation on high country land is pre-1990 and therefore would not qualify).

All carbon scenarios assume that there is an arrangement between The Crown and lessees to enable the lessee to receive the carbon credits. As it stands, ETS credits earned are the property of the landowner (The Crown).

The analysis showed: NPV = $6,638/ha, or an annuity of $364/ha.

Details on the assumptions behind the forestry financials are shown in Appendix 1.

Douglas Fir cannot be planted in Marlborough (refer Section 9). Correspondingly, it was not included in the Marlborough case study, and the potential area to be planted (refer Section 8.1.3) excluded the area for Marlborough.

For each case study 2.5% of the effective area of the farm was planted in forestry, on the lower pastoral producing hill country. The implications for each farm were that total existing stock numbers were reduced by 2%.

5.0 Horticulture

There is a wide range of potential horticultural crops that can be grown. In noting this, there are again a variety of issues that determine whether a crop is commercially viable. In particular, whether there is an established value chain/industry infrastructure, the availability of labour to run an orchard as well as harvesting the crop, and whether a market exists. This is apart from physical issues such as soil type, typography, climate, and the availability of water for irrigation.

For the purposes of this analysis, three crops were chosen to illustrate horticultural opportunities, namely viticulture, pipfruit, and cherries. These were chosen for three key reasons: they exist as an industry within New Zealand, there is financial data available to assess their viability, and they are grown in the South Island

5.1 Viticulture

There is already an extensive viticulture industry in the South Island, very largely dominated by Marlborough (Table 5).

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Table 5: South Island Viticulture Areas (ha)

Nelson	1,077
Marlborough	30,444
Canterbury	1,551
Otago	2,163

Source: NZ Wine Growers

The analysis is largely based on the 2024 Marlborough Vineyard Monitoring Report[4], using the 5-year average figures 2019-2023.

A Discounted cashflow was constructed using this data.

Key assumptions were:

- Capital Cost: $75,000/ha
- Average yield: 12.9 tonnes/ha
- Average return: $2,185/T

The cashflow was taken out over 20 years, using a 5% discount rate.
The results of this were:

NPV: $5,201/ha, or an annuity equivalent of $417.32/ha/year
IRR: 5.5%

5.2 Pipfruit

Pipfruit is not a major crop in the South Island, outside of the Tasman District (Table 6)

Table 6: South Island Pipfruit Areas (ha)

Tasman	2,210
Canterbury	310
Otago	380
Total South Island	2,810

Source: AgStats 2022

The analysis was based on the 2024 MPI Monitoring Pipfruit Orchard Model 2021-2024[5], utilizing the Nelson-Tasman model data. Inasmuch as the pipfruit industry had been through some lean financial times in 2021/2022, the average of the last 2 years (2023/2024) was used as the basis for the analysis. There were two aspects to this:

(i) The model is based on a range of varieties. Several of which are relatively old, with lower yields and returns. Using the average Economic Orchard Surplus (EOS) figure as a basis for the cashflow analysis ($6,304/ha) gave a negative NPV and IRR.

(ii) Based on (i), the assumption was made to plant the top (new) 4 varieties, which had both a higher yield, and greater return. This lifted the EOS to $17,500/ha.

[4] https://www.mpi.govt.nz/dmsdocument/65616-2024-Marlborough-vineyard-monitoring-report/
[5] Available from MPI

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A Discounted cashflow was constructed using this data.

Key assumptions were:

- Capital Cost: $150,000/ha [Note this can vary widely depending on varieties, tree spacing, etc. Royalties are also payable on some varieties)
- EOS $17,500/ha
- 5 years to full production

The cashflow was taken out over 20 years, using a 5% discount rate.

The results of this were:

NPV: $25,321/ha, or an annuity equivalent of $2,032/ha/year
IRR: 6.7%

5.3 Cherries

Cherries are grown throughout the South Island, with 94% of the cop located within central Otago (Table 7).

Table 7: South Island Cherry Areas (ha)

Marlborough	31.4
Tasman	16.5
Canterbury	19.4
Otago	1,048

Source: Figured NZ

Information on Cherries was provided by Thrive Consultancy[6]. Cherries are the main summer fruit exported from New Zealand. Domestically, summer fruits (apricots, cherries, nectarines, peaches and plums) meet the market, with limited opportunities for more fruit. At times the domestic sales of cherries can be soft due to an oversupply, as a result of non-export fruit coming to market, typically post-Christmas.

Cherry orchard production systems vary widely, influenced by site, management, and planting approach.

- **High-density systems**: Modern 2D trellised orchards use ~1,300+ trees/ha, enabling early yields and efficient management.
- **Traditional systems**: Central Leader orchards are lower density (~666–900 trees/ha) but carry lower establishment costs.

Establishment costs can vary widely depending on the production system adopted. For this analysis, the key financial assumptions were:

- Establishment cost: $200,000/ha
- 6 years to full production. A well-managed orchard could do 12 T/ha, but for this exercise maximum production assumed was 10T/ha
- Packout: 70% export, 20% domestic, 10% waste
- Income: export fruit at $18/kg + domestic at $9/kg = $144,000/ha gross
- Operating costs

[6] https://www.thriveconsultingnz.com/

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- Growing costs $30,000/ha
- Harvest, pack, export $75,600/ha

The cashflow was taken out over 20 years, using a 5% discount rate.

The results of this were:

NPV: $121,233/ha, or an annuity equivalent of $9,708/ha/year
IRR: 10%

Overall, profitability is highly sensitive to yield, quality, and market timing. The cherry industry has expanded rapidly over the past decade, driven by both small-scale growers and large investor-funded orchards. Growth is now slowing, with modest new plantings expected, and some small holdings are for sale, reflecting rising costs, labour shortages, and reluctance to replant ageing orchards. Reflecting that new plantings need some economies of scale.

For the horticultural venture, 20ha was taken out of the effective area of each case study farm, on the best (pastoral) producing land. The implications of this were that Farm A reduced sheep numbers by 1%, whereas Farm B reduced sheep and cattle numbers by 2%.

6.0 Renewable Energy

Both solar and wind power were considered, but data on wind power at a farm level was not readily available. Generally, a wind-turbine operation is a fully commercial enterprise, and the farm would benefit from lease rentals, but this is outside the scope of this report.

Agrivoltaics is the system whereby solar panels are installed on-farm, with stock (usually sheep) grazed amongst/under them. There is growing interest in this system in New Zealand, and information from various studies were drawn on[7], along with case study information from a Central Otago farm.

Figures from the Vaughan et al paper are highlighted in Table 8. Note that the key purpose of this development was to provide power into the national grid which may not be a viable option for some farmers.

[7] Agrivoltaics: Integrating Solar Energy Generation with Livestock Farming in Canterbury. 2023. Vaughan et al https://ourlandandwater.nz/outputs/integrating-solar-livestock-report/
Putting the Farm into Solar Farms. MPI Technical paper 2025/15. https://www.mpi.govt.nz/dmsdocument/68067-Putting-the-Farm-into-Solar-Far.ms/

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Table 8: Agrivoltaics costs

Area (ha)	5.8	5.8
System	Fixed tilt	Single-axis tracking
Project development, consent, and grid connection ($)	$625,000	$625,000
Project design and build ($)	$4.7 - $6.3 million	$4.3 - $5.7 million
Estimated revenue ($/MWh)	$96 - $144	$96 - $144
Estimated revenue ($/kWh)	$0.096-0.144	$0.096-0.145
Estimated revenue per hectare ($/ha)	$84 - $127,000	$81 - $123,000
Energy per ha (kWh/ha)	884,310	836,552
Battery per 100kWh	50,000	50,000

Further detail is shown in Appendix 4.

This was used as the basis for developing a cashflow analysis, based on 20 years at a 5% discount, for a 10-hectare installation. The results are shown in Table 9 below.

Table 9: Solar Cost Benefit Results

	NPV	**IRR**	**Annuity/ha**
Fixed Tilt	$1,780,222	7.0%	$14,285
Single-axis tracking	$2,313,548	7.8%	$18,565

The literature indicates that while stock can be easily grazed amongst the panels, stocking rates do reduce by 30-50% (although the data is limited under New Zealand conditions). Given the size of most of the Crown Pastoral lease properties, and their relatively low stocking rate, such an impact would be largely negligible.

A key aspect affecting the financial viability of agrivoltaic systems is whether they can readily link into the national grid or not, so proximity to suitable power lines/substation is critical. Noting that some rural power lines are relatively low capacity, so any substantial agrivoltaic development may require an upgrade of the entire line – again with direct implications for economic viability.

Another key issue is of course the number of sunshine hours available to drive the system.

The market conditions for solar in particular are changing rapidly. The Central Otago case study farm that provided data to be used in the analysis is undertaking an expansion of their solar. The first instalment was made a year ago, and the case study farmer noted that prices have nearly halved in that time. The key purpose for this development was to provide power on-farm, especially for their irrigation system. In addition, the way batteries are used (or not used) alongside the solar panels makes a significant difference to the benefits realised. The particular mix of panels to batteries

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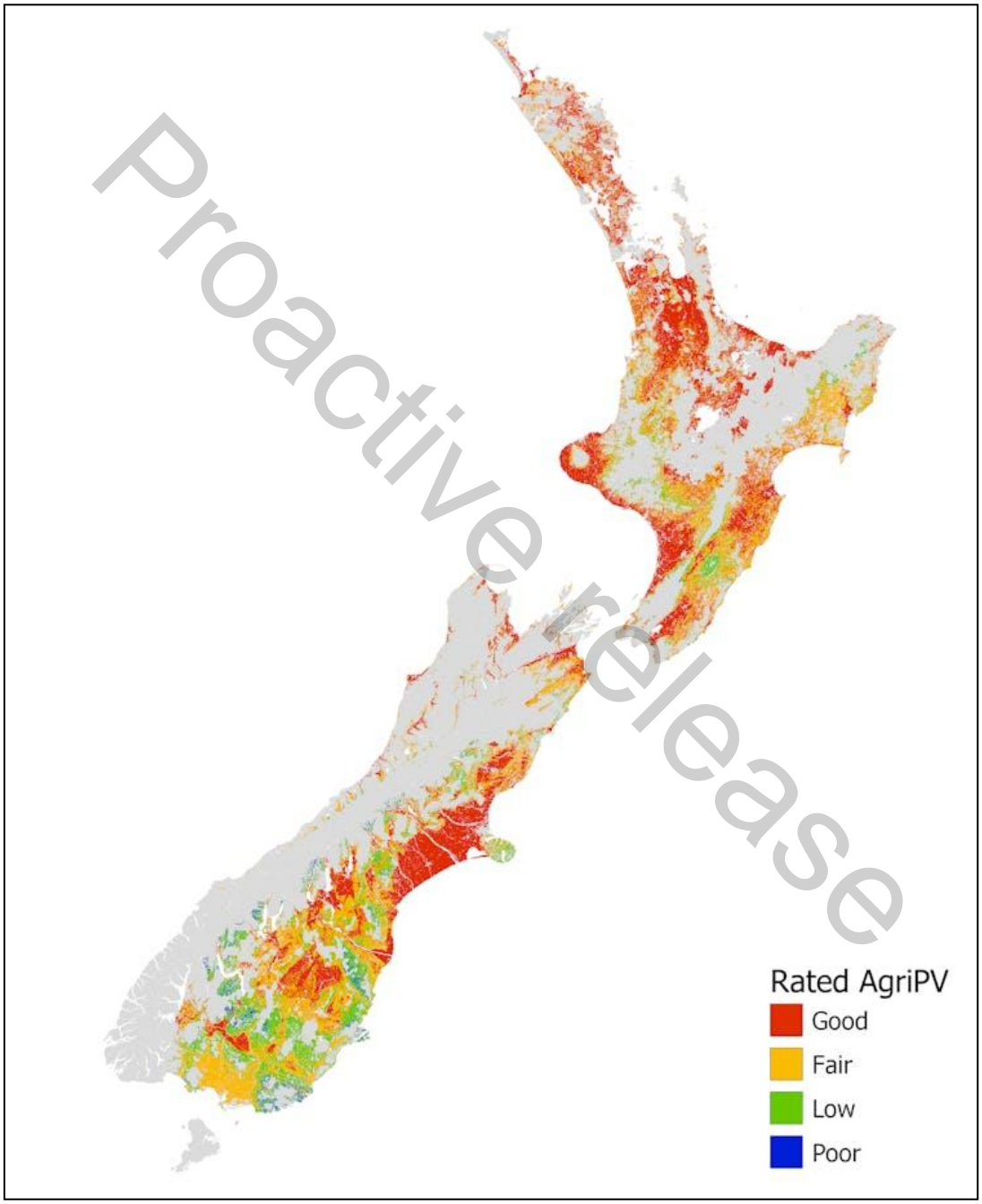
to optimise economic benefits will depend on current use, planned use, sunshine hours, proximity to the grid (and cost of accessing the grid), and the cost-benefit of these factors.

As can be seen from Figure 2 with respect to the Crown Pastoral Lease lands, the main area that could be suitable for agrivoltaics is Southwest Canterbury/Central Otago.

Figure 2: New Zealand Agri-Solar Potential



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Source: Brent & Iorns. https://theconversation.com/solar-farms-can-eat-up-farmland-but-agrivoltaics-could-mean-the-best-of-both-worlds-for-nz-farmers-230531

7.0 Tourism Venture

Tourism represents one of the most significant and diverse secondary-use opportunities on Crown pastoral land across the South Island high country. Many properties already support a variety of activities, including general touring, 4WD expeditions, heli-landings, guided (or unguided) hunting and safari experiences, filming, fishing, skiing and more. Visitor demand is underpinned by the region's striking landscapes, sense of remoteness, and connection to authentic high-country heritage; all of which align closely with New Zealand's premium nature- and adventure-based tourism brand.

Tourism activity on Crown pastoral lease land spans a wide spectrum of scale, cost, and market. At one end, there are low-cost, low-impact experiences such as day touring, mountain biking, or basic accommodation for independent travellers. At the other, high-value offerings such as helicopter sightseeing, guided safaris, or luxury lodges involve substantial investment in infrastructure, compliance, and service delivery. High-value tourism can generate strong regional economic returns, but these ventures typically require significant upfront and ongoing costs to meet visitor expectations and environmental standards.

There is also considerable diversity in who undertakes these activities. Some enterprises are operated directly by leaseholders, while others are managed through partnerships or by external operators who pay a fee or royalty to the lessee. This creates flexibility but also adds complexity in terms of access arrangements, liability, and consent processes.

Lessees currently require a recreation permit from the Commissioner for Crown Lands and pay a fee for this. There are a broad range of approaches for setting the fees the Crown receives for these activities. Some are fixed rate, others are based on a percentage of revenue, both with and without a cap.

Similar to other land uses, operating tourism ventures requires access (which many overcome by using helicopters), capability, capacity, and something of value that customers are willing to pay for. This means some properties and lessees are better suited to tourism ventures than others.

An indication of current returns from the various tourism activities on Crown Pastoral Lease properties is shown in Table 10:

Table 10: Gross Annual Returns from Existing Tourism Operations

Min	$17,170
Max	$300,000
Mean	$88,725
Median	$60,000

A simple cashflow analysis was carried out on two options:

(i) Unguided hunting operation, and

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(ii) High-end touring with 2 nights' accommodation (based on 30% occupancy over a year)

The results of this are in Table 11.

Table 11: Tourism Cost Benefit Results

	NPV	IRR	Annuity
Unguided Hunting	$249,244	n/a	$20,000
High End Lodge	$626,466	7%	$50,269

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8.0 Results

8.1 Case study Farmax modelling

The results from the Farmax modelling and the cost benefit analyses were collated and summarised in Figure 3 and Figure ***4*** below.

Figure 3: Analysis Results Farm A

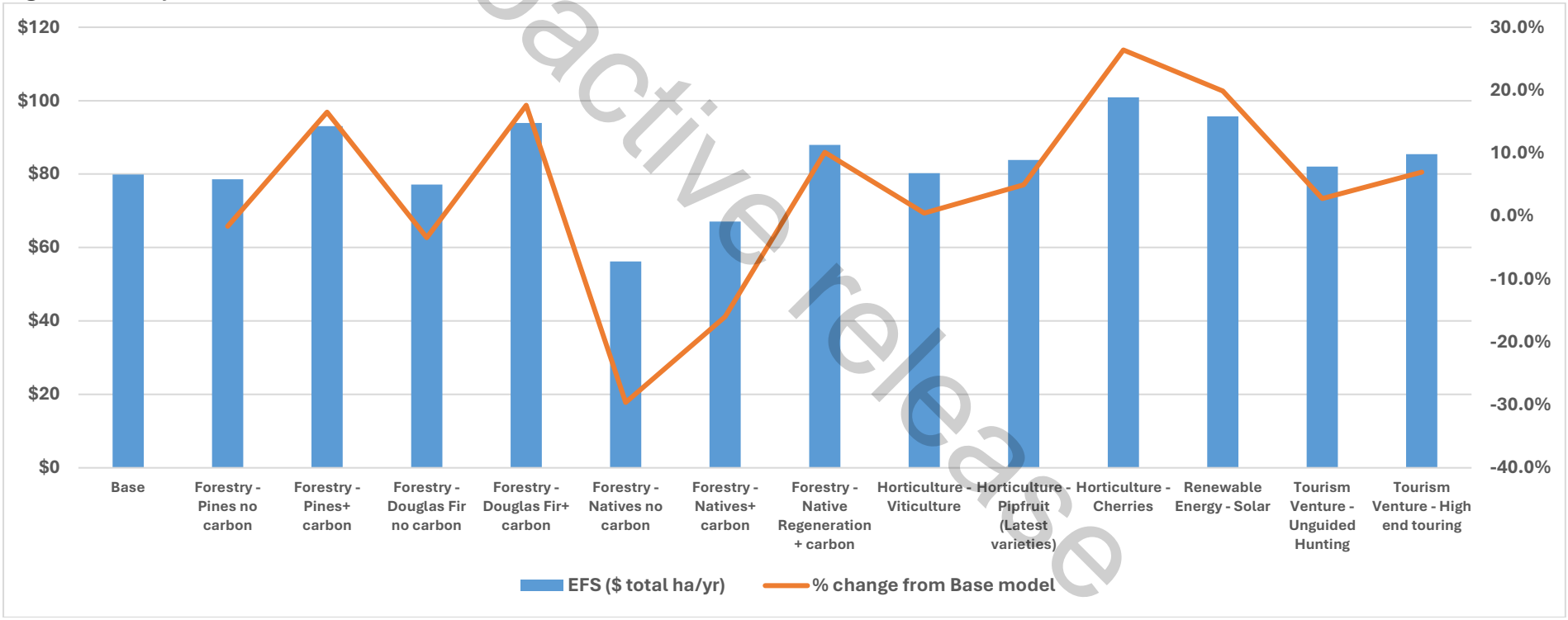

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Figure 4: Analysis Results Farm B

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Details of the analysis are shown in Appendix 2.

8.2 GIS Analysis

A GIS analysis was carried out on the Crown Pastoral Lease area, as a means to estimate likely areas suitable for the different enterprises analysed.

8.2.1 Land Use Capabilities

Land Use Classification (LUC) was developed in the 1950s and 1960s in New Zealand and is defined as *a systematic arrangement of different kinds of land according to those properties that determine its capacity for long-term sustainable use*. Capability is used in the sense of suitability for productive uses after taking into account the physical limitations of the land (Landcare Research, 2009[8]).

The system comprises eight land use classes, with limitations to use increasing, and versatility of use decreasing, from LUC 1 through to LUC 8 (Table 12).

Table 12: LUC Classification and land use suitability

LUC Class	Arable Cropping/Horticulture Suitability	Pastoral grazing suitability	Production forestry suitability	General Suitability
1	High ↓ Low	High ↓ Low	High ↓ Low	Multiple use land
2				
3				
4				
5	Unsuitable			Pastoral or forestry land
6				
7				Conservation land
8		Unsuitable	Unsuitable	

Source: Landcare Research 2009

Analysis of the Crown Pastoral Lease area is shown in Table 13 below.

Table 13: Crown Pastoral Lease by LUC

LUC	area (ha)
0*	3,783
2	142
3	7,304
4	51,200
5	5,136
6	366,365
7	585,423
8	317,508
Total	**1,336,861**

*Rivers, lakes, towns

[8] Land Use Capability Survey Handbook. https://www.landcareresearch.co.nz/__data/assets/pdf_file/0017/50048/luc_handbook.pdf

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A more disaggregated analysis is shown in Table 14 below.

Table 14: Crown Pastoral Lease by Disaggregated LUC

LUC Class	Area (ha)								
	Marlborough	Canterbury	Otago	Southland	West Coast	Canterbury/ Marlborough*	Canterbury/ Otago*	Otago/ Southland*	**TOTAL**
0**	277	2,607	503	11	270	68	5	41	**3,783**
2c	0	0	0	142	0	0	0	0	**142**
3c	0	0	444	148	0	145	0	0	**737**
3e	0	3,538	405	465	0	0	0	0	**4,407**
3s	5	146	308	743	0	22	0	354	**1,579**
3w	0	324	181	76	0	0	0	0	**581**
4c	0	0	355	412	0	0	0	0	**766**
4e	85	17,995	5,307	3,886	0	132	274	1,989	**29,669**
4s	2,551	8,484	3,326	2,599	1,055	0	205	805	**19,024**
4w	0	672	148	880	0	0	4	37	**1,741**
5c	0	60	0	0	0	3	0	0	**62**
5s	0	0	489	139	0	0	0	1,120	**1,748**
5w	0	3,299	27	0	0	0	0	0	**3,326**
6c	1,025	2,043	11,225	2,318	0	0	83	1,232	**17,926**
6e	13,204	128,654	103,993	34,352	0	2,314	6,342	16,248	**305,107**
6s	1,363	29,610	6,332	550	420	175	839	3,116	**42,405**
6w	0	0	848	80	0	0	0	0	**928**
7c	773	13,475	38,937	12,216	0	0	0	12,939	**78,341**
7e	29,769	190,142	190,383	36,265	50	7,874	11,309	29,475	**495,267**
7s	173	9,799	360	0	0	0	0	0	**10,332**
7w	0	0	894	69	519	0	0	1	**1,484**
8c	0	1,400	3,441	2,614	0	0	0	308	**7,763**
8e	28,766	165,067	70,793	12,803	17	7,590	5,305	19,088	**309,429**
8s	14	0	302	0	0	0	0	0	**316**
TOTAL	**78,006**	**577,312**	**439,003**	**110,768**	**2,331**	**18,323**	**24,365**	**86,754**	**1,336,861**
Number of farms	**9**	**75**	**74**	**9**	**2**	**2**	**3**	**4**	**178**

*These "regions" are based on a number of farms (as indicated) which straddle the borders between the different Regional Council regions. It was not possible to disaggregate these into separate regions.

** Lake/River/town

Note: LUC is based on the NZLRI dataset done at regional scale 1:50,000.

LUC maps are shown in Appendix 2.

As can be seen via these Tables, there is a total of 142 hectares of Class 2 land, all in Southland, 7,304 hectares of Class 3 (with various limitations) of which 55% is in Canterbury, 20% in Southland, and 18% in Otago. Of the Class 4 land (51,200 ha), 53% is

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in Canterbury, 18% in Otago, and 15% in Southland. Of the total area potentially available for horticulture (58,646 ha), this makes up 4.4% of the total Crown pastoral lease area.

8.2.2 Slope

Slope is an important consideration, especially for horticultural crops and solar energy units. The analysis is shown in Table 15 below.

Table 15: Slope Breakdown

	Area (ha)								
Class	Marlborough	Canterbury	Otago	Southland	West Coast	Canterbury/ Marlborough	Canterbury / Otago	Otago/ Southland	**Total**
Flat (0-7^0)	4,730	81,447	27,773	12,333	1,721	730	1,404	12,225	**142,363**
Rolling (8-15^0)	1,859	40,523	40,484	12,172	273	378	1,542	8,900	**106,129**
Easy (16-25^0)	5,844	102,822	130,337	39,642	50	2,268	3,519	28,836	**313,318**
Steep (>26^0)	65,297	348,512	239,877	46,610	17	14,879	17,895	36,752	**769,838**
Non-Productive	277	4,007	533	11	270	68	5	41	**5,213**
TOTAL	**78,006**	**577,312**	**439,003**	**110,768**	**2,331**	**18,323**	**24,365**	**86,754**	**1,336,861**

If slope is then cross correlated with LUC, the results are shown in Table 16 below.

Table 16: Area (ha) by LUC by Slope less than 7^0

	LUC 2	**LUC 3**	**LUC 4**
Marlborough	0	26	2,491
Canterbury	0	3,938	125
Otago	0	1,291	5,657
Southland	142	1,432	3,590
West Coast	0	0	1,055
“Straddled" farms	0	521	3,234
Total	142	7,208	16,152

Overall, this adds up to a total of 23,502 hectares, which is potentially convertible for horticulture. In many respects this would also pertain to areas suitable for solar installation, although based on Figure 2, it is very difficult to accurately define an area suitable for solar. In reality, the area suitable for horticulture and solar would be significantly less than this given that essentially, they require flat/gently sloping land, and other favourable conditions such as climate.

A breakdown of slope by all LUC classes is shown in Appendix 3.

8.2.3 Elevation

As part of the analysis on forestry, a simple rule was assumed whereby Radiata would be planted below 500 metres above sea level (masl), Douglas Fir would be planted between 500-800 masl, and nothing above 800masl.

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The GIS analysis was used to estimate the areas involved within the Crown Pastoral estate, give the above constraints. A summary of this is shown below in Table 17.

Table 17: Summary of Elevation Areas (ha)

Elevation (masl)	Marlborough	Canterbury	Otago	Southland	West Coast	Canterbury/ Marlborough	Canterbury/ Otago	Otago/ Southland	Total
>500	2,714	42,610	42,610	2,331	2,331	859	1,132	10,094	**104,678**
500-800	11,080	116,582	116,582	27,114	0	7,350	4,917	22,852	**306,477**
<800	64,213	264,257	264,257	64,775	0	10,115	18,317	53,808	**739,740**
TOTAL	**78,006**	**577,313**	**439,004**	**110,768**	**2,331**	**18,323**	**24,365**	**86,754**	**1,336,864**

With respect to the area that could be planted in forestry, the current existing area in forestry needs to be deducted. This current area is shown in Table 18:

Table 18: Current Forest Areas (ha) by Elevation

		Elevation (masl)		
		<500	**500-800**	**>800**
Natural Forest	Shrubland	4,206	15,781	5,639
	Tall Forest	5,855	20,176	23,939
	Wilding trees	105	422	29
Planted Forest - Pre 1990	Unknown	349	526	4
	Unspecified exotic species	10	23	
Post 1989 Forest	Wilding trees	90	1,007	241
	Pinus radiata	57	2	5
	Douglas fir	10	82	182
	Unspecified exotic species	261	197	96
	Regenerating natural species	72	39	41
Total		**11,016**	**38,256**	**30,176**

This shows that the maximum area that could be forested in Radiata (i.e.<500masl) is 104,678 hectares less the 11,016 hectares already in forest = 93,662 hectares.

For Douglas Fir, the potential maximum area is 306,477 hectares, less 38,256 hectares already in forestry, and less the potential area for Marlborough (11,080 hectares), giving a total potential area of 257,111 hectares.

Elevation was then cross-tabbed with slope (Table 19) – while forestry can be planted on steep land (i.e. $>26^0$) it can result in higher costs, although not necessarily significantly so.

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Table 19: Elevation Cross Tabbed with Slope, by Region

Marlborough	Flat (0-7⁰)	Rolling (8-15⁰)	Easy (16-25⁰)	Steep (>26⁰)	Non-Productive	TOTAL
<500	540	61	435	1,662	16	**2,714**
500-800	2,251	71	999	7,589	170	**11,080**
>800	1,939	1,727	4,409	56,046	91	**64,213**
TOTAL	**4,730**	**1,859**	**5,844**	**65,297**	**277**	**78,006**
Canterbury						**TOTAL**
<500	14,298	1,798	6,455	7,960	525	42,610
500-800	56,067	19,818	42,891	66,093	1,833	116,582
>800	11,082	18,907	53,477	274,459	1,650	264,257
TOTAL	**81,448**	**40,523**	**102,823**	**348,512**	**4,007**	**577,313**
Otago						**TOTAL**
<500	6,195	3,967	18,154	13,967	349	42,610
500-800	11,387	14,000	42,545	48,659	141	116,582
>800	10,192	22,516	69,638	177,251	44	264,257
TOTAL	**27,773**	**40,484**	**130,337**	**239,877**	**533**	**439,004**
Southland						**TOTAL**
<500	4,860	3,174	8,724	3,842	11	2,331
500-800	1,727	2,861	10,656	11,794	0	27,114
>800	5,840	6,101	20,202	30,974		64,775
TOTAL	**12,428**	**12,136**	**39,582**	**46,611**	**11**	**110,768**
West Coast						**TOTAL**
<500	1,721	273	50	17	270	2,331
500-800	0	0	0	0	0	0
>800	0	0	0	0	0	0
TOTAL	**1,721**	**273**	**50**	**17**	**270**	**2,331**
Marlborough / Canterbury						**TOTAL**
<500	245	0	297	273	43	859
500-800	371	234	1,544	5,176	25	7,350
>800	115	144	426	9,430	0	10,115
TOTAL	**730**	**378**	**2,268**	**14,879**	**68**	**18,323**
Otago/ Canterbury						**TOTAL**
<500	361	0	146	619	5	1,132
500-800	527	78	626	3,687	0	4,917
>800	516	1,464	2,748	13,590	0	18,317
TOTAL	**1,404**	**1,542**	**3,519**	**17,895**	**5**	**24,365**
Otago/Southland						**TOTAL**
<500	2,822	853	3,044	3,344	30	10,094
500-800	3,946	752	8,438	9,707	11	22,852
>800	5,457	7,295	17,354	23,701	0	53,808
TOTAL	**12,225**	**8,900**	**28,836**	**36,752**	**41**	**86,754**

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9.0 Regulatory constraints

As has been stated, the economic analysis has been done based on 'theoretically possible' while considering general limitations of the landscape. All of the regions where Crown Pastoral Lease land exists have Regional Plans which have varying degrees of regulatory constraint on the land uses considered in this analysis.

This is summarised in Table 20, and further detail is provided in Appendix 6 (including the permitted activities). This was a high-level scan of Regional Plans and may not cover all of the specific rules. It was also limited to regional level and touches on District Plan restrictions where information was readily available.

Table 20 Summary of regulatory constraints by Territorial Authority relevant to different land uses on Crown Pastoral Lease land.

	Marlborough	**Canterbury**	**Otago**	**Southland**	**West Coast**
Water	• Most catchments are either fully allocated or over allocated. There is some available for storage in some catchments. • Groundwater is not accessible for many farms. • Consent is required for any irrigation and storage beyond 5000m^3.	• Kaikoura is only freshwater management unit (FMU) that has headroom. All other FMU's range from constrained to over allocated. • Access to groundwater in high country areas is limited and would need to be assessed on a case-by-case basis.	• The following catchments and aquifers are near or fully allocated: Manuherikia, Cardrona, Kakanui, Low Burn, Waianakarua, Shag, Waikouaiti, Aquifers in schedule 4a.	• The following catchments and aquifers are near or fully allocated: Wendonside groundwater zone, North Range Aquifer, Lumsden Aquifer, Manapōuri catchment, Mararoa Surface Water Zone • Over-allocated above Gore under the Mataura Water Conservation Order.	• Consent required if more than permitted take is required or other standards are not met (setbacks, effects on surface water flows and other bores) which is likely if irrigation is to occur.
Solar / Wind	• Discretionary land use consent required for industrial / utility activity in Rural zone.	• VAL areas require publicly notifiable consents and typically have very high thresholds, particularly in the Mackenzie District.	• Restricted or non-complying (most rural zones); Prohibited within ONL/VAL areas in the Queenstown Lakes District.	• Any utility activities must not affect the "character of rural working landscapes" (preserving separation, openness, privacy, avoiding reverse sensitivity) in the rural zone.	• No specific rules in regional plan in relation to power generation – would require consent as not expressly permitted.

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	Marlborough	Canterbury	Otago	Southland	West Coast
Forestry	• The following species must not be planted: Douglas fir (*Pseudotsuga menziesii*), Lodgepole pine (*Pinus contorta*), Muricata pine (*Pinus muricata*), European larch *(Larix decidua*), Scots pine (*Pinus sylvestris*), Mountain or dwarf pine (*Pinus mugo*), Corsican pine (*Pinus nigra*). • Indigenous only in the Wairau Dry Hills High Amenity Landscape. • Consent required on Steep Erosion-Prone Land.	• Visual Amenity Landscapes (VAL) restrictions exist in Mackzenzie, Upper Waitaki, Selwyn, Waimakariri, Hurunui, and Ashburton. • Additional restrictions in and around pest management zones where the risk of wilding tree species are high.	• Visual Amenity Landscapes and Outstanding Natural Landscape restrictions apply in most districts – these are very restrictive in the Queenstown Lakes District. • Additional restrictions in and around pest management zones where the risk of wilding tree species are high.	• Some species (e.g. Scots Pine, Corsican Pine, Douglas Fir, larches) are restricted in the Mountains Overlay. • Clearance of indigenous vegetation is limited, and you cannot clear native vegetation extensively in order to afforest without consent.	• Removal (clearance) of more than 2,000 m^2 of indigenous vegetation (per site) requires resource consent in the Westland District. • South of Haast, most of the land is classified as "High" or "Very High" erosion susceptibility and adjacent to significant natural areas (SNAs) or wetlands which restricts the establishment of new forestry.
Land Use	• Conversion and expansion of existing land to dairy requires discretionary resource consent. • Total cumulative N applications (fertiliser (organic and inorganic) and FDE) must not exceed 200kgN/ha/yr – applies to all land use activities.	• Any intensification of land use requires intensification consent. • Nutrient management restrictions apply and vary by land use and catchment.	• Any intensification of land use requires intensification consent. This includes the conversion from pasture to horticulture that is irrigated. • Packhouse, processing facilities and frost fans require consent.	• No new intensification without showing nutrient neutrality or improvement. Under Rule 20, any land-use change or intensification that increases nutrient losses above baseline modelling requires consent and justification. • Regional limits will apply once numeric catchment load limits are set (Mataura, Aparima, Oreti, Waiau). This applies to all farming / horticultural land within catchment.	• Consents are required for associated activities with land intensification e.g. drainage and earthworks (humps and hollows).

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10.0 Environmental and cultural considerations

The above section highlights regulatory constraints, which to a large extent address many environmental considerations. The below provides a broad consideration of environmental and cultural considerations of the different land uses considered in the analysis. Much of these would be up to the lessee to address in implementing land use changes.

10.1 Cultural considerations

- Local iwi and hapū ngā mātāpono (values) and wāhi tapu (scared places) will need to be considered which may restrict or constrain any new developments.

10.2 Forestry

Some environmental impacts of forestry include:

- Reduced water yield and altered flow timing after afforestation. This impacts downstream users (irrigation/hydro) who depend on baseflows. New Zealand catchment studies [9] show tall vegetation increases interception and evapotranspiration, lowering downstream yields and flows.
- Erosion and sediment risks are high due to the shallow erodible land found across much of the Crown Pastoral Estate. These risks rise significantly during earthworks, roading, and harvest.
- Many plantation species pose a high spread risk. This can negatively impact biodiversity and can result in the loss and fragmentation of indigenous species and associated ecosystems. This is a significant issue in the South Island high country currently.
- Fire risk is significant in forestry in high county environments as they are largely very arid, and often with a large fuel load due to the extensive nature of pastoral management and surrounding native vegetation.

10.3 Tourism

- Walking and mountain biking tracks on steep terrain with fragile soils in high country can increase the risk of erosion and sediment loss.
- Many high-country areas have remnant biodiversity value. Tourism increases the risk of introduced pest species as visitors can act as vectors for weeds or pests into fragile high-country ecosystems.
- Increased tourism increases the waste generated (solid, greywater, stormwater) and risk of pollution through littering or spillages. This also includes light pollution in dark-sky areas (e.g. the Aoraki Mackenzie Dark Sky Reserve).

[9] https://icm.landcareresearch.co.nz/knowledgebase/publications/public/Forestry%26water%20yield-the_NZ_example.pdf

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10.4 Land development – horticulture

- Horticultural land development increases the use of chemicals to manage soil fertility, plant productivity and to supress weeds and pests. This increases the risk of spray drift and contamination of soil and groundwater.
- The risk of fire increases significantly as a result of increased machinery use and potential electrical faults in dry environments.
- Land conversion (terracing, ripping, contouring) increases erosion and slope instability, while machinery use and irrigation can degrade soil structure and cause compaction.

11.0 Overall financial impact

The overall impact of any land use change was calculated based on the financial analysis earlier in this report. The "base" situation of just pastoral sheep and beef farming was based off the Beef + Lamb New Zealand (B+LNZ) Economic Service data, as per Table 2, inasmuch as this is much more of a statistically based sample, rather than the 2 case study farms.

This estimate was based on the area within the Crown Pastoral Lease estate of 1,152,280 hectares in pasture (refer Appendix 5), with the alternative land use options deducted from this. The average EFS/ha from the B+LNZ data was used to establish the 'current farming system' ($19,000,000). The analysis was based on converting varying percentages of the potential area for each of the alternative land uses, as shown in

Figure 5 and Table 21.

Table 21: Total Economic Impact of Alternative Land Uses (EFS $ million)

	25%*	% Difference to current	50%*	% Difference to current	75%*	% Difference to current	100%*	% Difference to current
Current farming system	$19		$19		$19		$19	
Forestry - Radiata + carbon	$32	69%	$45	139%	$58	208%	$71	278%
Forestry- Douglas Fir + carbon	$57	202%	$95	405%	$134	607%	$172	809%
Horticulture - viticulture	$21	13%	$24	25%	$26	38%	$29	51%
Horticulture - pipfruit	$31	63%	$43	126%	$55	189%	$66	252%
Horticulture - cherries	$76	302%	$133	604%	$190	907%	$247	1209%
Solar	$103	444%	$187	888%	$271	1332%	$354	1776%

*Percentage of potential land converted for each alternative land use

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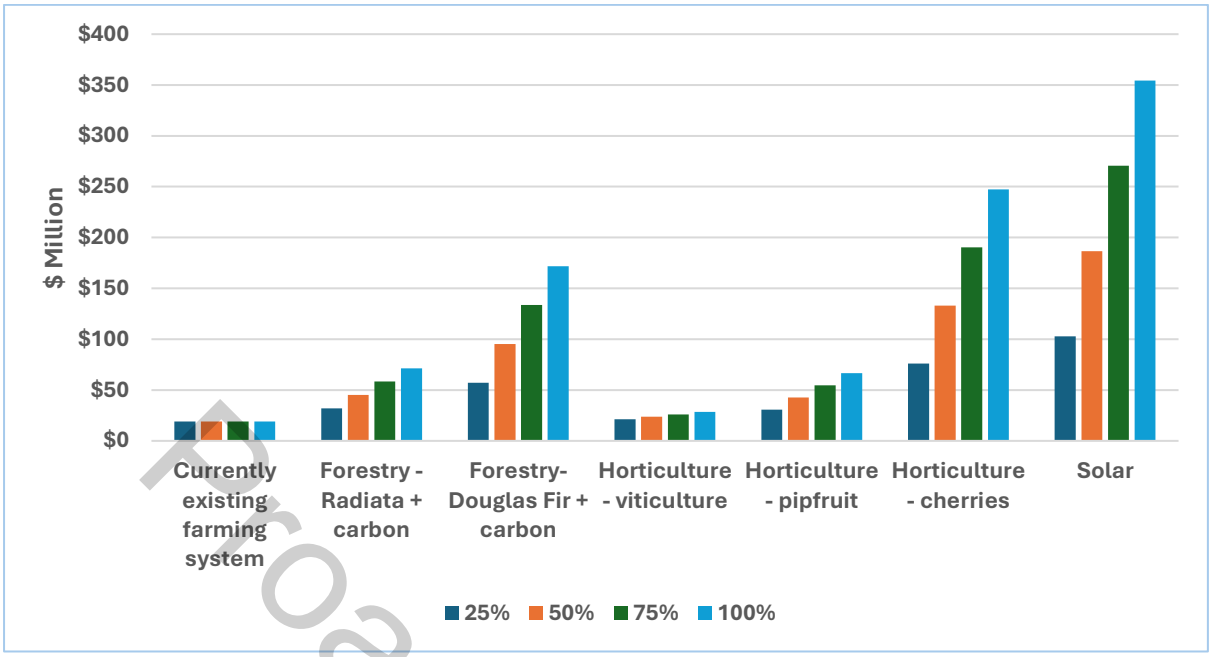
Figure 5: Total Economic Impact of Alternative Land Uses (EFS $ million)



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It is important to note that these figures are indicative only given the range of variabilities involved. A case in point, for horticulture (for example) is market dynamics. While the return on cherries looks very positive, currently there is a total of 1,350 hectares planted in New Zealand. If (say) 25% of the potential area in the Crown Pastoral Lease Estate was planted up, this would equate to 5,875 hectares – a 400% increase which would (a) flood the market and therefore (b) collapse the price – meaning that most of the development would not take place.

12.0 Summary

To summarise, each option showed:

(i) Forestry. Essentially forestry for timber only was unprofitable, although noting that for some farms with easier access (and hence lower costs) and closer to a port or mill, a timber-only regime may be profitable. The addition of a value for carbon pushed radiata pine and Douglas fir into a profitable situation, remembering that under the averaging scheme, carbon credits would only be claimable for 16 years for pines, and 26 years for Douglas fir. Also noting that Douglas fir cannot be planted in Marlborough.

Native forestry as a financial venture would only be profitable at significantly higher carbon values. In noting this, allowing native regeneration could be profitable *if* the area met ETS requirements and carbon credits could be claimed.

(ii) Horticulture. The options considered were all profitable, to varying degrees. The key factor, other than the caveats mentioned below, is that there is very

limited area that may be suitable. As the GIS analysis indicated, there is a maximum of 23,500 hectares of LUC 2-4 land with a slope of less than 7^0, and in reality, the area suitable would likely be much less than this.

(iii) Renewable Energy. This was analysed on the basis of solar energy and indicated that it could be quite profitable. In noting this, across the whole of the Crown Pastoral Lease area, there is a relatively limited area where sunshine hours would be sufficient. There is again a limit in the area below 7^0 slope, and the ability to link into the national grid would be crucial.

(iv) Tourism. Many existing farms are already involved in tourism to a greater or lesser degree, and again the analysis would indicate this could be a profitable enterprise.

While the analysis showed that there are potential enterprises which could provide financial benefit to Crown Pastoral Lease farms, there are a number of caveats that apply.

- The financial figures and assumptions made relate to an "average" situation. Within all of the options considered, there would be significant variations depending on the location of the farm, and the skill and expertise of the operator.
- The areas for the options assumed in the analysis are arbitrary and again could vary widely for individual farms. The intent was to illustrate the option, not, as mentioned earlier, an exercise in due diligence. In many respects a key factor, especially for any horticultural and solar energy venture, is that economies of scale would be crucial.
- For horticulture, ready access to existing infrastructure, value chains, skilled labour, and water for irrigation would all be crucial factors.
- Similarly with forestry, the on-farm location, and related access costs, as well as the distance of the farm to the nearest mill or port would also be crucial.

Overall, therefore, while there are options for consideration that show promise in terms of economic benefit, essentially it would come back to a case-by-case analysis for each individual farm.

13.0 Suggestions for further research/analysis

1. More detailed analysis of:
    - LUC by slope, for horticulture
    - Areas suitable for forestry, and suitable tree species
    - Areas suitable for solar energy
2. Analysis of suitable horticultural crops, including tree nuts & arable cropping considering market requirements, supply-chain management, climate, topography, soils, etc.
3. Review of current/required labour.

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4. Due diligence exercise for 1 or 2 case studies – assess issues around access to existing value chains, regulatory compliance, access to the grid for renewable energy.
5. Detailed assessment of environmental impacts of different land use relative to current.
6. An economic impact assessment at a regional or South Island level of the changes in land use

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14.0 Appendix 1- Forestry financials

14.1 Key cost and return assumptions

The cost assumptions for forest establishment, thinning and management are given below (Table 22).

Table 22: Effect of forest type on establishment and growing costs.

Forest Type	Establishment costs $/ha Year 0 (stems/ha)	Thinning costs
Radiata Pine	$2,300 (1000 sph)	$850 (yr 9)
Douglas fir	$3,933 (1650 sph)	$1000 (yr 17)
Native Forest	$8,000 (1600+ sph)[10]	$5,000 release costs to Yr 11

For radiata pine timber yield and log grade mix was calculated using Forecaster Calculator. These were reduced by 20% to allow for uncertainties in actual production from these sites.

For Douglas fir, yield and log grade mix was also estimated using forecaster calculator, using the Douglas fir model. Again, estimates were reduced by 20% to allow for uncertainty in actual yield.

Harvest cost was based on a mix of easy to moderate and some steeper country giving a rate of $40/m3. This was used for both radiata pine and douglas fir.

Transport cost was based on a distance of 100 km and a rate of $0.30/tonne/km, giving a cost of $30/tonne.

Three-year rolling average log prices for radiata pine were used from the Ministry of Primary Industries June 2025 price series.

For Douglas fir, a combination of information from published reports over the last 5 years, plus contact with a harvest manager working in the South Island were used to derive approximate log prices.

Log yield and log prices are listed in the tables below (Table 23 and Table 24).

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[10] In addition, about 300 sph of other forest species are planted later for enhancement

Table 23: Radiata pine yield, log price and stumpage

Log grades	Yield (m3/ha)	Log price	Harvest & Transport cost	Net Stumpage ($/ha)
A	264	$121.55	$82.16	$10,387
K	141	$112.20	$82.16	$4,244
KI	100	$105.40	$82.16	$2,330
KIS / Pulp	37	$98.6	$82.16	$605
Total/ha	542			$17,566

Table 24: Douglas fir yield, log price and stumpage

Log grades	Yield (m3/ha)	Log price	Harvest & Transport cost	Net Stumpage ($/ha)
DS & CF+	543	$146	$81.15	$35,213
CF-	42	$133	$81.15	$2,178
Pulp	39	$75	$81.15	-$240
Total /ha	624			$37,151

Two scenarios of carbon price were used. No carbon return ($0 per NZU) and $60 per NZU.

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15.0 Appendix 2: Case Study Farmax Modelling

The results from the Farmax modelling and the cost benefit analyses were collated and summarised below.

Analysis Results Farm A

	Pastoral Area	New Horticulture/Forest Area	Total property	Stocking rate (pastoral area)	Production kg/ha	% change	Pastoral		Forestry/Horticulture	Total enterprise net profit	Net profit	
	ha	ha	ha	SU/ha			EFS ($ pastoral total/yr)	EFS ($ pastoral ha/yr)	Annuity ($/ha/yr)	EFS + Annuity ($/yr)	EFS ($ha/yr)	% change from Base model
Scenarios												
Base	9,000		9,000	1.2	18.3		$718,751	$80		$718,751	$80	
Forestry - Pines no carbon	8,775	225	9,000	1.2	18.4	0.5%	$709,537	$81	-$11	$707,062	$79	-2%
Forestry - Pines+ carbon	8,775	225	9,000	1.2	18.4	1%	$709,537	$81	$569	$837,562	$93	17%
Forestry - Natives no carbon	8,775	225	9,000	1.2	18.4	1%	$709,537	$81	-$905	$505,912	$56	-30%
Forestry - Natives+ carbon	8,775	225	9,000	1.2	18.4	1%	$709,537	$81	-$470	$603,787	$67	-16%
Forestry - Native Regeneration + carbon	8,775	225	9,000	1.2	18.4	1%	$709,537	$81	$364	$791,437	$88	10%
Horticulture - Viticulture	8,980	20	9,000	1.2	18.2	-1%	$713,863	$79	$417	$722,203	$80	0%
Horticulture - Pipfruit	8,980	20	9,000	1.2	18.2	-1%	$713,863	$79	$2,032	$754,503	$84	5%
Horticulture - Cherries	8,980	20	9,000	1.2	19.2	5%	$713,864	$79	$9,728	$908,424	$101	26%
Renewable Energy - Solar	8,990	10	9,000	1.2	18.3	0%	$718,751	$80	$14,285	$861,601	$96	20%
Tourism Venture - Unguided Hunting	9,000		9,000	1.2	18.3	0%	$718,751	$80	$20,000 (total)	$738,751	$82	3%
Tourism Venture - High end touring	9,000		9,000	1.2	18.3	0%	$718,751	$80	$50,269 (total)	$769,020	$85	7%

Note Douglas Fir plantings were excluded from this case study, as it is not permitted to be planted in Marlborough

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Analysis Results Farm B

	Pastoral Area	New Horticulture/Forest Area	Total property	Stocking rate (pastoral area)	Production kg/ha	% change	Pastoral		Forestry/Horticulture	Total enterprise net profit	Net profit	
	ha	ha	ha	SU/ha			EFS ($ pastoral total/yr)	EFS ($ pastoral ha/yr)	Annuity ($/ha/yr)	EFS + Annuity ($/yr)	EFS ($ha/yr)	% change from Base model
Scenarios												
Base	6,825		6,825	2.0	36.1		$553,493	$81		$553,493	$81.10	
Forestry - Pines no carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	-$11	$537,931	$79	-3%
Forestry - Pines+ carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	$569	$636,531	$93	15%
Forestry - Douglas Fir no carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	-$68	$528,241	$77	-5%
Forestry - Douglas Fir+ carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	$603	$642,311	$94	16%
Forestry - Natives no carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	-$905	$385,951	$57	-30%
Forestry - Natives+ carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	-$470	$459,901	$67	-17%
Forestry - Native Regeneration + carbon	6,655	170	6,825	2.0	36.3	0.6%	$539,801	$81	$364	$601,681	$88	9%
Horticulture - Viticulture	6,805	20	6,825	2.0	35.5	-1.7%	$540,798	$79	$417	$549,138	$80	-1%
Horticulture - Pipfruit	6,805	20	6,825	2.0	35.5	-1.7%	$540,798	$79	$2,032	$581,438	$85	5%
Horticulture - Cherries	6,805	20	6,825	2.0	35.5	-1.7%	$540,799	$79	$9,728	$735,359	$108	33%
Renewable Energy - Solar	6,815	10	6,825	2.0	36.1	0%	$553,493	$81	$14,285	$696,343	$102	26%
Tourism Venture - Unguided Hunting	6,825		6,825	2.0	36.1	0.0%	$553,493	$81	$20,000 (total)	$573,493	$84	4%
Tourism Venture - High end touring	6,825		6,825	2.0	36.1	0.0%	$553,493	$81	$50,269 (total)	$603,762	$88	9%

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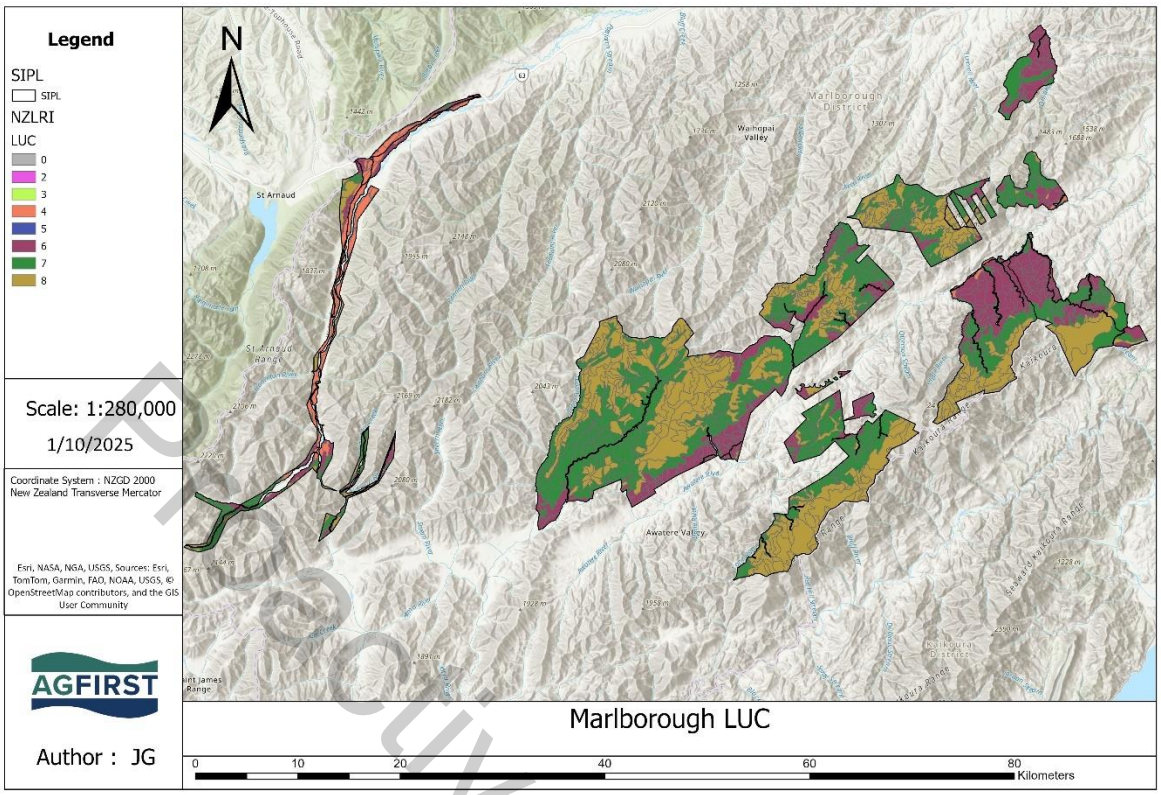
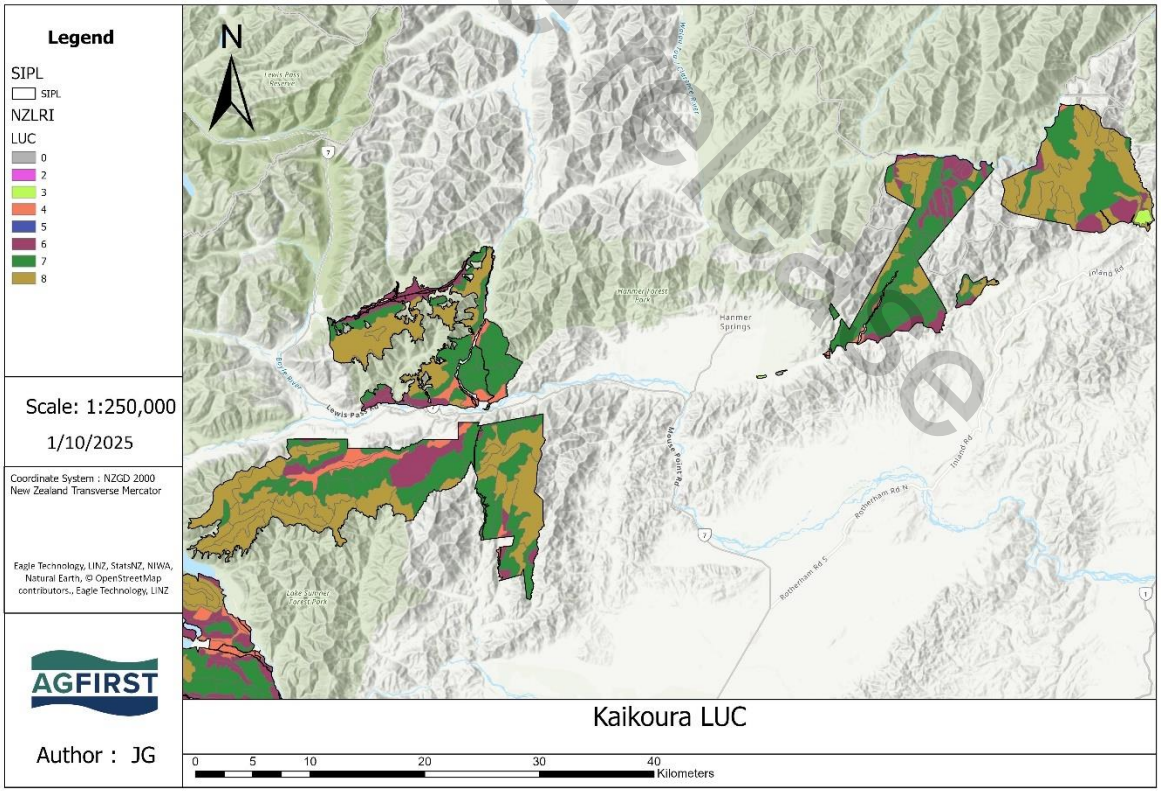
16.0 Appendix 3: LUC Maps





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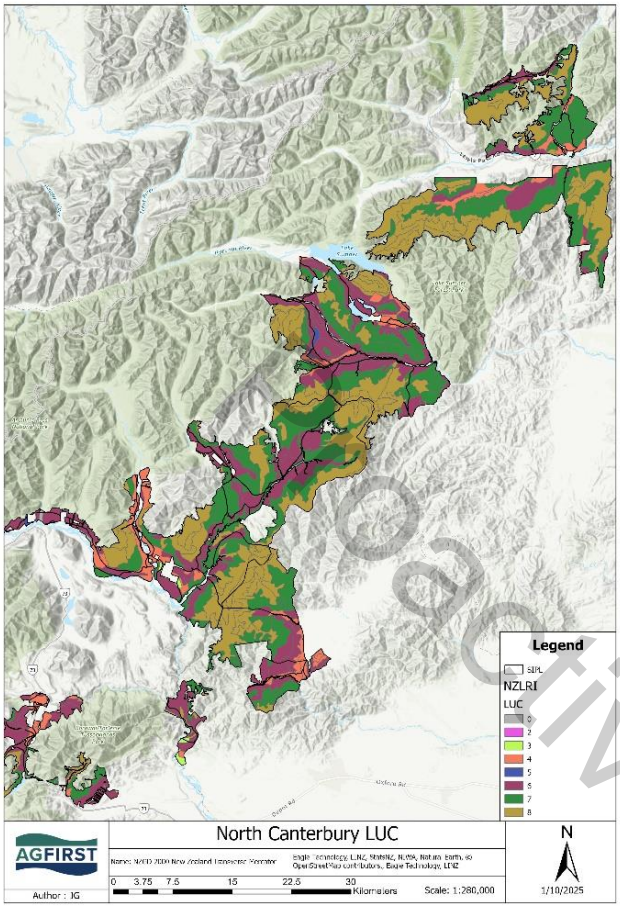
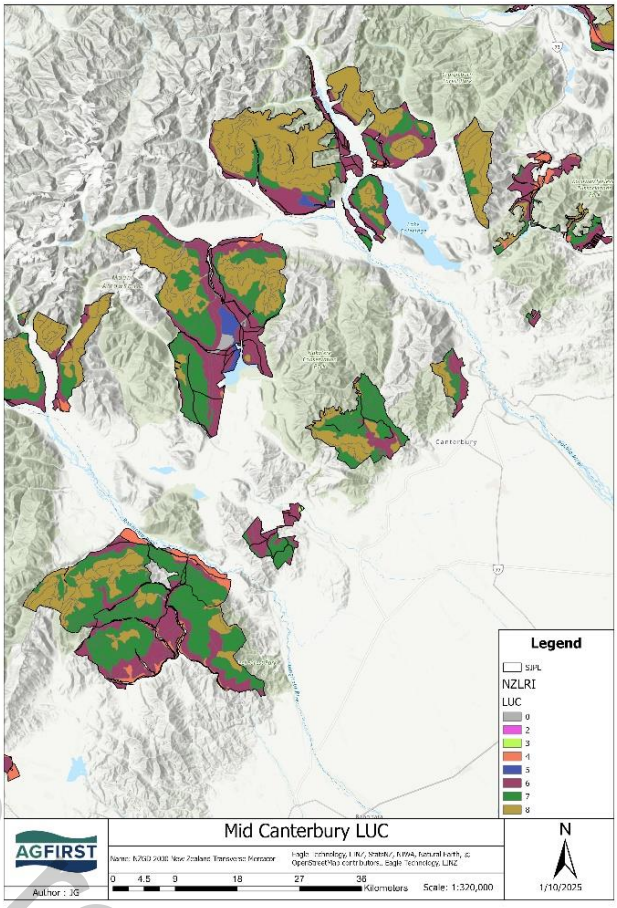
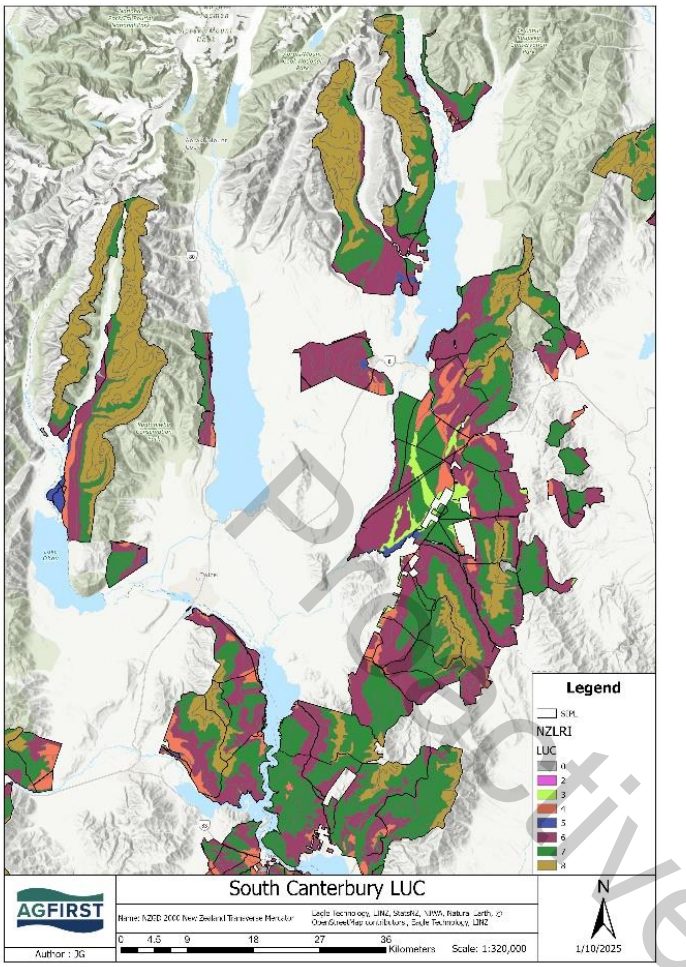
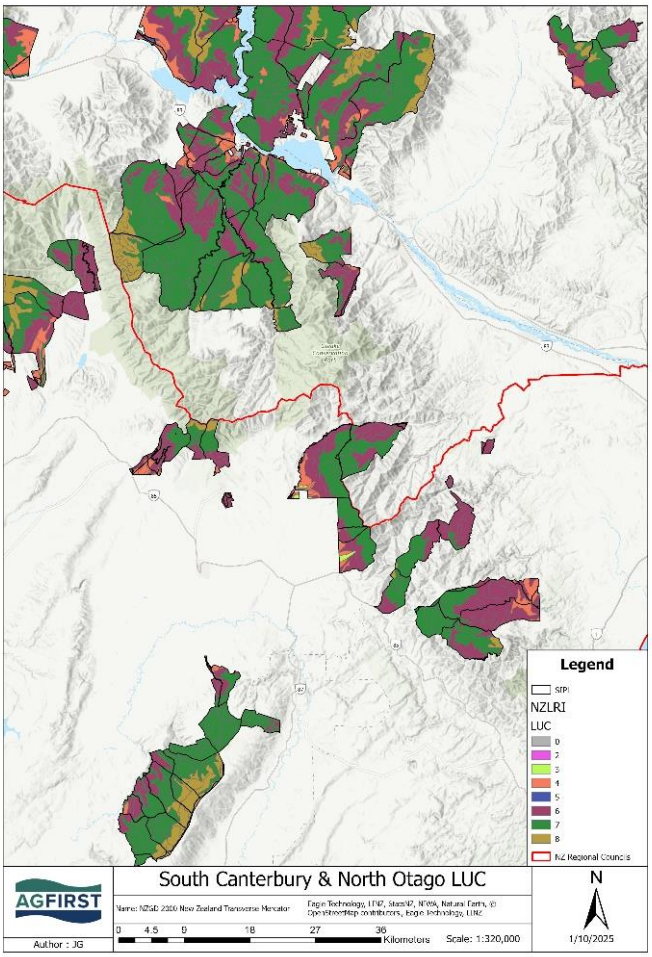




Active release





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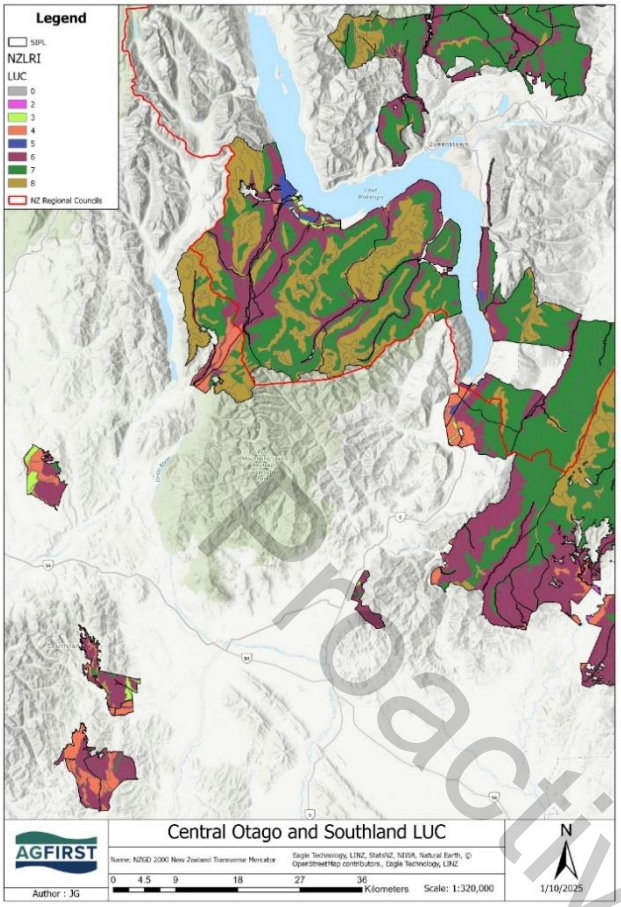

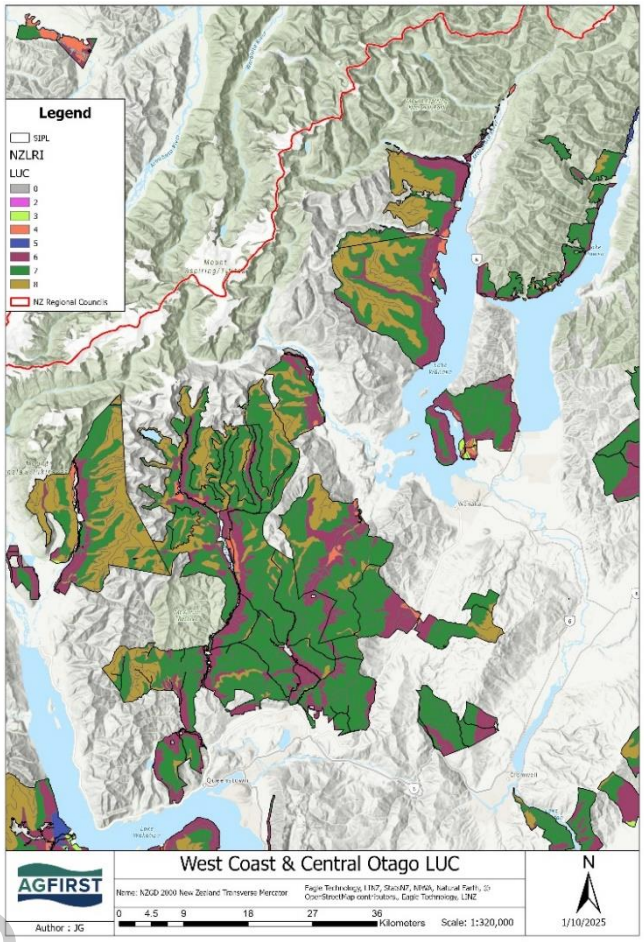

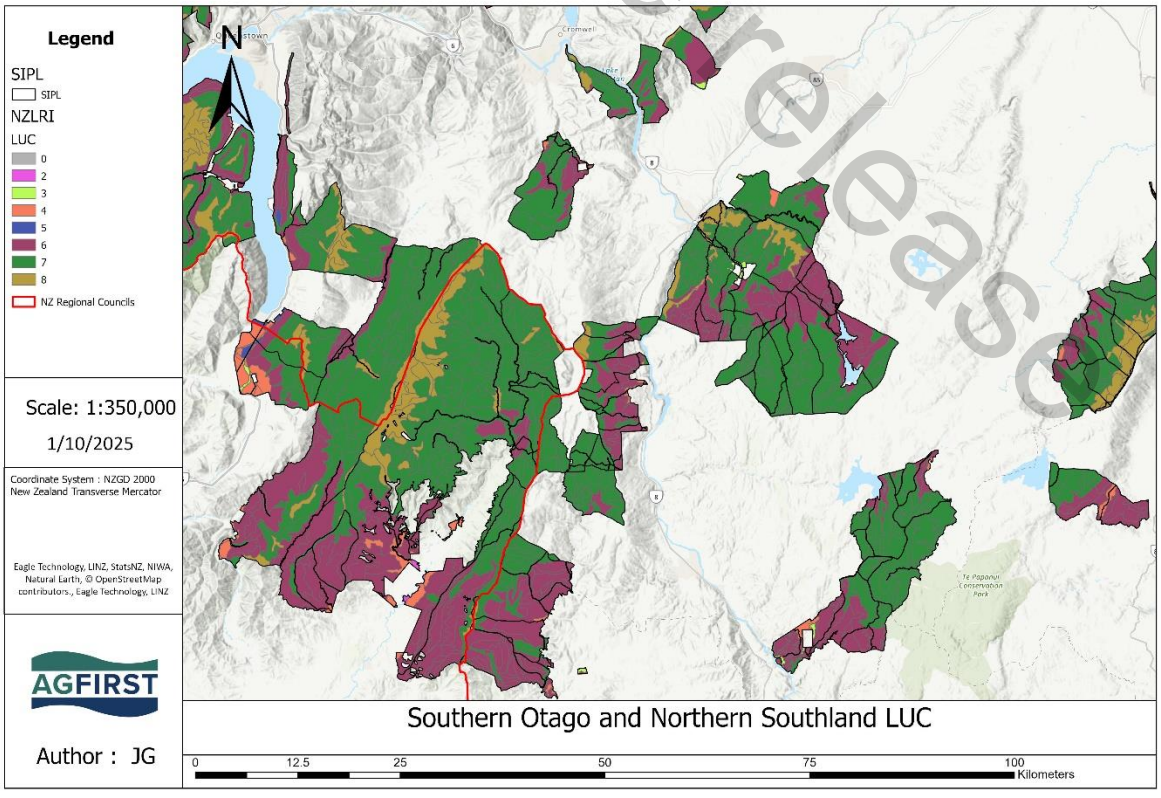

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17.0 Appendix 4: LUC by Slope by Region

		<7°	8-15°	16-25°	>26°
Marlborough	LUC 2				
	LUC 3	5			
	LUC 4	2,492	108	36	
	LUC 5				
	LUC 6	1,933	750	3,126	9,784
	LUC 7	256	874	2,373	27,212
	LUC 8	44	127	309	28,300
Canterbury	LUC 2				
	LUC 3	3,938	69		
	LUC 4	21,125	5,813	213	
	LUC 5	3,299	60		
	LUC 6	38,626	23,291	64,416	33,973
	LUC 7	14,312	8,741	28,530	161,833
	LUC 8	148	2,550	9,663	152,706
Otago	LUC 2				
	LUC 3	1,291	48		
	LUC 4	5,657	3,479		
	LUC 5	414	102		
	LUC 6	9,083	9,765	64,003	39,548
	LUC 7	10,012	24,807	61,280	134,474
	LUC 8	1,316	2,283	5,053	65,855
Southland	LUC 2	142			
	LUC 3	1,432			
	LUC 4	3,590	4,186		
	LUC 5	139			
	LUC 6	1,547	2,551	19,825	13,377
	LUC 7	4,949	5,065	17,468	21,068
	LUC 8	630	334	2,289	12,165
West Coast	LUC 2				
	LUC 3				
	LUC 4	1,055			
	LUC 5				
	LUC 6	147	273		
	LUC 7	519	0	50	
	LUC 8				17
Straddled Farms	LUC 2				
	LUC 3	521			
	LUC 4	3,234	212		
	LUC 5	1,008	113		
	LUC 6	5,240	1,869	10,443	12,796
	LUC 7	3,976	8,321	21,728	27,572
	LUC 8	380	304	2,449	29,158

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18.0 Appendix 5: Agrivoltaic Assumptions

Area (ha)	5.8	5.8
Racking	Fixed	Tracking
Inverter (MW Central Inverter)	3	3
Row spacing *centre to centre) (m)	13	8
Space between rows (m)	9	6
Cover ratio	35%	28.9%
DC size (kW)	3,364	2,693
AC size (kWac)	2,500	2,195
Racking	Fixed	Tracking
Specified yield (kWh/kWp)	1,533	1,802
Annual energy (MWh)	5,129	4,852
Energy per ha (MWh/ha)	884	837
Energy per ha (kWh/ha)	884,310	836,552
System	Fixed tilt	Single-axis tracking
Project development, consent, and grid connection ($)	$625,000	$625,000
Project design and build ($)	$4.7 - $6.3 million	$4.3 - $5.7 million
Estimated revenue per Megawatt-hour ($/MWh)	$96 - $144,000	$96 - $144,000
Estimated revenue per hectare ($/ha)	**$84 - $127,000**	**$81 - $123,000**

Central Otago Case Study
Small-scale venture to supply electricity for: domestic consumption and irrigation, with surplus sold to the grid

Solar (covering 0.5ha)	72	kw array
Battery (Able to store electricity for up to 4 hours at peak)	100	kWh
Annual generation	98,500	kWh
Battery and inverter	$69,000	
Construction costs	$73,000	
Consumption	160	kWh per day
Area of irrigation (ha)	53.5	

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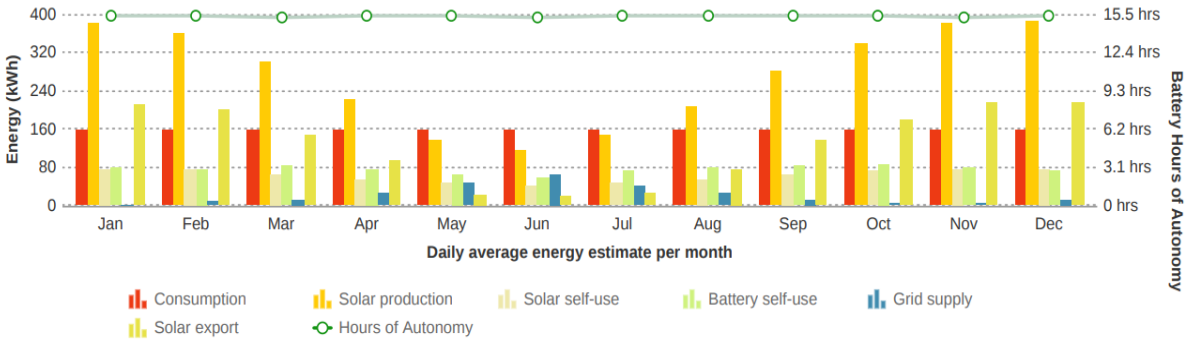

87%

Clean Energy Consumed

$$8,312

Grid Export Earnings

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19.0 Appendix 6: Land Cover – 2020 LUCAS Database

		Area (Ha)
71 - Natural Forest	120 - Shrubland	25,528
	121 - Tall Forest	49,735
	122 - Wilding trees	556
72 - Planted Forest - Pre 1990	0 - Unknown	879
	203 - Unspecified exotic species	33
73 - Post 1989 Forest	122 - Wilding trees	1,338
	201 - Pinus radiata	64
	202 - Douglas fir	274
	203 - Unspecified exotic species	555
	204 - Regenerating natural species	152
74 - Grassland - With woody biomass	0 - Unknown	78,713
75 - Grassland - High producing	502 - Grazed - dairy	1
	503 - Grazed - non-dairy	23,094
76 - Grassland - Low producing	503 - Grazed - non-dairy	866,031
	504 - Ungrazed	184,441
77 - Cropland - Orchards and vineyards (perennial)	0 - Unknown	1
78 - Cropland - Annual	0 - Unknown	891
79 - Wetland - Open water	0 - Unknown	1,448
80 - Wetland - Vegetated non forest	0 - Unknown	11,948
81 - Settlements or built-up area	0 - Unknown	31
82 - Other	0 - Unknown	91,027
TOTAL		**1,336,741**

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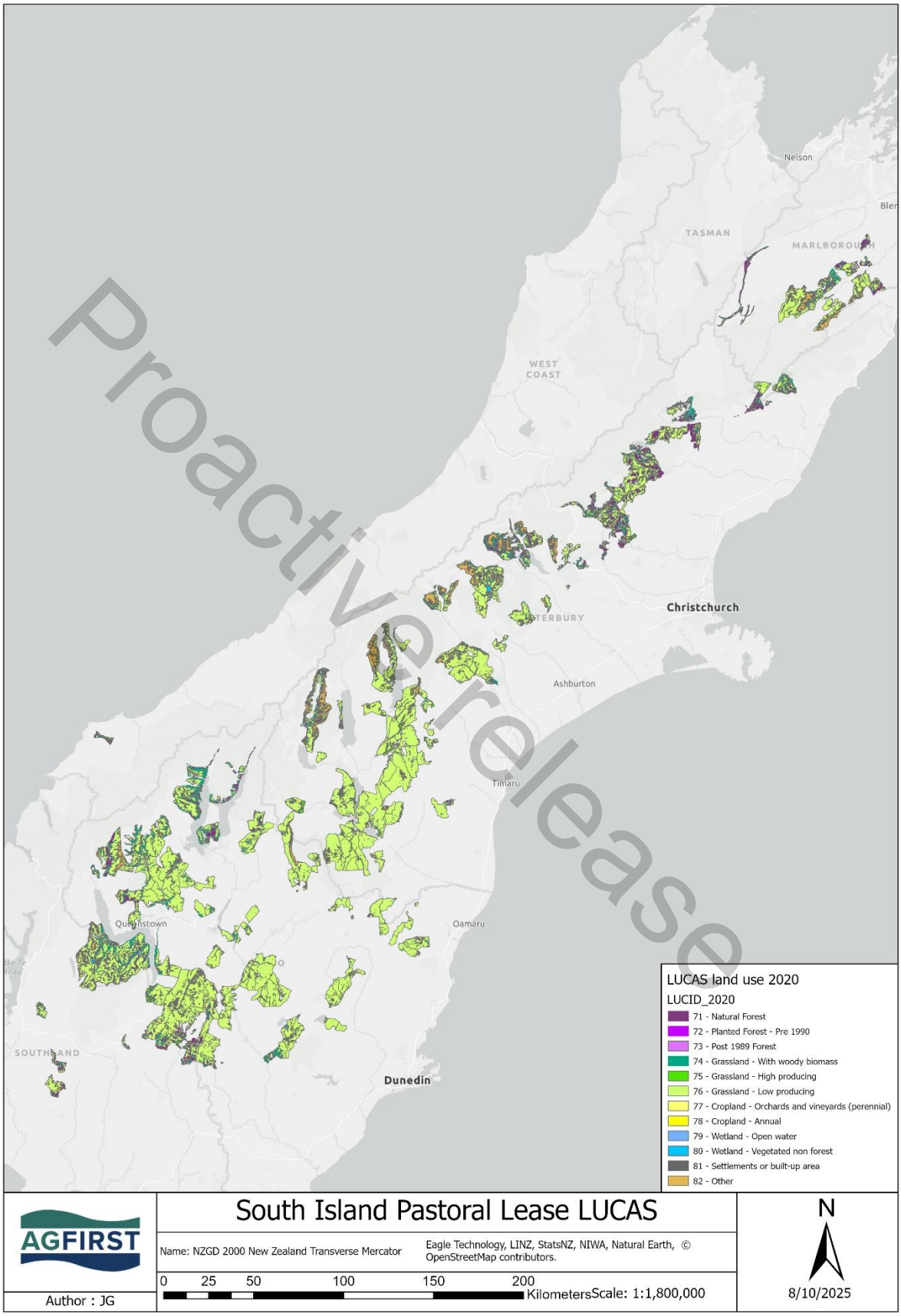
19.1 Crown Pastoral Lease Land Cover



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20.0 Appendix 7 – Summary of regulatory constraints by region.

20.1 Marlborough

	Permitted Activity	Regulatory constraints
Water	• Take and use of water for incidental use associated with farming is permitted up to 5 m^3per day. • Up to 5,000m^3 permitted to be stored at any time.	• Most catchments are either fully allocated or over allocated. Some class C peak flow allocation is available in some catchments (for storage). • Groundwater is not accessible for many farms. • Consent is required for any irrigation and storage beyond 5,000m^3.
Forestry	• Establishment of new forestry is permitted. • NES-CF regulations apply to any new forest plantations. This includes: ○ Preparation of an Afforestation Management Plan. ○ Any conifer plantings require Wilding Tree Risk Calculator. Score needs to below 12 to be permitted activity.	• The following species must not be planted: a) Douglas fir (*Pseudotsuga menziesii*); b) Lodgepole pine (*Pinus contorta*); c) Muricata pine (*Pinus muricata*); d) European larch (*Larix decidua*); e) Scots pine (*Pinus sylvestris*); f) Mountain or dwarf pine (*Pinus mugo*); g) Corsican pine (*Pinus nigra*). • Only indigenous species may be planted within the Wairau Dry Hills High Amenity Landscape. • Consent required on land identified as Steep Erosion-Prone Land.
Land Use	• Land use change is permitted except the conversion into dairy.	• Conversion and expansion of existing land to dairy requires discretionary resource consent. • Total cumulative N applications (fertiliser (organic and inorganic) and FDE) must not exceed 200kgN/ha/yr – applies to all land use activities.
Solar / Wind	• Highly Productive Land standards apply for LUC class 3 land.	• Discretionary land use consent required for industrial / utility activity in Rural zone.

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20.2 Canterbury

	Permitted Activity	Regulatory constraints
Water	• Permitted activity takes vary by catchment but are low and don't cover agricultural or horticultural irrigation in most cases. • Most water use for irrigation is managed by irrigation schemes who hold the consents.	• Land and Water Regional Plan (LWRP) Environmental Flow and Allocation Limit Zones cover a large number of catchments and aquifers. • Kaikoura is only freshwater management unit (FMU) that has headroom. All other FMU's range from constrained to over allocated. • Access to groundwater in high country areas is limited and would need to be assessed on a case-by-case basis.
Forestry	• Establishment of new forestry is permitted. • NES-CF regulations apply to any new forest plantations. This includes: ○ Preparation of an Afforestation Management Plan. ○ Any conifer plantings require Wilding Tree Risk Calculator. Score needs to below 12 to be permitted activity. • Additional district council standards in relation to visual amenity may shift the activity from permitted to requiring consent.	• Visual Amenity Landscapes (VAL) restrictions summary by district: a) Mackenzie, Extensive area, Non-complying / Restricted consent required. b) Waitaki, Upper catchments, Controlled / Restricted. c) Selwyn, Limited to the foothills, Restricted consent required. d) Waimakariri, Scenic overlays, Restricted consent required. e) Hurunui, Hill country & basin, Restricted consent required. f) Ashburton, Outstanding Natural Landscapes (ONL) only, restricted consent required within ONL area only. • Additional restrictions in and around pest management zones where the risk of wilding tree species are high.
Land Use	• Most land use activities operate around baseline data. If the activity can illustrate that there is no greater impact than the baseline, the activity is likely to be permitted.	• Any intensification of land use requires intensification consent. • Nutrient management restrictions apply and vary by land use and catchment.
Solar / Wind	• Considered utility and infrastructure – consent required if the land is zoned rural. • Highly Productive Land standards apply for LUC class 3 land.	• VAL areas require publicly notifiable consents and typically have very high thresholds, particularly in the Mackenzie District.

Preactive release

20.3 Otago

	Permitted Activity	Regulatory constraints
Water	• Permitted activity takes allow for the taking and use of groundwater and surface water for domestic needs or for animals drinking water up to 25m^3/day. • From major waterbodies (main stem Clutha/Mata-Au, Kawarau, or Lakes Wanaka, Hawea, Wakatipu, Dunstan, Roxburgh): up to 100 L/s and 1,000,000 L/day, one take per landholding, with fish screening and no backflow is permitted and this rule doesn't limit use, so irrigation is permitted if all standards can be met. NOTE: this can be suspended at any point by Otago Regional Council.	• The following catchments and aquifers are near or fully allocated: g) Manuherikia h) Cardrona i) Kakanui j) Low Burn k) Waianakarua l) Shag m) Waikouaiti n) Aquifers in schedule 4a
Forestry	• Establishment of new forestry is permitted. • NES-CF regulations apply to any new forest plantations. This includes: ○ Preparation of an Afforestation Management Plan. ○ Any conifer plantings require Wilding Tree Risk Calculator. Score needs to below 12 to be permitted activity. • Additional district council standards in relation to visual amenity may shift the activity from permitted to requiring consent.	• Visual Amenity Landscapes and Outstanding Natural Landscape restrictions apply in most districts – these are very restrictive in the Queenstown Lakes District. • Additional restrictions in and around pest management zones where the risk of wilding tree species are high.
Land Use	• Most land use activities operate around baseline data. If the activity can illustrate that there is no greater impact than the baseline, the activity is likely to be permitted.	• Any intensification of land use requires intensification consent. This includes the conversion from pasture to horticulture that is irrigated. • Packhouse, processing facilities and frost fans require consent.
Solar / Wind	• Considered utility and infrastructure – consent required if the land is zoned rural. • Highly Productive Land standards apply for LUC class 3 land.	• Restricted or non-complying (most rural zones); Prohibited within ONL/VAL areas in the Queenstown Lakes District.

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20.4 Southland

	Permitted Activity	Regulatory constraints
Water	• Total permitted take (surface + groundwater): up to 86m^3 per landholding per day. Up to ≤ 40 m^3/day per landholding (2,000 L/day + 250 L/ha/day, up to 40 m^3) can be from a surface water take.	• The following catchments and aquifers are near or fully allocated: o) Wendonside groundwater zone p) North Range Aquifer q) Lumsden Aquifer r) Manapōuri catchment s) Mararoa Surface Water Zone • Over-allocated above Gore under the Mataura Water Conservation Order (only up to 5% of natural flow may be taken; consents exceed that in the upstream reach).
Forestry	• Establishment of new forestry is permitted. • NES-CF regulations apply to any new forest plantations. This includes: o Preparation of an Afforestation Management Plan. o Any conifer plantings require Wilding Tree Risk Calculator. Score needs to below 12 to be permitted activity. • Additional district council standards in relation to visual amenity may shift the activity from permitted to requiring consent. • Written notice required for plantation forestry activities (for areas ≥1 ha) before undertaking afforestation works.	• Some species (e.g. Scots Pine, Corsican Pine, Douglas Fir, larches) are restricted in the Mountains Overlay. • Clearance of indigenous vegetation is limited, and you cannot clear native vegetation extensively in order to afforest without consent.
Land Use	• Most land use activities operate around baseline data. If the activity can illustrate that there is no greater impact that the baseline the activity is likely to be permitted.	• No new intensification without showing nutrient neutrality or improvement. Under Rule 20, any land-use change or intensification that increases nutrient losses above baseline modelling requires consent and justification. • Regional limits will apply once numeric catchment load limits are set (Mataura, Aparima, Oreti, Waiau). This applies to all farming / horticultural land within catchment.
Solar / Wind	• No specific rules in relation to power generation – would require consent as not expressly permitted. • Highly Productive Land standards apply for LUC class 3 land.	• Any utility activities must not affect the "character of rural working landscapes" (preserving separation, openness, privacy, avoiding reverse sensitivity) in the rural zone.

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20.5 West Coast

	Permitted Activity	Regulatory constraints
Water	• Total permitted take for surface water is up to 25m^3 per landholding per day and up to 50m^3 per landholding per day for groundwater. There are no restrictions on use associated with the take. • Haast catchment is not fully allocated.	• Consent required if more than permitted take is required or other standards are not met (setbacks, effects on surface water flows and other bores) which is likely if irrigation is to occur.
Forestry	• Establishment of new forestry is permitted. • NES-CF regulations apply to any new forest plantations. This includes: o Preparation of an Afforestation Management Plan. o Any conifer plantings require Wilding Tree Risk Calculator. Score needs to below 12 to be permitted activity.	• Removal (clearance) of more than 2,000 m^2 of indigenous vegetation (per site) requires resource consent in the Westland District. • South of Haast, most of the land is classified as "High" or "Very High" erosion susceptibility and adjacent to significant natural areas (SNAs) or wetlands which restricts the establishment of new forestry.
Land Use	• No current rules limiting the intensification of land in the West Coast.	• Consents are required for associated activities with land intensification e.g. drainage and earthworks (humps and hollows).
Solar / Wind	• Te Tai Poutini – West Coast Renewable Energy Strategy provides regionally specific guidance and policy direction supporting renewable projects (including solar) in the West Coast. • Highly Productive Land standards apply for LUC class 3 land.	• No specific rules in regional plan in relation to power generation – would require consent as not expressly permitted.

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