TARARUA DISTRICT COUNCIL

Tararua District Council Right Tree Right Place Project

17 December 2021

Project Brief

- The project builds on the research and framework of a PGF approved project (Alternative Land Use Tararua).
- The first tranche was focused on horticulture.
- The Tararua District Council (TDC) believed that what is still lacking for landowners is the information to consider alternative tree species.
- Council is also trying to guide the location of future forestry that delivers the right tree in the right place that reflects community impacts, iwi aspirations and community infrastructure.
- This project aims at addressing some of this information gap.

Project Team

- James Powrie (Redaxe)
- Simon Taylor (Fresh Prospective Insight)
- David Palmer, Peter Hall, Richard Yao, Tim Ryan (Scion)
- Lochie MacGillivray (AgFirst)
- Also leveraged off work done by the Hawke's Bay Regional Council in their Right Tree Right Place Project.
- Other Contributors included.
  - Rangitāne o Tamaki Nui-ā-Rua
  - Ngāti Kahungunu ki Tāmaki nui-a-Rua
  - Andrew Clarke (PF Olsen)
  - Forest 360
  - Land Vision
  - Phil Journeaux & Phil Tither (AgFirst)
  - Tararua Community

Project Breakdown

- Project split into 3 major milestones.
  - Assess and Select Ten Species for the Project
    - Leverage off prior work to narrow down to five species for further analysis
    - Assess Human Factors involved with a Right Tree Right Place process
  - Review of Five Selected and Targeted Tree Species
    - Spatial Analysis of suitable trees species
    - Community consultations
    - Case studies
    - Downstream and Value Added Processing opportunities
    - Workforce Implications
  - Final Report Summary

Part I
Report Summaries

Community Feedback

- Need to be cognisant of the environment and cultural heritage
- To aid in addressing loss of soil, improve water quality and bio diversity
- Whole sale farm afforestation not an answer
- A shared responsibility to reduce GHG emissions
- Opportunities exist to promote rural initiatives and innovation

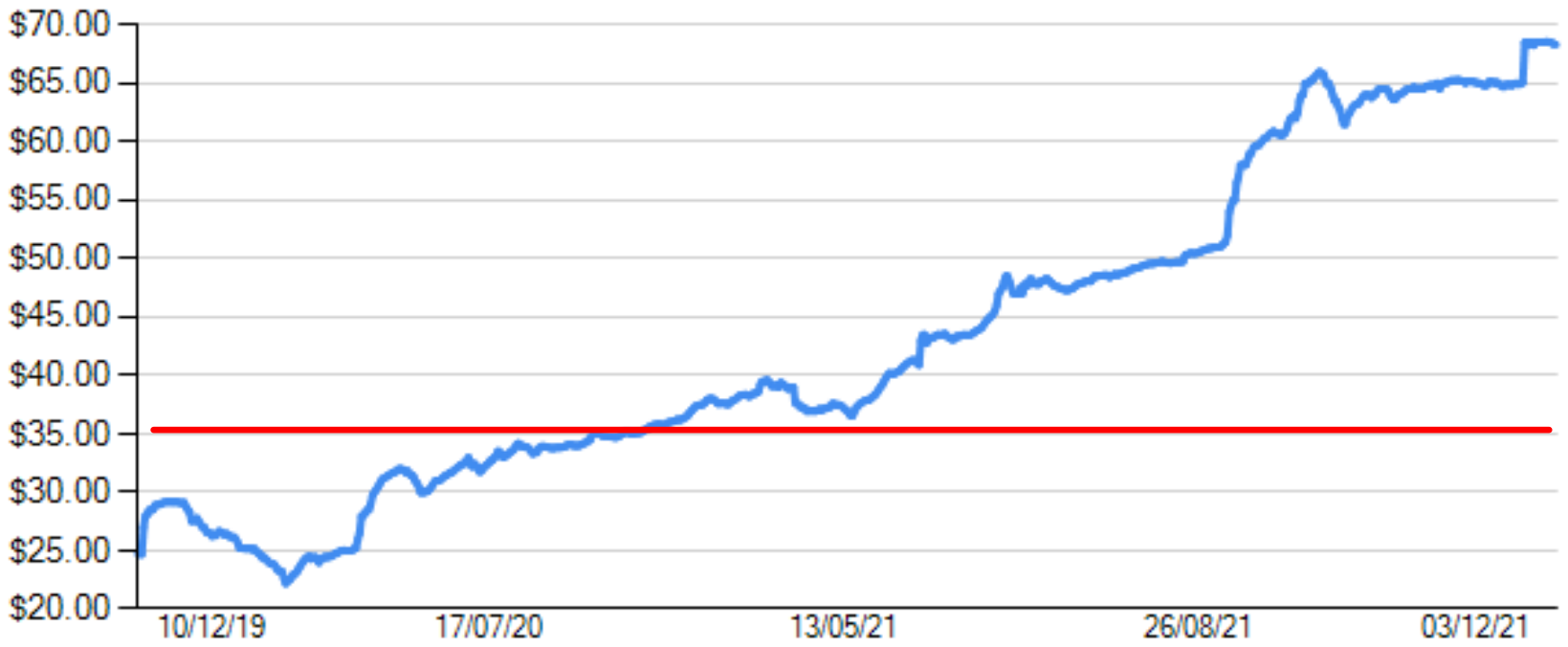
The Scene Reiterated

- Original project started with the impact of regulations on land use
- Still holds but other factors coming into play

- 2019- 85% of land area traded went into forestry
- ~ 20,000 stock units lost
- ~$2,000,000 loss of community spend
- 2019 carbon price (NZU) <$25/t. Current price (17/12/2012) $68/t
- Carbon price seen as a driver in land sale values in the Tararua District

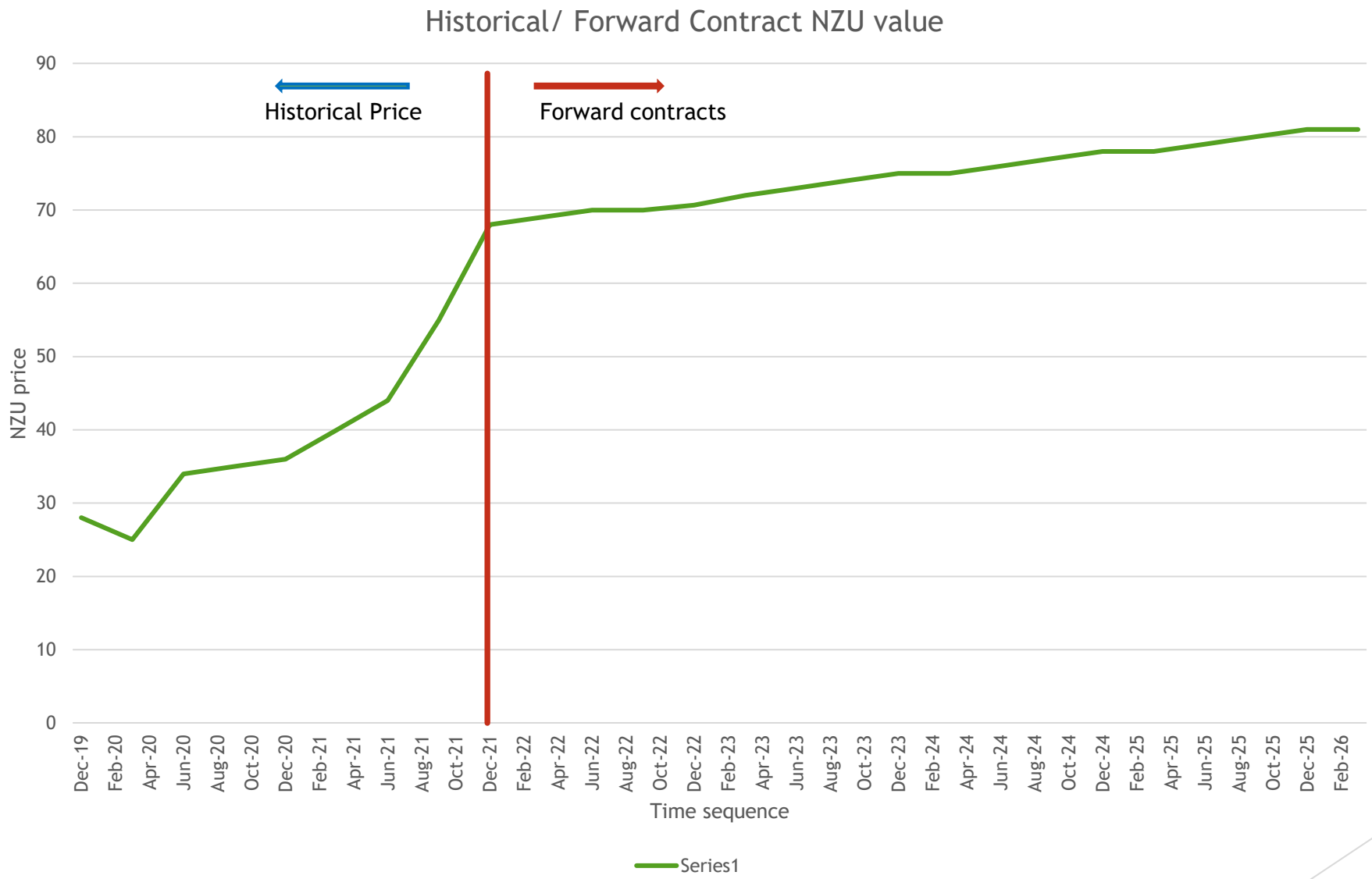
- Pricing used in the report modelling $35/t currently at $68/t

Carbon Price History



Base carbon price used in analysis

Source -Jarden Carbon News


Historical/ Forward Contract NZU value
Historical Price
Forward contracts
NZU price
90
80
70
60
50
40
30
20
10
0
Dec-19
Feb-20
Apr-20
Jun-20
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Oct-25
Dec-25
Feb-26
Time sequence
Series1

Climate Change – Some positive and negatives

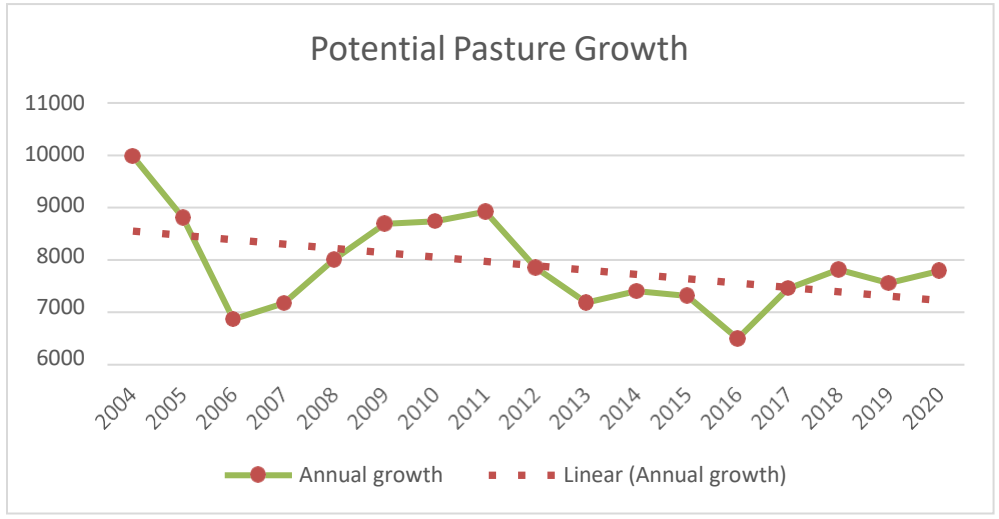
- Change in crop types and yields
- Impact on forestry mainly positive due to higher potential growth rates

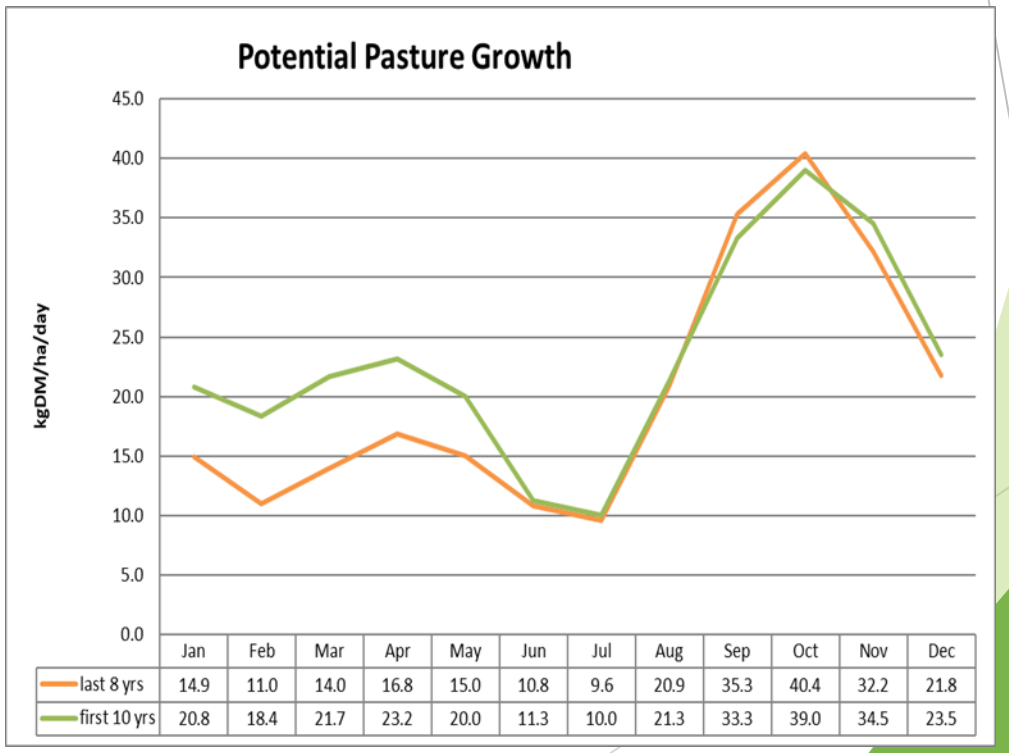
BUT

- Higher demand for water
- More probable storm and fire events
- Higher risks in forestry establishment
- More variable pasture production

More variable Pasture Production (non irrigated)

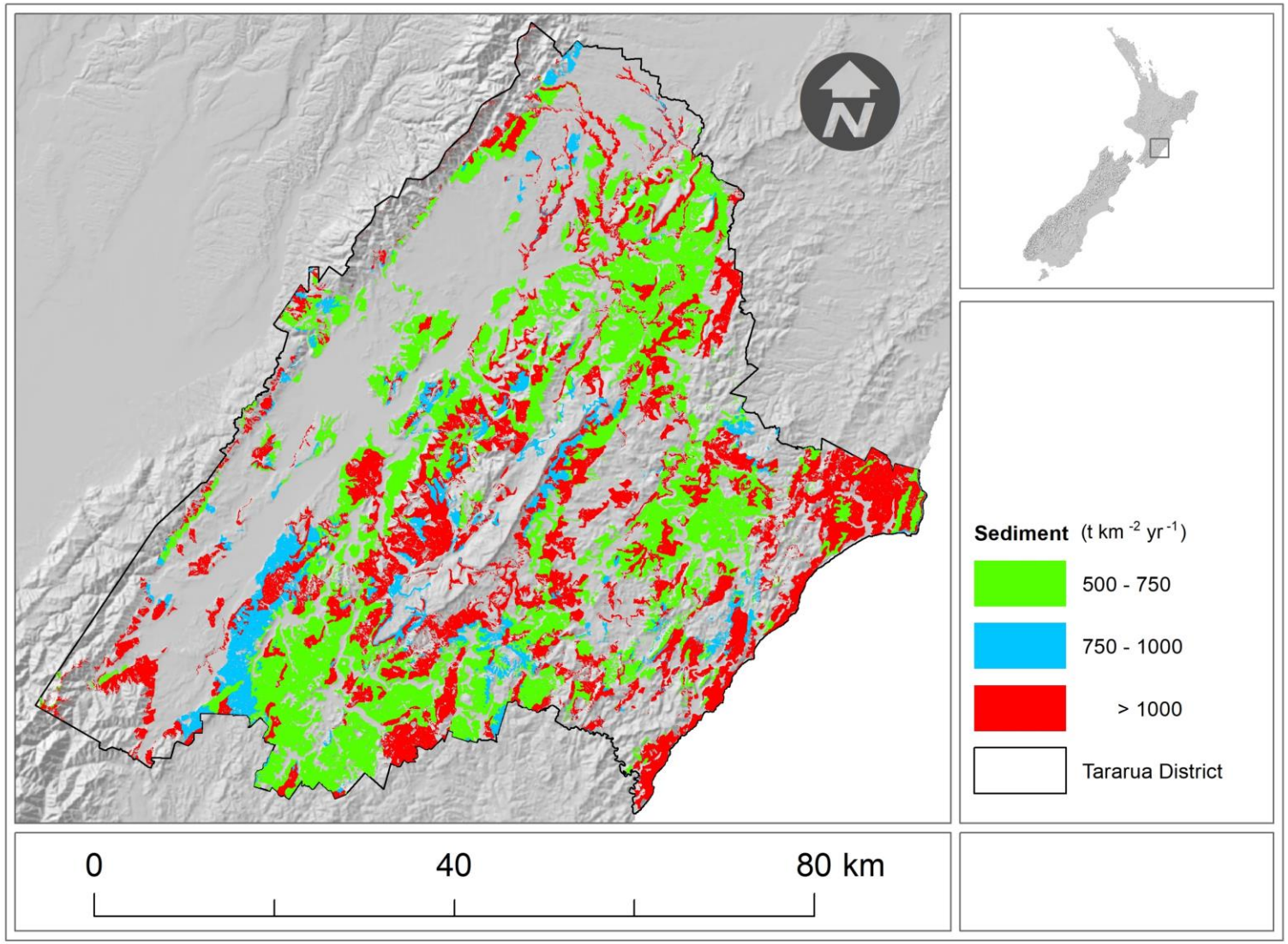
Hawke's Bay Data





	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
last 8 yrs	14.9	11.0	14.0	16.8	15.0	10.8	9.6	20.9	35.3	40.4	32.2	21.8
first 10 yrs	20.8	18.4	21.7	23.2	20.0	11.3	10.0	21.3	33.3	39.0	34.5	23.5

TDC - A high sediment loss risk area



Trees in the Landscape

- NZ has for the last 100 years a high rate of soil erosion
- Exacerbated by human activity, particularly agriculture
- Agriculture has also had a big impact on the loss of bio diversity
- Pastoral systems generally have:
  - higher water yields & flows,
  - higher water nutrient levels
  - higher sediment levels
  - higher faecal coliform levels
  - And higher water temperatures.

- Some forestry regimes can
  - Increase carbon reserves
  - Reduce erosion and sedimentation
  - Increase bio diversity
  - Enhance FW quality.
  - Add profitability to the district economy

Ten Species

Species		Market Risk	Site Suitability	Erosion Control	Financial Risk	Farmer appeal*	Further Analysed
1	Cypress	7	6	7	6	7	✓
2	Dryland Eucalyptus	7	7	6	7	7	✓
3	Kauri	n/a	4	n/a	n/a	5	
4	Totara	n/a	7	9	n/a	6	✓
5	Manuka for Honey	9	6	9	7	8	✓
6	Silvopastoral	7	4-8	8	6	8	
7	Radiata	9	7	7	9	5	✓
8	Coastal Redwood		7	8	7	7	✓
9	Douglas Fir	8	4	7	8	5	
10	Mixed Species Indig		7	9	n/a	6	

Scion Report
with input from Redaxe & AgFirst

- Four separate reports;
  1. TreeScape: mapping landscapes suitable for commercial forestry compared to retirement landscapes for the Tararua District
  2. Spatial mapping of tree species site suitability for Tararua District
  3. Spatial economic assessment of potential afforestation areas across the Tararua District
  4. Tararua District wood supply and processing opportunities

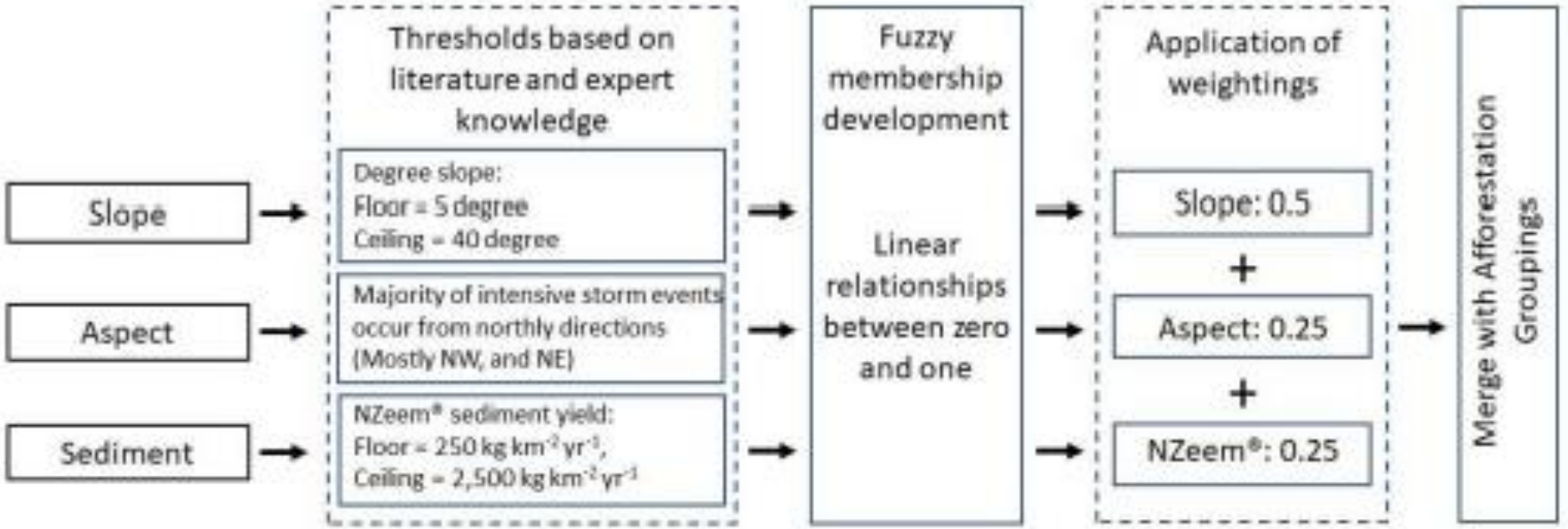
Provides a valuable high-resolution GIS database for individual land managers

Scion Report 1

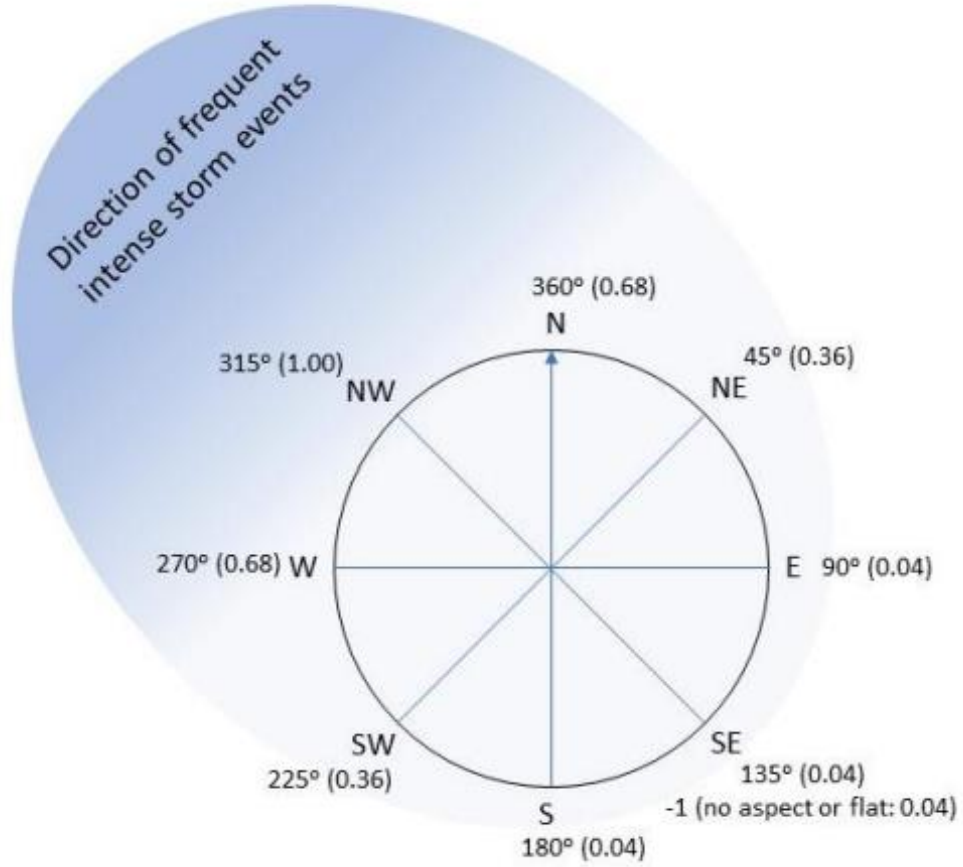
TreeScape:

- The TreeScape model and maps identify landscapes where the establishment of commercial plantation forests is appropriate.
- The report spatially identifies and quantifies erosion-susceptible areas for targeted afforestation.
- This report provides a database that will influence tree species selection or if trees should not be planted.
- It considers the suitability of high elevation landscapes with cooler temperatures, skeletal soil types, steep slopes, exposure to intensive storm events, which can all influence tree survival, for afforestation.

Workflow for developing greater detail to Land Resource Inventory - LRI



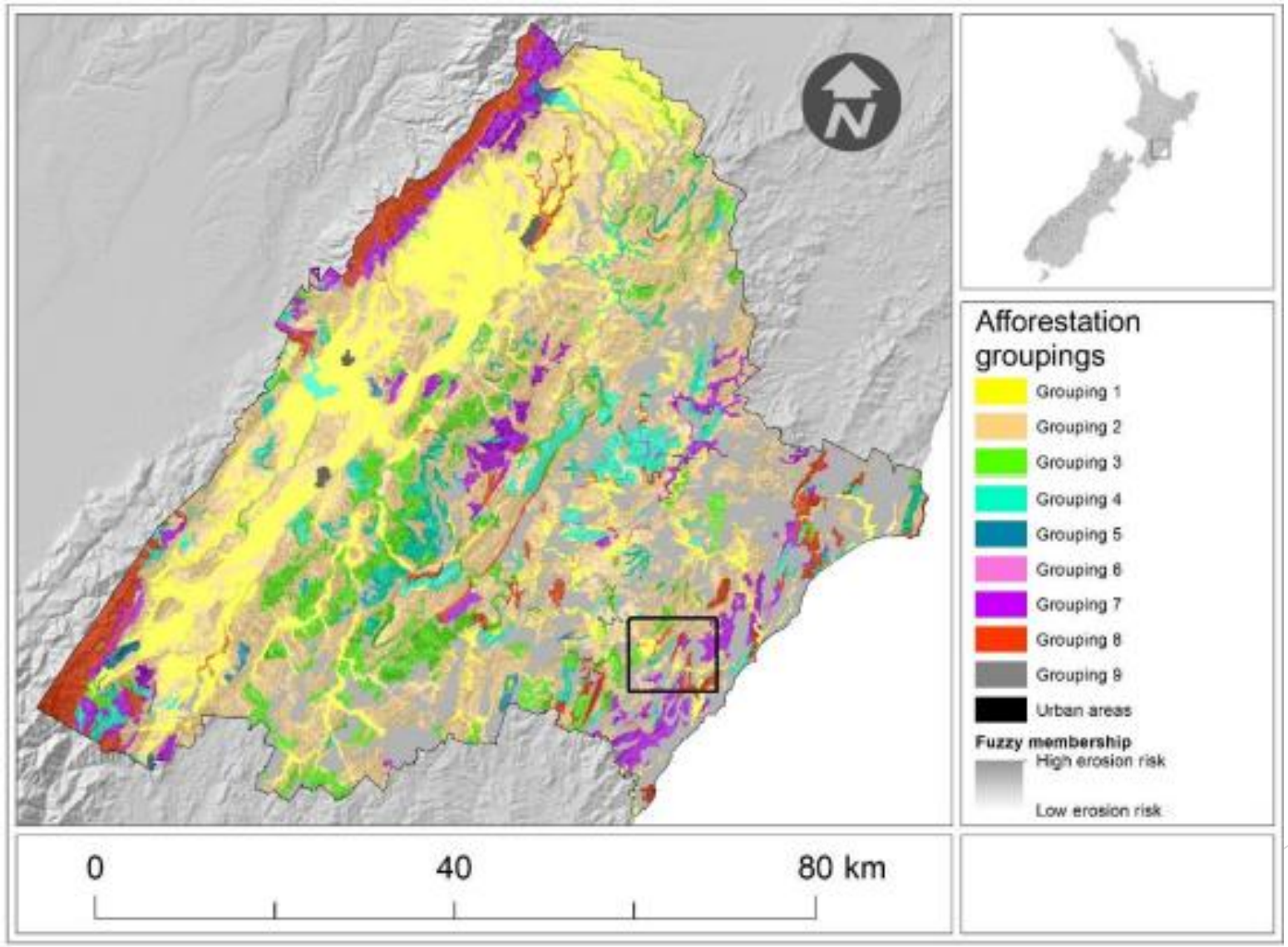
Fuzzy membership values for storm events

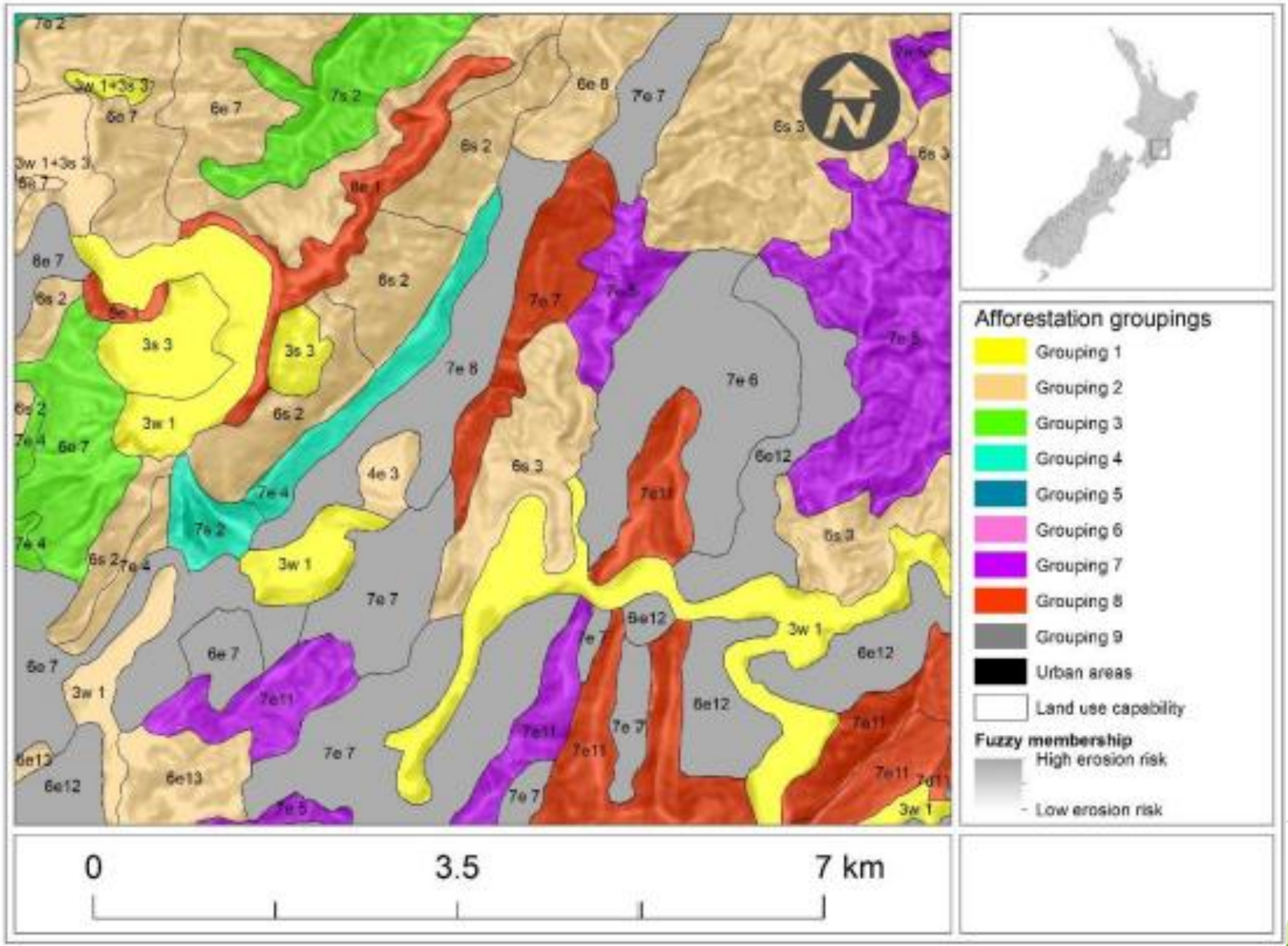


Spatial Analysis
Fuzzy Membership

Group	Commentary
1	Generally, alluvial valleys or terraces, fertile, lower altitude.
2	Generally, rolling to moderately steep hill country, fertile & lower altitude.
3	Rolling to steep, prone to some forms of sheet, rill or gully erosion.
4	Area on varying topographies, with climatic, altitudinal and erosion limitations
5	Moderate to steep landforms that are prone to soil slip or sheet and gully erosion under pasture.
6	Limited productivity under grazing on steeper terrains and prone to gully erosion
7: Skeletal	Limited productivity under grazing, thin soils on steeplands. vulnerable to debris flow /debris avalanche initiation
8: Reversion	Generally steep greywacke range lands subject to high rates of natural or induced erosion.
9: Earthflow	Generally moderate to rolling hill country subject to deep seated mass earthflow or shallow colluvial earthflow erosion.

Spatial Analysis
Fuzzy Membership




Afforestation groupings
Grouping 1
Grouping 2
Grouping 3
Grouping 4
Grouping 5
Grouping 6
Grouping 7
Grouping 8
Grouping 9
Urban areas
Land use capability
Fuzzy membership
High erosion risk
Low erosion risk
0
3.5
7 km

Scion Report 2

Spatial mapping of tree species sites

- The report utilises a Tree Species Site Suitability model (TSSS) which identifies where in the landscape it is suitable for a range of tree species establishment and growth.
- TSSS provides high level information to landowners and regulating bodies wishing to inform and encourage appropriate afforestation

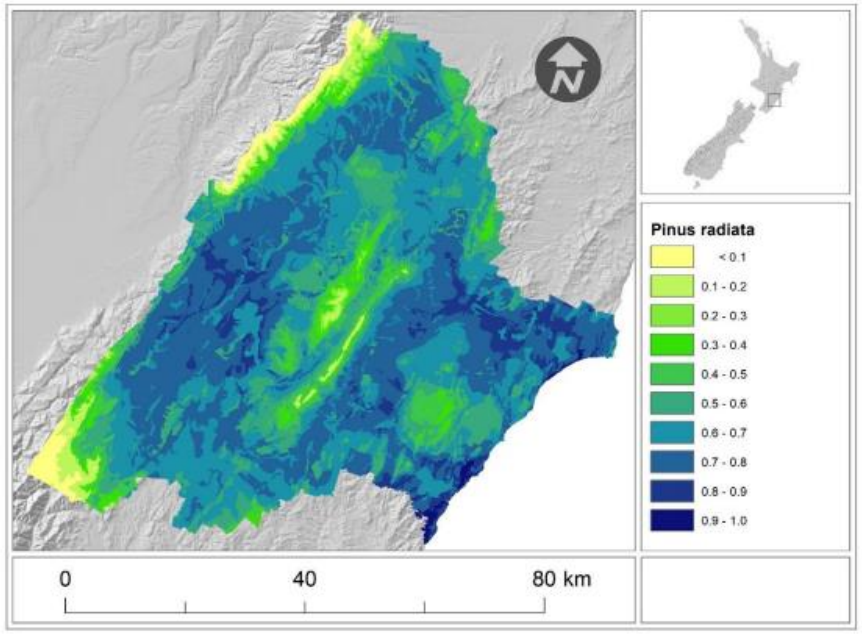


Figure 3: Tree species site suitability degree of membership for radiata pine.

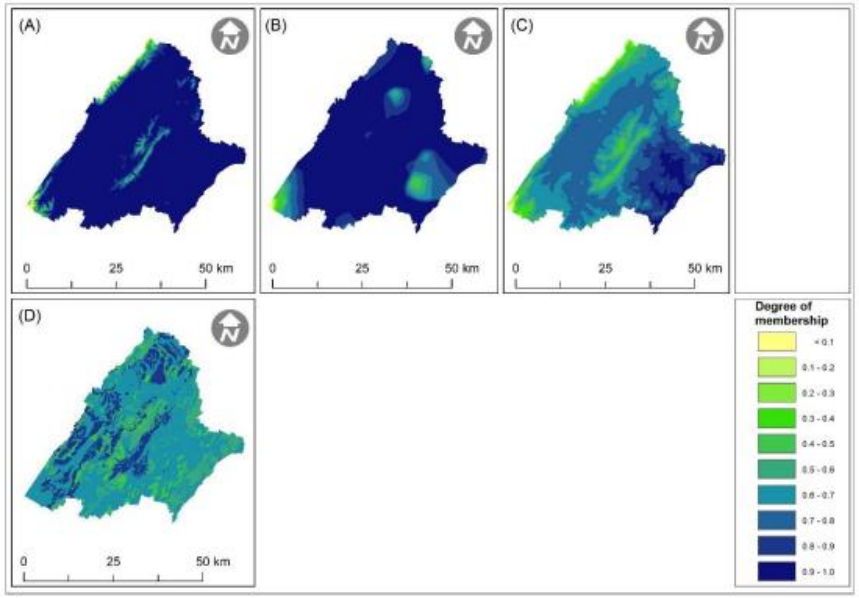


Figure 4: Radiata pine site suitability characteristic maps for (A) elevation, (B) total annual rainfall, (C) mean annual temperature, and (D) Profile Available Water (PAW).

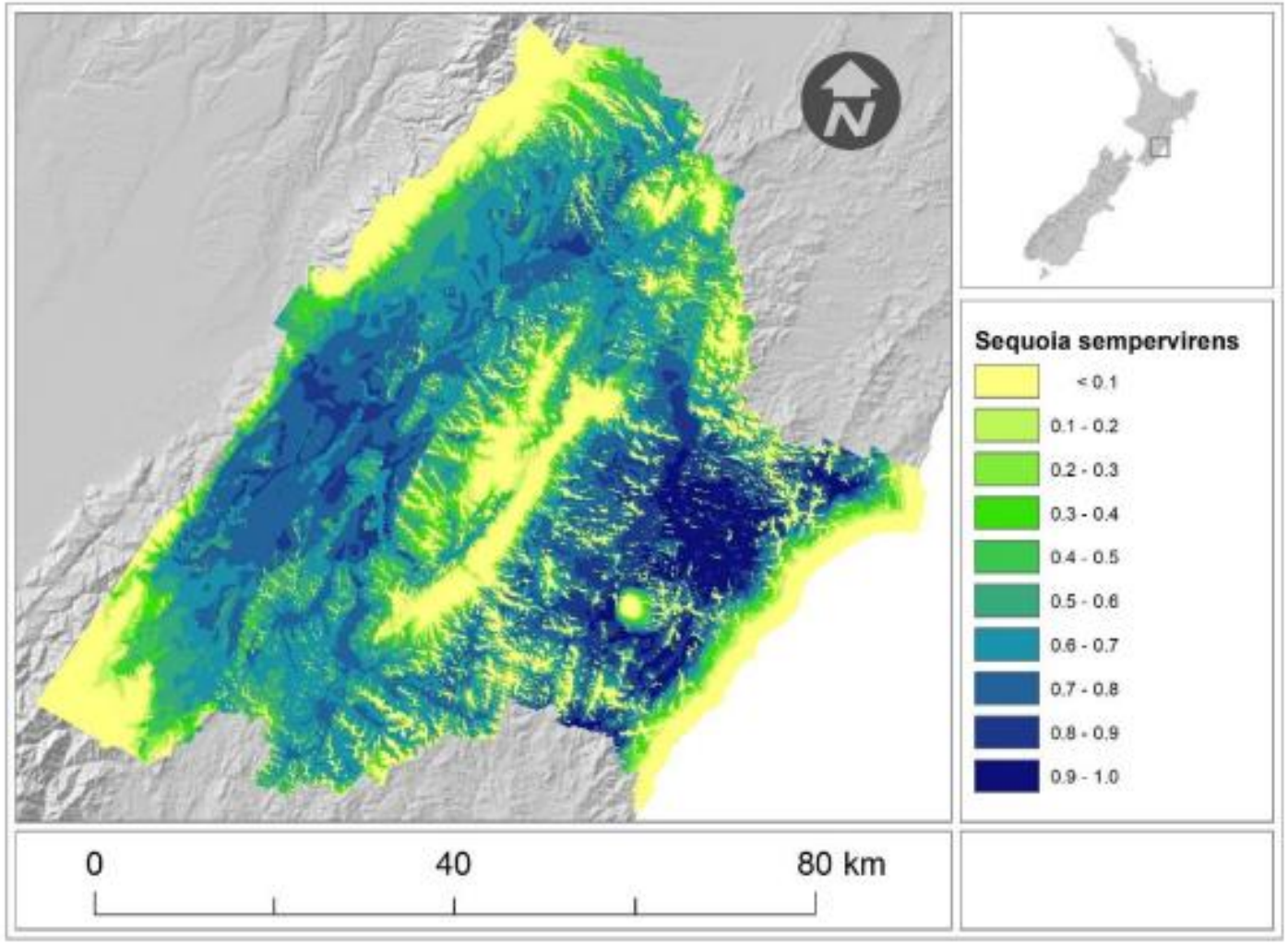


Figure 5: Tree species site suitability degree of membership for coast redwood.

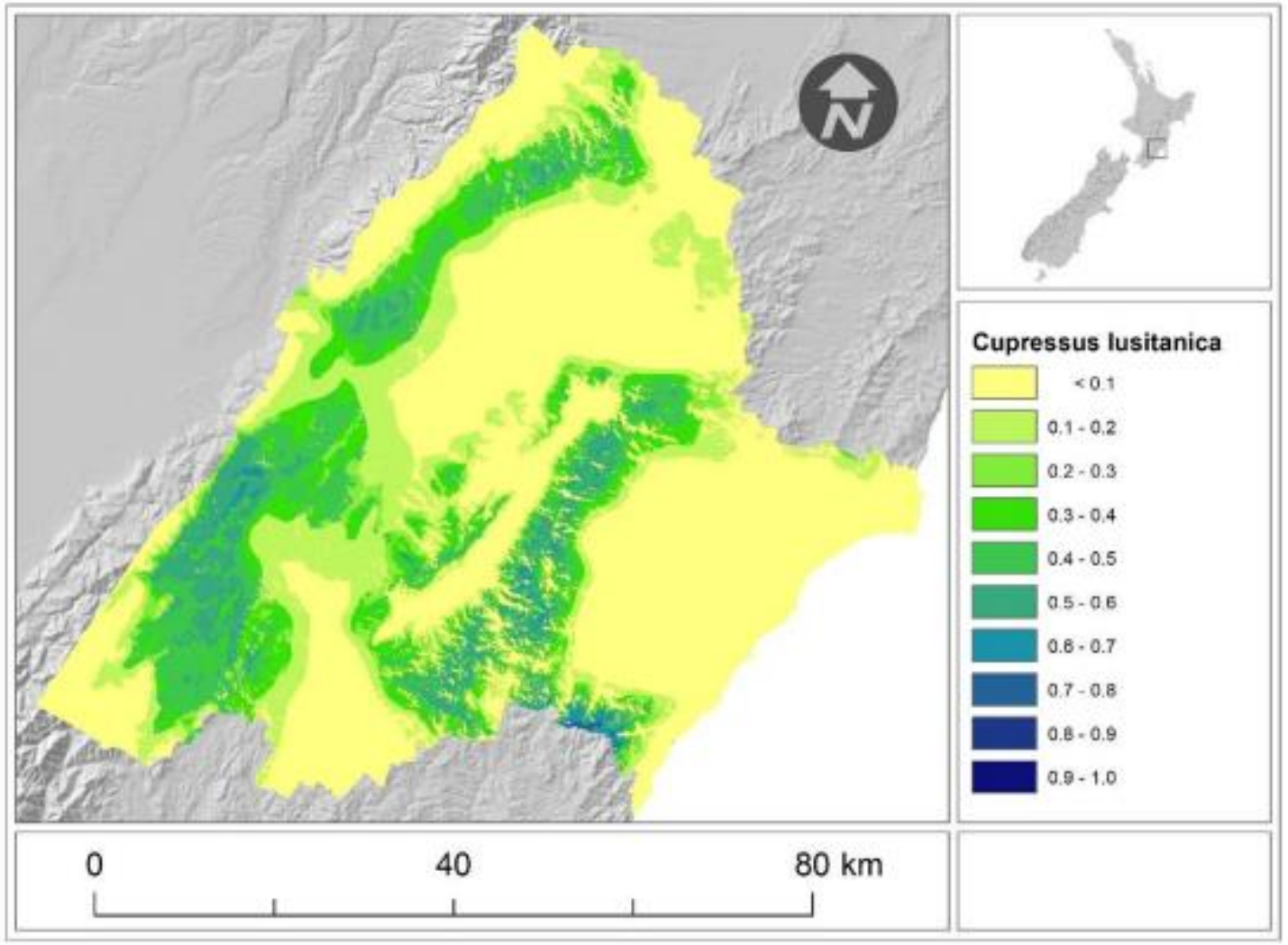


Figure 7: Tree species site suitability degree of membership for *Cupressus lusitanica*.

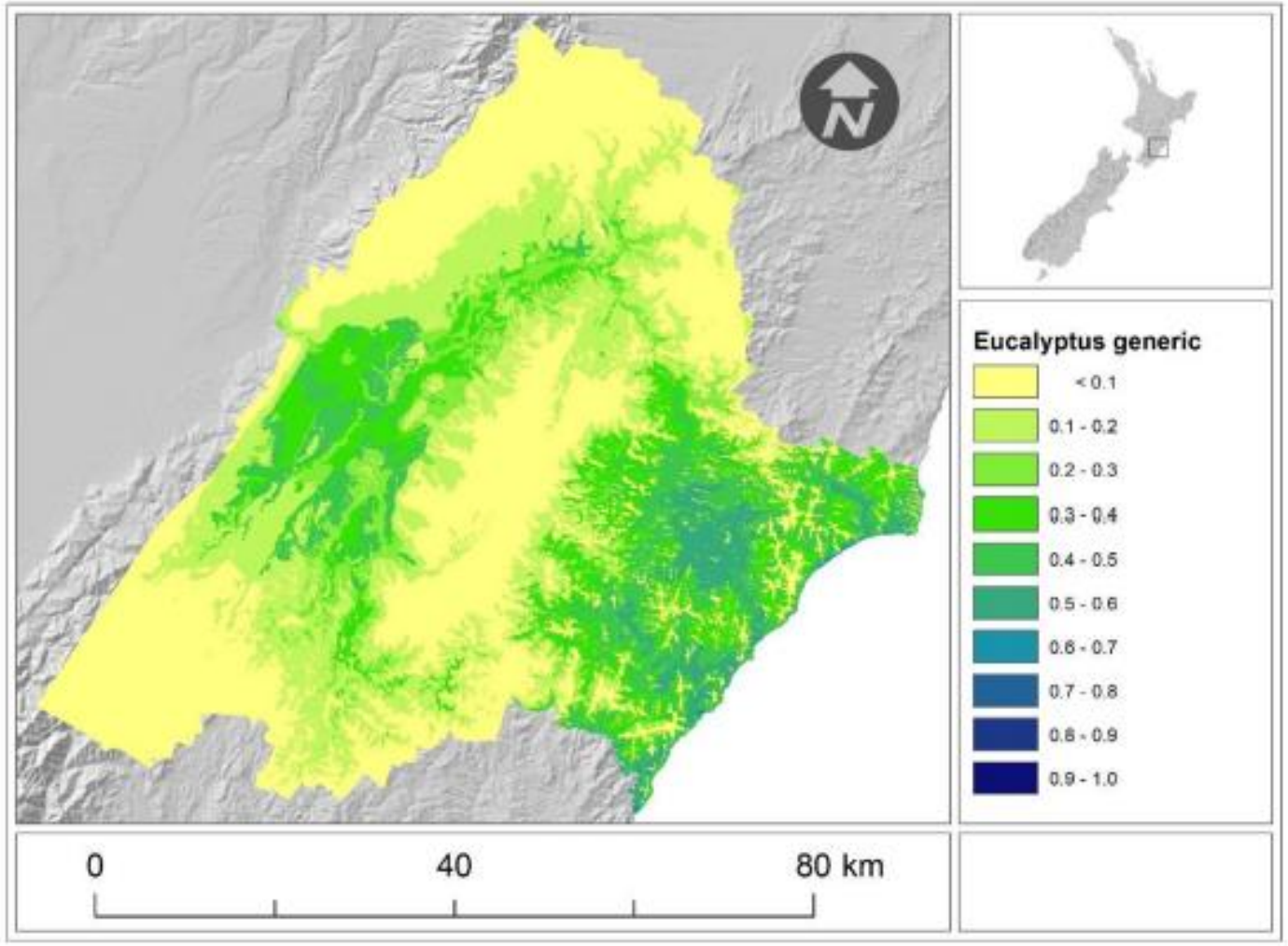


Figure 9: Tree species site suitability degree of membership for *Eucalyptus* generic scenario.

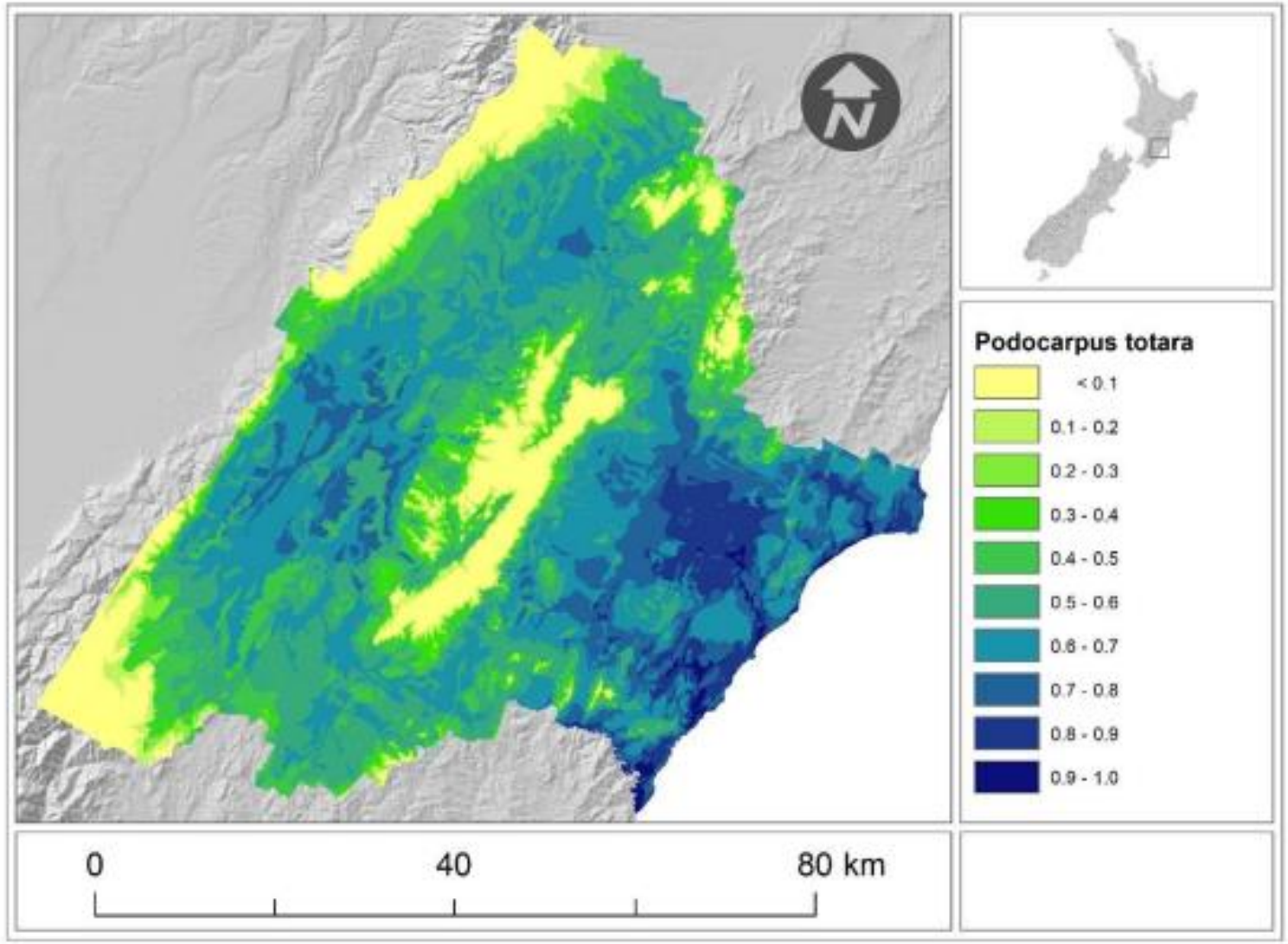


Figure 11: Tree species site suitability degree of membership for tōtara.

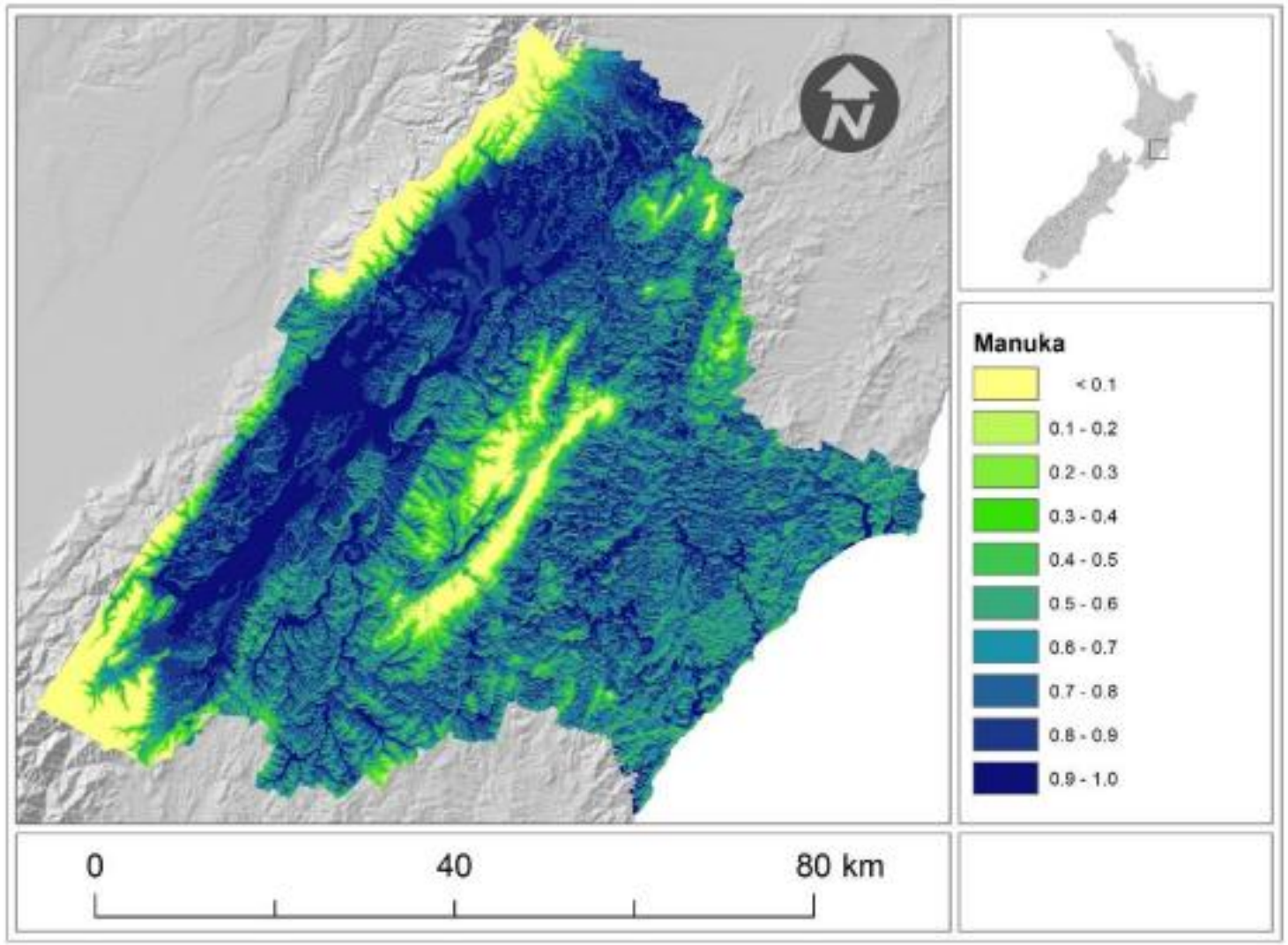


Figure 13: Tree species site suitability degree of membership for mānuka.

Scion Report 3

Spatial economic assessment of potential afforestation areas

- The Forest Investment Framework (FIF) models and maps the costs and returns from plantations.
- FIF was used to calculate the cost of plantation establishment, pruning, thinning, internal forest roads and landings, log transportation, and map potential financial returns from forestry stands.

Siting variation

- Sensitivity of returns (NPV/ha) to site variables - radiata

Distance to market	Topography - Hauler terrain (%)		
	Flat	Rolling	Steep
25	3,500	2,900	1,500
50	2,700	2,000	700
75	1,800	1,200	-200
100	1,000	300	-1,000

Scale (ha)	Roading Access Required		
	100m	1km	2km
1	5,100	-12,600	-32,200
10	7,000	5,100	3,100
100	7,100	7,000	6,800
1000	7,200	7,200	7,100

Source -PF Olsen

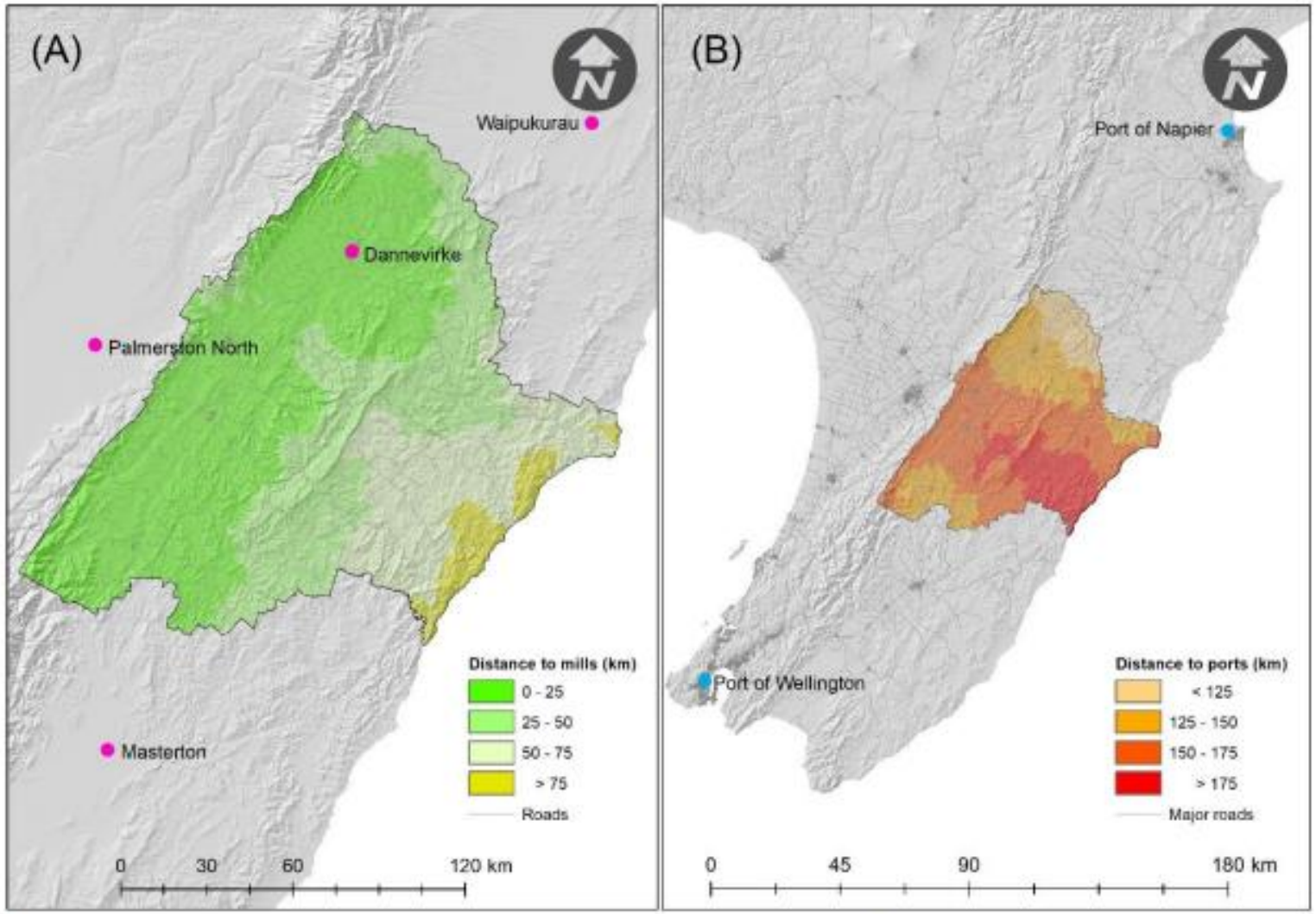


Figure 1: Distance from (A) wood processing plants (Dannevirke Waipukurau, Masterton, and smaller plants in Palmerston North), and (B) ports (Napier and Wellington).

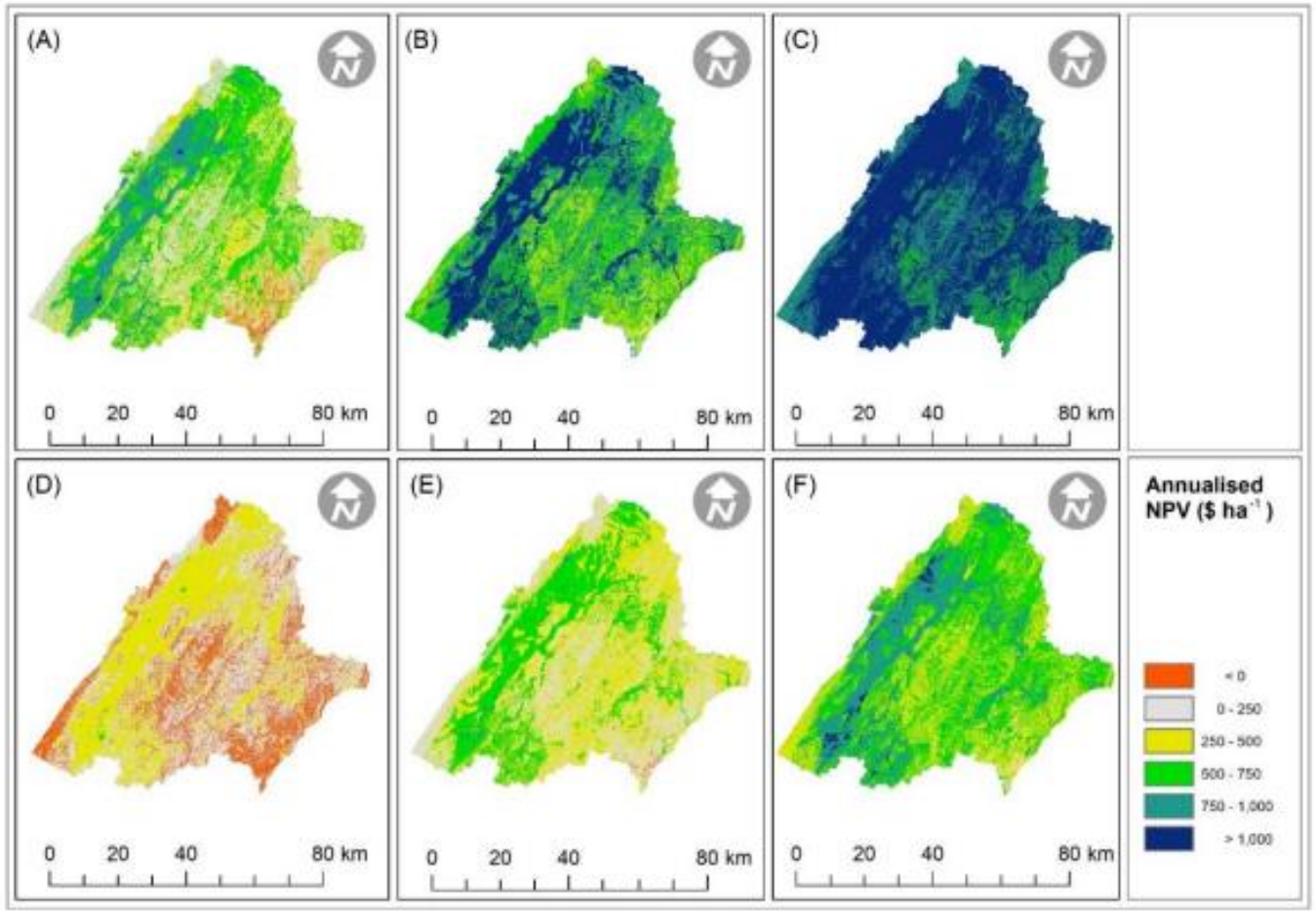


Figure 6: Annualised NPV calculated using a 3% discount rate (upper graphics) with log prices at minus 18% of the average (A), the average (**B**) and plus 18% of the average (C), and at a 6% discount rate (lower graphics) with log prices at minus 18% of the average (D), the average (E) and plus 18% of the average (F) for the Tararua District using the FIF model.

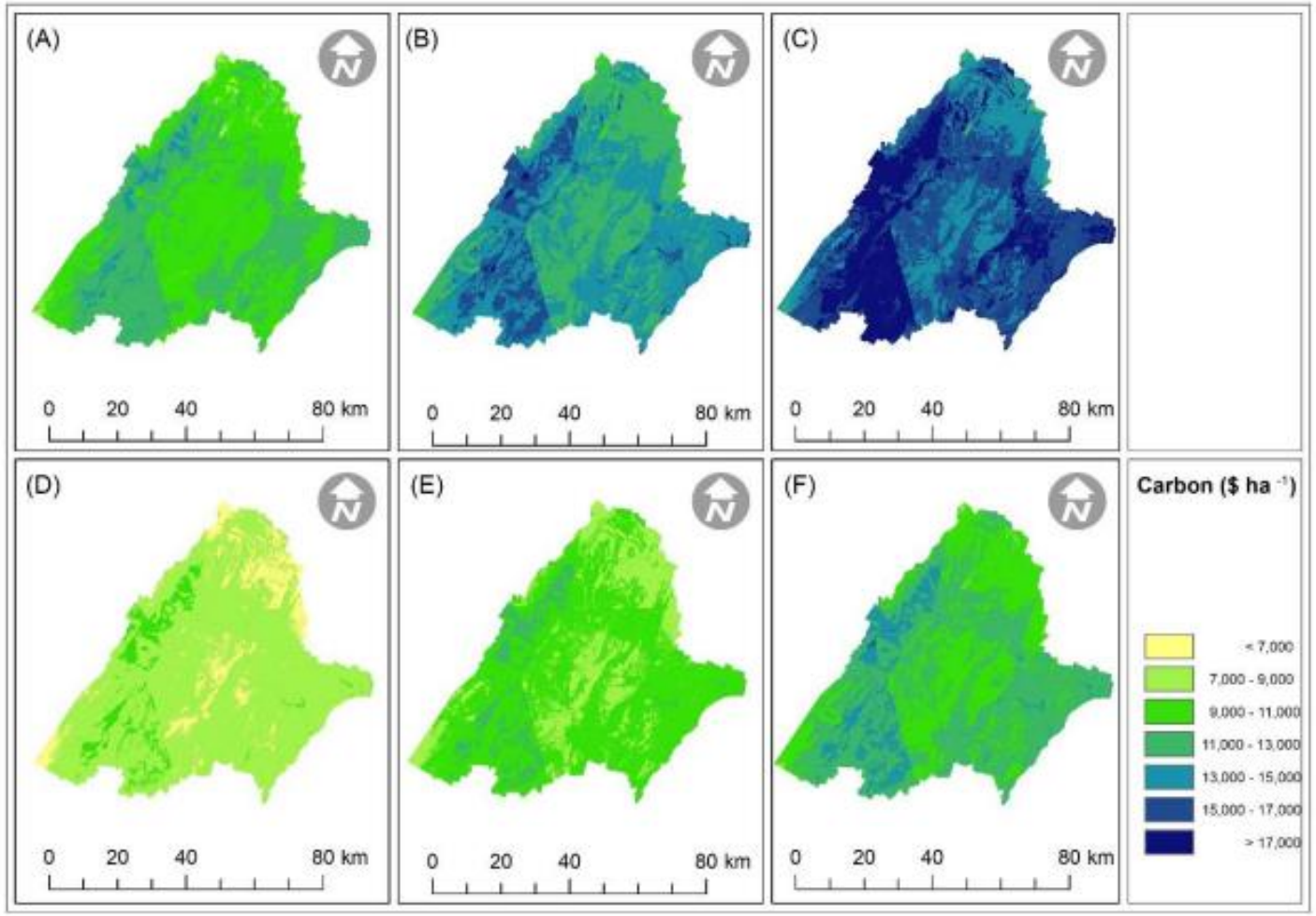


Figure 8: Carbon sequestration was calculated using a 3% discount rate (upper graphics) with carbon prices at minus 18% of the average (A), the average (B) and plus 18% of the average (C), and at a 6% discount rate (lower graphics) with carbon prices at minus 18% of the average (D), the average (E) and plus 18% of the average (F) for the Tararua District using the FIF model.

Carbon price - $35/t NZU

Relative IRR Returns

	IRR without carbon	IRR with Carbon	Annual Carbon income (av/ ha over 17 years)
Radiata Pine	9%	31%	$1,060
Redwood	7%	11%	$543
Poplar poles		31%	$746
Native Regeneration		1.5%	$318
Manuka (JV 30% honey)	5.4%	12.8%	$405
Pine/ plant and leave		31+%	$1,060

Scion Report 4

Tararua District wood supply and processing opportunities

- This report describes the existing wood supply and the potential for expanded wood processing based on this resource.
- It also discusses the potential for future expansion of afforestation and the impact of this on wood processing options.
- The quantity of forest residues is also described, along with its potential for use as an energy resource and other added value processing.

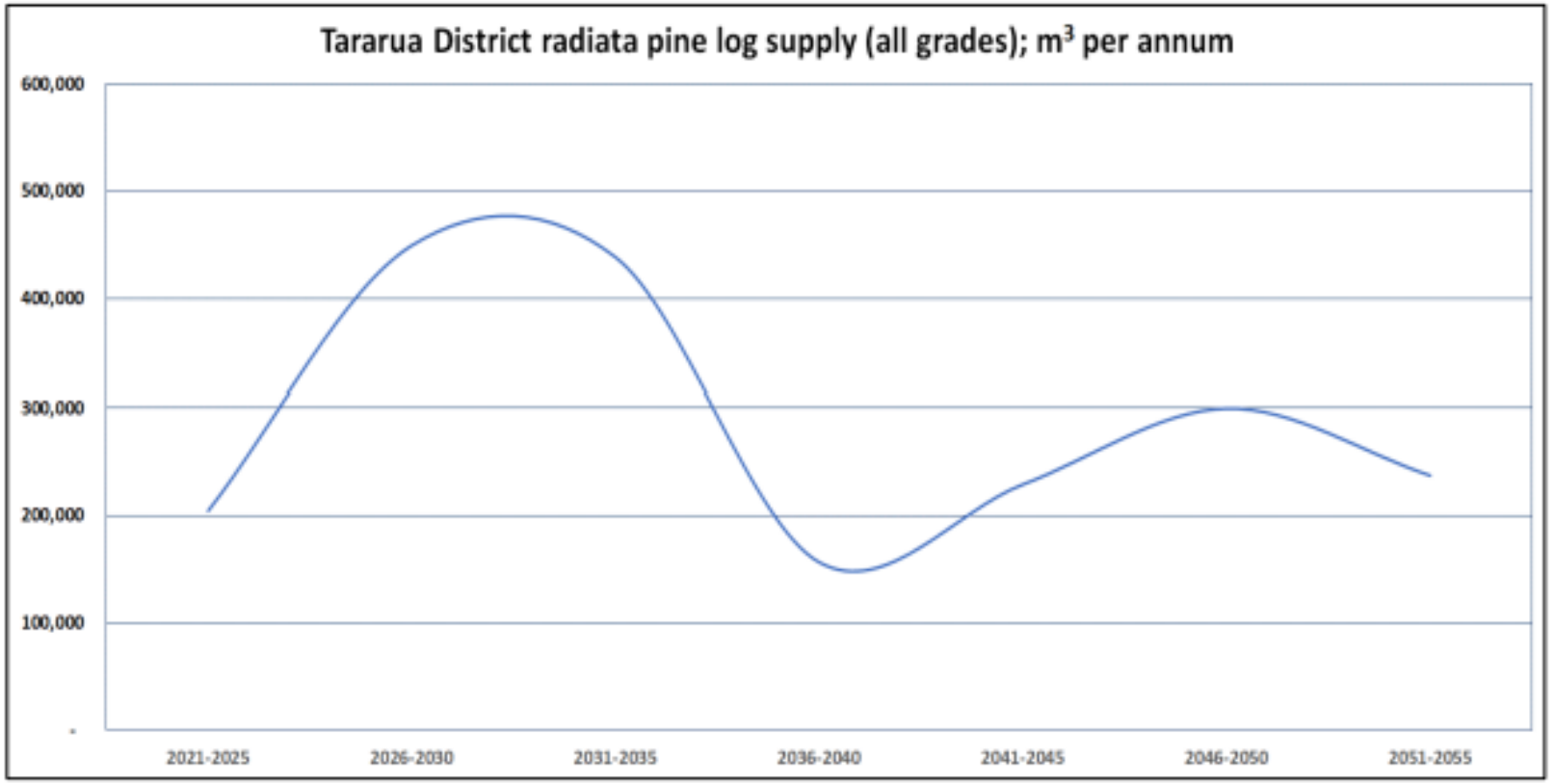


Figure 1: Radiata log supply in Tararua District to 2055

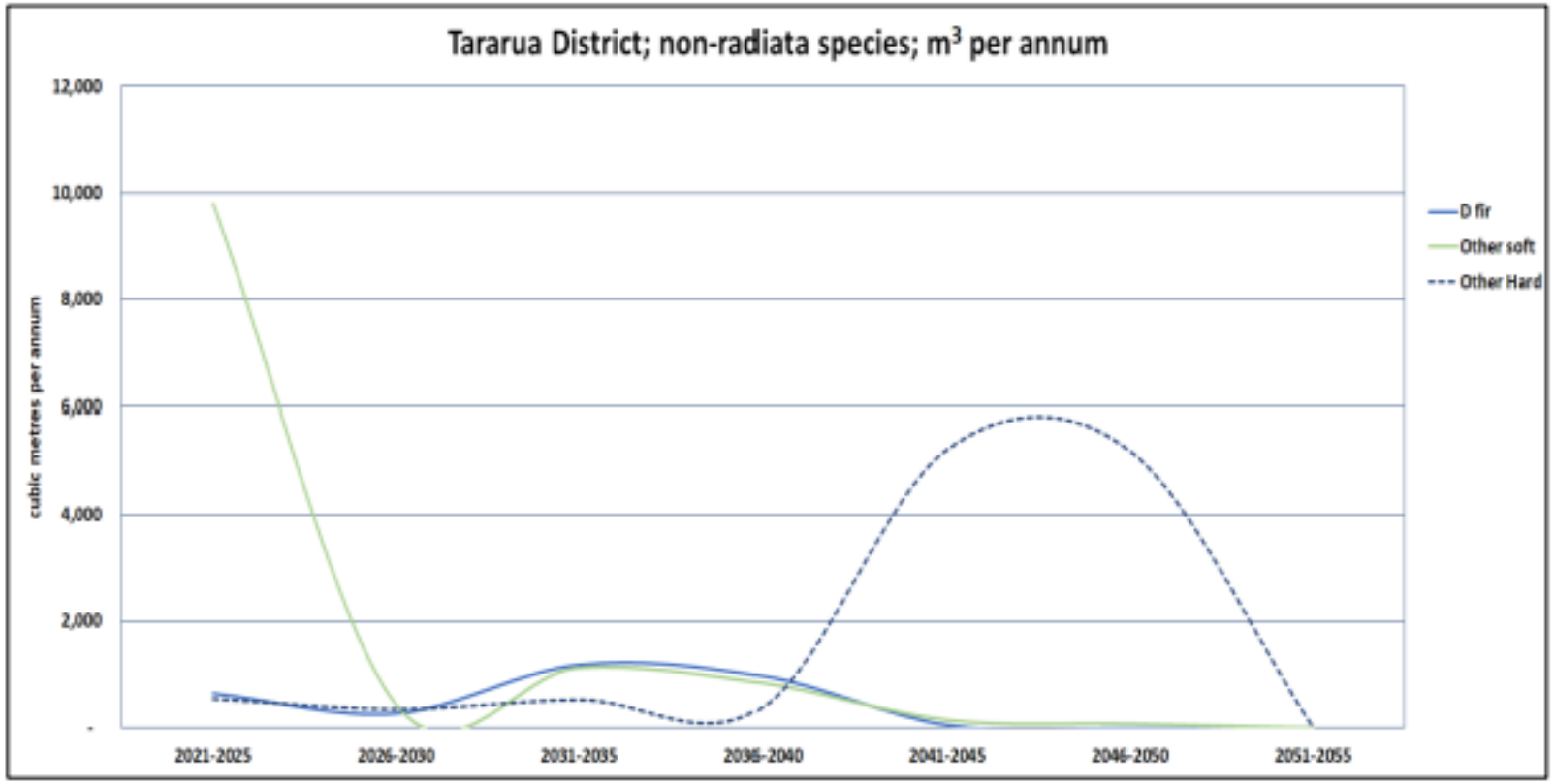


Figure 3: Non-radiata species log supply

- It was estimated that there was a need for around 225,000 m3 per annum of extra log supply to stabilise the wood supply in the period 2035 to 2045.
- Based on the yields used in the report it was estimated that around 520 ha per annum of new plantings for a period of around 10 years (total of 5,200 ha) would be sufficient to provide some log supply to fill in the shortfall.

Wood processors

- The Tararua District does not have a lot of major wood processors. The largest being Kiwi Lumber in Dannevirke, which is a sawmill focused on appearance grade products. This mill takes largely pruned logs, with a capacity of around 60,000 m3 of log in per annum.
- There are also some smaller processors although their capacity is not known, manufacturing a range of products including treated posts and poles.

Nearest processors outside of the district

Mill name	Location	Type	Capacity, m^3 of log in
Kiwi Lumber	Masterton	Appearance Sawmill	90,000
JNL	Masterton	Ply and LVL	120,000
JNL	Masterton	Appearance Sawmill	65,000
Watts to Mill	Waipukurau	Minor Species / Cypress	7,000
Waipawa Timber	Waipawa	Appearance	35,000

There are also numerous businesses with heat demands
Dairy & Meat Industries aprrox 175,000 tonnes pa.

Wood Processing Options

- The forest resource in the Tararua District is comparatively small and variable over time.
- The species of wood available is almost exclusively Radiata pine, with little to indicate an appetite amongst local growers for other species.
- Some of the common (in other regions) non-radiata species (Cypresses and Eucalypts) are not present. A range of Eucalyptus species could potentially be grown.
- The modest volume of Radiata pine and the variability in its supply over time limit the processing options, as larger mills tend to be more financially attractive.
- Some plantings of Radiata pine on a 16-year rotation sawlog regime would help stabilise the wood supply and allow some larger processing plants to be considered.
- Processing options that would be viable include;
  - Big Squares
  - Optimised Engineered Lumber (OEL™)
  - Mixed product sawmill co-located with a Cross Laminated (CLT) plant and a remanufacturing plant –
  - Wood pellet mill with extraction of terpenes and resins
- The largest impact on employment and GDP would be from a sawmill, remanufacture and CLT combination

Table 6: Summary of capital cost, GDP impact and employment numbers for promising processing options

	ROCE %	Capital $M	Capital weighted ROCE %	GDP $M	Direct employment	Total Emp. Inc. Indirect and Induced
Sawmill (1)	10.2	$10.95		$21.8	54	145
CLT (2)	23.8	$19.70		$60.7	137	367
Reman (3)	23.4	$46.60		$68.6	45	121
Combined 1+2+3*	***20.0***	***$75.25***	***20.0***	***$151.1***	***236***	***633***
Big squares	30.8	$1.14		$5.1	9	23
OEL™	24.4	2$0.8		$42.4	27	72

*The sawmill on its own is not particularly attractive, and the CLT and Reman. plants need the sawmill to do the primary breakdown of logs so need to be considered together

Farmer Attitudes

- The decision to plant trees on a farm is a strategic decision that is unique to an individual farmer.
- Needs start with a clear distinction between commercial planting and non-commercial.
- For those with commercial intent, pine is the default species.
- In the non-commercial world there is a desire and willingness to use a variety of species linked to site suitability, variety/diversity, native plantings and various cost considerations.

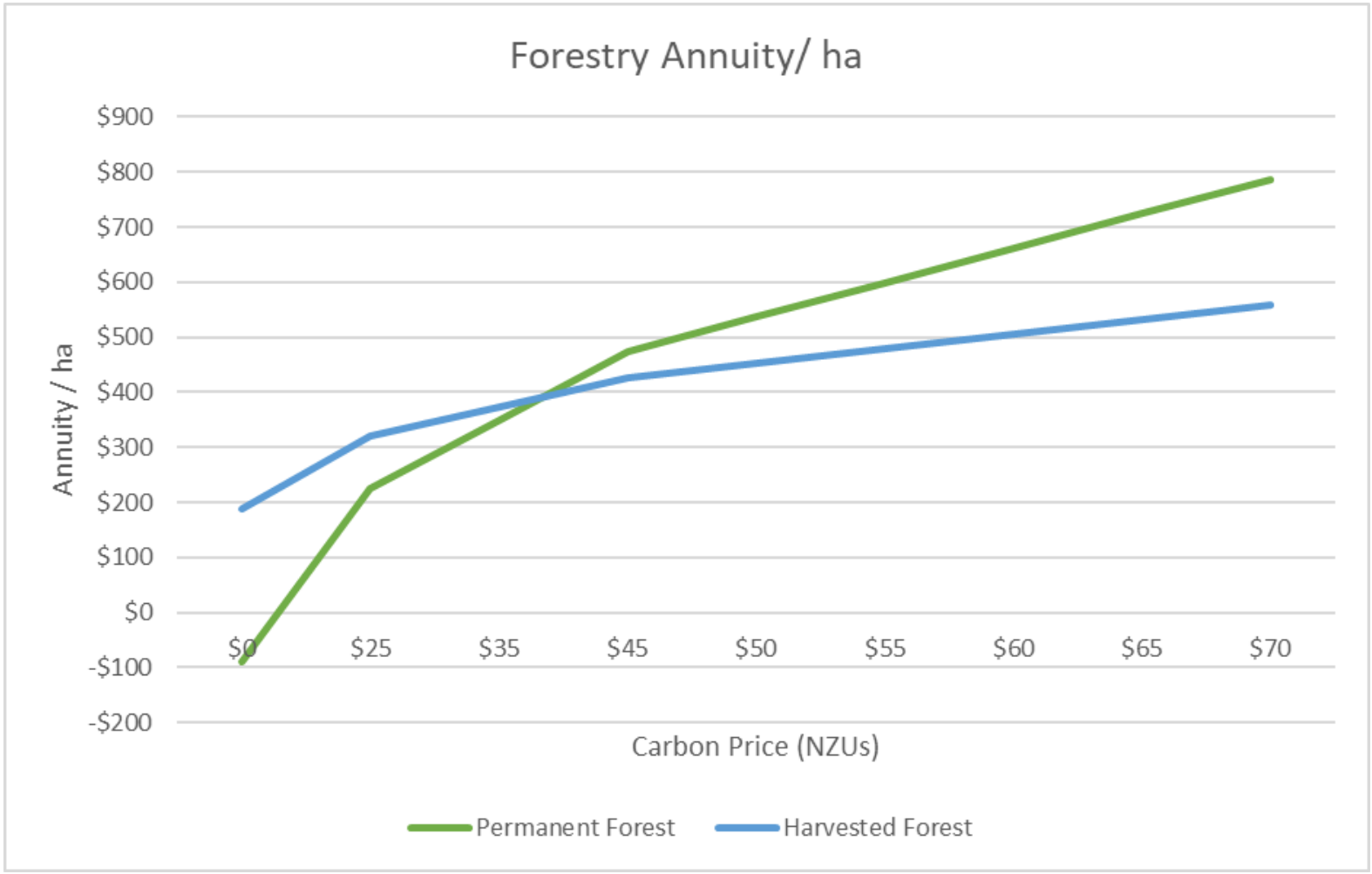
Farmer Quotes

- *"If we put something in trees, we want it to fit with our morals and values as farmers." –* ***Farmer goals are deeper then just wealth creation***
- *"It can cost a lot of money to run scenarios. And each species you add to that increases the cost."* ***Farmers understand issues around complexity***
- *"In the past we have tried poplars and we didn't have a good run with them".* **Farmers will be species specific**
- *"Farming is known. Forestry is not." "Pines are simple and known."* ***Read understanding complexity above***
- *"The Douglas Fir was planted by my father. He just liked to see a bit of variety. They may never be harvested."* ***Farmers are generational***
- *"I'm not keen on pines due to my thoughts around generational farming and their aesthetics as well."* **Read all of the above**
- *"You have to search out a lot of info at the start. It would be good to get help with where to start."* **Key issue, there is a lack of good trusted help and information**

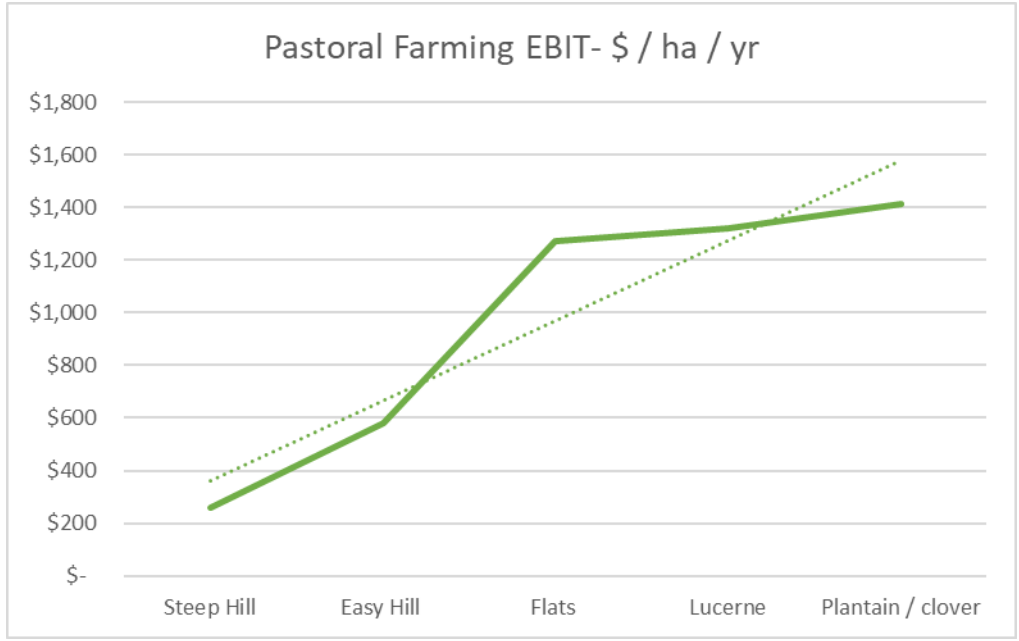
Rules of Engagement with Farmers

- It is the landowner's plan – not our plan.
- Genuinely illustrate the right tree, right place ethos.
- Relationship focus, not transactional focus.
- Introduce people who can help or who have 'been there, done that'

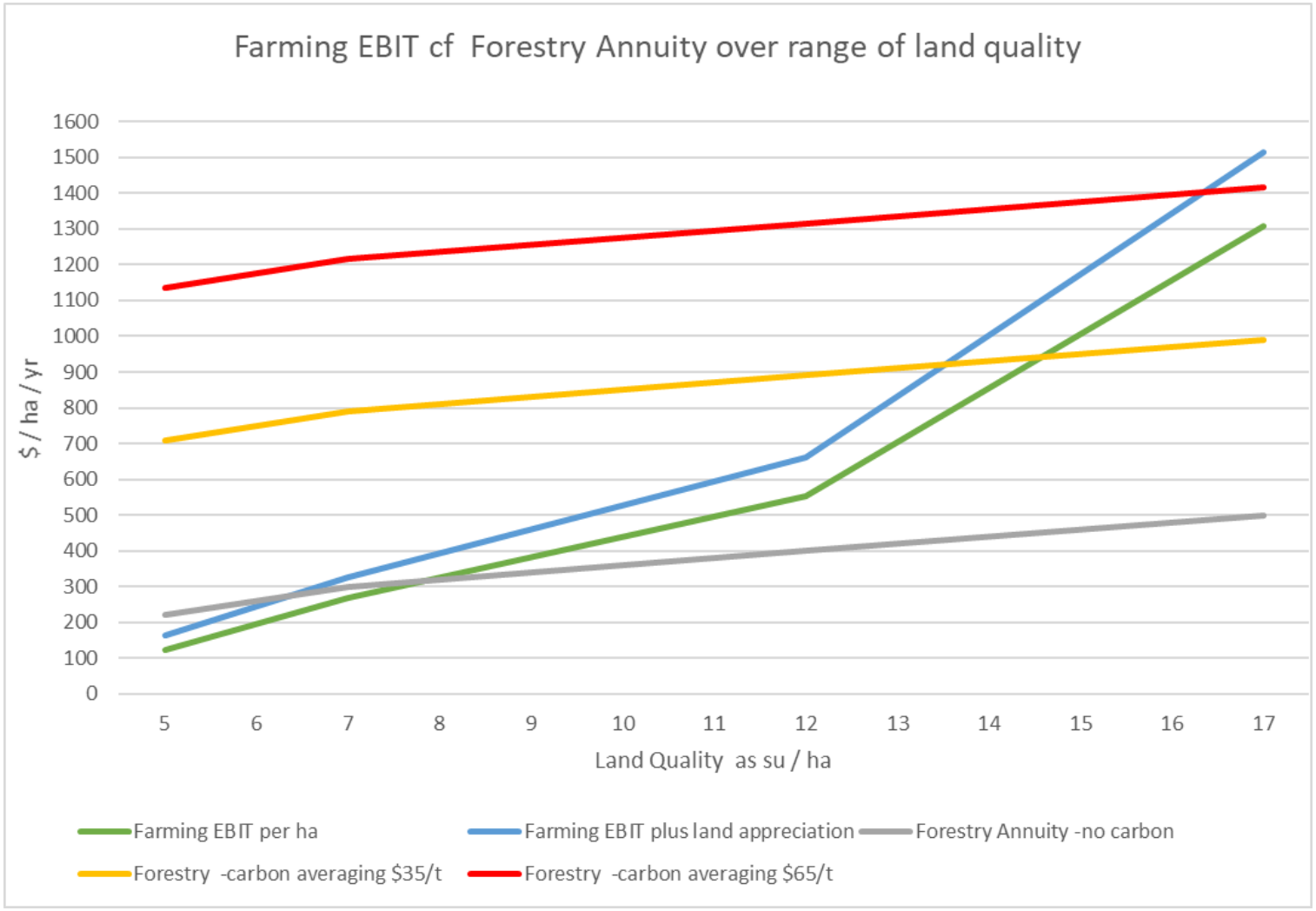
Radiata Returns/ ha/ NZU value



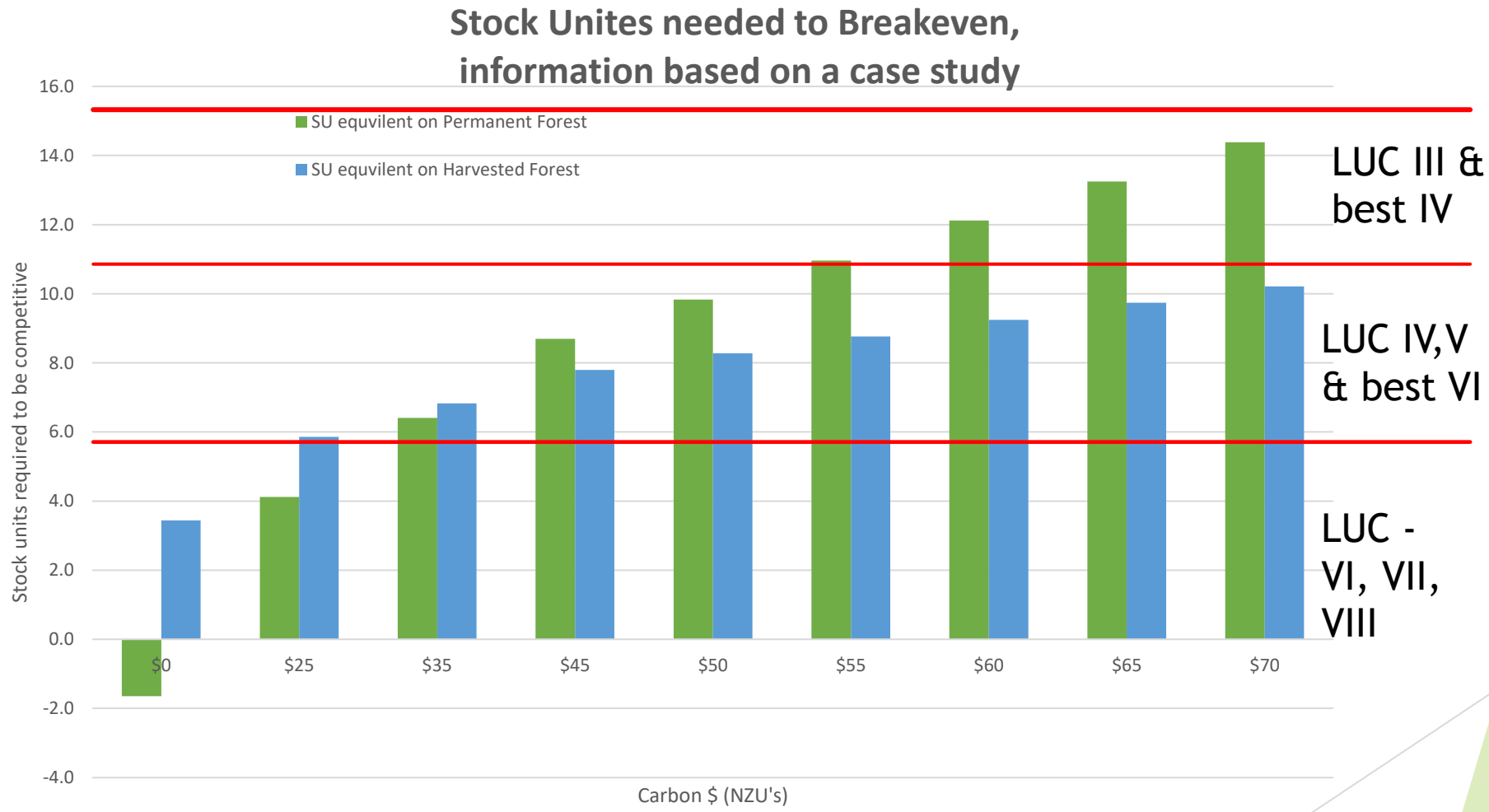
Right Tree Right Place Principle

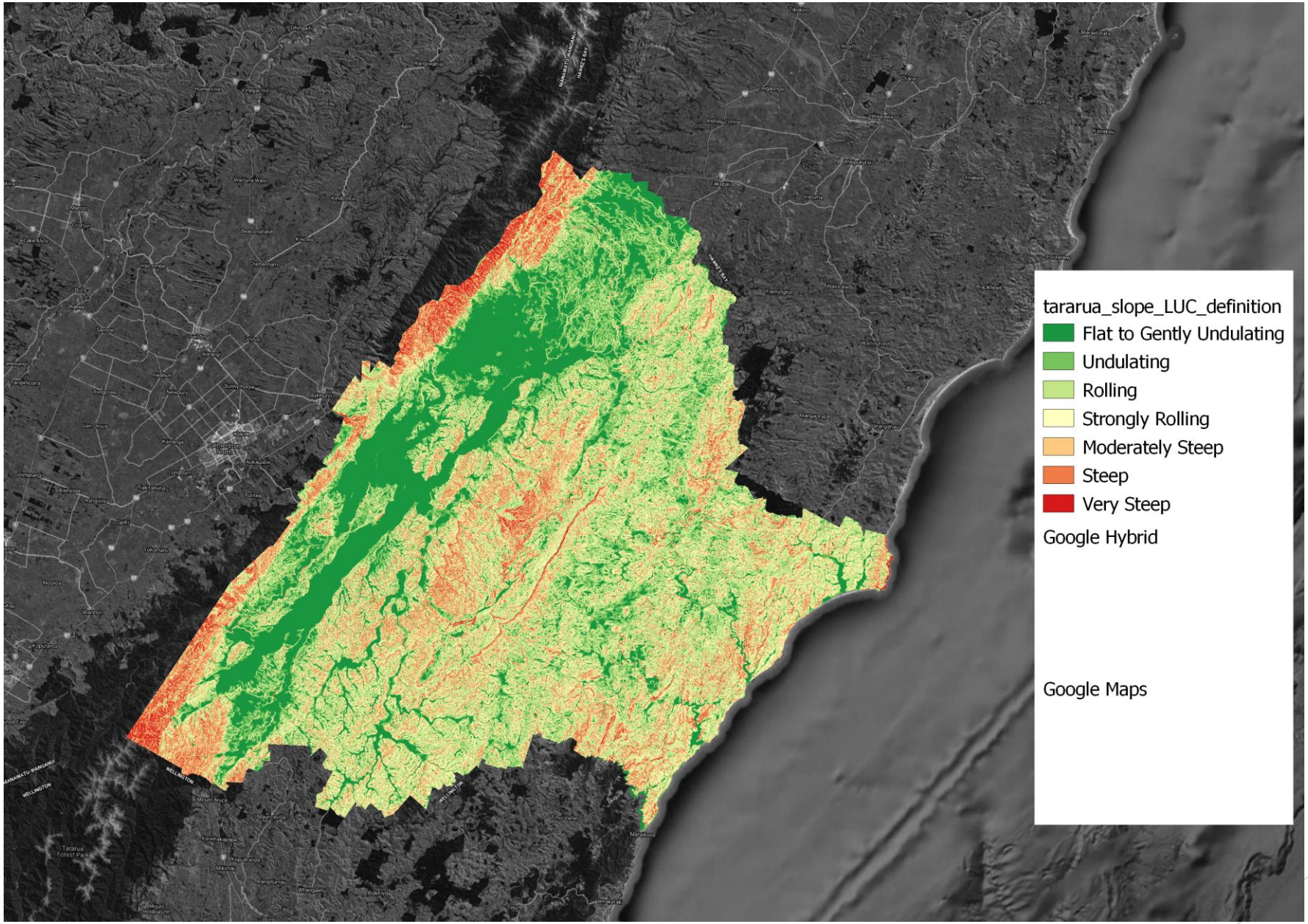


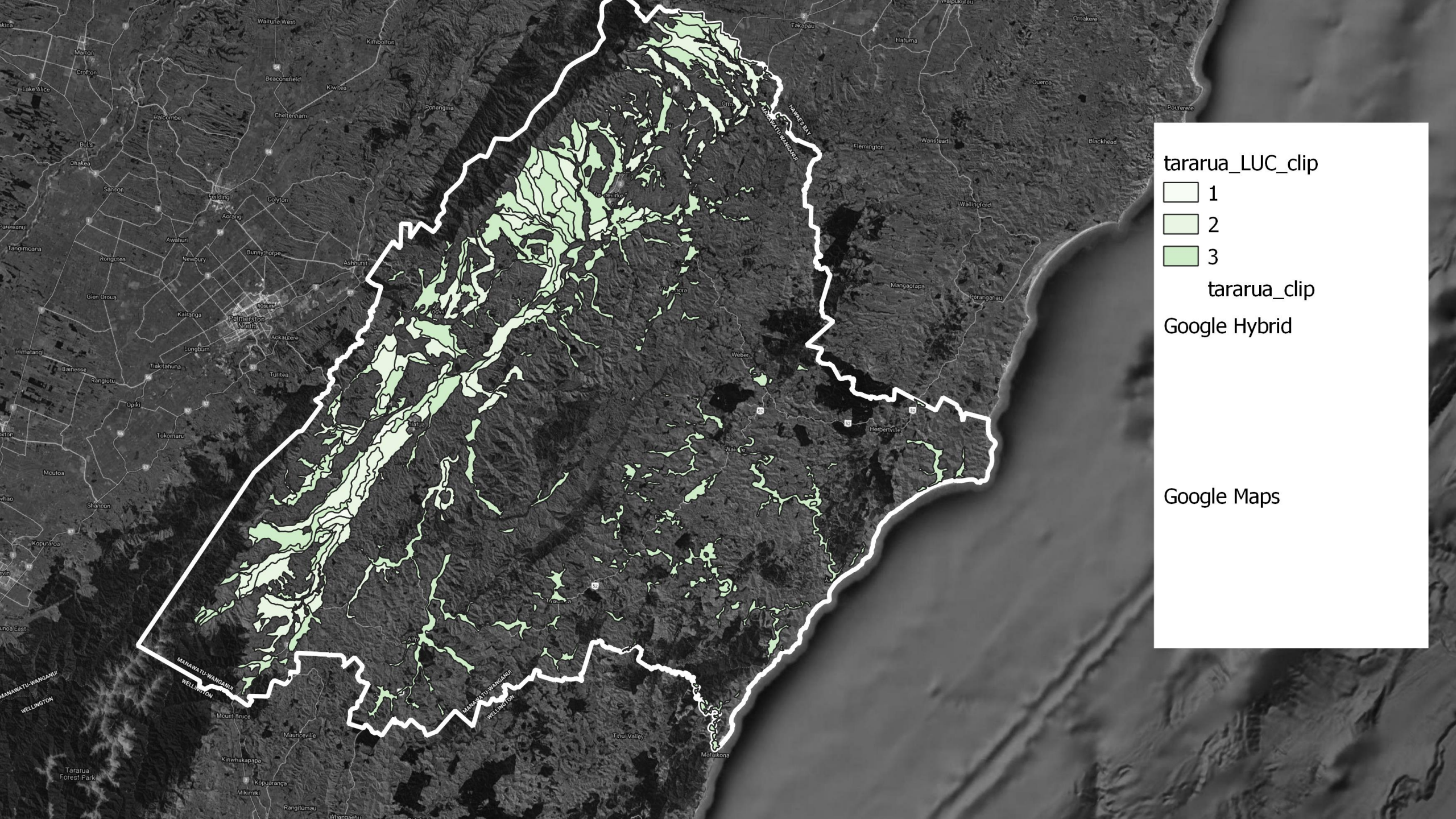
Forestry vs Pastoral Comparisons

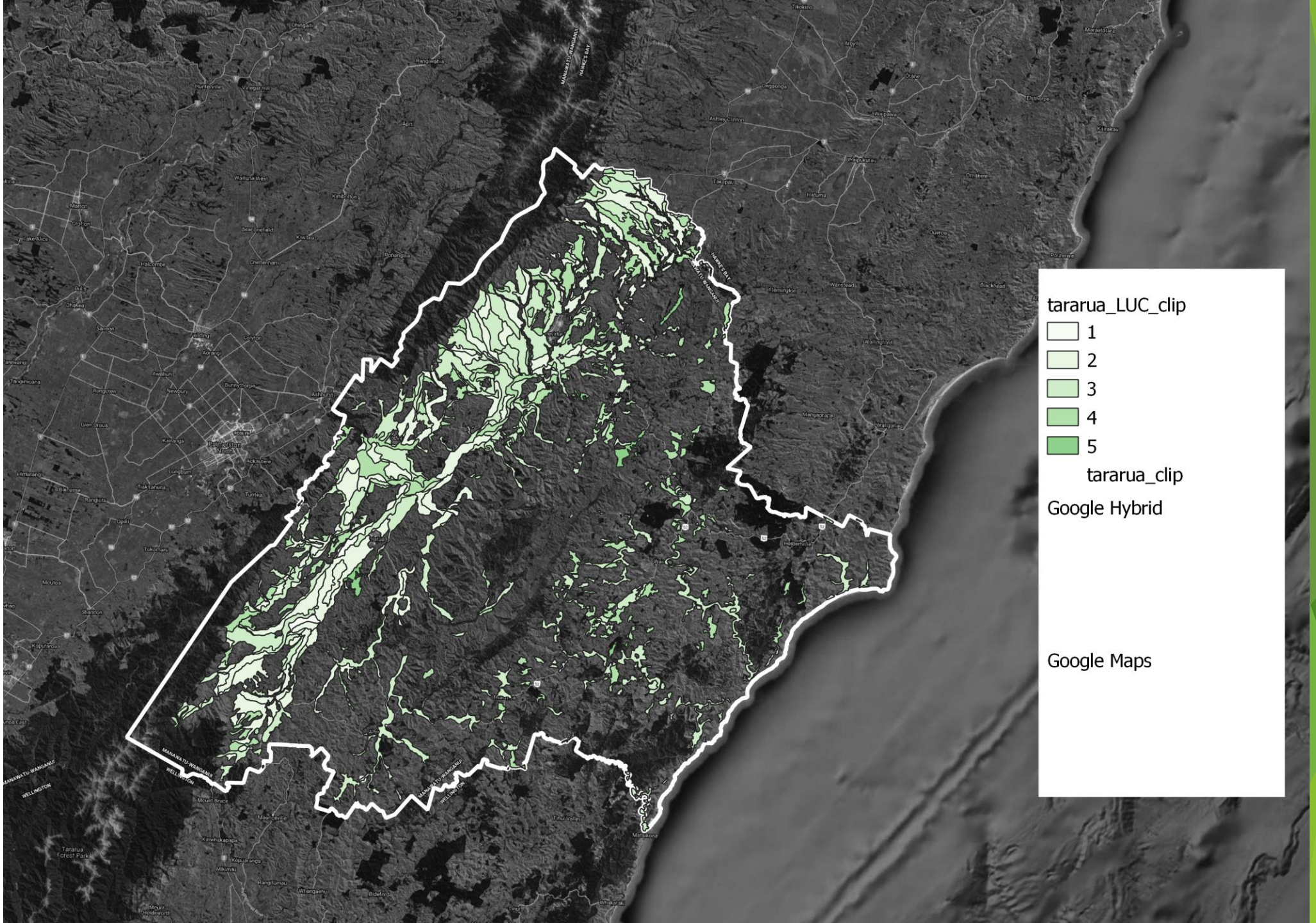


Equivalent stock carrying to meet Forestry + ETS returns




tararua_slope_LUC_definition
Flat to Gently Undulating
Undulating
Rolling
Strongly Rolling
Moderately Steep
Steep
Very Steep
Google Hybrid
Google Maps


tararua_LUC_clip
1
2
3
tararua_clip
Google Hybrid
Google Maps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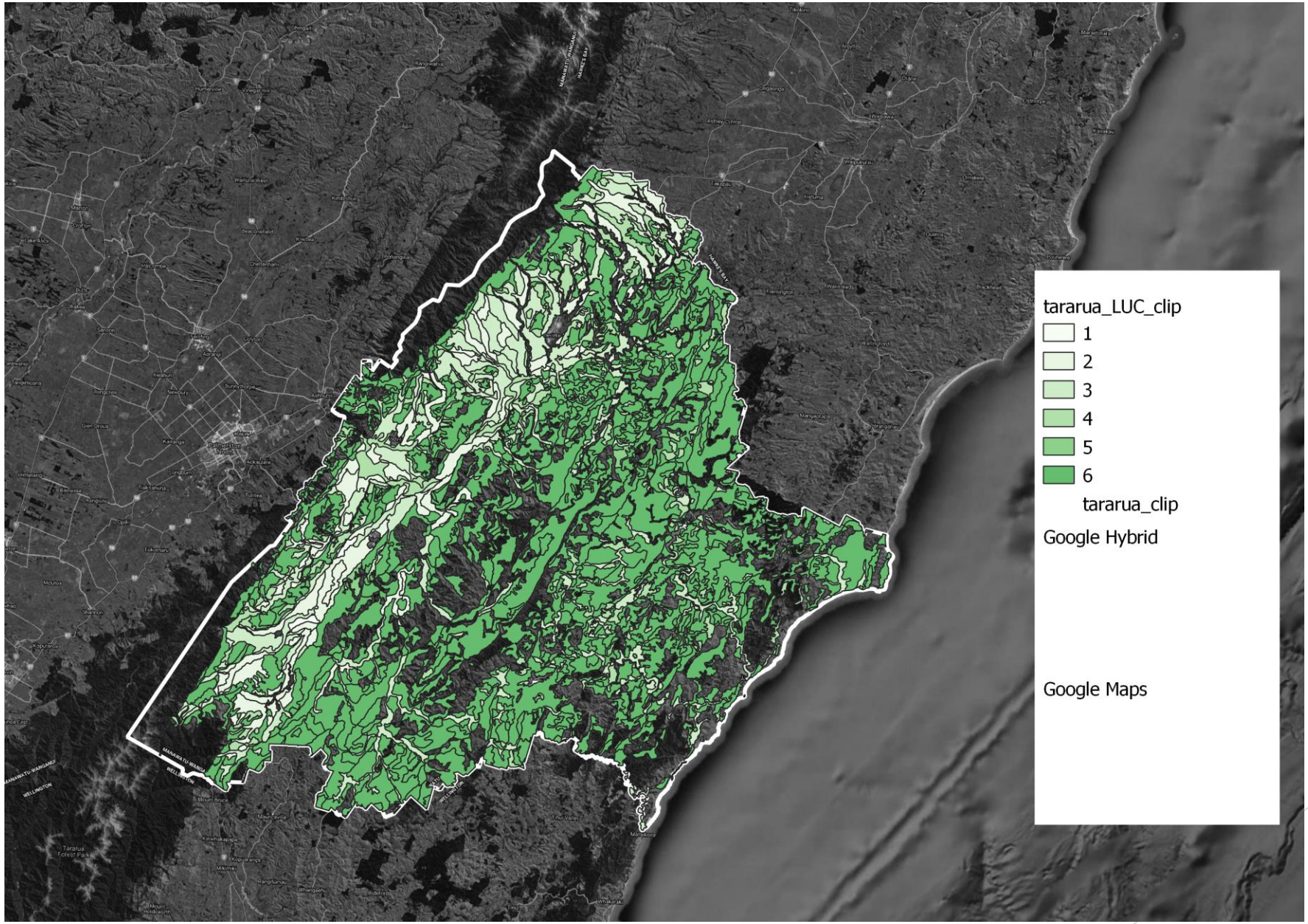
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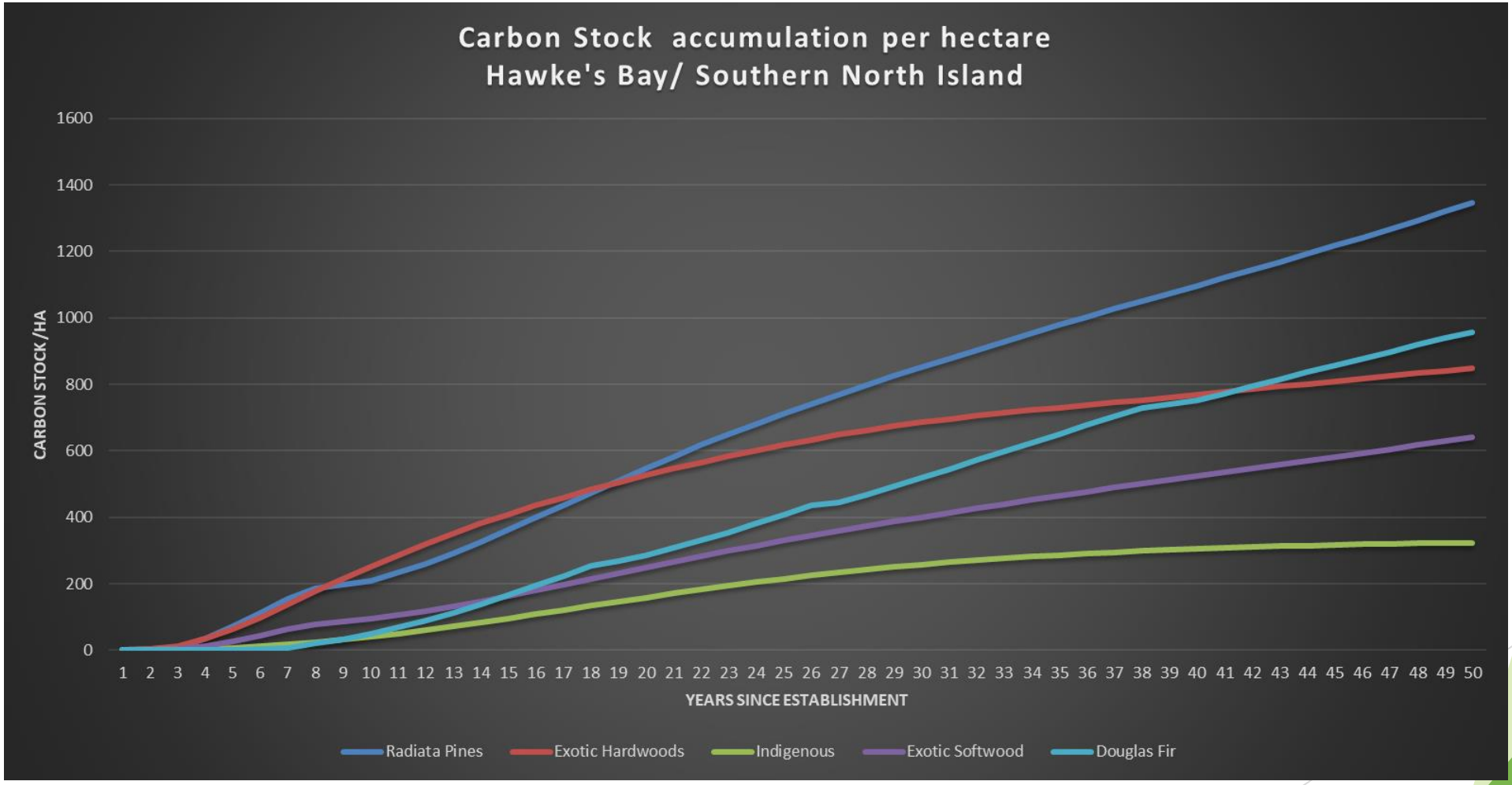
Carbon Sequestration rates



Area of forestry in hectares required to offset GHG

Using Averaging Scheme

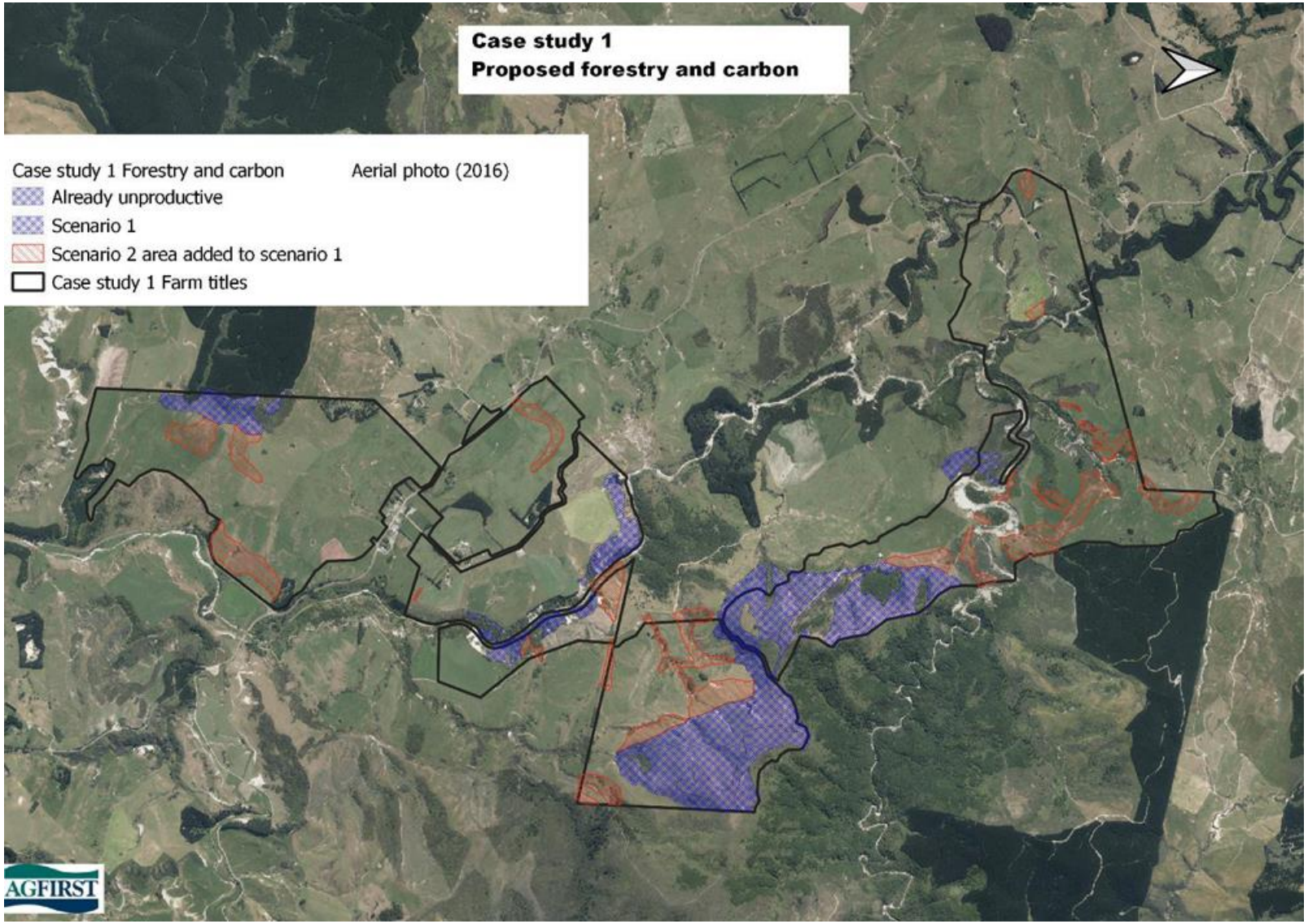
% Offset	5%	10%	25%	50%	100%
151 ha dairy farm- (ha)	3.3	6.6	16.5	33.0	66.0
640 ha sheep and Beef farm – (ha)	4.6	9.2	23.0	46.1	92.2

Note: this table is based on average Pinus radiata and gives a 17-year offset.

Case Studies

- Three Case studies
- In depth discussions with all
- Two fully modelled RTRP programmes.
- Both in depth modelling case shows that there are parcels of land that under pastoral systems are giving only marginal returns.
- In these situations a positive benefit from a harvestable forestry programme.
- Other benefits include;
  - Reduction in sediment losses
  - Reduction in GHG
  - Carbon returns provide positive cashflows
  - Bio diversity/ ecological corridor benefits

Case Study 1 – Weber district

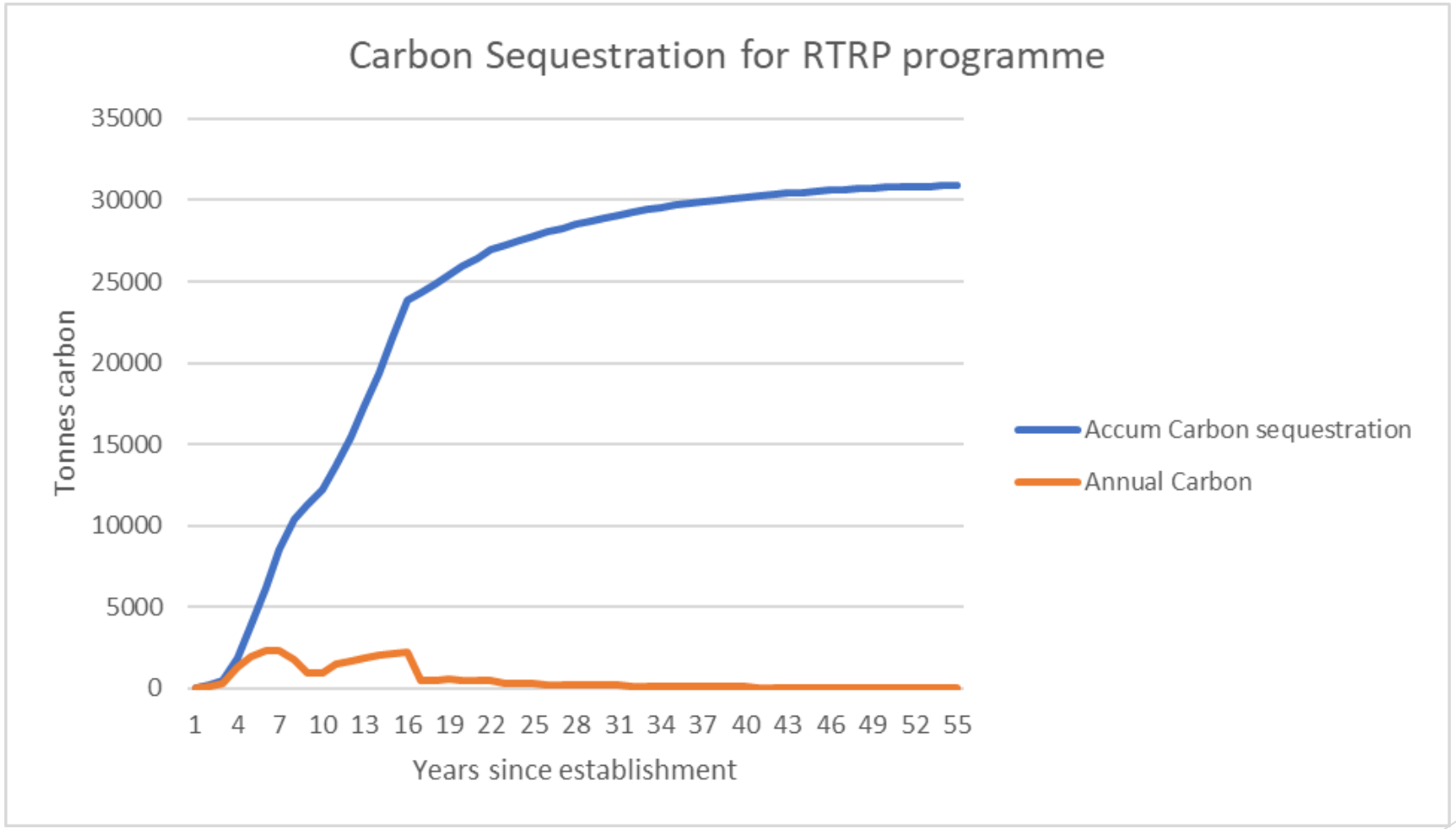

Case study 1
Proposed forestry and carbon
Case study 1 Forestry and carbon
Aerial photo (2016)
Already unproductive
Scenario 1
Scenario 2 area added to scenario 1
Case study 1 Farm titles
AGFIRST

Case Study 1; Comparison of Scenarios.			
	Base	**Scenario I** LUC VI3e Vs2 removed from grazing	**Scenario II** LUC VI3e, **VIe7** & Vs2 removed from grazing
Grazed pasture area (ha)	791	661	576
Incremental change in grazed area	-	130	85
Total Annualised Stock units	7,134	6,510	5,953
Average whole of farm stocking rate (grazed)	9.0	9.8	10.3
Incremental Stock units removed		624	556
stock units removed /ha change		4.80	6.54

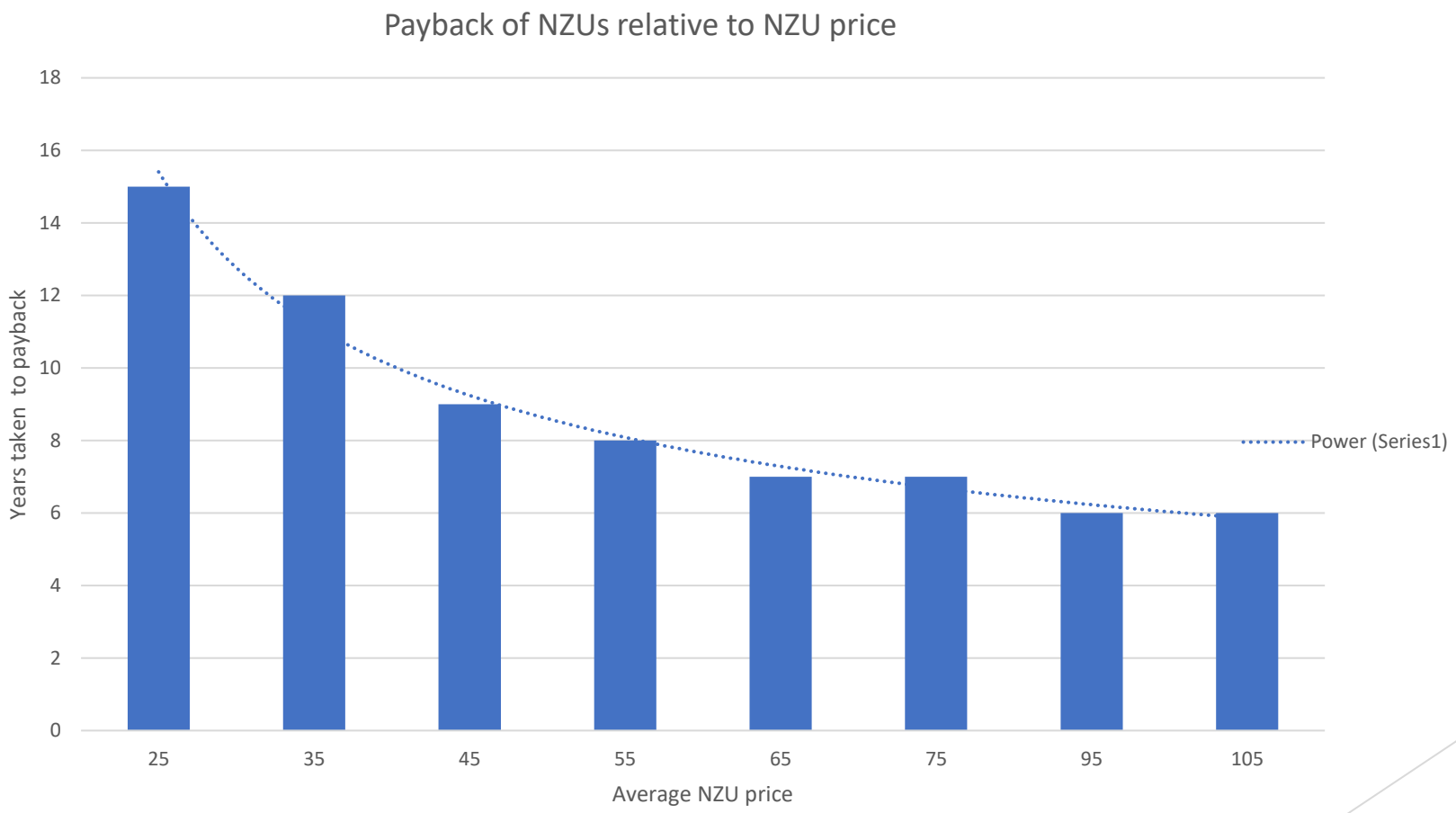
Case Study 1; Comparison of Scenarios.

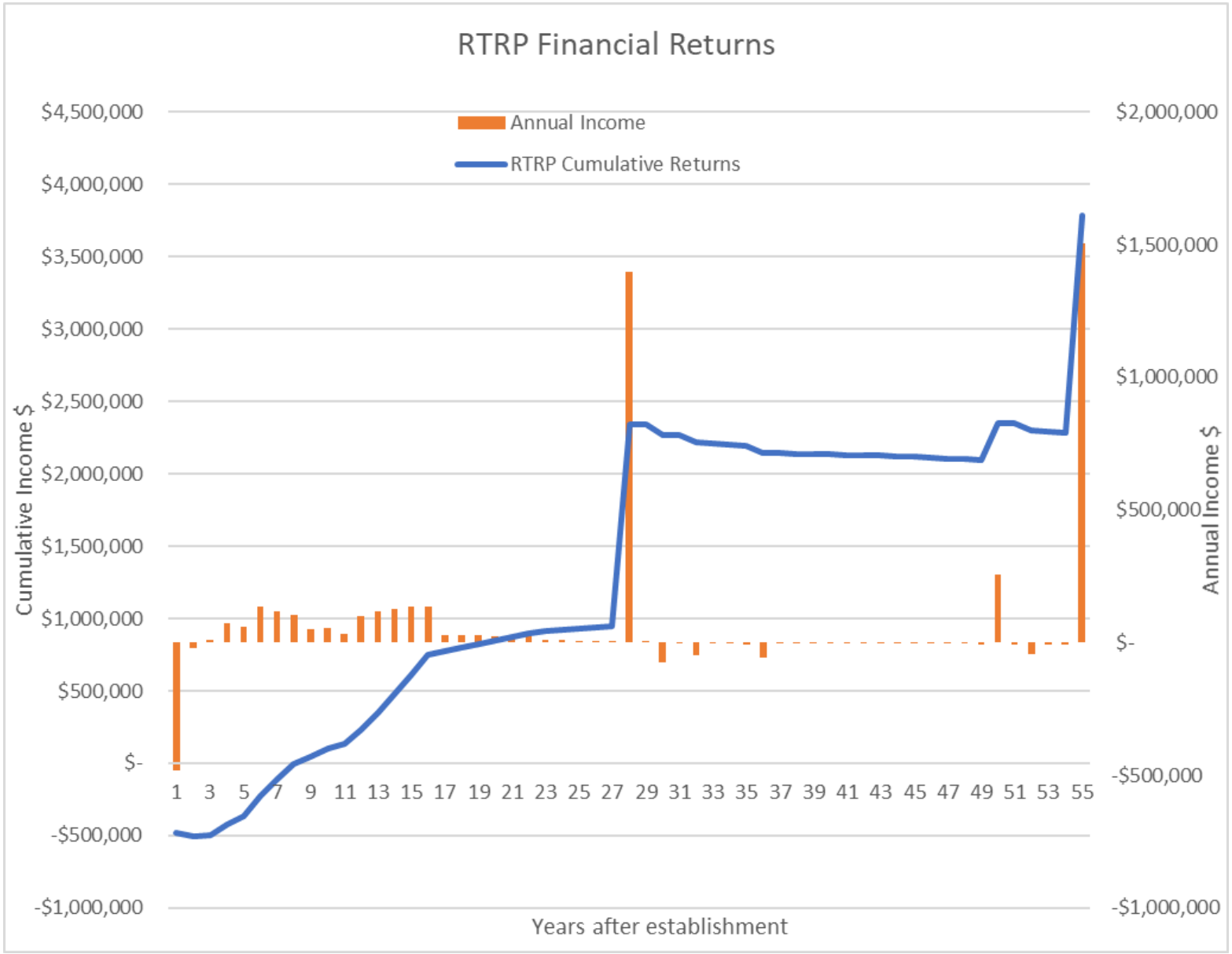
	Base	Scenario I LUC VI3e Vs2 removedfrom grazing	Scenario II LUC VI3e, **VIe7** & Vs2 removed from grazing
Economic Farm Surplus (EFS)	**$ 126,993**	**$ 149,950**	**$ 126,619**
EFS/ha Total land area	**$ 161**	**$ 190**	**$ 160**
EFS/ha grazed land	**$ 161**	**$ 227**	**$ 220**
Contribution of removed grazing land to Base Scenario	-	-$22,957	$ 23,330
- per ha		-$177	$ 274
Annualised Carbon and Forestry/ha		$ 283	$ 283
Annualised Carbon and Forestry return from Scenario change		$ 36,726	$ 24,013
Carbon and Forestry Adjusted EFS		**$ 186,676**	**$ 150,633**
Adjusted EFS/ha		$ 236	$ 190
Total CO2 E generated from farming & forestry activities (t/year)	2,426	2,203	1,987
CO2 E generated from farming & forestry activities (kgs/ha/ year)	*3,066*	*2,785*	*2,512*
Reduction in CO2E generated due to scenario changes (t/year)		222	438
% reduction		9%	18%
Reduction in CO2E /combined ha (t/year)		1.71	2.04
Nitrogen Losses	6459	6160	5948
% reduction from base		5%	8%
Phosphate losses	121	118	116

Carbon Sequestration



Payback in RTRP based on NZU value




RTRP Financial Returns
Annual Income
RTRP Cumulative Returns
$4,500,000
$4,000,000
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$-
-$500,000
-$1,000,000
Cumulative Income $
$2,000,000
$1,500,000
$1,000,000
$500,000
$-
-$500,000
-$1,000,000
Annual Income $
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55
Years after establishment

Break- Part II
Conclusions, Recommendations and Discussion

A Farmer role in RTRP

- The decision to plant trees on a farm is a strategic decision that is influenced by a range of factors, each unique to an individual farmer.
- Any discussion or scheme to support tree planting needs to start with an understanding of and taking into consideration the factors that are at an individual farmer level.
- The needs or considerations of a farmer start with a clear distinction between commercial planting and non-commercial planting.
- There is a farmer need for information and supporting evidence around different species.
- To best support farmers into a ‘right tree right place’ programme there needs to be a clear path of support (including the role of TDC)
- This needs to be easily navigated by farmers and provide genuine ‘right tree right place’ guidance and advice throughout in keeping with the objectives of the individual farmer.

- Carbon farming is here
- The Tararua district may well be used by carbon investors to offset their emissions as relative land prices are lower (hill country)
- A planned RRTRP programme may allow pastoral and forestry (for harvest or permanent skinks) to co exist
- But it will come at an employment cost

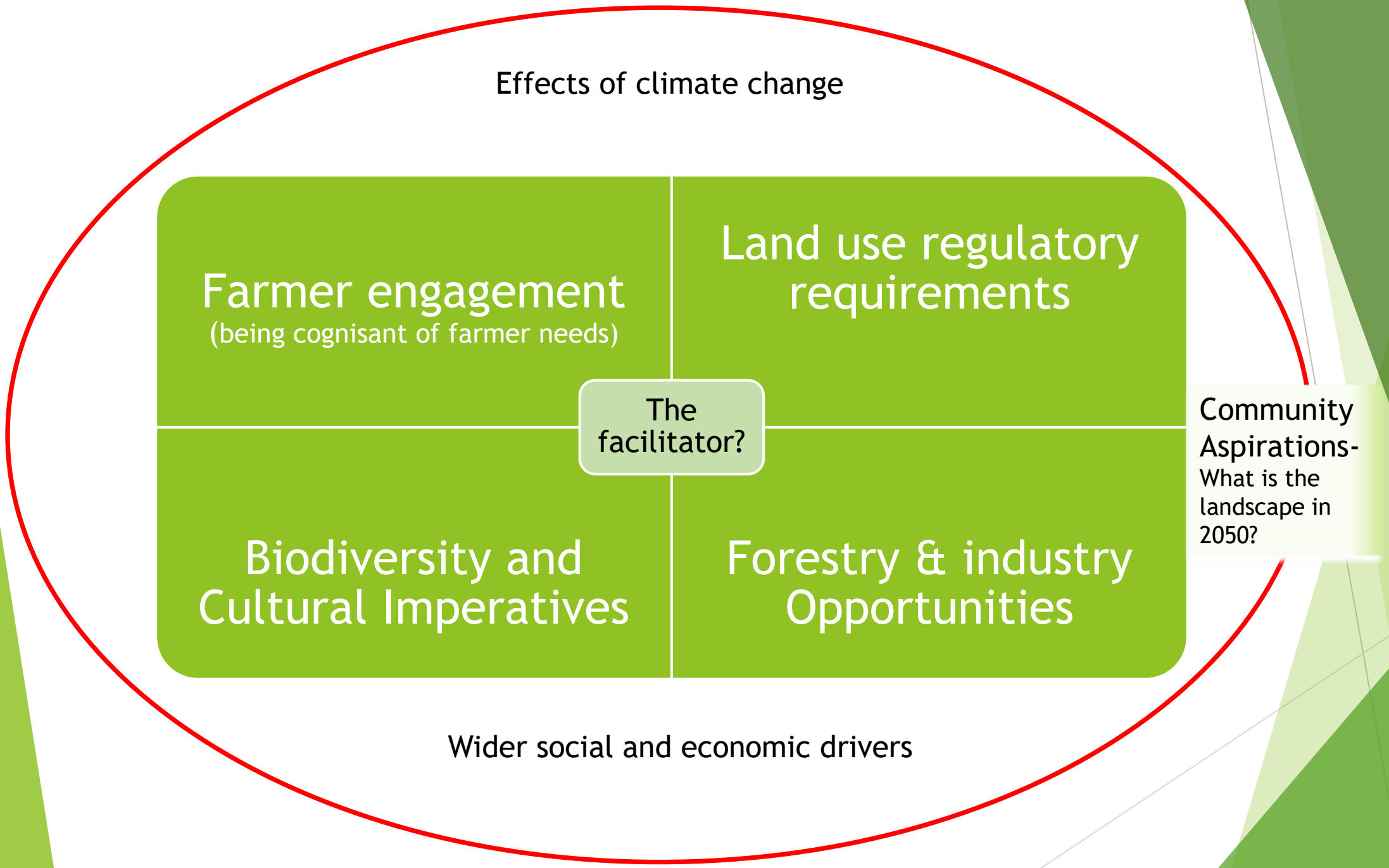
- For those farmers with commercial intent, pine is the default species.
- Where the commercial pressures aren't the primary driver there is a desire and willingness to use a variety of species linked to site suitability, variety/diversity.
- Having a system that recognises the value of ecological benefits would assist in the promotion of native plantings.
- Spatial sensitivity analysis indicates a number of areas where there is a considerable risk for forestry based on pine timber returns only. However, the potential returns from selling carbon credits more than offsets this risk.
- Carbon farming offers a paradox with continuing whole farm conversions into forestry on productive pastoral land, yet carbon can offer a cashflow inroad for selective afforestation on the right land types and forms.
- At the current price (~$70/t C2O E) much of the pastoral country in the Tararua District is vulnerable to wholesale land use change to carbon farming through afforestation.
- Discussions around carbon farming ideally need to take a long-term view, beyond the first tree rotation (and carbon cycle).

A combination of actions for the Tararua District Council is recommended and in particular:

- Developing internal forestry expertise and resources.
- Targeted incentives that promote RTRP programmes.
- Information support at farm/farmer level as to the options available on their land.
- GIS spatial work from this report should be available online and at farm scale resolution.
- Support and leverage existing industry and infrastructure.
- A team approach is required to assist farmers as the solutions are multi-disciplinary the TDC can help facilitate this.
- Promoting that permanent carbon regimes should be managed with a harvest approach for a timber/fibre crop. This strategy has forest health benefits but accounts for alternative income streams if there is a very different future environment (i.e., collapse of the ETS and or high timber/fibre prices).
- Establish working links with other councils

Failure to increase afforestation using the right tree, right place principles could lead to:

- Continued or accelerating erosion with climate change and severe storm events
- Widescale afforestation on non-eroding (productive fertile) landscapes including whole farm conversations, resulting in a long-term loss of employment and community viability.
- Not achieving highest and best land use.
- Legacy issues:
  - Community dissatisfaction and lack of engagement and uptake of appropriate afforestation options.
  - Failure to meet environmental legislation.
  - Increased risk of widespread fires.


Effects of climate change
Farmer engagement
(being cognisant of farmer needs)
Land use regulatory requirements
The facilitator?
Biodiversity and Cultural Imperatives
Forestry & industry Opportunities
Community Aspirations-
What is the landscape in 2050?
Wider social and economic drivers

Discussions