Land

Water

Living heritage

Farm business

Jim & Ruth Rainey

WHOLE FARM PLAN

Kawhatau Valley, Mangaweka

STRATEGIC FIVE YEAR PLAN

sustainable land use

green hills, safe communities
clean streams

Plan Number: WFP/2006/P02
Prepared by: AgResearch Ltd.
Date: 30/05/06

CONTENTS

BACKGROUND

The Sustainable Land Use Group was established in response to the February 2004 storm event to develop a Sustainable Land Use Package that aims to (1) Protect people & assets from future storms, (2) Protect the soil asset upon which our rural economy depends, and (3) Reduce the Region's reliance on government relief in the future. Whole Farm Plans (WFPs) are targeted as the key vehicle to deliver future-proofing assistance to the Region's land owners. Plan purpose is focused primarily on resource conservation (soils, land, water, vegetation) and sediment management, but also extends into enterprise development in recognition that environment and farm business cannot be treated separately.

Proactive targets are necessary: (1) Half the Region's most-at-risk farms operating under a WFP by 2015; (2) Half the Region's farms with an operational WFP by 2015, and; (3) 90% of most-at-risk farms with an active WFP by 2030.

This report summarises an exploratory prototype WFP for Jim & Ruth Rainey, who farm a 357 ha hill-country property situated in the Kawhatau Valley. **This is the second application of the WFP prototype framework**. Compilation involved (1) Review of the existing farm business using benchmarking, (2) Assessment of land, water, living heritage and farm production resources, (3) Identification of environmental issues and recommendation of tailored best practice, (4) Planning of an integrated long-term farm business plan and 5-year environmental programme, and (5) Design of a follow-up precedure to clarify responsibilities, monitoring, maintenance and support.

Long-term strategic planning is an important tool for sustainable farm development, but situations and circumstances can change for both the Regional Council and the land holder, so it can be difficult to plan specific activities for an extended period. It is therefore critically important to review progress and plan operational activities on an annual basis. This is accomodated by having a detailed strategic plan (5yr duration) and a concise operational plan (1yr duration).

The strategic plan (this report) contains a full breakdown of descriptions and assessments, and strategically overviews recommended activities for a 5-year planning duration. It is intended as a resource containing core information for future purposes, and is not meant to undergo significant revision over the 5-year term. Year-by-year activities are captured in an annual Operational Plan, which is prepared by a regional council representative according to how the Raineys may wish to proceed. Successive Operational Plans include a progress review of the previous year's works.

1.0 PLAN SUMMARY

- **Purpose:** This Whole Farm Plan (WFP) has been prepared for Jim & Ruth Rainey's farm located in the mid-reaches of the Kawhatau Valley, Mangaweka. It represents the 2nd WFP prototype developed for the Sustainable Land Use Initiative (SLUI), and aims to identify farm-specific opportunities that lead to sustainable resource management ***and*** sustained business development.

- **Farm overview:** A 357ha summer-moist hard-hill country property producing 8020kg of pasture DM/ha/yr, and running 3420 stock units mostly as a high performance sheep flock (89:11 sheep:beef ratio) across an effective area of 335ha (10.2 su/ha). Approximately 90% is hill and steepland with a mudstone/sandstone base, with only 14ha of terraces and river flats being suitable for cultivation. Currently the Meat & Wool NZ Monitor Farm for the Wanganui-Rangitikei district.

- **Business assessment:** Business performance has been assessed using the APM Profit Check system that benchmarks production and financial performance against averages calculated from local farms with similar farming environments. Typical indicators (e.g. lambing %, weaning weight, EFS, etc.) all score high, demonstrating that the farm is currently operating under excellent management and strong all-round business performance. Key limitations include scale of operation, topography and the production environment.

- **Recommendations for business development:** Good management and strong all-round business performance actually limits the identification of future business opportunities under the current enterprise regime. Evaluation of new sheep systems may be necessary (particularly with hogget production), and several alternatives are proposed. [redacted] even though the borrowing power of your financial resource is quite strong (but somewhat under utilised at present). Potential exists to increase pasture production from 8,020kg DM/ha/yr to 10,400kg DM/ha/yr, some of which can be realised by lifting Olsen P to a uniform 20 units for the hill country blocks. A new farm succession plan is also necessary: As a guide, to support 2 full labour units may require a minimum of 7,000 stock units, which is well above the capacity of the current farming operation.

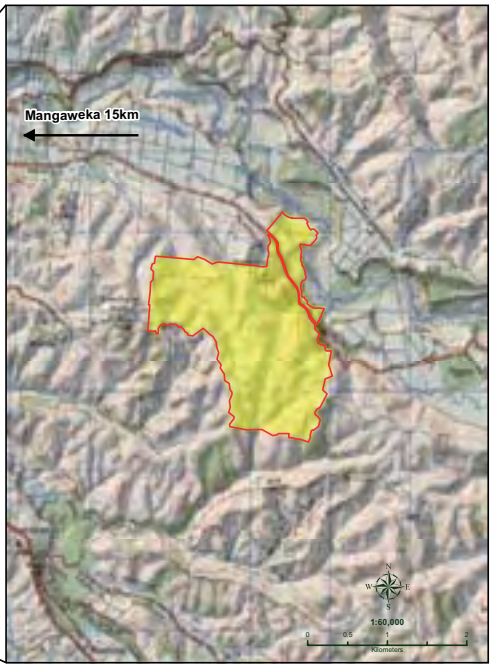
- **Environmental assessment:** Assessments focused on erosion and sediment contribution (the main concerns for this farm), but water quality, weeds and pests, wetland management and indigenous biodiversity have also been considered. Erosion risk ranges from moderate to severe for large areas of the hill country, mostly as soil slip and gully erosion types, and a significant proportion associates with mid-slope tracking. Some previous erosion control plantings are reaching the end of their useful life. Pugging risk is low for the stoney flats, but ranges in the hill country. Several dams appear to have very low water quality even for stock watering purposes, and sediment contributions from the Mongrel catchment area are likely to be high. Many perennial waterways are already well protected with non-pastoral vegetation. Features of biodiversity value include 3 major (unfenced) bush remnants and a sizeable natural wetland (unfenced).

- **Recommendations for environmental enhancement:** Recommendations centre around erosion control, firstly for the protection of physical assets (fences, tracks, public roads, etc.), and secondly to minimise permanent loss of soil production capability. Key recommendations include space plantings, retirement of some marginal land, and protection of significant natural heritage areas.

Year	Recommended activities
2006	Space plant alders in Mongrel & Whare paddocks; 80 poplars in gullies between Mongrel catchment detention dams; intermittent poplars for sites with slump, tunnel gully or earthflow erosion; formalise retirement of VIIIe3 land; install 6 small coffer dams; control small area of Old Mans Beard; install 2 horizontal bores; consider QEII areas; prune R4 poplars.
2007	100 poplars for Middle & Sues paddocks; evaluate economics of forestry block B (if viable → poison existing poplars); poplars for Lane paddock at 10m spacings; monitor & control any Old Mans Beard regrowth.
2008	100 poplars for Richardos and Goodys; evaluate economics of afforesting Block B; install 2 horizontal bores; manage coffer dam sediment.
2009	150 poplars in Marks & McCoards paddocks; retirement fencing of main bush block; fencing & planting of wetland in Middle Flat paddock.
2011	150 poplars in Kristins, Bunnys & Bills paddocks; plant Block C in native timber-producing species; install two horizontal bores for water supply; manage coffer dam sediment.

- **Monitoring & follow up**: Both Horizons Regional Council and the Raineys have ongoing responsibilities for the implementation & maintenance of this plan. Monitoring & review is best undertaken annually to accommodate yearly changes in situations and circumstances. Further clarification is required regarding the degree of Council implementation support and assistance.

- Considerable time and effort has been invested by all parties in the development of this prototype, and the plan represents a balanced compromise between business and environment for the original level of investment. Effective implementation, support and maintenance promises to deliver both the depth of progressive business development ***and*** the level of environmental management that is required to future-proof this first small part of Horizons Region against future storm events.



This property is located 15 km east of Mangaweka. The turnoff onto Kawhatau Valley Road is just north of Mangaweka along State Highway 2.
(Distance calculated by road between the house and Managweka town boundary).

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green hills safe communities clean streams

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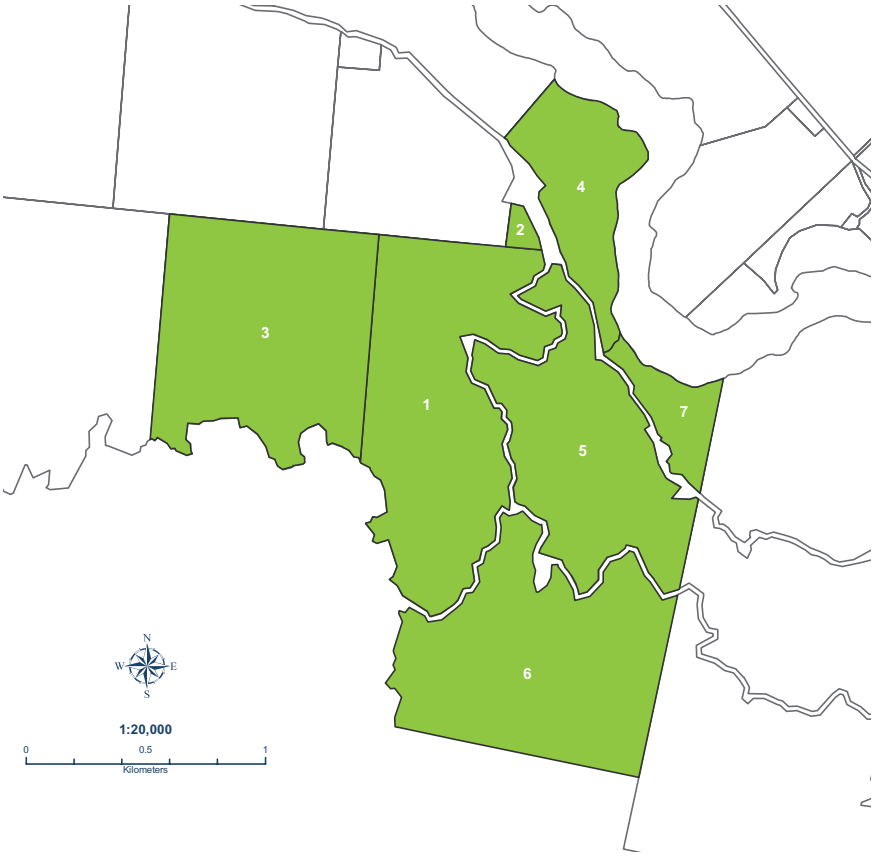
1. Half the Region's **most-at-risk farms** by 2015
2. Half of **all** the Region's farms by 2015
3. 90% of the Region's **most-at-risk farms** by 2030

FARM LOCATION & ACCESS

J & R Rainey, Kawhatau Valley Road, Mangaweka

Prepared for Horizons Regional Council by AgResearch Ltd, as part of the Sustainable Land Use Initiative (SLUI).
May 2006.

agresearch



ID	Legal description	Legal area (ha)
1	Sec 9 Blk XII Hautapu SD	81.80
2	Sec 25 Blk XII Hautapu SD	1.87
3	Sec 8 Blk XII Hautapu SD	79.68
4	Pt Sec 7 Blk XII Hautapu SD	29.83
5	Sec 10 Blk XII Hautapu SD	60.56
6	Sec 11 Blk XII Hautapu SD	81.28
7	Sec 10 Blk XII Hautapu SD	11.93
		346.96*

* The precision & accuracy of legal land parcels for rural areas can be variable. Legal areas are not used in this report. Rather, more reliable information has been calculated using high resolution orthophotography. Total farm area by this method is 357 ha (a large part of the difference is explained by the presence of a paper road).

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LEGAL TITLES AND PARCELS

J & R Rainey, Kawhatau Valley Road, Mangaweka

Prepared for Horizons Regional Council by AgResearch Ltd, as part of the Sustainable Land Use Initiative (SLUI).
May 2006.

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2.0 FARM DESCRIPTION & RESOURCE ASSESSMENTS

2.1 Existing farm business

2.1.1 The physical resource

- The farm is a summer-moist hard-hill country property located in the mid-reaches of the Kawhatau Valley. Lowest point is 380m rising up to 735m asl. Approximately 90% of the property is hill and steepland underlain by a mudstone/sandstone base, with the remainder being a series of stepped terraces associated with the Kawhatau River. Only 14 ha is suitable for cultivation.
- Total area of the property has been mapped by AgResearch at **357 ha** with an estimated **297 ha** in pasture (all non-pastoral vegetation mapped out at a high level of detail – see subdivision map over the page). Total farm area differs from the **347 ha** legal area (a large part of the difference is paper roads), and effective area differs from that used in the monitor farm programme (**335 ha** effective).
- [For interest, total surface area of the farm is **403 ha** (calculated from 1m contour data), which may have implications regarding current fertiliser application rates, stocking rates, and pasture production].

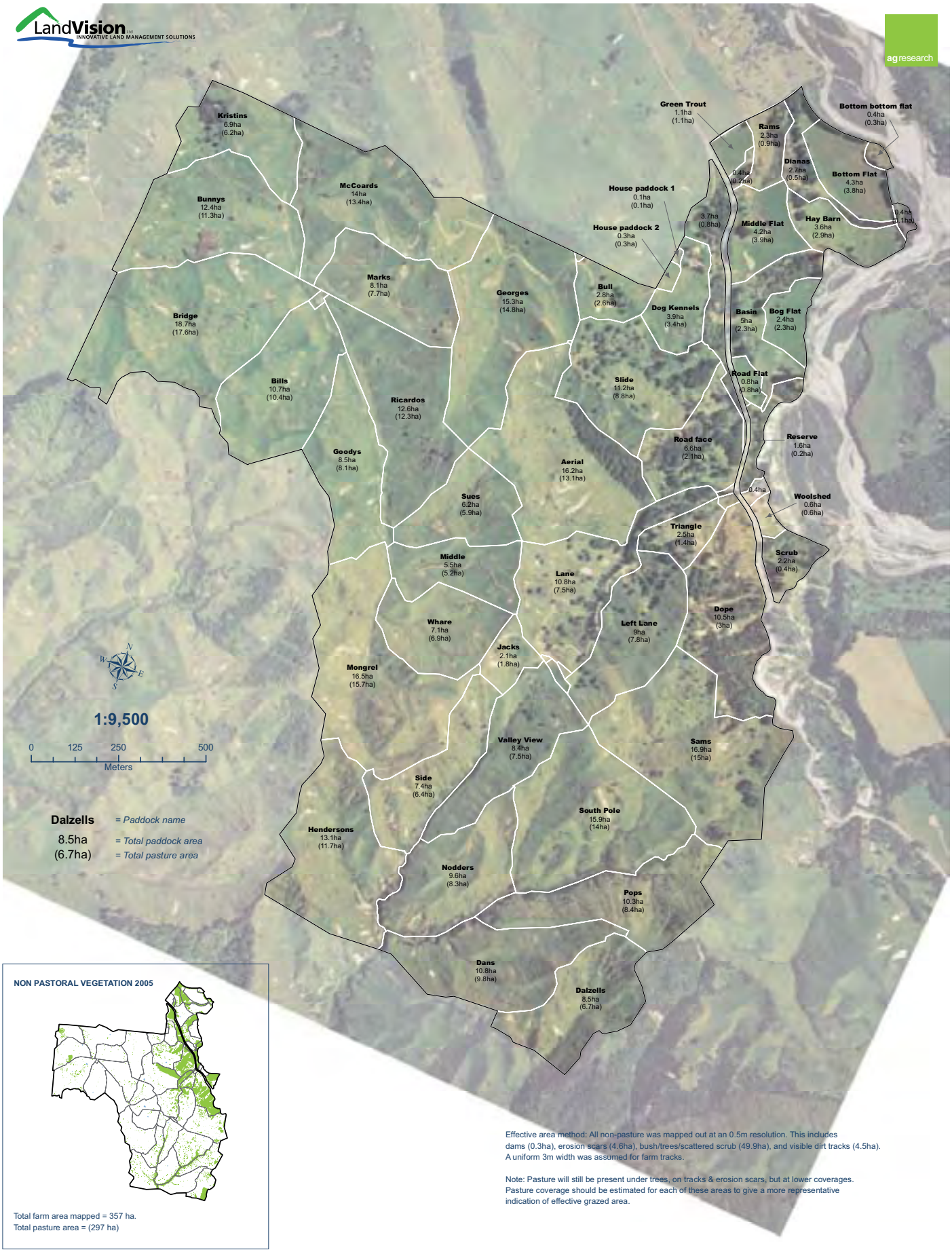
2.1.3 Infrastructure

- Access throughout the farm is good, with approximately **15.8 km** of discernable tracking (likely to be slightly more than this).
- Stock water is adequately supplied through a reticulated system on the flats, and a series of dams and spring-fed streams for the hill country.
- Farm buildings, yards and other structures are in good serviceable condition.
- The farm has approximately 46 individual paddocks greater than 0.5 hectares (subdivision map over the page), the largest of which is 18.7 ha (Bridge paddock). Subdivision is not intense because of limitations imposed by contour. However, despite the low intensity of subdivision, livestock production levels are exceptional (see below). Potentially a further 6-10 paddocks could be created if necessary.
- Total length of fencing for the farm is **61.3 km** (boundary fencing = 13.4 km, internal fencing = 47.9 km).

2.1.3 Current Farming Practice

Livestock wintered to June 2006 is expected to be **3420 stock units** in total, which gives a stocking rate of **10.2 su/ha** (using monitor farm effective area of 335 ha).

Sheep	**June 2006**
MA Ewes	2425
Ewe Hoggets	745
Rams	30
Sheep Stock Units	3045 stock units
Cattle	**June 2006**
R2yr Steers	50
Beef MT Cows	25
Cattle Stock Units	375 stock units
Summary	**June 2006**
Total Stock Units	3420 stock units
Sheep:Cattle ratio	89:11
Stocking Rate	10.2su/ha



Total farm area mapped = 357 ha.
Total pasture area = (297 ha)

Effective area method: All non-pasture was mapped out at an 0.5m resolution. This includes dams (0.3ha), erosion scars (4.6ha), bush/trees/scattered scrub (49.9ha), and visible dirt tracks (4.5ha). A uniform 3m width was assumed for farm tracks.

Note: Pasture will still be present under trees, on tracks & erosion scars, but at lower coverages. Pasture coverage should be estimated for each of these areas to give a more representative indication of effective grazed area.

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SUBDIVISION & EFFECTIVE AREA

J & R RAINEY

Kawhatau Valley Road

Information collected by Landvision Ltd, 2006. Map by AgResearch. Aerial photography Flown Jan 2006 by Laurie Cairns & Associates Ltd. 50cm resolution. Orthocorrected to remove camera & terrain distortion by AgResearch.

Effective area calculated by mapping out trees, dams/ponds, scattered scrub, tracks, erosion scars, and other non-pasture vegetation at an 0.5m resolution.

2.1.4 Enterprises

Sheep:

- The ewe flock is comprised of a Highlander composite bred sheep.
- Mixed age ewes are mated from the 10th of April; hoggets from 1st May; and weaning occurs at the New Year.
- Shearing is undertaken between June & July for the mixed age ewes; January for the lambs; and August for the hoggets.
- Lamb selling policy:
  - 30% of ram lambs are sold prime at weaning.
  - 70% of remaining ram lambs are sold store with the balance (tail end) sold by May.
  - Surplus ewe lambs are sold to SheepLink at weaning.
  - Primera Terminal Sires are mated to a small number of ewes.
- Lambing performance:
  - Lambing percentage is 150% in the mixed age ewes.
  - Hoggets lamb at 50-60%. This is lower than it should perhaps be, given high scanning results (113%).

Cattle:

- Up to 100 R2 Friesian/Hereford steers are purchased annually.
- Steers are purchased between May-July at 375kg, and sold progressively at 600kg from January to March/April.
- Majority of steers are sold prime.
- A small number of empty cows are carried through winter and sold in a finished condition.

Cropping:

- Approximately 14ha of the farm is suitable for cropping.

2.1.6 Financial position

- Equity position is sound. Net equity has been calculated at

Rainey financial position May 2006

Liabilities		Assets		
Term liabilities		Land & Building		
Overdraft Limit		Livestock		
		Plant/Machinery		
		Trees (960ac)		(20% of 60ac)
		Green Trout		

- Borrowing position is strong. Total potential assets =

2.1.7 Financial and Physical performance summary (APM results)

The farm business has been analysed using the "Profit Check" database system (APM). This system provides a benchmark for existing performance and identifies opportunities for improvement by management. Based on data generated through APM (summary over the page), the features that are most notable about the business are:

- Its scale, the environment and topography which are the most limiting factors to growing the business.
- You are achieving excellent sheep performance – from lambing percentage through to hogget tupping weight and their scanning results. Hogget lamb wastage is high (it is a challenging environment for them to lamb in) limiting performance from this class of stock.
- Stock deaths and missing are reasonably high which may be a reflection of the environment you are farming.
- Total meat and fibre production of is good and you convert this (and beef product) into dollars very well, generating a GFI of
- A gross farm income of is exceptional given the farm type and is a reflection of great production, good stocking rates and excellent marketing.
- Even at high production levels you have maintained a good control on expenditure at . This is difficult considering the scale of your business and lack of economies of scale.

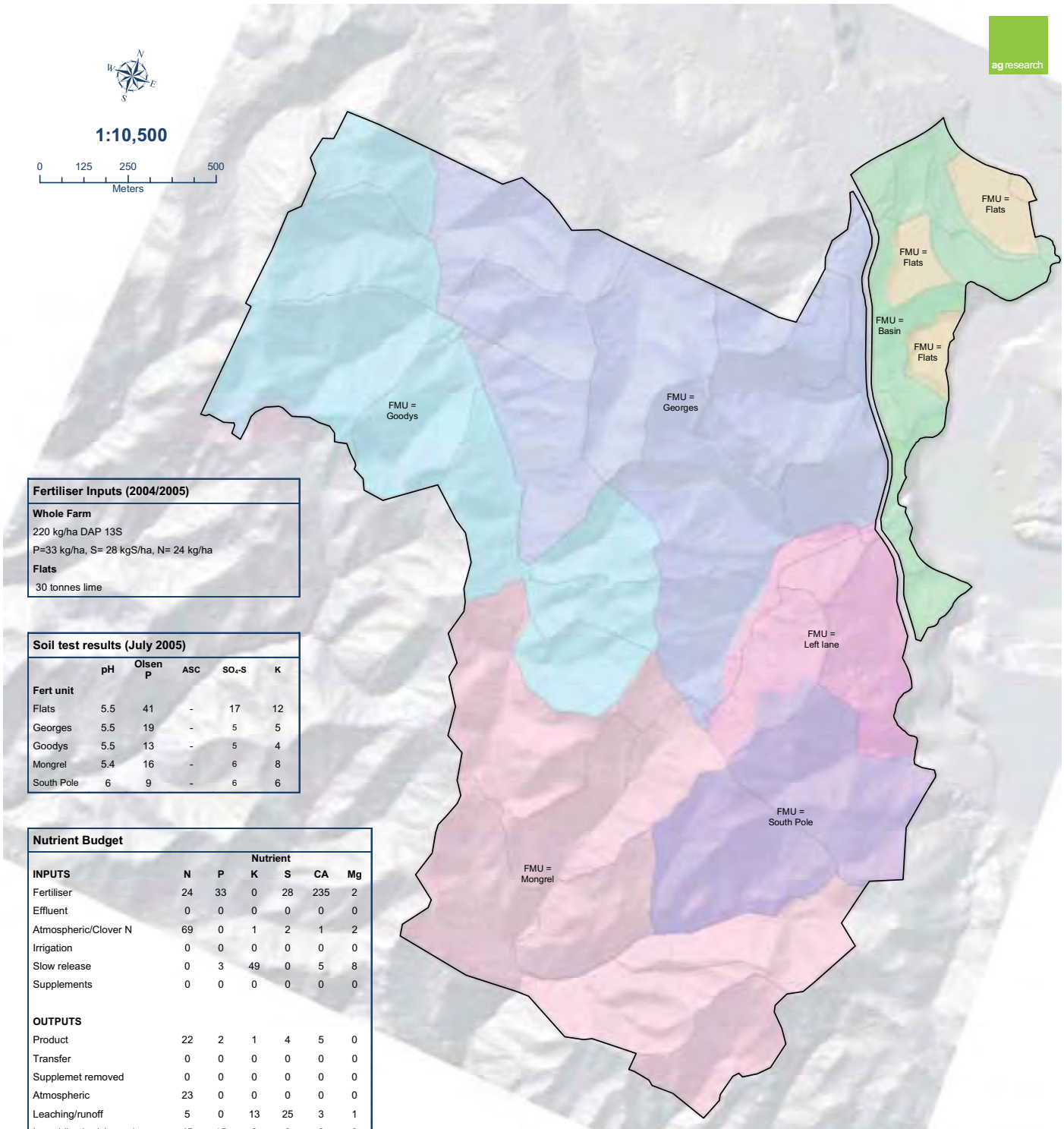
- Because of your relatively high income and efficient cost structure your EFS at very good for the class of country farmed at [redacted] With greater economies of scale the EFS would be higher as depreciation and wages of management represent less cost per hectare in larger farm business.
- Importantly for you the EBIT at [redacted] is very good. It is however slightly below your target of [redacted]
- Return on capital of [redacted] which are excellent results and a reflection of the good management and productivity you are achieving.

Key APM performance indicators include:

Indicator	Rainey's	Class Average	Comments
General Production KPI's			
Area (ha)	355	327	
Stocking Rate (su/ha)	10.9	10.5	Slightly above average
MA Lambing %	149.8%	118.9%	Well above average
Hogget lambing %	63.1%	34.4%	Good
Flock lambing %	131.6%	99.8%	Very Good
Average weaning weight	28.5 kg	NA	Very good given lambing %
MA ewe efficiency index	67.9%	NA	Very good
Sheep deaths and missing	10.0%	12.5%	High (target 7%)
Cattle deaths and missing	3.5%	5.3%	High given cattle class
Meat & Fibre (kg/ha)	235 kg	164 kg	Very good
Financial KPI's			
Sheep GFI $/ssu	[redacted]	[redacted]	Very good
Cattle GFI $/csu			Poor in relation to sheep
Total GFI $/su			Well above average (+$10/su)
Total GFI $/ha			Well above average
R&M Expenses			20 % above average
Fertiliser (kgP/ha)			Below Maintenance
Total FWE $/su			Good
FWE /GFI %			Very good
EFS/ha			Very good for class of country
EFS/GFI %			Target 45%
EBIT $/ha			6.3% of Total Capital. Target 7%
Interest & rent/GFI %			Too low. Not effectively using Equity
Return on Capital %			Very good given current L&B values
Return on Equity %			Very good
Change in Equity			
% change in Equity			This meets your target level

2.1.8 Fertiliser & nutrient management

- Amounts of fertiliser applied in the last 12 months (2004/05), along with the latest soil test information (July 2005) are summarised in the nutrient management map on the next page.
- Annual stocking rate on the farm is just under 14 su/ha. Comments from Jim and Ruth indicate that, of the hill country blocks, Goodies carries more livestock and tends to have higher animal performance. Higher production levels from this block are reflected in the lower Olsen P values given the same amount of fertiliser is applied across the whole farm. Only the Flats receive additional fertiliser inputs to reflect their greater productivity. Georges has the best legume growth which is predictable from the Soil P data. Low Olsen P values in South Pole and Goodies are currently limiting production. It explains why the legume growth in Goodies is not as good as in Georges.
- With the farm operating at a very high level with excellent utilisation of grown pasture by animals there is significant production gains available from lifting soil P tests values across the farm to 20. Currently the most productive part of the farm (Goodies) is limited by its P status. It would be interesting to have a look at the potassium status of the pastures in Goodies in mid spring to check on their K content given the low soil K levels.
- The nutrient budget, potential for nitrate leaching losses, phosphorus run-off risk and greenhouse gas emissions from the farm were calculated from current inputs and production levels using Overseer. The increase in soil inorganic P pool reflects the above maintenance fertiliser inputs. The potential for N and P losses are both low.



Fertiliser Inputs (2004/2005)

Whole Farm

220 kg/ha DAP 13S

P=33 kg/ha, S= 28 kgS/ha, N= 24 kg/ha

Flats

30 tonnes lime

Soil test results (July 2005)

	pH	Olsen P	ASC	SO_4-S	K
Fert unit					
Flats	5.5	41	-	17	12
Georges	5.5	19	-	5	5
Goodys	5.5	13	-	5	4
Mongrel	5.4	16	-	6	8
South Pole	6	9	-	6	6

Nutrient Budget

	Nutrient					
INPUTS	**N**	**P**	**K**	**S**	**CA**	**Mg**
Fertiliser	24	33	0	28	235	2
Effluent	0	0	0	0	0	0
Atmospheric/Clover N	69	0	1	2	1	2
Irrigation	0	0	0	0	0	0
Slow release	0	3	49	0	5	8
Supplements	0	0	0	0	0	0
OUTPUTS						
Product	22	2	1	4	5	0
Transfer	0	0	0	0	0	0
Supplemet removed	0	0	0	0	0	0
Atmospheric	23	0	0	0	0	0
Leaching/runoff	5	0	13	25	3	1
Immoblisation/absorption	45	15	0	0	0	0
Change in inorganic soil pool	0	18	36	0	232	11

Nutrient loss, Greenhouse gas emissions and energy use

Parameter	Rainey	Average NZ Farm
Nitrate leaching loss	5	5-20
Phosphorus Run-off risk	Low	
Greenhouse gases		
Methane	3153	2000-3000
N_20 emissions	732	400-1400
CO_2 emissions	438	30-130
Fuel and Electricity	4	5-20

Fertiliser Management Units (FMUs)

Basin	(22.5 ha)	
Flats	(10 ha)	
Georges	(103.1 ha)	
Goodys	(76.1 ha)	
Left lane	(23.8 ha)	
Mongrel	(86.9 ha)	
South Pole	(34.4 ha)	
	[356.8 ha]	

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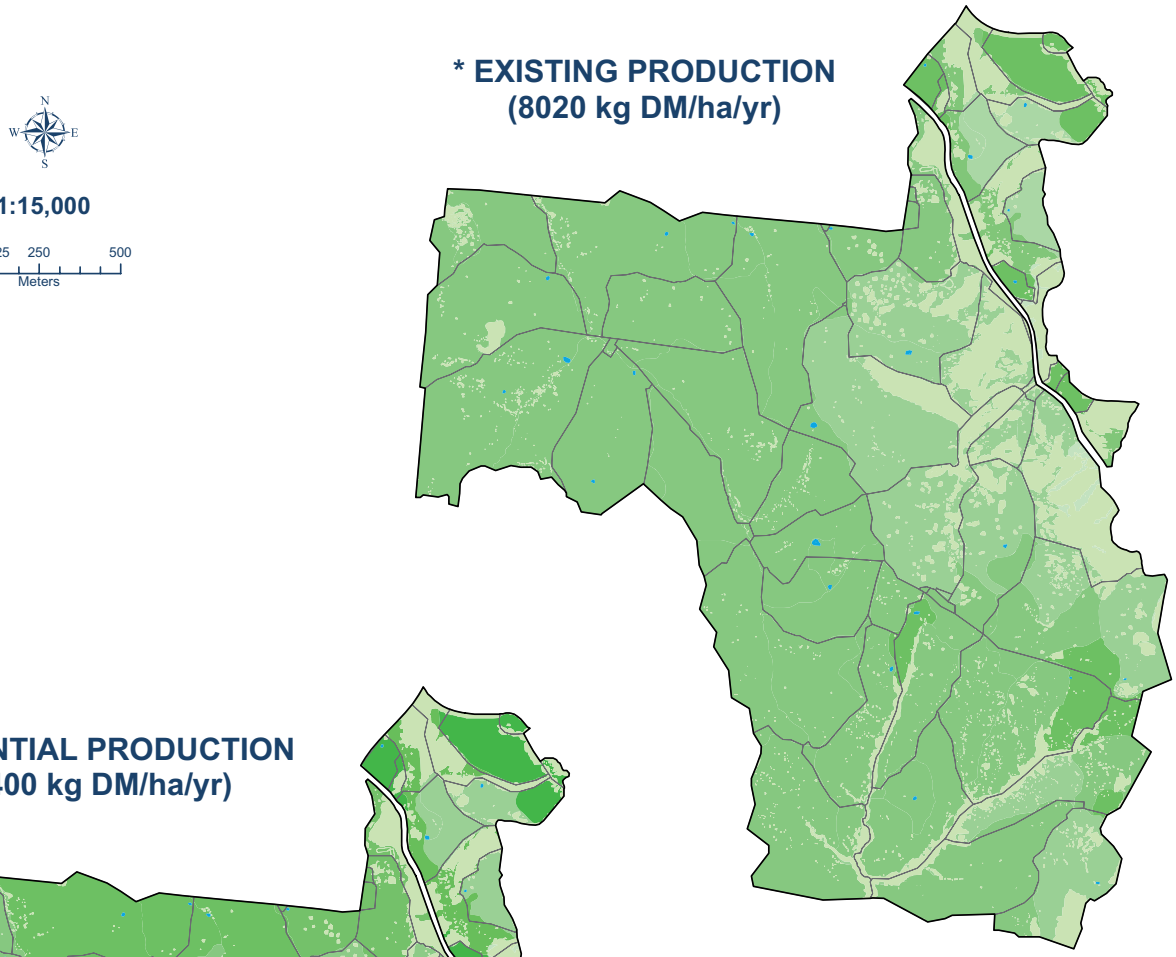
NUTRIENT MANAGEMENT

J & R RAINEY

Kawhatau Valley Road

Fertiliser management units represent groupings of paddocks that are similar in terms of soils, fertiliser, use, and management.

Overseer analysis undertaken by AgResearch.



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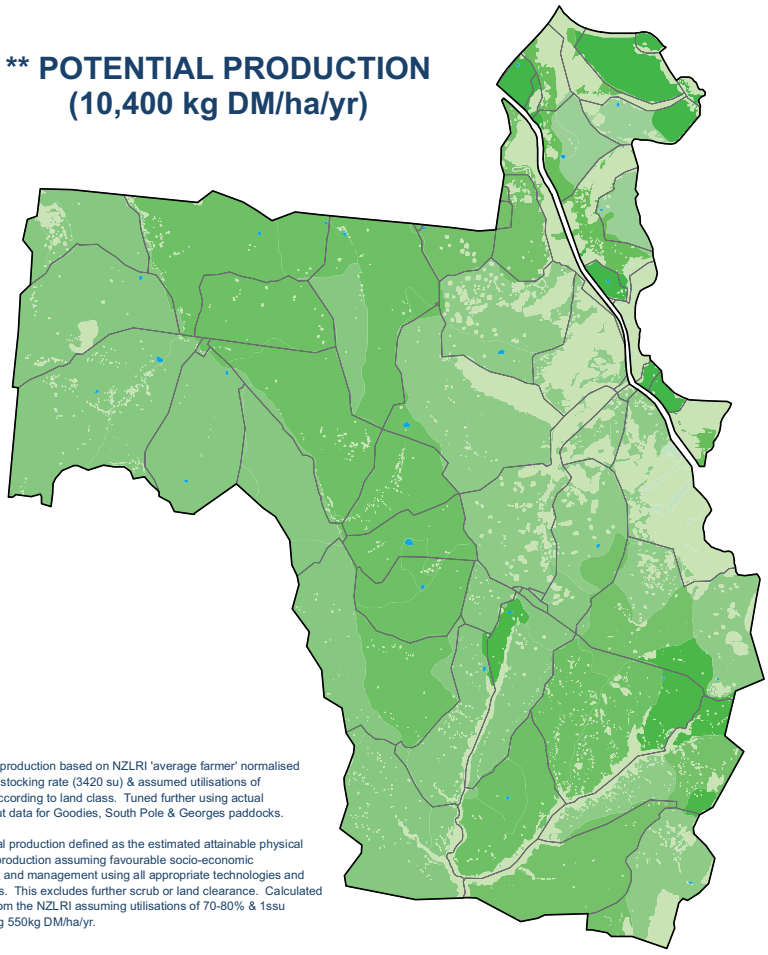
Meters



Pasture yield categories
(Kg DM/ha/yr)

- 0 - 1,000
- 1,001 - 2,000
- 2,001 - 3,000
- 3,001 - 4,000
- 4,001 - 5,000
- 5,001 - 6,000
- 6,001 - 7,000
- 7,001 - 8,000
- 8,001 - 9,000
- 9,001 - 10,000
- 10,001 - 11,000
- 11,001 - 12,000
- 12,001 - 13,000
- 13,001 - 14,000
- 14,001 - 15,000
- 15,001 - 16,000
- 16,001 - 17,000
- 17,001 - 18,000
- 18,001 - 19,000
- 19,001 - 20,000

Dams (no pasture)

* Existing production based on NZLRI 'average farmer' normalised to current stocking rate (3420 su) & assumed utilisations of 70-80% according to land class. Tuned further using actual pasture cut data for Goodies, South Pole & Georges paddocks.

** Potential production defined as the estimated attainable physical potential production assuming favourable socio-economic conditions and management using all appropriate technologies and techniques. This excludes further scrub or land clearance. Calculated straight from the NZLRI assuming utilisations of 70-80% & 1ssu consuming 550kg DM/ha/yr.

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PASTURE PRODUCTION

J & R RAINEY

Kawhatau Valley Road

Pasture production estimates derived from current stocking rates, and regional carrying capacities for average and potential production recorded in the NZLRI database. Non-pastoral areas excluded from the analysis (0kg DM/ha/yr). Figures should be treated as indicative only.

2.1.5 Grazing management

With the sheep enterprise comprising 89% of all stock-units wintered, grazing systems have been developed to assist in achieving high performance from this enterprise. Cattle are run largely to condition pasture for the sheep enterprise and in a set-stocked state. General grazing systems employed include:

- Ewes set-stocked at lambing.
- Ewes rotationally grazed post weaning.
- Winter rotation used.
- Cattle set-stocked all year round.
- Lamb post-wean policy: Ewe lambs are spread out, and hoggets are mobbed up and rotated from mating ahead of the ewes.

2.1.9 Pasture production

- Existing stocking rate of 3420 sheep stock unit equivalents (SSU) suggests a minimum annual pasture intake of 5615 kg DM/ha/yr (assuming 1 SSU requires a 550kg DM/yr intake). Assuming an average 70% utilisation rate, this equates to an annual pasture yield of **8020 kg DM/ha/yr** (or 9360 kg DM/ha/yr @ 60% utilisation; 7020 kg DM/ha/yr @ 80% utilisation).
- Existing levels of pasture production for different parts of the farm have been estimated using land classes (map opposite) and regional carrying capacity averages and potentials recorded in the NZLRI database (converted using the 550kg DM/yr intake & 70-80% utilisation according to land class). Results were normalised according to actual levels of production (pasture-cut data from Goodies, Georges & South Pole paddocks).
- Many assumptions have been used to generate the results below. They should be treated with caution if used for decision-making. However, they do suggest that the Rainey property has a wide scope for increasing annual pasture yield.
    - Current pasture yield = **8020 kg DM/ha/yr**.
    - Average farmer = **6366 kg DM/ha/yr**.
    - Potential pasture yield = **10,400 kg DM/ha/yr**.

2.2 Resource & Environmental Assessment

Method of resource and environmental assessment is determined by the purpose of having a farm plan prepared, and the nature of the environmental issues of most relevance to the farm. Primary purpose is dictated by SLUI objectives (namely the management of erosion & sediment contributions), and an implicit need to better understand the capability of the land resource (the ability of land to sustain different farming activities over time). Several other environmental issues of regional interest have also been considered, including wetland management, water quality, weeds and pests, and indigenous biodiversity. Many other environmental issues exist, but these were deemed most relevant to the farm in question.

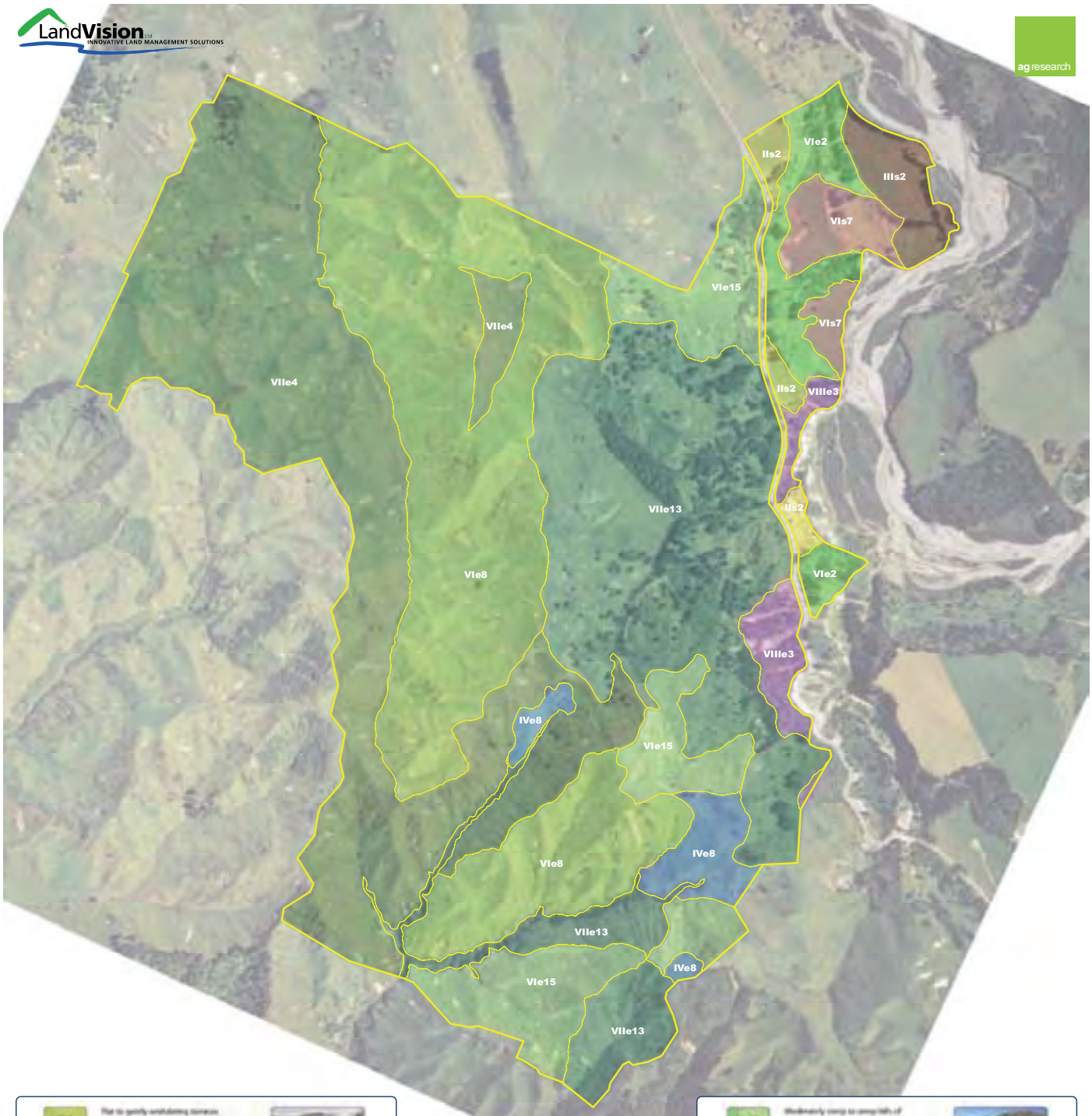
2.2.1 Land resources

The land resource has been described and evaluated according to the Land Resource Inventory (LRI) and Land Use Capability (LUC) Classification. Survey was undertaken at a 1:10,000 scale. The LRI system involves mapping landscape units according to five inventory factors (rock type, soil unit, slope class, erosion type & severity, and vegetation).

LRI was then classified as LUC, which further groups similar units according to their capacity for sustainable production under arable, pastoral, forestry or conservation uses. The LUC code (e.g. 6e7) indicates *general capability* (1-8 classes), the *major limitation* (4 subclass limitations of **w**etness, **e**rosion, **s**oil and **c**limate), and the *capability unit* to link with regional classifications and known best management practices.

Due to reasons of space, only LUC is presented here (over the page). Full LRI/LUC map is appended as the Resource Planning Map. Description of the land resource by LUC is summarised as Table 1, and an assessment of the resource in terms of strengths and weaknesses is presented as Table 2.

Resource Planning Map appended



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The Sustainable Land Use Initiative (**SLUI**) aims to prepare Whole Farm Plans for:

1. Half the Region's **most-at-risk farms** by 2015
2. Half of **all** the Region's farms by 2015
3. 90% of the Region's **most-at-risk farms** by 2030

LAND USE CAPABILITY

J & R RAINEY

Kawhatau Valley Road

Survey and classification by Landvision Ltd, 2006. Map by AgResearch. Aerial photography Flown Jan 2006 by Laurie Cairns & Associates Ltd. 50cm resolution. Orthocorrected to remove camera & terrain distortion by AgResearch.

Full Land Resource Inventory included in the appendicies as the large Resource Planning Map.

TABLE 1: Land resource description by LUC unit

Resource	LUC & description	Total area (ha)	Parent material	Dominant soil type	Slope (degree)	Dominant vegetation	Area (ha)	Erosion degree & severity	
								Actual	Potential
	**IIs2** Flat to gently undulating terraces with yellow grey earths developed on loess.	3.7	Loess & colluvium over gravels	11	3-7	Pasture	3.7	Nil	Slight wind erosion under cultivation
	**IIIs2** River flat terraces with sandy or stony free draining soils.	6.6	Alluvium	9+8	3-7	Pasture	6.6	Nil	Slight to moderate stream bank erosion Slight wind erosion when vegetative cover removed
	**IVe8** Rolling to strongly rolling slopes formed from patchy andesitic tephra over siltstone or mudstone	8.4	Ash over course siltstone or patchy ash over coarse siltstone	7+2	8-20	Pasture	8.4	Nil	Moderate sheet & rill erosion under cultivation
	**VIe2** Strongly rolling to moderately steep short hill slopes and terrace scarps.	12.1	Gravels over sandstone	8	21-35	Low quality pasture	9.8	Nil to slight soil slip	Slight to moderate soil slip erosion and sheet erosion
						Indigenous bush	2.3	Nil	Slight soil slip erosion
	**VIe8** Moderately steep to very steep slopes of consolidated siltstone	93.4	Coarse mudstone	3, 4, 5	21-35	Pasture	93.4	Slight soil slip Slight gully	Moderate soil slip, gully and sheet erosion Slight earthflow
	**VIe15** Moderately steep to steep hills of consolidated sandstone.	33.3	Consolidated silty sandstone or sandy siltstone parent material	4+1	20-25	Pasture	33.3	Slight to moderate soil slip and sheet. Slight tunnel gully	Moderate soil slip. Slight sheet & tunnel gully.
	**VIs7** Flat river terraces with alluvial soils varying in texture from course sandy to bouldery.	8.1	Gravels & coarse alluvium	8	3-8	Pasture	8.1	Nil	Nil
	**VIIe4** Steep to very steep slopes of consolidated siltstone.	101.5	Fine siltstone	5+4	25-35+	Pasture	101.5	Slight to moderate soil slip erosion Slight gully erosion	Severe soil slip, slight sheet, tunnel gully and earthflow erosion
	**VIIe13** Steep to very steep slopes of consolidated massive sandstone.	82.7	Massive sandstone (fine)	4, 1, 2	25-35+	Pasture	76.9	Slight to moderate soil slip and earthflow erosion	Moderate to severe soil slip and earthflow erosion, moderate gully erosion
						Indigenous bush	5.8	Slight to moderate soil slip and earthflow erosion	Moderate soil slip and earthflow erosion, moderate gully erosion
	**VIIIe3** Very steep slopes formed from moderately consolidated sandstone and siltstone	6.9	Massive sandstone (fine)	4	30-35+	Indigenous bush & Scrub	6.9	slight soil slip erosion	moderate to severe soil slip erosion

TABLE 2: Assessment of land strengths & weaknesses by LUC unit

Luc unit	Total area (ha)	Strengths	Limitations	Landuse suitability	Conditions of use
IIs2	3.7	▪ Access & location ▪ Holds on during summer	▪ Slight for sheet and rill erosion if cultivated ▪ Susceptible to gully erosion where watercourses and springs dissect plateaus ▪ Prone to pugging and treading damage from heavy cattle during wet periods ▪ Size ▪ Poor drainage ▪ Exposed to the elements ▪ 'Sunday' soils when cultivating – often too wet on Saturday and too dry on Monday.	▪ Intensive pastoral production	▪ If cultivating, ensure it is done at the correct moisture levels to avoid structural breakdown ▪ Care with heavy stock during wet periods to prevent pugging and treading damage ▪ Monitor soil health with VSA
IIIs2	6.6	▪ Winter dry – pugging and treading resistant ▪ Opportunity for excellent winter feed pad ▪ Free draining ▪ Contour ▪ Access and location	▪ Potential for slight to moderate stream bank erosion ▪ Summer dry ▪ Potential for slight wind erosion when vegetative cover removed ▪ Low moisture holding capability	▪ Intensive pastoral production	▪ Maximize use during wet periods ▪ Maintain vegetative cover to prevent wind erosion ▪ If constructing a feed pad ensure drainage through wetland system before the river.
IVe8	8.4	▪ Good soil physical properties ▪ High natural fertility ▪ Free draining ▪ Contour	▪ Potential for severe surface erosion under cultivation ▪ Size ▪ Poorly subdivided to maximize use and parcels separated ▪ Access limits intensification ▪ High phosphate retention	▪ Intensive pastoral production	▪ Use minimum tillage techniques when cultivating
VIe2	12.1	▪ Relatively stable ▪ Regenerates quickly ▪ Location and access	▪ Limited topsoil ▪ Summer dry ▪ Limited production potential ▪ Low fertility ▪ Potential for moderate soil slip and slight sheet erosion ▪ Potential for sheet erosion during dry summer months if vegetative cover removed	▪ Extensive pastoral production ▪ Forestry (specialist species)	▪ Maintain vegetative cover during summer months to prevent surface erosion ▪ Space plant trees over the erosion prone parts of the slope at 12-15 metre spacings
		▪ Biodiversity ▪ Shelter ▪ Nil erosion	▪ Limited stock access ▪ Weed and pest habitat	▪ Retirement from grazing	▪ Animal and plant pest control
VIe8	93.4	▪ Good soil physical properties ▪ Productive hill country unit – the power house of the property	▪ Potential for moderate soil slip, gully and sheet erosion ▪ Has the potential for minor pugging and treading damage with heavy cattle during wet periods	▪ Intensive pastoral farming with conservation	▪ Care with heavy classes of stock to reduce incidence of pugging and treading damage during wet periods ▪ Space plant trees over the erosion prone parts of the slope at 12-15 metre spacings
VIe15	33.3	▪ Soil physical properties ▪ strong hill country	▪ Moderate potential for soil slip, sheet and tunnel gully erosion ▪ Potential for gully systems to present a hazard to stock management ▪ Can dry out during dry summer months	▪ Intensive pastoral farming with conservation	▪ Space plant trees over the erosion prone parts of the slope at 10-12 metre spacings
VIs7	8.1	▪ No susceptibility for pugging or treading damage ▪ Ideal winter cattle country ▪ Sheltered country	▪ Low natural fertility ▪ Summer dry ▪ Limited pasture production potential during summer and autumn	▪ Extensive pastoral farming ▪ Winter feed pad potential	▪ Maintain vegetative cover during summer ▪ Consider fertiliser policy for N based rather than P based due to the summer dryness
VIIe4	101.5	▪ Productive hill country unit	▪ Potential for gully systems to present a hazard to stock management ▪ Pasture production limited often insufficient soil depth ▪ Severe erosion potential	▪ Extensive pastoral grazing on lower slopes, or 'managed retirement ▪ Some forestry	▪ Stabilize gullies with pair and block plantings and debris dams. ▪ When considering forestry as a land use option consider the depth of topsoil and hardness of the underlying rock material when deciding on species..
VIIe13	82.7	▪ Lower colluvial slopes may support forestry and continued pastoral grazing	▪ Pasture production limited often insufficient soil depth ▪ Severe erosion possible ▪ Erosion scars heal slowly ▪ Slope ▪ Bare areas common on the upper slopes	▪ Extensive pastoral grazing on lower slopes, or 'managed retirement' ▪ Forestry	▪ Maintain retirement of indigenous bush areas ▪ Where extensive pastoral farming continues, ensure gully systems are stable. ▪ Space plant poles on the lower slopes where there is adequate soil depth at 10-12 metre spacings ▪ When considering forestry as a land use option consider the depth of topsoil and hardness of the underlying rock material when deciding on species
		▪ Biodiversity ▪ Shelter	▪ Limited stock access ▪ Weed and pest habitat ▪ A potential for erosion even when under indigenous bush	▪ Retirement from grazing	▪ Animal and plant pest control
VIIIe3	6.9	▪ Biodiversity ▪ Shelter	▪ Limited stock access ▪ Weed and pest habitat	▪ Retirement from grazing	▪ Animal and plant pest control

Key recommendations for sustainable management of land resources

- Environmental issues and recommendations for their solution are summarised over the page as Table 3.
- Soil erosion is the priority environmental issue for this property. Strategic afforestation or land retirement is recommended for the most-at-risk areas (totalling 11.7ha) that have a notable susceptibility to slip and gully erosion (part VIe8, Vie15, VIIe4, VIIe13, & VIIIe3), and/or pose a threat to community assets (namely the main road). Targeted space-planting of conservation trees is recommended for the remainder of the hill country with an erosion risk (part VIe8, VIIe13, VIe2, VIe15, & VIIe4).
- Many of the existing poplar trees are near the end of their useful life for erosion control, and should be gradually replaced.
- Resilience to pugging varies, and should be monitored using Visual Soil Assessment (VSA). Opportunity exists for the strategic use of LUC IIIs2 land as a stand-off area for cattle during particularly wet periods.

2.2.2 Water resources

- The farm straddles two main catchments – the Mangawhararikі catchment to the south, and the Kawhatau Valley catchment to the north. Within the farm itself, there are 5 sub-catchments that can be managed individually.
- Kawhatau River borders the north-east boundary, and the farm contains approximately 10.4 km of perennial waterways. 25 dams and ponds provide reliable water for stock.
- Some dams appear to have low quality water even for stock use. Springs could be tapped through horizontal boring techniques, and used to establish new troughs.
- Many of the perennial waterways are already well protected with scrub and native-shrub riparian vegetation.
- Sediment contributions from sheet erosion (particularly with summer high-rainfall events on north-facing sandstone country that tends to dry out) and mass-movement erosion can be mitigated somewhat through the use of coffer dams.

Key recommendations for sustainable management of water resources

- Consider installing horizontal bores and new troughs to replace dams that appear to have particularly poor water quality.
- Initiate a coffer dam system to trap sediment in the Mongrel subcatchment.
- Establish a water quality monitoring programme for several stream access sites using the Stream Monitoring & Assessment Kit.

2.2.3 Natural heritage

- Native/indigenous forest fragments are a feature of the property. Stock are not currently excluded from these areas. Of particular note are three large fragments in Aerial, Dope and the Road Face paddocks, representing a combined area of 10.2ha. There is evidence to suggest possums may be a problem in these areas.
- Low density scrub or scattered scrub is a feature of the gully systems and some of the more marginal hill country. Such areas would struggle to carry more than 4-5 stock units.
- A remarkable natural wetland is present in the Middle Flat paddock. Stock are not currently excluded. Wetlands provide a habitat for ducks & other wildlife, and when fenced, they lessen the risk for stock misadventure.
- Old man's beard and Matagouri are persistent weeds.
- The Rainey property scores very high in terms of visual aesthetics, due partly to the characteristic stepped terracing and braided river channelling of the Kawhatau Valley; partly because of a diversity of landscape features such as dams, bush fragments and trees; and partly because of the Ruahine Range as a visual backdrop. New forestry, conservation trees, wetland protection and managed bush would further enhance aesthetics.

Key recommendations for sustainable management of natural heritage

- Fence and retire the three large bush fragments. Consider covenanting under the QEII Trust scheme to help minimise costs.
- Exclude grazing stock from the wetland area on the intermediate terrace and enhance with additional planting.
- Eradicate Old man's beard and the scattered Matagouri.
- Maintain a comprehensive possum control programme.

2.2.4 Physical business resources

- Pasture, subdivision & nutrient management have been evaluated elsewhere.
- Tracking represents a considerable investment for the farm, but some areas have less than adequate surface drainage and culverting.

Key recommendations for physical business resources

- Consider upgrading surface drainage and culverting on strategically important tracks as part of future track maintenance.

TABLE 3: Recommendations summary by environmental issue

Environmental Issue	Component	Description of specific issue	LUC unit or location	Priority (1 = high)	Solutions or control measures
LAND					
Soil Health	Soil erosion	Surface erosion	IVe8	3	▪ Care with cultivation to prevent severe rill and sheet erosion.
			VIe2, VIe8, VIe15, VIIe4	3	▪ Maintain pasture sward through grazing management and fertility.
		Streambank erosion	IIIs2	2	▪ Strategic armoring of streambanks at pressure points using willows and poplars. Particularly important near infrastructure. Any plantings need to be managed. Reduce heavy stock access to banks.
		Slump & earthflow erosion	VIe8, VIIe13	2	▪ The first objective is to protect the toe of the slope using space planted poplars. The second priority is to plant up ephemeral watercourses. ▪ Some existing planting needs more poplar planting to increase the density to an effective level.
		Soil slip erosion	VIe2, VIe8, VIe15	1	▪ Where soil slip is slight, space planting at 12 metre spacings over the erosion prone parts of the slope. ▪ Control storm water from tracking and ensure discharge is on to stable ground.
			VIIe4, VIIe13,	2	▪ Only undertake space planted poplars on the colluvial footslopes over the whole slope at 12 metre spacings. ▪ Where the erosion is severe, or where the erosion moderate to severe and adjacent to infrastructure or assets, undertake managed retirement or afforestation.
			VIIIe3	1	▪ Retirement from livestock.
		Gully erosion	VIe8, VIe15, VIIe4, VIIe13	1	▪ On actively eroding gully systems either allow scrub regeneration or undertake pair plantings of poplars up the gully system. ▪ Minimise access of heavy cattle to main gully systems during winter period.
		Tunnel gully erosion	VIe15, VIIe4	3	▪ Generally located on the colluvial footslopes – undertake space planting of poplars at 12 metre spacings on the erosion prone parts of the slope.
		Wind erosion	IIs2, IIIs2	3	▪ Care with cultivation or undertake conservation tillage techniques
	Nutrient balance	Maintaining soil fertility levels	All pastoral units	2	▪ Undertake biannual soil fertility tests on set transect lines, to establish fertility trends over time. Undertake nutrient budgeting
	Chemical use		All units	3	▪ Use chemicals according to manufacturer's instructions. Be aware of potential effects of the products, and avoid off-site effects (such as avoiding waterways, windy conditions, toxic accumulation).
	Contaminated sites		N/a		
	Physical health	Potential for over-cropping	N/a		
		Soil pugging and treading from livestock	Pastoral units	2	▪ Monitor soil health using Visual Soil Assessment. Utilize the IIIs2 as a standing off area for heavy cattle during wet periods..
	Flooding	Sediment deposition	N/a		
WATER					
Water quality	Stream protection	Stock access to streams	Watercourses	2	▪ Alternative water supply would reduce stock impact to streams and reduce bank erosion ▪ Utilize single wire electric fencing to exclude cattle
	Water supply	Some of the dams are providing poor quality water and posing a threat to stock.	Pastoral hill country units	2	▪ Utilize the springs present on the property by tapping using horizontal boring techniques and feeding to one or two toughs. This will also dry out slip failure zones.
	Point source contaminants	Direct runoff from dips, yard runoff, refuse tips	N/a		
	Non point source contaminants	Sediment or nutrients in surface runoff	Pastoral units	3	▪ Encourage riparian vegetation/strip on permanent watercourses ▪ Construction of coffer dams to trap sediment in main gully system
	Fertilizer use	Discharge to watercourse Overuse	Pastoral units	3	▪ Avoid direct application to watercourse. ▪ Biannual nutrient budgeting
LIVING HERITAGE					
	Shelter	Stock access to shelter	Pastoral units	3	▪ Adequate opportunities for shelter through shifting stock.
Biodiversity	Indigenous bush	Formal protection	Bush blocks	3	▪ Consider QEII National Trust Covenant Protection
		Possums	Bush blocks	3	▪ Shooting and poisoning.
		Old mans beard	Bush blocks	1	▪ Cut and painting with herbicide
		Stock access	Bush blocks	3	▪ Fencing to exclude stock.
	Wetlands	Stock access	Wetland	2	▪ Fence wetland areas to reduce risk to stock and improve water quality.
		Biodiversity limitations	Wetland	1	▪ Enhancement planting for habitat and continuous food supply
	Exotic plantings	Replacement of existing old poplars that have reached their use by date	Road face & Lane paddocks	1	▪ Poisoning and cutting down of mature poplars that have reached their use-by date.
		Shading effects of poplars and multiple leaders	Pastoral units	2	▪ Form pruning of poplars for ease of future management. This will require pruning to one main leader in year three.
Shade & shelter	Shade	Stock access to shade	Pastoral units	3	▪ Strategic poplar planting in paddocks that do not already provide shade.
Biosecurity	Plant pests	Old mans beard	Bush blocks	1	▪ Cut and paste
	Animal pests	Possums		2	▪ Shooting and poisoning
	Insect pests				
Cultural sites or sites of significance	Cultural		N/a		
	Sites of significance		N/a		
PHYSICAL BUSINESS					
Pasture	Plant pests	Matagouri	Easy hill country	3	▪ Spray
		Scotch thistle	Pastoral units	3	▪ Spray
		Californian thistle	Pastoral units	3	▪ Spray
		Variegated thistle	Pastoral units	3	▪ Spray & grub
	Animal pests	Possums	Pastoral units	3	▪ Poisoning.
	Chemical use			3	▪
	Trace elements		Pastoral units	3	▪ Monitor
	Insect pests	Cover root weevil	Pastoral units		▪ Monitor
		Pirina	Pastoral units	3	▪ Monitor
Infrastructure	Tracking	Storm water control, stability		2	▪ Maintenance as required. ▪ Take care to place tracks away from springs and avoid mid-slope tracking to reduce risk of subsidence. ▪ Spoil should be placed on stable ground, rather than over the side to maintain slope stability. ▪ Manage storm water appropriately
	Water supply	Poor water supply from dams		2	▪ Utilize springs with tapping and feeding to troughs
	Fencing			3	▪ All new subdivision undertaken with reference to Land Use Capability map and soils information.

3.0 FIVE-YEAR STRATEGIC PLAN

3.1 Environmental programme

This section details what works or management changes are recommended and outlines a works programme for the next five years (summarised as Table 4). The farm has a reasonable mix of land resources that allow a variety of farming enterprises. Although parts of this report focus on the negative aspects, there are many strengths that complement each other and create some opportunities for the farm business.

3.1.1 Managed retirement

On areas with moderate to severe erosion, and where there is poor access or conditions for forestry, it is recommended that the areas be gradually retired from grazing, using a *managed retirement* approach. This involves the continuation of sheep grazing, in the short to medium term, but with no further inputs such as fertiliser or scrub clearance. With time, these areas will naturally revert back to native bush. Grass would continue to grow, although the quality would be reduced significantly. For this approach to work, cattle need to be removed from the grazing system.

Approximately 26.7ha is recommended for *managed retirement*, mostly represented as areas that continually struggle to carry more than 4-5 stock units. With the regeneration of manuka scrub there may exist an opportunity for niche honey production.

3.1.2 Soil slip erosion

At least 30% of the soil slip erosion that has occurred on this property has resulted from mid-slope tracking. Mid slope tracking causes over steepened upper slopes and fill material on the lower track slopes. The problem is magnified on tracks with inadequate storm water drainage. For other areas, slipping has resulted primarily because pasture lacks the rooting density to hold soil on steep terrain.

Afforestation and 'managed retirement' is recommended where erosion is moderate to severe, or the erosion potential threatens community assets. Consideration has been given to access for harvesting, site conditions and appropriate tree species.

There are areas of class VIIe land where the erosion potential is only slight to moderate. No erosion control plantings are recommended for these areas. Space planting is likely to be ineffective, and off-site effects can be minimised if erosion does occur. A series of debris dams are recommended for the main valley system, to trap sediment, and limit gully down-cutting.

3.1.3 Targeted soil conservation planting

Density of recent plantings is inadequate for erosion control. Likewise, many were not planted at the most effective sites – it would be of greater benefit if they had been focused more intensely at erosion prone parts of the slope. This is determined by the type and severity of erosion present.

One paddock should be planted at a time, so grazing management and stock policy can be more easily controlled to ensure maximum tree survival. Priority paddocks should be determined by erosion potential and it's threat to assets and infrastructure. Pole planting should only be undertaken on the LUC class VIe units or the colluvial foot-slopes of class VIIe land where there is adequate soil depth.

Mongrel and Whare paddocks

In the first year, it is recommended Mongrel & Whare paddocks are space planted with alders at 10-12m intervals over the most erosion-prone slopes. Protection from sheep grazing is required, and cattle should be excluded for the first 3-4 years to ensure tree survival.

3.1.4 Shade & shelter

Shade and shelter are an important animal health issue. This property contains significant vegetation for shade however there are many paddocks with inadequate shade during the hot summer period. The planting of shade trees can be used to manipulate stock movement during these periods. Often the shade trees can also be used for erosion control.

3.1.5 Afforestation

In areas where erosion potential is moderate to severe and would affect personal or community assets, afforestation is recommended. Harvesting, access and species suitability have all been considered for selection of the recommended forestry sites.

Three blocks covering 11.7ha are recommended for afforestation. These are located in Slide and Road-Face paddocks.

A popular option to help finance afforestation is through joint ventures, where an investor pays for establishment and silviculture, while the landowner provides the land. Returns are split proportionally after the trees are harvested.

Afforestation Block A

Block A (3.9ha) has moderate to severe erosion even with space planted poplars on it. The gully is cutting-down, and resulting debris is continually spilling out onto the public road. Research has demonstrated that space plantings will have a minimal effect on this type of problem. *Cypress lusitanica* is recommended, to be planted amongst the poisoned poplars and managed in a commercial context.

Afforestation Block B

Block B (7ha) has a moderate to severe erosion risk, and the main road is located at the bottom of this Block. Erosion continues largely unchecked, despite the presence of existing soil conservation trees. A closed canopy is required in this situation. Commercially managed *Cypress lusitanica* is recommended.

Afforestation Block C

Block C (0.8ha) is directly above a stand of native bush. Rather than fencing off the bush with a mid-slope fence, it is recommended that the fence is taken to the top of the ridge, and the non-bush component is managed as a commercial woodlot (e.g. Rimu, Kahikatea).

3.1.6 Poplar tree management

A small part of the farm has some established poplar stands. A high rate of wind-throw and damage indicates these trees are near the end of their useful life as an erosion control measure. These need to be gradually replaced over the next five years, or taken out of the rotation through afforestation (see above). Options for removal include poisoning, 'do nothing' (letting them die naturally), or cutting down. The most suitable option(s) depends on location and the surrounding landscape condition. Consideration also needs to be given to debris and stock flow, and replacement trees for continued erosion control. Like a fence, pole planting requires maintenance. Trees should be form pruned back to one leader at year three, and pruned up to 5-6 metres.

3.1.7 Track maintenance

Farm tracks are an essential part of the farm business. An annual track maintenance programme is required to ensure culverts and water tables remain unobstructed.

The most important track leads up to the woolshed. Unfortunately this is sited through some of the most erosion prone land on the property. Number of culverts needs to be increased, and the track surface crowned to promote runoff from the track rather than along the track. Water runoff and discharge should be directed on to stable, vegetated ground.

3.1.8 Wetland enhancement

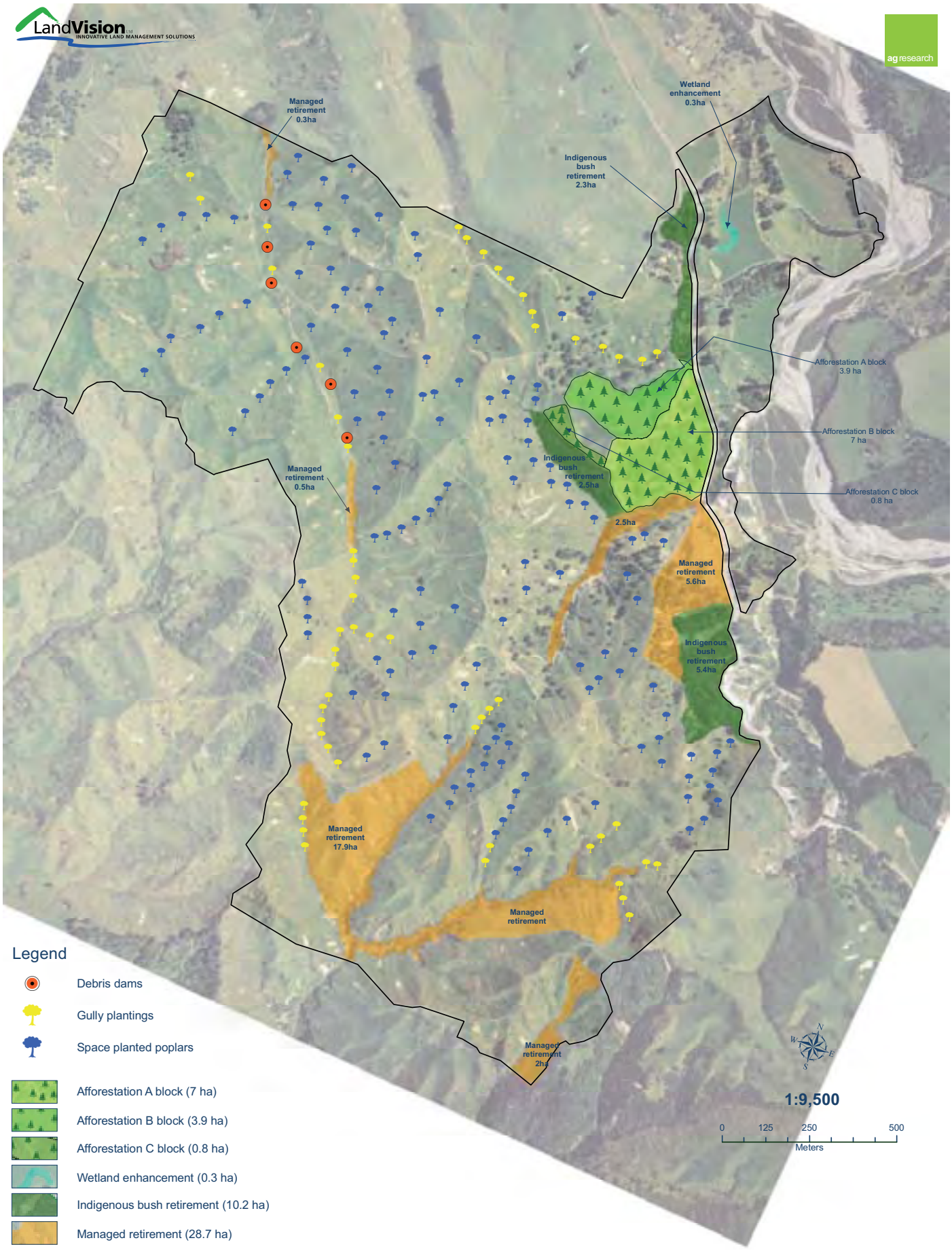
On the intermediate terrace below the road there is a large wetland present. There is an opportunity to enhance this wetland for waterfowl habitat with significant plantings that would provide shelter and food. Some species include flax, oaks, alders. Exclusion of cattle would further enhance water quality, and could be achieved successfully with a two wire electric fence although a 7 wire post and baton fence would be preferable.

3.1.9 Detention or coffer dams

Some areas of LUC VIIe land have only a slight to moderate erosion risk. Space-planted polar trees would be less than fully effective on these areas. Consequently, a degree of erosion has to be accepted as a necessary part of farming these areas. However, off-site impacts can be minimised through installing a series of 'coffer dams' to trap sediment in the main valley system (see works map). Gully systems can be further stabilised with paired-plantings of conservation trees.

Care is needed in positioning these dams to avoid cutting into the adjacent hill face. It is important that the overflow spillway flows over well-vegetated grass to avoid scouring. It is also recommended that the overflow of these dams should be a pipe that is discharged on to butyol/rubber material. New coffers should be constructed further up the gully when existing dams reach sediment capacity. Previous coffers should be stabilised with poplar plantings. Under this proposal pastoral farming would continue and slight to moderate erosion would be accepted whilst minimizing the off site effects.

Cattle in this area will promote down cutting of the gully system. Ideally they should be removed from the gully system during the wet periods of the year. They should also be excluded from the coffer dams for the whole year once they have been constructed.



Legend

- Debris dams
- Gully plantings
- Space planted poplars
- Afforestation A block (7 ha)
- Afforestation B block (3.9 ha)
- Afforestation C block (0.8 ha)
- Wetland enhancement (0.3 ha)
- Indigenous bush retirement (10.2 ha)
- Managed retirement (28.7 ha)

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WORKS PROGRAMME

J & R RAINEY

Kawhatau Valley Road

Information produced by Landvision Ltd, 2006. Map by AgResearch. Aerial photography Flown Jan 2006 by Laurie Cairns & Associates Ltd. 50cm resolution. Orthocorrected to remove camera & terrain distortion by AgResearch.

This map is reproduced as the Operational Plan to show the breakdown of works on an annual basis.

TABLE 4: Environmental works programme

Environmental Issue	Description of specific issue	LUC unit or location	Priority	Five year proposed works programme				
				Year 1	Year 2	Year 3	Year 4	Year 5
LAND								
Soil erosion	Surface erosion	IVe8	3	Care with cultivation to prevent unnecessary sheet & rill erosion → ongoing activity				
		VIe2, VIe8, VIe15, VIIe4	3	Maintain pasture sward through grazing management & fertility → ongoing activity				
	Streambank	IIIs2	2	Protection of streambanks using willows & poplars. Minimise stock access. → ongoing activity				
	Slump/earthflow	VIe8, VIIe13	2	Poplar planting @ toe of erosion. Increase density of existing plantings.	Gradually aim to space plant the ephemeral waterways	→	→	→
	Soil slip erosion	VIe2, VIe8, VIe15	1	Space planting of alders in Mongrel & Whare paddocks	Space planting 100 poplars middle and Sues paddocks.	Space plant 100 poplars in Richardos and Goody's paddock	Space plant 150 poplars in Marks and McCoards paddocks	Space plant 150 poplars in Kristins, Bunny's and Bills paddocks
		VIIe4, VIIe13,	3		Evaluate cost benefit of planting Block B in Road Face paddock with *Cypress lucitancia.* Plant Lane paddock with poplars at 10 metre spacings.	Evaluate 2008 cost-benefit of planting Block A with *Cypress lucitancia*		Planting of Block C with native species
		VIIIe3	1	Completely retire	→	→	→	→
	Gully erosion	VIe8, VIe15, VIIe4, VIIe13	1	Scrub regeneration of identified areas. Cattle restricted from main gully system in winter. Space plant main gully system between detention dams with 80 poles	→	→	→	→
	Tunnel gully erosion	VIe15, VIIe4	3	Plantings in association with that for slip erosion	→	→	→	→
	Wind erosion	IIs2, IIIs2	3	Care with cultivation	→	→	→	→
Nutrient balance	Maintaining soil fertility levels	All pastoral units	2	Soil testing and nutrient budgeting		Soil testing and nutrient budgeting		Soil testing and nutrient budgeting
Soil Health	Soil pugging	Pastoral units	2	Undertake VSA	→	→	→	→
WATER								
Stream protection	Stock access to streams	Watercourses	2	Install two horizontal bores for water supply		Install two horizontal bores for water supply		Install two horizontal bores for water supply
Water supply	Some dams have low quality stock water	Pastoral hill country units	2	Same as above		Same as above		Same as above
Non point source contaminants	Sediment or nutrients in runoff	Pastoral units	1	Construction of six coffer dams.	Maintenance of dams as necessary	→	→	→
Fertilizer use	Water contamination	Pastoral units	3	Avoid direct application to water	→	→	→	→
LIVING HERITAGE								
Indigenous bush	Formal protection	Bush blocks	3	Consider QEII				
	Possums	Bush blocks	3	Shooting & poisoning → ongoing activity				
	Old mans beard	Bush blocks	1	Cut & painting with herbicide	Monitor & control infected sites to avoid re-establishment	→	→	→
	Stock access	Bush blocks	3				Retirement fencing of main bush block	
Wetlands	Stock access	Wetland	2				Fencing and planting of wetland in Middle Flat paddock	
Cultural sites		N/a						
Tree health	Replacement of existing old poplars that have reached their use by date	Road face & Lane paddocks	2		Poplar poisoning in forestry Block B and Lane paddock			
	Shading effects of poplars and multiple leaders	Pastoral units	2	Form prune existing three year old poplars	→	→	→	→
Animal pests	Possums		3	Shooting & poisoning → ongoing activity				
Plant pests	Matagouri	Easy hill country	3	Control	→	→	→	→
	Scotch thistle	Pastoral units	3	Control	→	→	→	→
	Californian thistle	Pastoral units	3	Control	→	→	→	→
	Variegated thistle	Pastoral units	3	Control	→	→	→	→
PHYSICAL BUSINESS								
Insect pests	Cover root weevil	Pastoral units	3	Monitor	→	→	→	→
	Porina	Pastoral units	3	Monitor	→	→	→	→
"Experts' (pests)	Councils, consultants, etc.	Usually on your front doorstep	3	Avoid where possible. Challenge everything they claim, and repeatedly ask for hard proof → ongoing activity				
Tracking	Storm water control, stability		2	Maintenance as required	→	→	→	→
Water supply	Some dams have low quality stock water	Pastoral hill country units	2	Install two horizontal bores for water supply		Install two horizontal bores for water supply		Install two horizontal bores for water supply
Shade	Stock access to shade	Pastoral units	3					
Shelter	Stock access to shelter	Pastoral units	3					

3.1.10 Bush retirement

Bush fragments are a feature of the property. One of the largest is currently unfenced (in Aerial paddock). Protection from grazing would accelerate regeneration and enhance indigenous biodiversity. Mid-slope fencing is probably impractical. A better option is to retire the upper part of the slope also, into high value natives for timber production (*e.g*. rimu, kahikatea).

Two further bush blocks could also be enhanced by excluding stock. These are adjacent to the road (shown on the works map). Retirement of all three bush blocks could be funded using QEII National Trust.

Infrequently monitoring the progress of regeneration is a rewarding and interesting exercise. It is also useful for helping maintain an effective possum control programme. Progress is readily assessed using the Visual Bush Assessment kit.

3.1.11 Persistent weeds

The remnant bush block on the road by the driveway contains a small amount of Old man's beard. This will require controlling through cutting and painting with herbicide. Likewise, areas of Matagouri are regenerating on some of the better LUC VIe land, and should be slashed to ensure they don't establish more extensively.

3.1.12 Gully regeneration

The property contains some excellent examples of gully regeneration. This is a cheap and effective form of gully-erosion control. These areas along with several more have been identified on the recommended works map, as areas for retirement and bush regeneration.

The most effective method for scrub regeneration is to 'do nothing', although a one-wire electric fence to exclude cattle will speed up the regeneration process.

3.1.13 Shelterbelt establishment

A small alder shelter belt has been planted in the middle paddock during the 2005 winter. Many of these trees are dying due to loose planting material. These need to be replaced in the 2006 winter. Not replacing the dead material will result in wind funnel holes through the belt rendering it ineffective.

3.1.14 Positioning new tracks

The property is reasonably well tracked with good access to most parts. It is estimated that up to 30% of the historical soil slip erosion can be attributed to mid slope tracking and the associated storm water control. Any new tracking should be restricted to the ridge tops for as much as possible.

3.2 Environmental investment

Protecting and enhancing environmental resources does involve a monetary cost. However, benefits eventually outweigh costs, in the form of improved resilience to future storm events, maintained production-potential of soils, and piece of mind as responsible farmers helping protect New Zealand's environment. Benefits also extend well beyond the farm, and it is recognised that the wider community has a responsibility for an 'in kind' contribution. Community has made this contribution by financing the preparation of this Whole Farm Plan, which amounts to an investment of at least $5,000 (and further support may be available if the farm is eligible for environmental grants). This section focuses on the investment required to implement the recommended works programme.

3.2.1 Managed retirement costs

Managed retirement is recommended on land that has the capacity to carry four to five stock units with fertiliser and scrub clearance input. Returns from this land will slowly decline but the costs of inputs will be eliminated. Furthermore, these are areas where it is easy to lose cattle. It is recommended that these input costs are targeted on other more productive areas of the property.

3.2.2 Afforestation costs

Blocks A & B

Block A and Block B are recommended for *Cypress Lusitancia* and consists of 3.9 and 7 hectares respectively. Both areas are currently vegetated with 'old man' poplars that need removal via poisoning (by drilling) in the Autumn, approximately 15 months prior to planting and cut down three months prior to planting. This program will remove much of the smaller material before planting. Seedlings are then planted at 1000 stems/ha around the fallen trees.

Afforestation cost estimate for Blocks A & B (June 2006)			
	Per hectare	**Block A (3.9 ha)**	**Block B (7.0 ha)**
Poisoning of poplars (labour and chemical)		$500	$800
Cutting down of poplars		$400	$700
Machine to remove trees on road			$1000
Seedlings	$550	$2145	$3850
Planting	$250	$975	$1750
Releasing	$230	$897	$1610
Total		**$4917**	**$9710**

Afforestation cost estimate for Block C (June 2006)		
	Unit cost	**Total cost**
Seedlings (PB3)	$4.80	$1920
Planting	$1.50	$600
Release spray	$0.40	$160
Total	**$6.70**	**$2680**

Block C

It is recommended that this block is afforested using Rimu and Kahikatea species at 500 stems per hectares. It will also require approximately 250 metres of 7 wire permanent fencing. The cost of the fencing is estimated at $12 per metre or $3000. The total area for planting is 0.8 hectares.

3.2.3 Space planting costs

Poplar poles: Poplar poles should be spaced 10-12 metres apart over erosion prone areas. This will vary between 40 to 80 poles/ha. It is proposed to plant 150 poles per annum at a cost of $1,695. Poles and sleeves can be sourced from the Regional Council. It is imperative to undertake pole planting before mid-August and to use good quality stock that has not been lying around a nursery for several weeks.

Poplar pole cost (June 2006)	
3 metre Planting material	$5.00
Sleeve	$3.80
Laying & planting	$2.50
Total	**$11.30/pole**

Alder tree species: It is proposed to space plant alders over the erosion prone parts of the slope in Mongrel and Whare paddocks on the LUC class VIe and where there is adequate soil depth on the LUC class VIIe land at 10-12 metre spacings. It has been estimated that this will require 400 seedlings with seedling protectors. Planting material can be sourced from Murray's Nursery in Woodville and the seedling protectors from the Regional Council.

Year 1: Alder tree planting costs (June 2006)		
	Unit cost	**Total cost**
Seedlings	$3.30	$1320
Protectors & stakes	$5.00	$2000
Planting	$2.50	$1000
Release spray	$0.40	$160
Total	**$10.70**	**$4480**

Poplar management – new plantings: At year three, new poplar plantings should be form pruned to remove double leaders and pruned to reduce the effects of pasture shading. Pruning should be undertaken to leave ½ the green crown and to reduce the effects of re-growth it should be undertaken in the early summer period. Once the property is in an annual planting program of 150 poles per year, the annual form pruning will also be 150 poles per year. The estimated cost for this work is $1.50 per tree. Annual cost for this work is estimated at $225.

3.2.4 Bush retirement cost

It is estimated that the main bush block requires 250 metres of 7 wire permanent fencing to become stock proof. The estimated cost for this work is $12 per metre or $3000. The QEII National Trust should be approached for a covenant on the main bush block and in return are likely to provide half the cost of the fencing.

3.2.5 Wetland enhancement cost

Wetland enhancement requires about 300 metres of permanent 7 wire fence at $12 per metre ($3600 total). It is estimated that 500 carex and flaxes and 40 specimen trees are required.

Wetland enhancement costings (June 2006)		
	Unit cost	**Total cost**
Fencing		$3600
500 Carex & flax seedlings	$2.20	$1100
Planting Carex & flax seedlings	$1.50	$600
Release spray	$0.40	$160
40 Specimen trees	$12.00	$360
Planting 40 Specimen trees	$2.50	$100
Total	**$6.70**	**$2680**

3.2.6 Coffer dam cost

It is estimated that the installation of six debris dams will require two days with a digger, some culverts and rubber butyol material. Associated with this will be single wire electric fencing.

Coffer dam costings (June 2006)	
	Total cost
Digger hire – two days	$1600
Pipes	$800
Rubber butyol sheeting	$700
Electric fencing	$300
Total	**$3400**

3.3 Business strategy

3.3.1 Personal and Business Aspirations

Vision

- To operate a successful farming business in partnership with one of the children whilst being semi retired on a downland block.
- To continue to operate the Green Trout tourism venture.

Personal goals

- To move from the current farm to a warmer climate within 10 years.
- Allow for farm succession (4 children, 17-21 years of age).
- Provide financial stability and offer security (by acting as a guarantor) to the children if needed.
- Ideally, to retain the current farm as part of a succession pathway, and have a 40ha small-farm in the Hawkes Bay.

Business goals

- Realise equity growth of per annum on average.
- Improve business profitability. This needs to be quantified, and will be a combination of (a) cash surplus as a percentage of total capital, and (b) an Earnings Before Interest and Tax (EBIT) which is of total capital.
- The combination of equity growth and cash profit from farming is to provide a return on total capital.
- To have financial stability and security so as to be in a position to be a guarantor for each of the children to a level of at least (you want to be able to have of your total equity employed by your children).
- To complete the Land Environmental Plan within the time frames specified.

3.3.2 Issues for consideration

Business Succession

There is a strong desire to develop the business to include one or more of the children. Currently the business is operating as a partnership between Jim and Ruth.

Business structural changes are required if farm succession is to be achieved effectively. This may involve the establishment of a family trust (for asset protection) and a company. The formation of a company will facilitate the transfer of assets to the next generation with minimal tax implications (via the sale and purchase of shares).

A discussion with the children must occur in the near future to determine if farm succession is a necessary evolution for the business. If one or more of the children wish to become involved in the business, a succession plan needs to be developed clearly presenting timeframes and the expectations individuals have.

With equity, the business is in a strong financial position. However, with a cash surplus of just (largely due to education costs) in 2005, the cashflow of the current business is not sufficient to support another full time labour unit at the present time. For business succession to occur viably, the business must expand. Timeframes determined in a business growth plan will provide an indication as to how quickly and in what way growth must occur.

As a guide, it is suggested that a farm business with a minimum of 7,000su will be required for business succession to operate viably (assuming only one child wishes to become involved). This will allow the business to feasibly support 2 labour units.

Opportunities may exist to develop a stepping stone approach to growth.

If farm succession is a necessary part of your plan, then its start date needs to be now.

Ewe Productivity

Although the MA ewes are performing at a very good level (150% lambing) performance from the ewe hoggets has not been as good as desired despite scanning well. The reasons for this may include:

- A high parasite challenge as a result of the very high sheep to cattle ratio.
- The effect of the climate on lambs born to hoggets (starvation/exposure)
- Lack of suitable lambing country for ewe hoggets
- Impact of a relatively low level of subdivision.

Consideration of alternative sheep systems is necessary. Alternatives may include:

- Purchase of all replacement 2 tooth ewes via SheepLink
- Grazing ewe hoggets off farm until 2 tooth stage
- Altering lambing dates.

An evaluation of all the costs and benefits associated with these alternative policies is recommended to determine the most appropriate sheep system for your business.

Hogget Grazing Analysis

The following is a summary of a simple analysis on the merits of grazing hoggets off farm versus the current system:

Assumptions:

- All hoggets were grazed off at a cost of $1/kg liveweight gain
- A total gain of 30kg was achieved in the 12 months that they are off farm
- Additional ewes were run in place of hoggets on a one for one basis

Income from the two systems is very similar. If ewe performance can be increased (because they become the priority stock class year round) then potential financial gains are possible. There may be other factors to consider such as changes in grazing costs, price received for lambs produced, labour input and worm challenge levels.

3.3.4 Long term business viability

As this report highlights, the productivity and profitability of the business is very strong under the current management systems.

It is highly likely that with the implementation of the Land Environment Plan, the operational management will become more efficient leading to some financial gains. These gains however are likely to be relatively small as the business is operating at such a high level at the current time.

They key issues facing you at the present time is that of farm succession and business growth. The resource you have developed includes land, livestock, management systems, human resource (yourselves) and the financial position. Of these resources the one most under utilised is that of the financial resource as reflected by the very low debt servicing cost (5.9% of GFI).

To meet your longer term goals you need to:

- Discuss farm succession with your children
- Develop a business growth plan
- Implement that plan effectively

The key viability issue is that of ensuring farm succession can occur in a timely and profitable fashion meeting the full range of family expectations.

4.0 REPORTING

4.1 Monitoring programme

Two main aspects are covered in the following reports, including a) progress towards the farms business objectives and b) monitoring of the farms environmental performance. Once implementation of works programme within the environmental programme is complete, the monitoring programme will shift to direct measures of environmental performance, rather than activity based measures.

	2006	2007	2008	2009	2010	2011
4.1.1 Progress towards the farm's business objectives						
(a) Business goals						
Realise equity growth of 7% per annum on average	→	→	→	→	→	→
Financial stability & security	→	→	→	→	→	→
Complete Land & Environmental Plan	→	→	→	→	→	→
(b) Personal goals						
Work towards moving to a warmer climate by 2016	→	→	→	→	→	→
Arrange succession	→	→	→	→	→	→
Own a small (40ha) farm in the Hawkes Bay	→	→	→	→	→	→
(c) Environmental Work Programme						
Formalise the retirement of the block above the district road (5.4 and 5.6 ha)						
Complete retirement of main bush block						
Complete poplar poisoning in forestry block B						
Allow scrub regeneration in gully below debris dams ((0.5 ha)						
Complete retirement and planting of the lane paddock						
Complete the Poplar planting programme of 100-150 poles/year	→	→	→	→	→	→
Space planting of Mongrel and Whare with Alders						
Form prune 3 year old poplar and new planting each year	→	→	→	→	→	→
Complete enhancement of wetland						
Continue with pest and weed control	→	→	→	→	→	→
(d) Capital development programme						
Investigate the cost benefit of Forestry blocks A, B and C						
Install a series (6) of debris dams						
Install two horizontal bores for water supply						

		2006	2007	2008	2009	2010	2011
4.1.2 Monitoring of the farm's environmental performance							
LAND	**Soil erosion** (Reducing the risk of soil erosion)	**Environmental works programme → → →**					
	Soil health ('Flat Land' management unit)		**VSA**		**VSA**		
	Soil fertility		**Soil test**		**Soil test**		
WATER							
	In stream health (Two locations)	**SMAK**	**SMAK**	**SMAK**	**SMAK**	**SMAK**	
	Nutrient Budget						
	Nitrate leaching loss		**Overseer**		**Overseer**		
	Phosphorus run-off risk		**Overseer**		**Overseer**		
LIVING HERITAGE							
	Indigenous Bush		**VBA**		**VBA**		
	Wetlands		**VWLA**		**VWLA**		
	Plant & animal pests	**Environmental works programme → → →**					

Results from the Visual soil Assessment (VSA), soil testing, stream monitoring assessment kit (SMAK), Overseer, Visual Bush Assessment (VBA) and the Visual Wetland Assessment (VWLA), along progress in the implementation of the environmental works programme will be recorded and reported in the progress report contained in the annual operational plan.

4.2 Shared responsibilities

Rate-payers have ultimately funded the preparation of this Whole Farm Plan as an investment for the good of the local and regional community. While implementation is entirely voluntary, there is a moral expectation that agreed recommendations and actions will be undertaken by the land holder. However, it is recognised that farming situations and circumstances can change markedly during a year, and that sometimes there are just too many other concerns and jobs that need doing. It may not always be possible or practical for every farmer to adhere to the recommended actions of this plan.

Horizons Regional Council has a responsibility to the landholder and the regional community (i.e. rate payers). Our role is to help with implementation, monitoring and annual renewal of the plan. Depending on individual circumstances, implementation support to the landholder may take on the form of financial grants (if eligible), the provision of some materials (e.g. poplar poles), labour and technical support. Monitoring and renewal is to help keep the plan on track, and is critically important to ensure that rate-payers' money is being invested effectively and efficiently.

Like most aspects of farming, environmental management requires a commitment to long term maintenance. Shelterbelts, erosion-control plantings, and riparian plantings all require a degree of periodic maintenance. Problems associated with the farm's 'old man poplars' is an example of what can happen if environmental works are not managed. Similarly, farming situations change, and new environmental challenges can arise (e.g. nitrogen leaching was barely even acknowledged 20 years ago). We therefore suggest a long term partnership with Horizons, where this Whole Farm Plan is continued well beyond its explicit duration of five years.

Responsibilities regarding the business side of this plan are a little different. Responsibility for designing an operational plan, and for implementing the business strategy, is completely in the hands of the landholder. We suggest that the landholder work closely with their business development consultant. Business strategies should be revisited and evaluated at least annually.

Contacts for follow-up and further information include your Horizons Regional Council representative, and the farm business development consultant involved in this project:

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5.0 ACKNOWLEDGEMENTS

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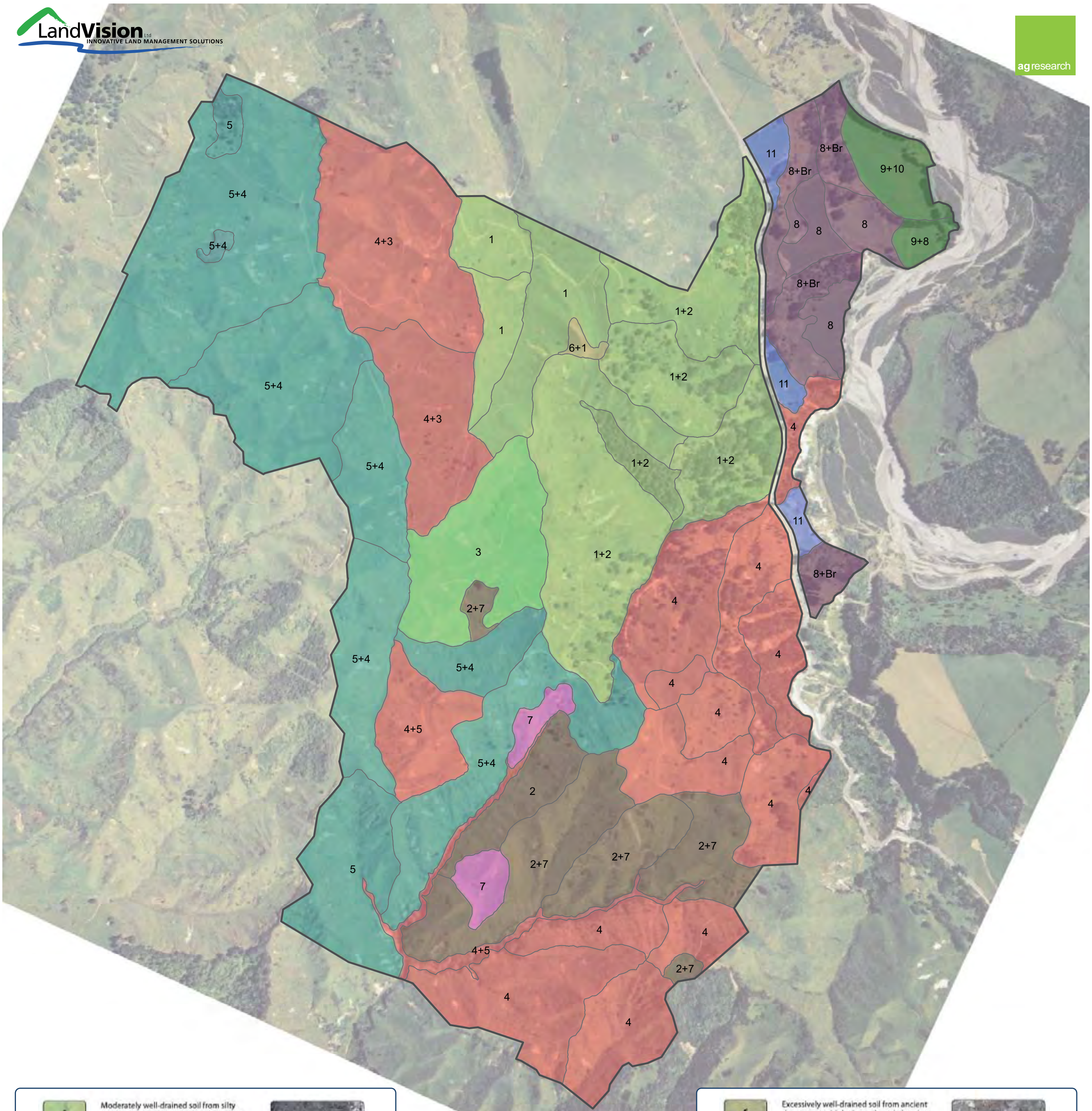
4.0 APPENDIX: FARM SOIL REPORT

The Rainey property comprises a wide diversity and versatility of different soils. They have been mapped and described by LandVision surveyors, according to attributes directly relevant to the pastoral farming operation. Soil type names (local soil names) are not well defined for Rangitikei hill country, particularly at detailed farm scales. For this reason, soil classification names have not been used. Soil map presented over the page.

4.1 Extended soil map legend

	**Name**: Soil 1 **LUC map symbol:** 1 **Distribution on the property**: On front half of the property. **Drainage status**: Moderately well drained. **Topsoil consistence**: Friable when moist, slightly plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: Medium. **Parent material**: Moderately consolidated massive silty sandstone. **Profile description:** 20 cm of moderately developed dark red brown fine nutty crumb silt loam on moderately developed dark yellow brown fine to medium nut-crumb sandy silt loam and some large consolidated sandstone blocks, on moderately consolidated silty sandstone. **Comments**: Good soil structure and internal drainage makes this soil suitable for heavy cattle for extended periods during the wet season. The steeper sunny faces are prone to soil slip erosion especially when associated with tracking. Erosion scars can be slow to heal. **Management considerations**: Where this soil occurs on the easier slopes consideration needs to be given to protecting it against soil slip erosion. Soil health monitoring is required if the number of heavy cattle is increased on this soil type over winter.
	**Name**: Soil 2 **LUC map symbol**: 2 **Location:** On boundary near top of hill adjacent to track and dam. **Distribution on the property**: Widely distributed on the property. **Drainage status**: Moderately well drained. **Soil consistence**: Topsoil friable when moist and slightly plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: Medium. **Parent material**: Massive siltstone. **Profile description:** 21 cm moderately developed grayish orange fine nutty crumb silt loam on 9cm moderately developed dusky pale orange fine to medium blocky and fine nutty crumb silt loam with medium siltstone blocks, on massive siltstone. **Comments**: Good internal drainage and soil development will enable grazing with cattle over the winter period however the soil health condition should be monitored. **Management considerations:** Annual monitoring for treading and pugging damage.
	**Name**: Soil 3 **LUC map symbol**: 3 **Distribution on the property**: Found mostly on LUC unit VIe8. **Drainage status**: Imperfectly drained. **Soil consistence**: Friable when moist, plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: High. **Parent material**: Fine siltstone - coarse mudstone **Profile description:**19 cm moderately developed light olive gray fine nutty crumb silt loam on 13 cm pale orange moderately developed fine to medium blocky and fine nutty crumb silty clay loam on 23cm of pale orange moderately developed medium blocky fine nutty crumb clay loam with few faint light orange mottles on fine siltstone/coarse mudstone material **Comments**: The slower internal drainage means this soil will be wetter for longer and slower to warm up in the spring. **Management considerations:** Care with heavy cattle during wet periods.
	**Name**: Soil 4 **LUC map symbol**: 4 **Distribution on the property**: Extensively distributed throughout the property. **Drainage status**: Moderately well drained **Topsoil consistence**: Friable when moist, and slightly plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: Medium. **Parent material**: Silty sandstone. **Profile description:** 23 cm moderately developed fine nutty crumb and some medium nuts dark yellow brown sandy loam on 25 cm moderately developed fine nutty crumb dusky yellow brown sandy loam on weakly developed yellowish brown silty sandstone. **Comments**: The good internal drainage means that this soil will warm up quicker in the spring. Although it only has a medium susceptibility to pugging, the soil health should be monitored if cattle numbers are increased. **Management considerations:** Soil health monitoring using VSA, especially if cattle numbers are increased.
	**Name**: Soil 5 **LUC map symbol**: 5 **Distribution on the property**: Found on the silty mudstone half of the property. **Drainage status**: Imperfectly drained. **Topsoil consistence**: Friable when moist, plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: High. **Parent material**: Fine siltstone. **Profile description:** 15 cm moderately developed fine nutty crumb with few medium blocks orange grey silty clay loam on 23 cm moderately developed pale orange yellow fine nutty crumb with medium blocks clay loam with few orange mottles on massive fine siltstone. **Comments**: Reasonable natural fertility. Part of the power house of the property. **Management considerations:** Care with heavy cattle during wet periods.



1	Moderately well-drained soil from silty sandstone. Medium pugging risk means it can withstand moderate cattle stocking over the winter months.	
2	Moderately well-drained soil from siltstone that occurs in association with Soil 7. This combination, coupled with a medium pugging risk, allows moderate cattle stocking in winter.	
3	Imperfectly drained soil from siltstone & mudstone. Pugging risk is high, & is not therefore suitable for winter cattle. Natural background fertility should be higher than soils from coarser sedimentary rocks.	
4	Moderately well-drained soil from silty sandstone, found extensively across the property. Generally a medium pugging risk.	
5	Imperfectly drained soil from fine siltstone. Natural background fertility is likely to be high, but a high pugging risk requires careful winter management of cattle.	

N W E S

1:10,500

0 125 250 500
Meters

6	Excessively well-drained soil from ancient river terraces, high above the existing river bed. Small in extent, but a high resillience to damage from cattle pugging.	
7	Well-drained soil from volcanic ash material. Represent some of the farm's most productive soils. High versatility & suitability for many uses, and a high resillence to pugging.	
8	Well-drained soil from very coarse river gravels and boulders. Droughty due to limited water-storage capacity, but excellent for standing cattle in winter.	
9	Moderately well-drained soil from coarse river sediments & gravels. Found on some of the lower terraces. High pugging risk due to weak and limited topsoil development.	
11	Imperfectly drained soil from loess and colluvium. High pugging risk, partly due to the accumulation of runoff from surrounding slopes. Opportunity for drainage.	

sustainable land use
green hills safe communities clean streams

The Sustainable Land Use Initiative (**SLUI**) aims to prepare Whole Farm Plans for:

1. Half the Region's **most-at-risk farms** by 2015
2. Half of **all** the Region's farms by 2015
3. 90% of the Region's **most-at-risk farms** by 2030

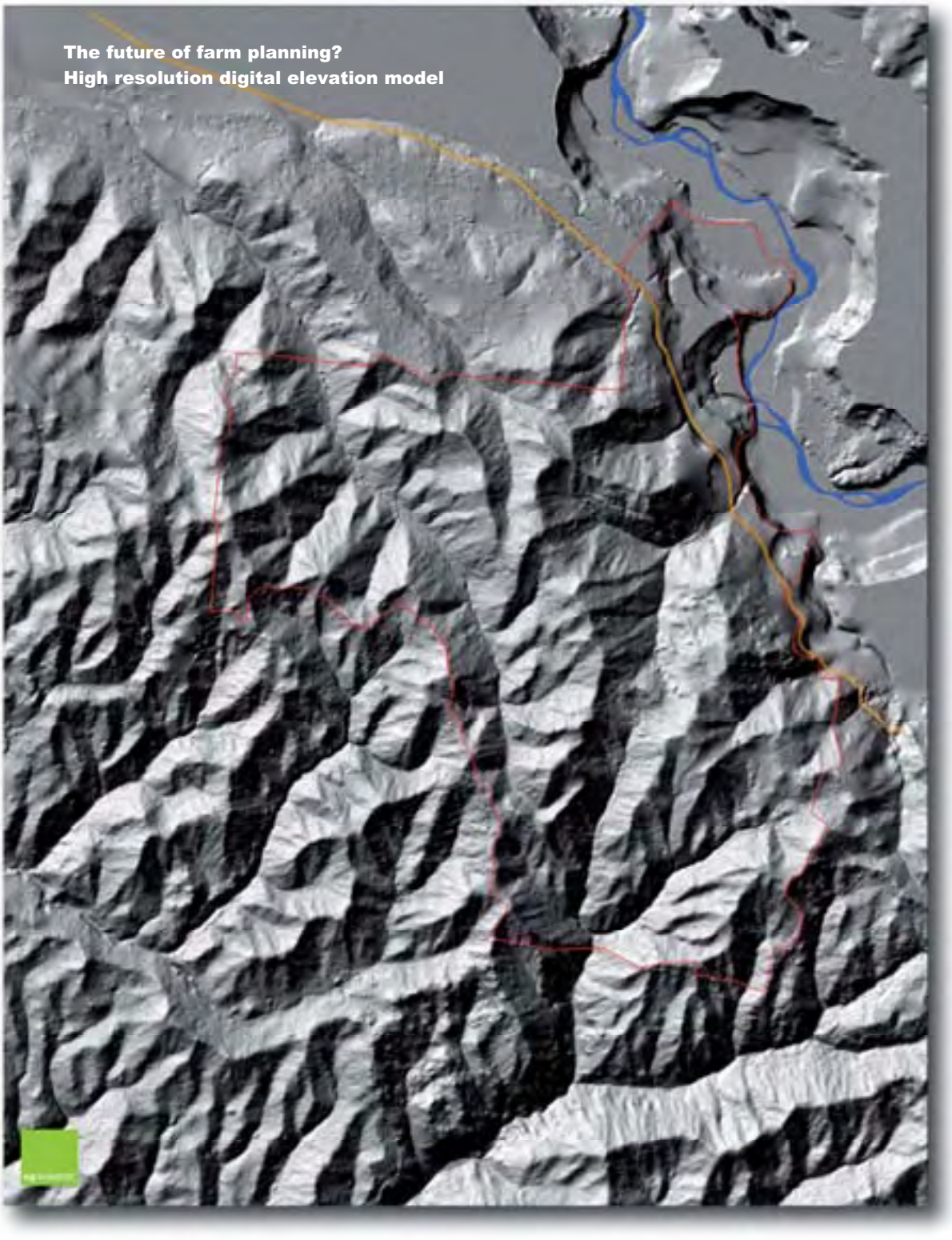
SOIL RESOURCES

J & R RAINEY

Kawhatau Valley Road

Survey and classification by Landvision Ltd, 2006. Map by AgResearch. Aerial photography Flown Jan 2006 by Laurie Cairns & Associates Ltd. 50cm resolution. Orthocorrected to remove camera & terrain distortion by AgResearch.

	**Name**: Soil 6 **LUC map symbol**: 6 **Distribution on the property**: Found in Georges & Sues paddocks up high. Limited distribution on the property. **Drainage status**: Excessively well drained. **Topsoil consistence**: Loose to friable when moist, slightly plastic when wet (with stones removed). **Degree of topsoil development**: Moderately developed but shallow. **Pugging susceptibility**: Low. **Parent material**: Conglomerates over massive mudstone or fine siltstone **Profile description:** 9cm excessively well drained moderately developed dusky dark yellow brown fine nutty crumb sandy loam with fine to medium sandstone gravels on 30 cm moderately developed dark yellow brown fine nutty crumb sandy loam with fine to medium sandstone gravels on gravels over massive mudstone. **Comments**: Limited distribution on property. **Management considerations:** Too small to manage separately.
	**Name**: Soil 7 **LUC map symbol**:7 **Distribution on the property**: On LUC unit IVe8 and some of the easier class VIe units. **Drainage status**: Well drained. **Topsoil consistence**: Very friable when moist, slightly plastic when wet. **Degree of topsoil development**: Weakly to moderately developed. **Pugging susceptibility**: Medium due to topsoil development. **Parent material**: Andesitic tephra. **Profile description:** 17 cm weakly to moderately developed dusky orange fine nutty crumb loam on weakly developed yellow orange fine crumb granular loam and some fine nuts formed from andesitic tephra. **Comments**: These soils are some of the most productive on the property. Their weak to moderate development will inhibit cultivation (along with access). These soils are derived from andesitic tephra and have high phosphate retention. **Management considerations:** consider fencing this unit out where it is practical.
	**Name**: Soil 8 **LUC map symbol**: 8 **Distribution on the property**: Intermediate terraces below the road. **Drainage status**: Well drained. **Soil consistence**: loose. **Degree of topsoil development**: Weakly developed. **Pugging susceptibility**: Very low. **Parent material**: Gravels. **Profile description:** 8cm weakly developed fine nutty crumb silt loam over deep alluvial gravels. **Comments**: These soils are wide spread over the intermediate terraces on the property. **Management considerations:** Summer dry, but make excellent area for heavy cattle during the wet winter months.
	**Name**: Soil 9 **LUC map symbol**: 9 **Distribution on the property**: Found on low river terrace. **Drainage status**: Moderately well drained. **Soil consistence**: Friable when moist, slightly plastic when wet. **Degree of topsoil development**: Weakly developed. **Pugging susceptibility**: Medium. **Parent material**: Coarse alluvium. **Profile description:**15 cm of weakly developed light orange grey fine nutty crumb sandy silt loam on alluvial gravels **Comments**: These soils are still susceptible to pugging due to their weak topsoil development and soil consistency when wet. They are found on the low river terrace (along with Soil 10) and are well drained. Their drainage properties reflect their positioning the landscape. The soils on the low terrace are a mosaic which prevents their separation. **Management considerations:** Topsoil depth and depth to alluvial gravels will inhibit cultivation.
	**Name**: Soil 10 **LUC map symbol**: 10 **Distribution on the property**: Found on low river terrace. **Drainage status**: Imperfectly drained. **Soil consistence**: Very friable when moist, plastic when wet. **Degree of topsoil development**: Weakly developed. **Pugging susceptibility**: High. **Parent material**: Fine alluvium over gravels. **Profile description:**12 cm weakly developed light orange gray fine nutty crumb few fine blocks very friable when moist, and slightly plastic when wet sandy silt loam on 20 cm weakly developed light orange grey very fine crumby, granular and few plates sandy silt loam with few orange mottles and iron concretions on alluvium **Comments**: This soil occurs in a mosaic pattern with soil 9 that limits the opportunity to separate them. **Management considerations**: Care with heavy cattle over wet periods to prevent pugging and treading damage. When cultivating ensure it is undertaken at the correct moisture levels to prevent structural deterioration. These soils are often referred to as 'Sunday soils' – too wet on Saturday and too dry on Monday.
	**Name**: Soil 11 **LUC map symbol**: 11 **Distribution on the property**: On high terrace around the home stay cottage **Drainage status**: Imperfectly drained **Soil consistence**: Friable when moist, plastic when wet. **Degree of topsoil development**: Moderately developed. **Pugging susceptibility**: High **Parent material**: Loess and colluvium **Profile description:** 17 cm moderately developed fine nutty silt loam with few fine blocks and few mottles and few fine iron concretions on 23 cm weakly to moderately developed medium to large blocks clay loam with many orange mottles on clay derived from loess and or colluvium. **Comments**: This soil is influenced by runoff from the surrounding hill slopes. This combined with the fine nature of the subsoil limits drainage capability. **Management considerations:** This soil is highly susceptible to pugging and treading damage. However it would hold a mole drain and for drainage to be successful the surface and groundwater flow from the adjacent hill slopes would require intercepting first for it to be successful.



This is a high resolution digital elevation model (DEM) of the Rainey property (presented here as a hill-shaded picture). Each square metre (m^2) of the property has been assigned an elevation height.

The DEM and associated analysis technologies were not used in this farm plan (we were concerned about vertical accuracy errors caused by the way the DEM was generated), other than delineation of farm catchment boundaries. This is unfortunate, because high resolution DEMs are useful for calculating several production and environmental parameters of value to farm management. It does, however, make for an interesting picture.

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