Rangitikei Strategic Water Assessment Project

Final Case Study Reports

Table of Contents

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Kawhatau Limited (Chrystall) summary detailed irrigation case study

Report prepared as part of the
Rangitikei Strategic Water Assessment project,
jointly funded by Rangitikei District Council and the
Ministry for Primary Industries (Irrigation Acceleration Fund)

Rangitikei
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Manatū Ahu Matua

Acknowledgements

The Catalyst Group wishes to thank the following for their contribution to the production of this report:

- Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund) for supporting the Rangitikei Strategic Water Assessment project
- Mark and Richard Chrystall for allowing us to use their property as a case study for this project, and for giving their time and farm enterprise data so freely
- Lachie Grant of Landvision Ltd and Greg Sheppard of Sheppard Agriculture for undertaking the case study analysis

Report No. 2014/010(B)

17 November 2014

1 Introduction

The Rangitikei district is heavily reliant upon the primary sector for its economic and social well-being. This sector is founded upon the district's topography, soils, climate, water resources, and farmer innovation. However, the district's water resource is coming under increasing pressure from irrigators, and the impacts of droughts.

In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A summary case study has been prepared for Kawhatau Ltd, owned by the Chrystall partnership. The property is located on Te Moehou Road, at the top of the Kawhatau Valley. This case study has been prepared to assess the opportunities, costs, and on-farm implications of introducing irrigation to the property.

Kawhatau Ltd is a 932 hill country property wintering 8249 stock units (67:33 sheep:cattle ratio) across an effective area of 894 ha (average 9.2 su/ha). The property has the potential to irrigate approximately 38 ha of pasture or fodder crops, with the development of a Travelling irrigator with water abstracted from a water storage dam. Development of the proposed irrigation system is estimated to require up to $150,000 of capital investment.

The case study is presented at Annex A.

3 Findings

Key findings from the Kawhatau Ltd case study were:

1. The irrigation system considered most practical to develop the productive flats on the Kawhatau Ltd. property was a Travelling irrigator, supplemented by pods, abstracting water from a 4 ha dam constructed on the property. The estimated cost of this set-up is $150,000

2. Financial analysis indicates investment in additional irrigation will be economically rewarding. After adjustments for depreciation and the cost of capital, it is estimated business profitability will improve by $14-19,000 annually, at a Return on Capital of 9-12%.

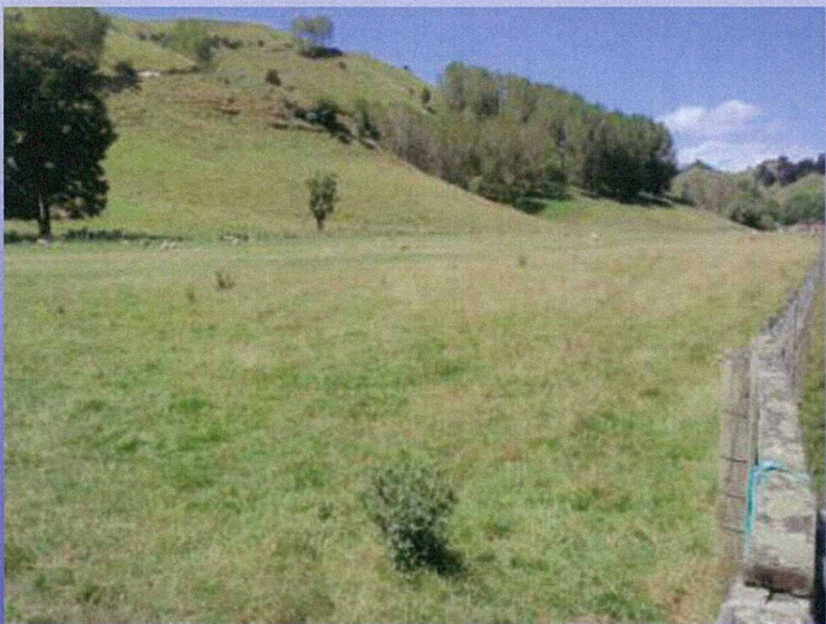
3. Modelling shows the predicted Nitrate loss from the property under an expanded irrigation set-up as 31 kg N/ha/yr, against the One Plan permissible Nitrate losses of 24 kg N/ha in year one, reducing to 18 kg N/ha in year 20 (Table 13.2). As the expanded irrigation proposal does not meet the permissible One Plan Nitrate loss limits, a restricted discretionary resource consent will be required. Any such consent will include conditions regarding the adoption of various nutrient loss mitigation options.

Irrigation Feasibility Assessment

Kawhatau Ltd

Mark Chrystall

Taihape



October 2014

1 Summary

This project has investigated the feasibility of developing an irrigation system totalling 38.3 ha on the highly productive flats of Kawhatau Ltd.

The irrigation system considered most practical involves the construction of a dam covering 4 ha with a capacity of 80,000 m^3 and purchase of a travelling irrigator and associated plant and equipment. This is estimated to require a capital investment of approximately $155,000.

It should be noted that the estimated costs are based on a desk top analysis. For accuracy and prior to any investment decision being made, it is highly recommended that an in depth irrigation system model be designed by a reputable irrigation specialist.

In this instance, the evaluation of possible benefits from irrigation are based on existing forage crops which have been developed specifically to match the overall production systems of the business. In this case irrigation is essentially an additive to the business.

This evaluation indicates that investment into irrigation has the potential to add significantly to the bottom line with a 9% and 12% return on investment. This is very promising and warrants further investigation by the owners.

The permissible N loss for the irrigated area has been calculated at 24 kg N/ha for year one, decreasing to 18 kg N/ha for year 20 from paddock scale LUC mapping. N loss from the proposed system is estimated at 31 kg N/ha using Overseer (Ver. 6.1.3) and consequently does not comply with Table 13.2 of the One Plan. Any application for a land use resource consent for irrigation to Horizons Regional Council would be treated as a Restricted Discretionary activity.

2 Table of contents

Disclaimer

3 Purpose

This Environmental Farm Plan (EFP) has been prepared for Kawhatau Ltd. located on Te Moehou (Dalghettys) Road, Kawhatau Valley. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm Overview

Kawhatau Ltd. is a 932.5 ha hill country property near Mangaweka, wintering 8249 stock units (67:33 sheep:cattle ratio) across an effective area of 893.5 ha (average 9.2 su/ha).

The property has the potential to irrigate approximately 38 ha of pasture or crops, with the development of a Travelling irrigation system with water extracted from a water storage dam. Development of the surmised irrigation system is estimated to require up to $150,000 capital investment.

5 Farm Resources and Current Enterprise

5.1 Land Resources

Kawhatau Ltd. covers a total of 932.5 ha of which 893.5 ha are estimated to be in effective pasture with 38.4 ha indigenous bush and scrub. The remaining 0.6 ha is non-productive buildings and utility areas.

The underlying geology consists of massive hard silty sandstone and massive mudstone in the hill country. The easier contoured hill country and much of the flats are predominantly covered in windblown loess and the lower river terraces consist of alluvium and alluvial gravels.

Approximately 8% of the property is flat or undulating, 12% is rolling to strongly rolling and 80% is steep to very steep hill country. Ten different Land Use Capability (LUC) units and eleven dominant soil types were identified as part of the land resource survey. Two different soils were identified on the proposed irrigation block.

The property contains over 17.0 km of waterways including the Kawhatau River and the Tunatau Stream.

5.2 The Current Farm operating System

Basic stock numbers, policies and performance levels of the current management system are outlined in the following table:

	Number	Comments
Sheep		
MA Ewes	5,500	
Breeding Rams	55	
MA Cows	190	
Cattle		
R2yr Steers	325	This varies from 300 – 350 depending on season and feed reserves
Breeding Bulls	4	
Total Stock Units	**8,249**	

The property is largely considered a breeding operation for the greater part of winter and spring. However, once lambs are weaned the limited area of flat land is utilised to finish as many lambs as possible over the summer and autumn period.

During the winter the flats, which are generally free draining, are utilised to winter 300 – 350 R2yr steers. This is achieved utilising forage crops (Fodder Beet, Italian ryegrass), pit silage and baleage.

The cropping and forage production regime employed on the flats consists of:

- 6 ha of Fodder Beet
- 10 – 15 ha of Moata Italian ryegrass
- 10 – 15 ha of Chicory
- 4 ha of Red clover
- 7 – 11 ha of Barley cereal silage

6 Proposed Irrigation System

6.1 Potential Irrigation System

Mapping indicates that at least 38.3 ha have the potential to be irrigated from a 4 ha dam (estimated size) developed in the Woolshed Flat/Spring Gully paddocks.

The irrigation system modelled comprises a Travelling irrigator system covering a maximum area of 38.3 ha. The incorporation of some K-Line irrigation pods may compliment this system.

6.2 Farm Operating System to fully capture the benefit of Irrigation

It is noted that due to a previous land owner repeatedly cropping the flats with Brassica crops, the level of Club Root disease prevalent in the soil now makes it unviable to sow such crops.

Furthermore it is acknowledged that the existing livestock and forage production system works effectively for management and as such irrigation development needs to compliment this system rather than being part of a total livestock system redesign.

The potential benefits from irrigation of the flats include:

- A greater level of production and longevity of Chicory crops
- A greater yield achieved from Fodder Beet
- A greater level of Red Clover production (use of K-Line irrigation required for this
- Establishment of Moata in January (as opposed to March) boosting overall herbage production

It should be noted that there are many different forage options and livestock policies for the flats with or without irrigation. The scenario detailed in this report is based on the owners desire to maintain a similar livestock business under irrigation and also takes into consideration the implications of Horizons Regional Council's One Plan regulations with respect to N leaching.

6.3 Livestock system on the flats under irrigation

It is proposed that a dam be built for water storage in a gully system adjacent to the flats. Dam construction is estimated to cost $25,000 and is unlikely to require an engineer's report as the dam wall will be 3 – 4 m in height.

The dam is expected to occupy an area of 4 ha and contain approximately 80,000 m^3. This represents sufficient stored water to irrigate the 38.3 ha in question to a level of 208 mm/ha. This represents a modest supply of irrigation water and should be used at critical times to assist in the establishment of crops and to supplement rainfall. There is sufficient storage of water to irrigate weekly (30mm/week) for 7 weeks.

The rate of dam recharge is estimated to be 173 m^3/day and will provide some additional irrigation during the course of the season. The catchment area for the dam is significant and should there be a substantial rainfall event occur during the summer or autumn, the dam will recharge quicker.

The response rate to irrigation water varies depending on the crop being irrigated and the severity of moisture limitation caused by lack of rainfall. It is known that low water efficiency crops such as pasture will produce approximately 12 kgDM/mm of irrigation water while high efficiency crops such as Lucerne will produce 25kg DM/mm of irrigation water. This range in response rates forms the basis for evaluation of irrigation in this study.

- Chicory – 25:1 response

  An opportunity to finish and additional 36 lambs/ha may be created from irrigation representing an increase in net revenue of $720/ha of Chicory.

  Area Modelled – 12.4 ha = $9,000

- Fodder Beet – 25:1 Response

  It is estimated that with the application of irrigation water at critical stages of crop development that an additional 10,000 kgDM/ha may be produced. Based on a value of Dry Matter of $0.35/kgDM, this may add $3,500/ha to the value of the crop.

  Area Modelled – 6.0 ha = $21,000

- Moata – Establishment in January

  Following the harvesting of Barley Cereal silage and with the use of irrigation, it will become possible to establish Moata Italian ryegrass in January. This is likely to produce a further 3000 – 4000 kgDM/ha over the summer and autumn period. This high quality finishing feed should be capable of allowing a further 53 lambs/ha to be finished over this period representing an improvement in financial performance of $1,065/ha

  Area Modelled – 14.5 ha = $15,450

That is the direct benefit of irrigation as outlined may equate to an additional $45,450. This excludes any benefit that may occur in other livestock on the farm as a result of being able to stock more lambs on the irrigated area over the summer and autumn.

If a situation arises whereby surplus water is stored, it could be sold to neighbours wishing to irrigate.

6.4 Non irrigated areas

Management of the area outside of that considered for irrigation remains unchanged from the status quo.

6.5 Possible issues or risks associated with this irrigation scenario

There are few operational risks associated with this irrigation opportunity. The most significant is that of dam wall failure. Should this occur substantial damage to property may result downstream (Wool shed and houses) with the possibility of loss of livestock and harm to humans.

6.6 Irrigation Costs

In the modelling undertaken for the farm, the capital cost of irrigation establishment (dam, pump, feed pipes and Travelling Irrigator) has been estimated to be up to $150,000. The annual operating expenses (maintenance, pump fuel, power) are predicted to be $10,000 - $15,000.

For the purposes of this report, it is estimated that up to 200 mm of irrigation water will be applied annually between December and April.

No estimation of costs associated with re-subdivision or the re-reticulation of stock water on the flats has been made in this investigation. This cost may be significant and should form part of a further in-depth feasibility investigation.

6.7 Implications of Irrigation on Existing Farm System

A balance between production and profitability levels must be reached with the nutrient restrictions imposed by Horizons Regional Council's One Plan (Table 13.2). To this end the forage production system detailed seeks to find this balance.

Adoption of an irrigation system should not be considered a drought management tool (although it is very useful in droughts as a tool to protect baseline productivity), but rather an opportunity to develop and diversify the business for greater financial reward. Typically in order to derive an acceptable return on investment from irrigation new and often novel farm systems need to be developed. These often require the acquisition of new skills and knowledge.

6.8 Financial Benefits of Irrigation

In this case, and under the parameters used, the investment into irrigation of the flats may result in a positive impact on the Net Benefit of the business. This is shown in the table below where the Net Benefit may vary from $13,700 to $18,700 representing a Return on Investment of between 9% and 12%.

The table below looks at the possible net benefit from growing more forage for lamb and steer production systems:

	$$
Irrigation Area	38.3 ha
Additional Income from Chicory	$9,000
Additional Income from Fodder Beet	$21,000
Additional Income from Italian ryegrass	$15,450
Additional Income	**$45,450**
Additional Costs	
Labour	$2,500
Irrigation Power/R&M	$10,000 - $15,000
Direct Expenses	$12,500 - $17,500
Interest on Irrigation Investment (6.5%)	$10,075
Depreciation (4% over 20 yrs)	$4,181
Net Benefit to the business	**$13,700 - $18,700**
Return on Investment	**9% to 12%**

This table highlights a very positive financial response to the investment into irrigation is possible given the parameters used in this evaluation.

Under a different management system the economics of developing an irrigation system may show a more positive outcome. In addition there may be some benefit to the capital value of the property as a direct result of irrigation development.

6.9 The permissible Nitrogen loss Limits

Conversion to irrigation requires the change in land use to meet the permissible N loss limits under Table 13.2 of Horizons Regional Council's One Plan.

The following table summarises the permissible N loss limits for 38.3 ha under irrigation for sheep and beef.

Year	Irrigated area	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	919	24
5	804	21
10	728	19
20	689	18

The quantity of N that the irrigated land is permitted to lose via leaching is 24 kg N/ha/yr (or 919 kg N) for year one and this decreases to 18 kg N/ha/yr (or 689 kg N) for year twenty.

6.10 N Loss calculations

The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3).

Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Trading stock on Irrigated Block	24	21	19	18	31

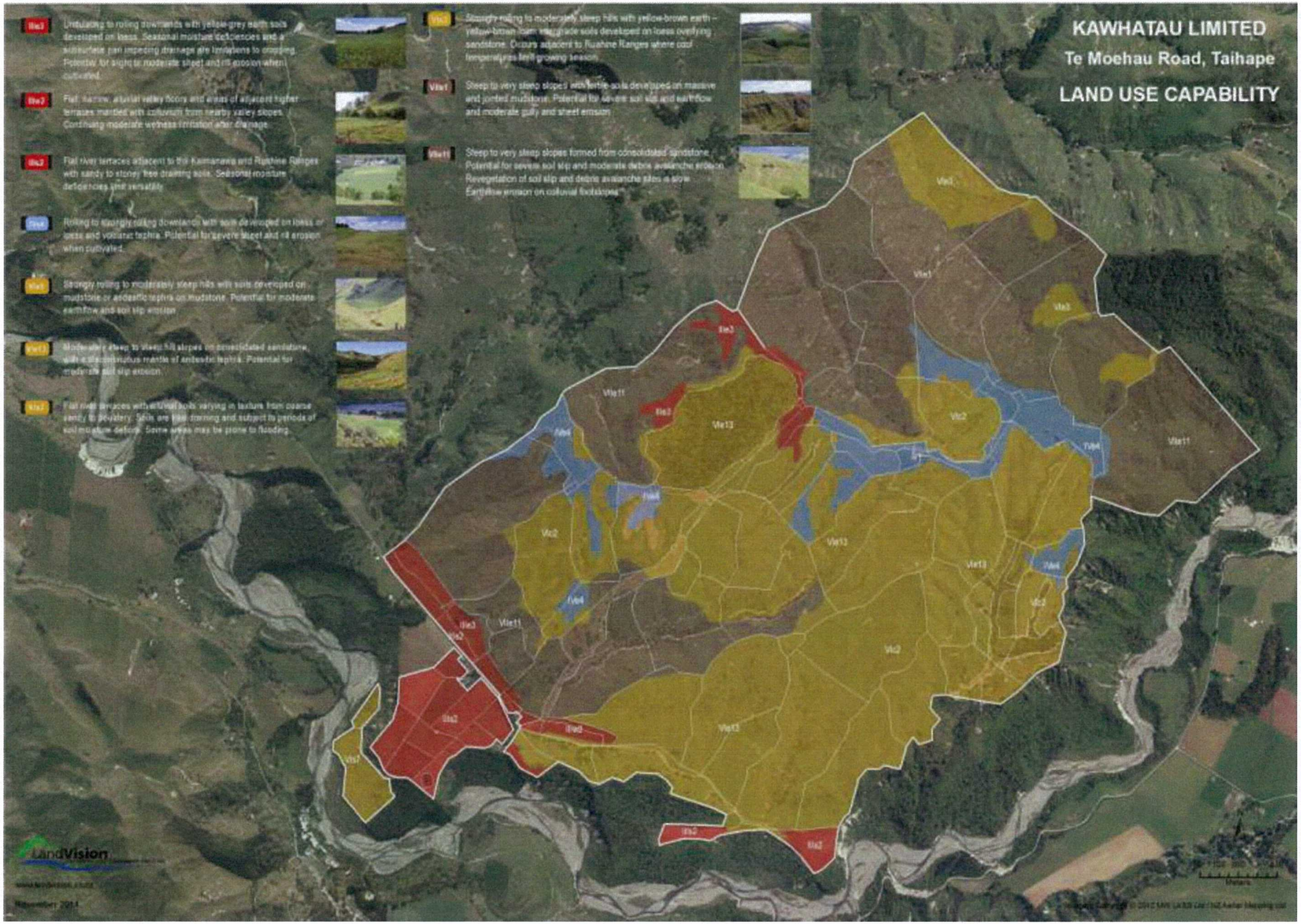
The permissible N loss for the irrigated area is 919 kg N (24 kg N/ha) for year one, decreasing to 689.4 (18 kg N/ha) for year 20. Overseer (Ver. 6.1.3) was used to determine the N loss from the irrigated areas. Under the proposed scenario the irrigated land is leaching 31 kg N/ha (1,202 kg N) and consequently does not comply with Table 13.2 of the One Plan. Any application for land use resource consent for irrigation would be treated as a Restricted Discretionary activity.

7 Appendix 1: Maps

7.1 Paddock Map

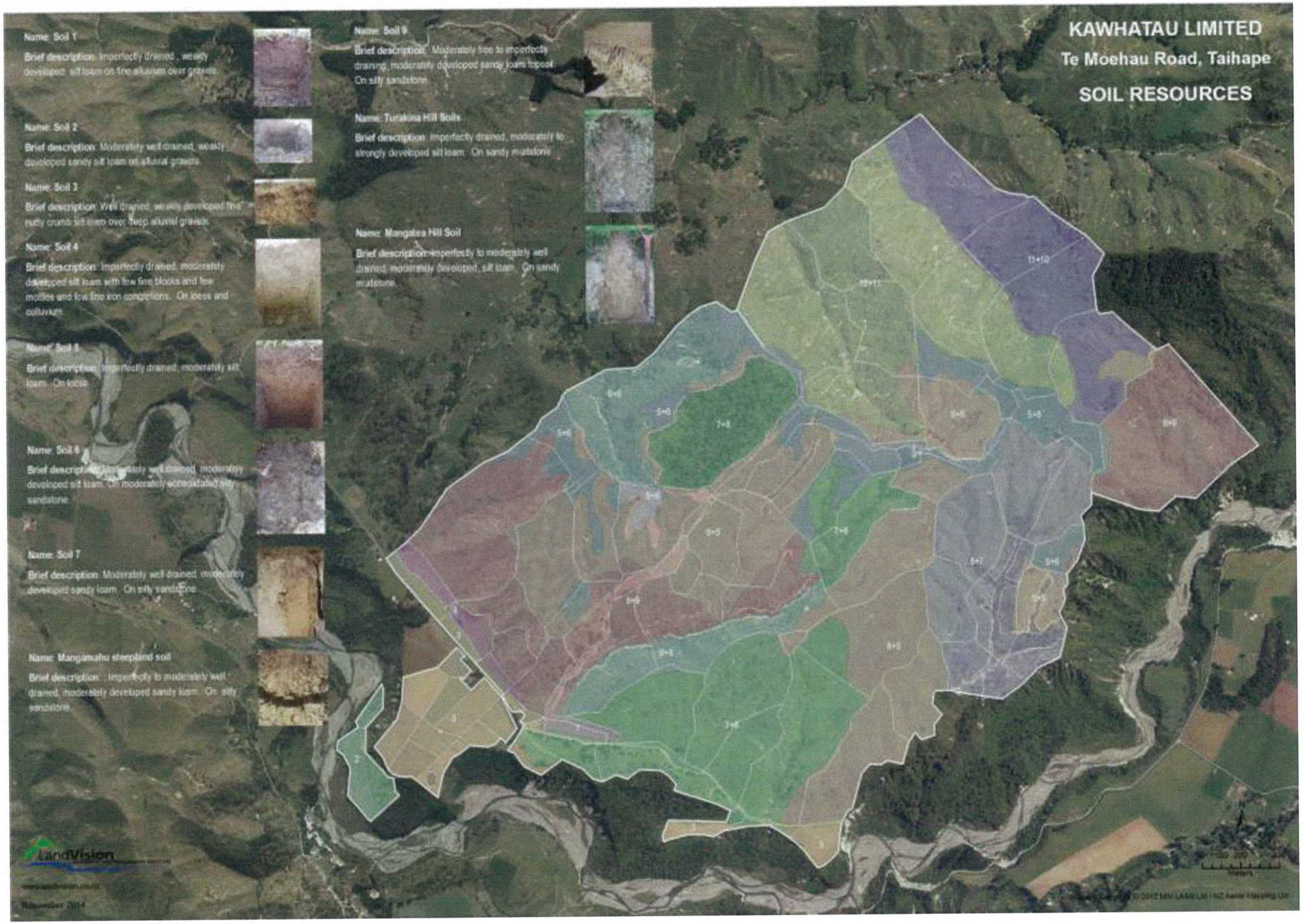
9

7.2 Landuse Capability Map



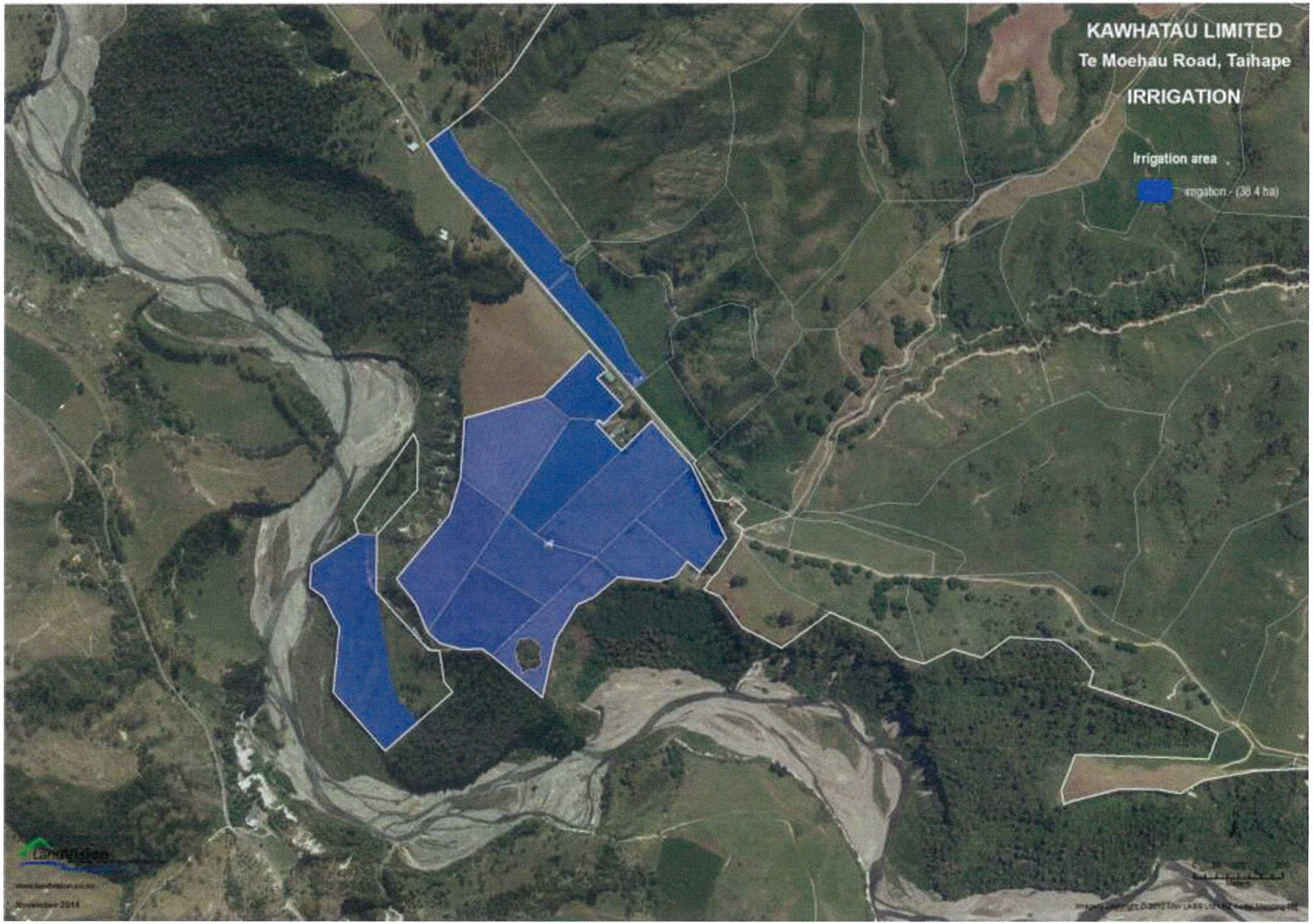
10

7.3 Soils Map



KAWHATAU LIMITED
Te Moehau Road, Taihape
SOIL RESOURCES
Name: Soil 1
Brief description: Imperfectly drained, weakly developed silt loam on fine alluvium over gravels.
Name: Soil 2
Brief description: Moderately well drained, weakly developed sandy silt loam on alluvial gravels.
Name: Soil 3
Brief description: Well drained, weakly developed fine nutty crumb silt loam over deep alluvial gravels.
Name: Soil 4
Brief description: Imperfectly drained, moderately developed silt loam with few fine blocks and few mottles and few fine iron concretions. On loess and colluvium.
Name: Soil 5
Brief description: Imperfectly drained, moderately silt loam. On loess.
Name: Soil 6
Name: Soil 7
Brief description: Moderately well drained, moderately developed sandy loam. On silty sandstone.
Name: Mangamahu steepland soil
Brief description: Imperfectly to moderately well drained, moderately developed sandy loam. On silty sandstone.
Name: Soil 9
Brief description: Moderately free to imperfectly draining, moderately developed sandy loam topsoil. On silty sandstone.
Name: Turakina Hill Soils
Brief description: Imperfectly drained, moderately to strongly developed silt loam. On sandy mudstone.
Name: Mangatea Hill Soil
LandVision
November 2014

7.4 Irrigation Map



12

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Heaton Park (Simpson) summary detailed irrigation case study

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Report No 2014/011(B)

17 November 2014

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In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
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Totman	Sheep/beef	Utiku	No
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Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A summary case study has been prepared for Heaton Park, owned by the Simpson family. The property is located on State Highway 3, north of Bulls. This case study has been prepared to assess the opportunities, costs, and on-farm implications of introducing irrigation to the property.

Heaton Park is a 938 ha sand country property wintering 7,695 stock units (57:43 sheep:cattle ratio) across an effective area of 786 ha (average 9.8 su/ha). The property has the potential to irrigate nearly 120 ha of pasture or crops, with the development of a lateral irrigation system with water extracted from a bore. Development of the proposed irrigation system is estimated to require up to $355,000 of capital investment.

The case study is presented at Annex A.

3 Findings

Key findings from the Heaton Park case study were:

1. The irrigation system considered most practical to develop the productive flats on Heaton Park was a Travelling irrigator, supplemented by pods, abstracting water from a 4 ha dam constructed on the property. The estimated cost of this set-up is $355,000. The property has a further 103 ha that are suitable irrigation, but due to the lack of a reliable electricity supply, this additional area was not considered as part of this analysis.

2. Financial analysis indicates investment in additional irrigation will be economically rewarding. After adjustments for depreciation and the cost of capital, it is estimated business profitability will improve by $135,000-$167,000 annually, at a Return on Capital of 35-43%.

3. Modelling shows the predicted Nitrate loss from the property under an expanded irrigation set-up as 62 kg N/ha/yr, against the One Plan permissible Nitrate losses of 24 kg N/ha in year one, reducing to 18 kg N/ha in year 20 (Table 13.2). As the expanded irrigation proposal does not meet the permissible One Plan Nitrate loss limits, a restricted discretionary resource consent will be required. Any such consent will include conditions regarding the adoption of various nutrient loss mitigation options.

Irrigation Feasibility Assessment

Heaton Park

Phil & Dougal Simpson

State Highway 3

BULLS

October 2014

1 Summary

This project has investigated the feasibility of developing an irrigation system totalling 119 ha on sand country flats and very low dunes for Heaton Park near Bulls.

The irrigation system considered most practical is a combination of two travelling irrigators which is estimated to cost between $280,000 and $355,000 to install and cover an area of 119 ha. In the financial assessment of this opportunity the higher of these two estimated values is used. It should be noted that the estimated costs are based on a desk top analysis. For accuracy and prior to any investment decision being made, it is highly recommended that an in depth irrigation system model be designed by a reputable irrigation specialist.

To maximise the opportunity from irrigation requires management to consider alternative livestock management systems. With the aid of irrigation and further investment into a Lucerne forage production system, it is estimated that 16,000 kg DM/ha of high quality feed can be produced annually on the irrigated block. In this instance, the scenario of finishing an additional 1650 hoggets and wintering an additional 175 R1yr steers on a lucerne, rape and green feed oats rotation was investigated.

Under the system modelled the net annual benefit to the business is estimated to range from $135,000 to $167,000 after the capital cost of the investment into irrigation and Lucerne establishment and depreciation is made. The Return on Investment has been calculated at 35% to 43%. This is considered a worthwhile development to maximise the financial returns to the business whilst paying attention to the environment.

With respect to the N loss under the Horizons Regional Council One Plan, the property is in a priority catchment and if it does not meet Table 13.2 (the permissible N loss limits) then it would be treated as a restricted discretionary consent. Calculations using Overseer (Ver. 6.1.3) show that the predicted N loss from the proposed system is 62 kg N/ha/yr and the permissible N loss limit is 24 kg N/ha for year one, decreasing to 18 kg N/ha for year 20. This means that the proposed system under irrigation does not meet Table 13.2 of the One Plan and Horizons Regional Council. Any application for a land use resource consent for irrigation to Horizons Regional Council would be treated as a Restricted Discretionary activity.

2 Table of contents

3 Purpose

This Environmental Farm Plan (EFP) has been prepared for Heaton Park located on State Highway 3 north of Bulls. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm Overview

Heaton Park is a 938.3 ha sand country property near State Highway 3 north of Bulls producing an average of 6500 – 7000 of pasture dry matter/ha/yr and wintering 7,695 stock units (57:43 sheep:cattle ratio) across an effective area of 785.6 ha (average 9.8 su/ha).

The property has the potential to irrigate nearly 119.6 ha of pasture or crops, with the development of a lateral irrigation system with water extracted from a bore. Development of the surmised irrigation system is estimated to be up to $355,000 capital investment.

5 Farm Resources and Current Enterprise

5.1 Land Resources

Heaton Park covers a total of 938.3 ha of which 785.6 ha are effective, 91.3 ha is exotic forestry (including cutover), 17.3 ha of indigenous bush and scrub, 1.5 ha of exotic trees, 12.3 ha of non-effective pasture and wetland species and 23.4 ha of coastal lake. The remaining 6.9 ha is non-productive races, laneways, buildings and utility areas. The property is located in the Southern Whanganui Lakes Catchment (West_5) and contains Lake Heaton. This is a high priority catchment under the Horizons One Plan.

The underlying geology on the eastern boundary consists of an old uplifted marine terrace covered with loess. The bulk of the property is formed from a complex of sand dunes and sand plains. Some of the wetter sand plains may be formed from peat material. The sand country is relatively young and generally less than 1-2,000 years old. The age of the sand dunes reflects the depth of topsoil present and dictates the soil types found on the dunes. The soils of the sand plains are determined by the depth to the watertable and the drainage characteristics.

Nearly 60% of the property is flat or undulating with small areas of steeper country, 6% rolling to strongly rolling, 25% strongly rolling to moderately steep hill country, 23% strongly rolling to moderately steep country, and 9% moderately steep to steep country. The remaining area is the coastal lake. Potentially these figures will change if any re-contouring work is undertaken as part of the irrigation conversion.

Thirteen different Land Use Capability (LUC) units and 11 dominant soil types were identified as part of the land resource survey. Seven soils were identified on the proposed irrigation block. These are likely to change significantly where re-contouring work is required.

The property has distinctive wet and dry soils. The wet soils are considered summer safe whilst the dry soils are generally safe from pugging and treading damage. The dry soils can be prone to wind erosion if the vegetative cover is removed. The wet soils are prone to pugging and treading damage.

The property contains over 6.5 km of waterways. These include 4.7 km of secondary streams, 1.6 km of ephemeral waterways and 0.2 km of drains. Lake Heaton is about 23 ha in size.

5.2 The Current Farm operating System

Basic stock numbers, policies and performance levels of the current management system are outlined in the following table:

	Number	Comments
Sheep		
MA Ewes	1500	
2 Tooth's	400	
Ewe Hogget's	1170	
Winter finishing Hogget's	1260	
Breeding Rams	18	
Cattle		
MA Cows	192	
R2yr Hfrs	98	67 In calf and 31 trading heifers
R1yr Hfrs	127	
R2yr Steers	13	
R1yr Steers	144	
R3yr Heifers	11	
Breeding Bulls	7	
Total Stock Units	**6639**	

With Heaton Park containing a range of soils types from dry sand country to high quality Marton soils, management has a wide range of options that can be employed. In addition, a hill country farm (Brooklands) is owned by the business. This property is the primary breeding farm with surplus lambs and cattle moving to Heaton Park for finishing as feed becomes available.

The basic objective of the Romney breeding ewe flock is to produce as many lambs as possible for finishing. The 1500 ewes wintered on Heaton Park are older stock and are mated to a terminal sire ram.

Replacement ewe Lambs are wintered on Heaton Park with the best 600 being mated.

A herd of Hereford, South Devon and Angus cross cows (3 way breeding cross) in maintained on the property. Steers produced from the herd are sold as yearlings in the Feilding spring sale (November) at 350 – 400 kg Lwt.

Replacement heifers are mated as yearlings with surplus heifers finished local trade at 220 kg Cwt.

The Brooklands breeding farm winters 2800 ewes and 50 breeding cows.

6 Proposed Irrigation System

6.1 Potential Irrigation System

Mapping indicates that approximately 119 ha of flats located close to the woolshed have the potential to be irrigated. A further 103 ha of the farm located at the Western end of the property also have the potential to be irrigated, however given the distance from a power source and the possible need to smooth off dunes (earthworks) it has not been considered at this level of investigation.

There are numerous resource optimisation scenarios that could be adopted by the owners such is the flexibility offered by the soil characteristics, climate and irrigation of sand country. Not all of these scenarios can be modelled and presented in this document.

Essentially the scenario investigated looks at the potential returns from irrigating 119 ha of flats located handy to facilities.

6.2 Farm Operating System to fully capture the benefit of Irrigation

It is suggested that the 119 ha adjacent to the woolshed be established in Lucerne for intensive livestock finishing and the conservation of baleage (approximately 68 TDM) for use as winter supplementary feed.

Basic stock numbers, policies and performance levels of the proposed management system are outlined in the following table:

	Breeding Unit	**Irrigation Unit**	**Comments**
MA Ewes	1500		
2 Tooth's	400		
Ewe Hogget's	1170		
Winter Hogget's	500	1650	500 hogget's may form part of the 1650 that are traded off the rape crop
Rams	20		
Sheep SU	**3135**	**1320**	
MA Cows	200		
R2yr Hfrs	50		
R1yr Hfrs	60		
R1yr Strs	320		Move onto GF Oats 1 July. Approximately 110 will be sourced from progeny born on the farm.
Breeding Bulls	10		
Cattle SU	**3240**		
Total SU	**6375**	**1320**	**Total SU 7695**
Sheep:Cattle	**57:43**		

With the development of 119 ha under irrigation there will be an opportunity to intensify the forage production level on the target area. To fully capture the benefit of irrigating this block it is suggested that:

- 85 ha is established in Lucerne
- 17 ha in Rape (winter feed for trade hogget's)
- 17 ha in GF Oats (winter feed for R1yr steers)

The reasons for Lucerne establishment include:

- Volume of high quality forage able to be grown in the environment with the addition of irrigation
  - The potential to grow 25 TDM/ha/yr
  - In the model presented, utilisation of 16 TDM/ha is used
- The water use efficiency of Lucerne is approximately double that of pasture
- Lucerne as a forage is very palatable to all livestock due to its high digestibility, energy and protein levels
- Lamb liveweight gains on Lucerne typically range from 200 to 350 grams/hd/day enabling rapid turnover/finishing or trading of lambs to occur

Whilst it is possible for Lucerne stands to persist for 10 – 15 years under optimum conditions, for the purposes of this investigation it is assumed that Lucerne is renewed on a 7 year cycle. This allows the establishment of green feed Oat crops for winter (feed for steers) and Rape crops for winter trade hogget's. This cropping programme allows areas to be spelled from Lucerne for 18 months. An alternative strategy may be to remove the Lucerne crop in spring and replace it with either Rape or Kale for the following winter. After this crop it could be re-sown into Lucerne giving a break period of 12 months. Weed and pest management may not be as effective under this regime.

As a Lucerne crop requires replacement, it can be sprayed out and established into green feed Oats in the autumn. It is proposed that the GF Oats be grazed by 320 R1yr Steers (or bulls) from July through August (supplemented with 2 kgDM/hd/day of Lucerne silage).

The herd of steers will be sourced from those bred on the farm (approximately 110) with the remainder purchased in the autumn. Assuming a weaning liveweight of 220 kg, these steers should start the crop at approximately 245 kgLwt. Over a 2 month period and a liveweight gain of 0.8 kg/d, they should be around 295 kgLwt. In September the Lucerne should be available for grazing by the steers. Based on a stocking rate of 3/ha and liveweight gain of 1.6 kg/day, it should be possible to sell the steers from early Nov at 400 - 450 kgLwt.

The Rape crop suggested would be sown November/December and grazed from late June by 1650 winter trade hogget's. It should be possible to finish these hogget's on the crop by the end of August/early September. Lucerne is then able to be re-established in mid to late September.

This new Lucerne crop requires careful management in its first season and as such it is recommended that it is first cut for baleage prior to being grazed on rotation by lambs.

In November as the steers are sold they can be replaced by ewes with lambs at foot until weaning in early December (approximately 1530 ewes plus 2050 lambs based on 135% lambing from ewes). As ewes move off the Lucerne following weaning room becomes available for lambs bred on the dryland part of the property to be grazed on Lucerne.

From December onwards up to 4,250 lambs can be grazed on the Lucerne (50/ha) under a rotational grazing regime. The monthly grazing totals are outlined in the following table:

Month	Number
Dec	4,250
Jan	4,250
Feb	5,000 (as new Lucerne crop becomes established)
Mar	5,000
Apr	4,000
May	3,000
June	0
July	0
Aug	0
Sept	320 Steers
Oct	320 Steers
Nov	1,530 ewes and 2050 lambs

In late May or early June the Lucerne needs to be given a hard graze and sprayed for insects and weeds. During June and July Lucerne will largely be dormant with new growth starting to appear in August. First grazing in the spring should occur early to mid-September.

It should be noted that there are many different forage options and livestock policies for the sand country with or without irrigation. The scenario detailed in this report is based on the owners desire to maintain a livestock business under irrigation and also takes into consideration the implications of Horizons Regional Council's One Plan regulations with respect to N leaching.

6.3 The breeding block

Essentially the remainder of the farm can be considered the "Breeding Block" and should be capable of supporting the following livestock:

Stock Class	Number	Notes
MA Ewes	1500	Producing 135% lambing
Two Tooth Ewes	400	
Ewe Hogget's	1170	Producing 30% lambing
Winter Trade Hogget's	500	
Rams	20	
Sheep Stock Units	**3,962**	
MA Cows & R2yr Heifers	250	Producing 90% calving
R1yr Heifers	60	
Breeding Bulls	10	
Cattle Stock Units	**1,200**	
Total Stock Units	**5,162**	
Stocking Rate (su/ha)	**7.7**	

With the relocation of 320 steers onto the irrigated block in early July it is anticipated that sufficient room will be available to winter a higher number of breeding cows than is currently run.

6.4 Possible issues or risks associated with this irrigation scenario

The possible issues or risks associated with this scenario include:

- Livestock are known to suffer from bloat on Lucerne. However with sound grazing management practice (following best practice methods) it is possible to avoid this. In addition adding bloat oil to water troughs or using Rumensin capsules can be used to mitigate the risk
- Under poor management weed and insect pests can have a major influence on the forage quality and volume produced. Best management practices are recommended
- Grazing Lucerne in very wet conditions can lead to plant damage reducing the longevity of the crop

With such a large number of lambs being traded, careful attention to animal health and in particular internal parasite management is recommended. A close relationship with the owner's veterinarian is suggested. Taking time to identify lamb suppliers operating sound animal health programmes is warranted.

6.5 Irrigation Costs

The capital cost of irrigation establishment is estimated to be up to $355,000 (pump, power setup, feed pipes and 2 travelling irrigators). The annual operating expenses (maintenance, pump fuel, power) are predicted to be $50,000 - $55,000.

The cost of establishing a water source is unknown and could be in the vicinity $25,000 to $100,000. Test drilling is recommended to determine availability of water.

On a per hectare basis the establishment cost of irrigation on 119 ha is likely to range from $280,000 to $355,000 ($2,350-$3,000/ha). If hydraulic booms are deemed necessary for the travelling irrigators (due to strong winds), the cost may increase by a further $80,000.

For the purposes of this report, it is estimated that up to 600 mm of irrigation water will be applied annually, between November and April.

It is noted that in most cases farmers choose to irrigate the largest possible area whether this is their initial intention or as a result of the financial benefits identified from irrigating a smaller area to begin with. It is therefore recommended that infrastructure be established at the outset to ensure the entire area available is irrigated. This will avoid costly additional infrastructural expenditure in the future to extend an existing system.

Importantly, the capital cost of developing the forage production system should be noted as approximately $132,600 (to establish 102 ha of Lucerne). This could be established in year one of the system change or spread over a seven year period.

Additional labour will be required and is estimated to be $10,000 for shifting irrigators and a further $35,000 for the employment of a shepherd associated with livestock management.

No estimation of costs associated with re-subdivision or the re-reticulation of stock water has been made in this investigation. This cost may be significant and should form part of a further in-depth feasibility investigation.

Soil fertility issues need to be considered as part of the proposed system.

6.6 Financial Benefits of Irrigation

The financial benefits associated with the irrigation of 119 ha is based on the current carrying capacity of approximately 7.5 su/ha. From this it can be estimated that the area in question produces approximately 6,500-7,000 kgDM/ha of average quality feed annually.

With the aid of irrigation and further investment into a Lucerne forage production system, it is estimated that 16,000 kgDM/ha of high quality feed can be produced annually. Such forage production will allow the livestock system outlined above to be adopted on the property. The net benefit to the business is estimated to range from $135,000 to $167,000 after the capital cost of the investment into irrigation and Lucerne establishment and depreciation is made. This represents a fantastic return on investment of **35 – 43%.**

The table below represents a partial budget of the proposed system.

	$$
Irrigation Area	119 ha
Net Income from Winter Hogget's	$57,750
Net Income from additional Steers	$66,150
Net Income from Lamb Trading	$252,960 - $295,800
Net Increase in Income	$376,800 - $419,700
Lost Income from existing operation	$30,345 - $40,950
Additional Costs	
Additional Cropping costs	$39,100
Fertiliser	$30,000
Spray	$15,000
Labour	$45,000
Irrigation Power/R&M	$50,000
Direct Expenses	$179,100
Interest on Irrigation Investment (6.5%)	$16.575
Interest on Lucerne Crops (6.5%)	$8,619
Depreciation (4% over 20 yrs)	$6,880
Net Benefit to the business	**$135,000 -$167,000**
Return on Investment	**35 – 43%**

In this instance it is assumed that 102 ha of Lucerne is established in the first year maximising the possible return on investment. In reality it is recommended that Lucerne is established and the new system be developed over a 3 – 5 year period to:

- Minimise risk of crop failure
- Develop the skills to operate the new system under best management practice
- Obtain a supply of quality lambs for trading over the summer and winter

The current livestock system on the area identified for irrigation revolves around lambing ewes and calving cows at approximately 7.5 su/ha (4 ewes/ha and 0.55 cows/ha). The Gross Income from this system is estimated to range between $555 and $650/ha with direct expenditure of approximately $300/ha. This generates a farm surplus per hectare of $255 - $350/ha.

As such, the opportunity cost of changing the land use, to incorporate irrigation and a Lucerne forage production system, amounts to approximately $30,345 - $40,950.

Effectively this indicates the system outlined has the potential to add $135,000 - $167,000 to the profitability of the business.

6.6 Assumptions used

The assumptions used include:

- 119 ha irrigated
- 102 ha of Lucerne over the summer months
- 17 ha of Rape for winter hogget finishing
- 17 ha of green feed Oats to winter 320 steers
- Steers gain an average of 180 kgLwt prior to sale in November
- Steer live weight value of $2.10/kg gained
- The Lucerne crops provide enough high quality feed to finish 124 – 146 lambs/ha
- Lamb trading margin of $20/hd
- Winter trade hogget margin of $35/hd

6.7 The permissible Nitrogen loss Limits

The permissible N loss is calculated from the area of LUC classes under irrigation for sheep and beef properties. Further to this, irrigated dry sand country has the opportunity to have the LUC classification reclassified as the dominant limitation of erosion is significantly reduced. The following table summarises the permissible N loss limits under irrigation for sheep and beef with the LUC units reclassified as if under permanent irrigation.

Year	Irrigated area	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	2,868	24
5	2,510	21
10	2,270	19
20	2,151	18

The quantity of N that the irrigated land is permitted to lose via leaching is 24 kg N/ha/yr (or 2,868 kg N) for year one, decreasing to 18 kg N/ha/yr (or 2,151 kg N) in year twenty.

6.8 N Loss calculations

The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3) for the different landuse options.

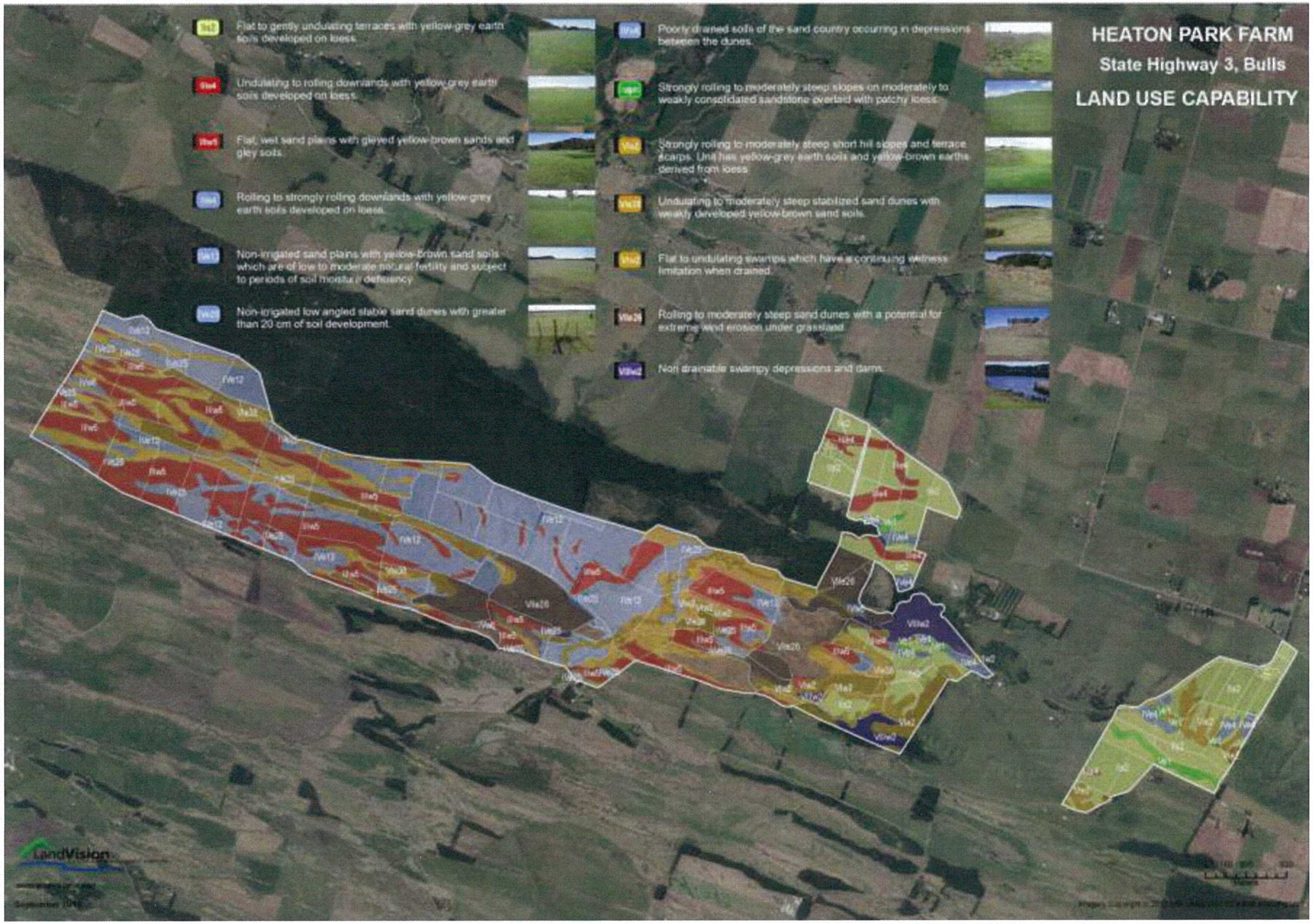
Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Trading stock on Irrigated Block	24	21	19	18	62

The permissible N loss for the irrigated area is 2,868 kg N (24 kg N/ha) for year one, decreasing to 2,151 (18 kg N/ha) for year 20. Overseer (Ver. 6.1.3) was used to determine the N loss from the irrigated areas. It is estimated the irrigated area is leaking **7,410 kg N/yr (62 kg N/ha/yr)**. Consequently the proposed system under irrigation does not comply with Table 13.2 and Horizons Regional Council would treat any consent application as a Restricted Discretionary activity.

7 Appendix: Maps

7.1 Subdivision Map

7.2 Landuse Capability Map



7.3 Soils Map


HEATON PARK FARM
State Highway 3, Bulls
SOIL RESOURCES
Name: Marton silt loam
Soil map symbol: Ma
Brief description: Imperfectly to poorly drained, moderately to weakly developed, sandy silt loam with few low chroma mottles and iron concretions. On loess and colluvium.
Name: Raumati silt loam
Soil map symbol: Rt
Brief description: Poorly drained, weakly developed, sandy clay loam with many orange mottles and few iron concretions. On colluvium derived mudstone and alluvium.
Name: Halcombe silt loam
Soil map symbol: Hc
Brief description: Imperfectly to poorly drained, moderately developed, sandy silt loam. On loess.
Name: Halcombe hill soil
Soil map symbol: HaH
Brief description: Imperfectly to poorly drained, moderately developed silt loam. On loess over massive sandstone or siltstone.
Name: Pukepuke black sand.
Soil map symbol: P
Brief description: Imperfectly drained, weakly developed, loamy sand. On windblown sand.
Name: Carnarvon fine sandy loam.
Soil map symbol: C
Brief description: Poorly drained, weakly developed, sandy loam with low orange and grey mottles sandy loam with many orange and grey mottles. On windblown sand and alluvium
Name: Omanuka peaty sandy loam, shallow phase.
Soil map symbol: Om
Brief description: Poorly drained, weakly developed, sandy loam with few to many brown mottles. On peat.
Name: Himatangi sand
Soil map symbol: Hm
Brief description: Well drained, weakly developed, sandy loam. On windblown sand.
Name: Foxton brown mottled sand.
Soil map symbol: F1
Brief description: Well drained, weakly developed, loamy sand. On windblown sand.
Name: Foxton black sand.
Soil map symbol: F
Brief description: Well drained, weakly developed, loamy sand. On windblown sand.
Name: Waitarere series.
Soil map symbol: W
Brief description: Excessively well drained, structureless, loamy sand. On windblown sand.
LandVision

7.4 Irrigation Map

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Kaiangaroa Station (Marshall) summary irrigation case study

Report prepared as part of the
Rangitikei Strategic Water Assessment project,
jointly funded by Rangitikei District Council and the
Ministry for Primary Industries (Irrigation Acceleration Fund)

Rangitikei
Unspoilt...

Ministry for Primary Industries
Manatū Ahu Matua

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The Catalyst Group wishes to thank the following for their contribution to the production of this report:

- Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund) for supporting the Rangitikei Strategic Water Assessment project
- David Marshall for allowing us to use the property as a case study for this project, and for giving of his and his staff's time and farm enterprise data so freely
- Lachie Grant of Landvision Ltd and Greg Sheppard of Sheppard Agriculture for undertaking the case study analysis

Report No 2014/012(B)

17 November 2014

1 Introduction

The Rangitikei district is heavily reliant upon the primary sector for its economic and social well-being. This sector is founded upon the district's topography, soils, climate, water resources, and farmer innovation. However, the district's water resource is coming under increasing pressure from irrigators, and the impacts of droughts.

In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A summary case study has been prepared for Kaiangaroa Station, a MyFarm partnership property manager by David Marshall. The property is located on Matawhero Road, east of Taihape. This case study has been prepared to assess the opportunities, costs, and on-farm implications of developing irrigation on the property.

Kaiangaroa Station is a 1277 ha hill country property, wintering 11,626 stock units (76:24 sheep:cattle ratio) across an effective area of 1191 ha (average 9.7 su/ha). The property has the potential to irrigate approximately 86.2 ha of pasture or fodder crops, with the development of a Travelling irrigator/K-line system or just a K-line system, with water abstracted from a water storage dam. Development of the proposed irrigation system is estimated to require between $255,000 and $345,000 of capital investment.

The case study is presented at Annex A.

3 Findings

Key findings from the Kaiangaroa Station case study were:

1. The irrigation systems considered most practical to develop the productive flats on Kaiangaroa Station were a Travelling irrigator/K-line set-up or a K-line set-upwith water abstracted from 2 water storage dams constructed on the property. The estimated cost of these two set-ups ranges between $255,000 and $345,000.

2. Financial analysis indicates investment in irrigation is marginal. After adjustments for depreciation and the cost of capital, it is estimated business profitability could change by between -$21,000 and $15,500, with a Return on Capital varying between -6% and 6%.

3. Modelling shows the predicted Nitrate loss from the property under an irrigation set-up as 11 kg N/ha/yr, against the One Plan permissible Nitrate losses of 18 kg N/ha in year one, reducing to 13 kg N/ha in year 20 (Table 13.2). As such, the proposed irrigation system meets the permitted limits in the One Plan, so would be processed as a Controlled activity.

Irrigation Feasibility Assessment

Kaiangaroa Station

Marshall

Taihape

October 2014

1 Summary

This project has investigated the feasibility of developing an irrigation system totalling 86.2 ha on the highly productive easy rolling country of Kaiangaroa Station.

This irrigation system will require the investment into either a combination of a Travelling irrigator and K-Line system or just a K-Line system with water extracted from two dams to be constructed on the farm. An alternative option being considered is that of drilling a well of up to 130 m in depth. For the purposes of this report consideration is limited to that of the construction of two water storage dams. Development of the surmised irrigation system is estimated to require between $255,000 and $345,000 of capital investment.

Financial analysis of irrigation shows that it represents a marginal gain in financial performance at best. In fact depending on the irrigation system developed and response to the limited amount of water available, the economic performance may range from -$21,065 to $15,545 representing a possible return on investment of between -6% and 6.1%. This evaluation of irrigation on Kaiangaroa Station does not look at possible benefits to livestock outside of the area considered for irrigation which may be significant.

The management proposed under this irrigation scenario meets the permissible N loss limits under Table 13.2 of the Horizons Regional Council One Plan as calculated using Overseer and paddock scale LUC mapping.

2 Table of contents

Disclaimer

Whilst LandVision Ltd and Sheppard Agriculture Ltd have taken all care to ensure the accuracy of the information supplied in this document, the company(s) take no responsibility for any actions the recipient of this report may make in respect to this information. LandVision Ltd and Sheppard Agriculture Ltd shall not be liable for any act, matter or thing, or any accident, loss or damage arising out of or suffered as a result of the use or misuse of this information or any action taken or not taken in reliance upon the validity of such information.

3 Purpose

This Environmental Farm Plan (EFP) has been prepared for Kaiangaroa Station located near Taihape. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm Overview

Kaiangaroa Station is a 1276.6 ha hill country property near Taihape, wintering 11,626 stock units (76:24 sheep:cattle ratio) across an effective area of 1191.1 ha (average 9.7 su/ha).

The property has the potential to irrigate at least 86.2 ha of pasture or crops, with investment into either a combination of a Travelling irrigator and K-Line system or just a K-Line system with water extracted from two dams to be constructed on the farm. An alternative option being considered is that of drilling a well of up to 130 m in depth. For the purposes of this report consideration is limited to that of the construction of two water storage dams. Development of the surmised irrigation system is estimated to require between $255,000 and $345,000 of capital investment.

5 Farm Resources and Current Enterprise

5.1 Land Resources

Kaiangaroa Station covers a total of 1,276.6 ha of which 1167.9 ha are estimated to be in effective pasture, 12.5 ha are pine forest and approximately 89.0 ha are indigenous bush and scrub. A further 2.6 ha is estimated to go into dams for the irrigation blocks, and the remaining 4.6 ha is ineffective pasture, laneways, buildings and utility areas.

The underlying geology consists of massive hard silty sandstone and massive mudstone in the hill country. The easier contoured hill country and all of the flats are covered in andesitic tephra.

Approximately 22% of the property is flat to gently rolling, 68% is moderately steep to strongly rolling country and 9% is steep hill country with the remainder being very steep gorges. Eight different Land Use Capability (LUC) units and fourteen dominant soil types were identified as part of the land resource survey. One main soil type was identified on the proposed irrigation block.

5.2 The Current Farm operating System

Basic stock numbers, policies and performance levels of the current management system are outlined in the following table:

	Winter 2015	Comments
Sheep		
MA Ewes	7,000	Kelso Composite ewes producing 140% lambing. Ewe hogget's generally pregnancy scans 110% resulting in lambing performance of 80%.
Ewe Hogget's	2,500	
Breeding Rams	95	
Cattle		
R2yr Steers	100	
R2yr Bulls	100	
R1yr Steers	200	
R1yr Bulls	200	
Total Stock Units	**11,626**	

The general objective of the breeding ewe flock is to produce as many lambs as possible for finishing prime off the farm. To aid in this goal approximately 20% of the farm has been developed into Plantain based forage.

R1yr cattle are purchased in the autumn at 6 months of age and approximately 200 kgLwt. Approximately one third of these will be sold prime/finished at 20 months of age with a further third sold as yearlings store and the remaining third are wintered a second year and finished as 2 year olds.

An overriding objective of the business is to ensure that lamb production can be achieved sustainably and in such a manner that breeding performance is not compromised. Management believes that having 20% of the farm in high performance forage species allows this goal to be realised and also ensures a stable level of revenue occurs.

6 Proposed Irrigation System

6.1 Potential Irrigation System

Mapping indicates that at least 86.2 ha have the potential to be irrigated from two dams situated in the 'Stock Yard Hill' paddock and 'Stock West' and 'Stock East' paddocks. This area has been established on land classified as being LUC IV and represents the area where the best return form irrigation is likely to occur.

There are two irrigation systems that could be employed on the farm. System one involves a combination of a Travelling irrigator and K-Line irrigation pods. System two is all K-Line pods. Based on contour it is estimated that the Travelling irrigator could be used over approximately 37.7 ha and a K-Line system irrigating approximately 48.5 ha (or K-Line over the whole 86.2 ha).

6.2 Farm Operating System to fully capture the benefit of Irrigation

With summer droughts occurring over the past two years the performance of the plantain crops grown has been substantially limited. In a "wet" summer and autumn, lambs are typically grazed at 60/ha. During the drought seasons, the stocking rate has been halved to 30/ha with lambs taking twice as long to finish.

It is proposed that they current livestock finishing system will continue to operate on the farm with overall performance improved as a result of:

- The production of greater yielding forage crops
- Minimising the influence of droughts on forage production
- Ability to finish more lambs per hectare on the area irrigated
- Ability to finish lambs to heavier weights off the area irrigated
- Greater management flexibility due to improved performance of the area under irrigation

It should be noted that there are many different forage options and livestock policies for the flats with or without irrigation. The scenario detailed in this report is based on the owner's desire to maintain a livestock business under irrigation and also takes into consideration the implications of Horizons Regional Council's One Plan regulations with respect to N leaching.

6.3 Livestock system on the flats under irrigation

It is proposed two dams be built for water storage. Once built, these two dams are estimated to be capable of storing approximately 75,000 m^3. This represents sufficient stored water to irrigate the 86.2 ha in question to a level of 87 mm/ha. This represents a very limited supply of irrigation water and should be used at critical times to assist in the establishment of crops and to supplement rainfall. There is insufficient water storage to irrigate weekly for more than 3 – 4 weeks.

The rate of dam recharge is unknown and will be dependent on the flow in the stream over the summer period, size of catchment and rainfall that may occur.

The response rate to irrigation water varies depending on the crop being irrigated and the severity of moisture limitation caused by lack of rainfall. It is known that low water efficiency crops such as pasture will produce approximately 12 kg DM/mm of irrigation water while high efficiency crops such as Lucerne will produce 25 kg DM/mm of irrigation water. Using this as the range in response to irrigation that may be expected it is noted that:

- At 12:1, an extra 13.4 lambs/ha may be finished over the season
    - Based on $2/kgLwt gain and a net gain of 10 kgLwt = $23,000 over 86.2 ha
- At 25:1, an extra 28.6 lambs/ha may be finished over the season
    - Based on $2/kgLwt gain and a net gain of 10 kgLwt = $49,306 over 86.2 ha

The net direct benefit of irrigation as outlined may range from $23,000 to $49,000. This excludes any benefit that may occur in other livestock on the farm as a result of being able to stock more lambs on the irrigated area over the summer and autumn.

6.4 Non irrigated areas

Management of the area outside of that considered for irrigation remains unchanged from the status quo.

6.5 Possible issues or risks associated with this irrigation scenario

The operational risks associated with this irrigation scenario are largely limited to the care and maintenance of the irrigation equipment. The contour of the area considered for irrigation is undulating and as such care is required in using a travelling irrigator to ensure it does not tip over and become damaged. This can occur when in transit between irrigation runs or when completing a run. As such operator awareness needs to be maintained.

Using K-line irrigation pods also requires operator care when moving them from one hydrant to the next to ensure the pods are not damaged. Typically pods are moved using ATV Quad bikes and care is required when towing pods on slopes to ensure the ATV does not tip and roll.

The construction of water holding dams poses a risk in terms of wall collapse and the sudden release of a large volume of stored water.

6.6 Irrigation Costs

There are two possible irrigation systems that could be developed on the property.

System One:

- Combination of Travelling Irrigator to cover 37.7 ha plus K-Line pods to irrigate a further 48.5 ha.
- The estimated cost of developing this system is $315,000 – 345,000

System two:

- K-Line pods irrigating all 86.2 ha.
- The estimated cost of developing this system is $255,000

Annual irrigation costs will include power to pump water, additional labour to move irrigation equipment daily and repairs and maintenance on the equipment. In addition there will be the costs associated with machinery (tractor and/or ATV) required to move the irrigator equipment.

The annual power cost is estimated to be $7,500 - $10,000 annually. No assessment has been made of the capacity of the local electricity supply network to meet the demands of this proposal.

Two dams will need to be constructed, the cost of which has been estimated at $25,000 (subject to determining if engineers reports are required).

For the purposes of this report, it is estimated that up to 87 mm of irrigation water will be applied annually, between December and April.

No estimation of costs associated with re-subdivision or the re-reticulation of stock water on the flats has been made in this investigation. This cost may be significant and should form part of a further in-depth feasibility investigation.

6.7 Implications of Irrigation on Existing Farm System

A balance between production and profitability levels must be reached with the nutrient restrictions imposed by Horizons Regional Council's One Plan (Table 13.2). To this end the forage production system detailed seeks to find this balance.

Adoption of an irrigation system should not just be considered a drought management tool (although it is very useful in droughts as a tool to protect baseline productivity), but rather an opportunity to develop and diversify the business for greater financial reward. Typically in order to derive an acceptable return on investment from irrigation development new and often novel farm systems need to be developed. These often require the acquisition of new skills and knowledge.

6.8 Financial Benefits of Irrigation

In this case, and under the parameters used, the addition of irrigation may result in a negative or positive impact on the Net Benefit of the business. This is shown in the table below where the Net Benefit may vary from -$21,065 to $15,545.

The table below looks at the range in net benefit from additional lamb finishing with the range in possible investment level required to establish the irrigation system.

Irrigation Area	86.2 ha
Additional Lamb Income	$23,000 - $49,000
Additional Costs	
Labour	$2,500
Irrigation Power/R&M	$7,500 - $10,000
Direct Expenses	$10,000 - $12,500
Interest on Irrigation Investment (6.5%)	$16,575 - $22,265
Depreciation (4% over 20 yrs)	$6,880 - $9,300
Net Benefit to the business	**-$21,065 to $15,545**
Return on Investment	**-6% to 6.1%**

Essentially this table highlights the condition that exists where the livestock production system currently employed is operating at a strong level and that irrigation is likely to result in small marginal gains in performance (given the volume of water that is available).

Under a different management system the economics of developing an irrigation system may show a more positive outcome. In addition there may be some benefit to the capital value of the property as a direct result of irrigation development.

6.9 The permissible Nitrogen loss Limits

Conversion to dairying or irrigation requires the change in land use to meet the permissible N loss limits under Table 13.2 of the Horizons Regional Council One Plan.

The following table summarises the permissible N loss limits for 86.2 ha under irrigation for sheep and beef.

Year	Irrigated area	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	1,552	18
5	1,379	16
10	1,207	14
20	1,121	13

The quantity of N that the irrigated land is permitted to lose via leaching is 18 kg N/ha/yr (or 1,552 kg N) for year one, decreasing to 13 kg N/ha/yr (or 1,121 kg N) in year 20.

6.10 N Loss calculations

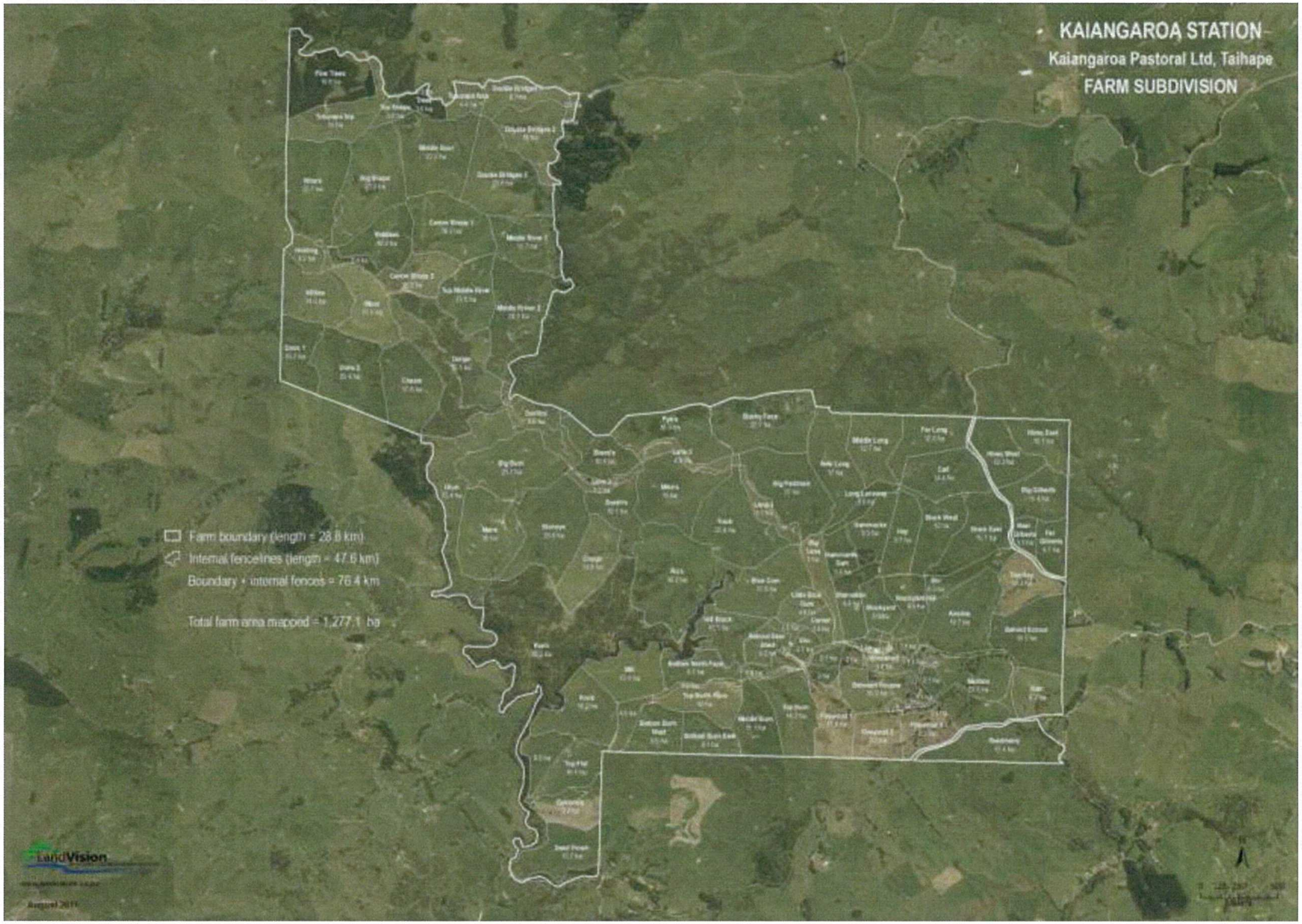
The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3) for the different landuse options.

Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Trading stock on Irrigated Block	18	16	14	13	11

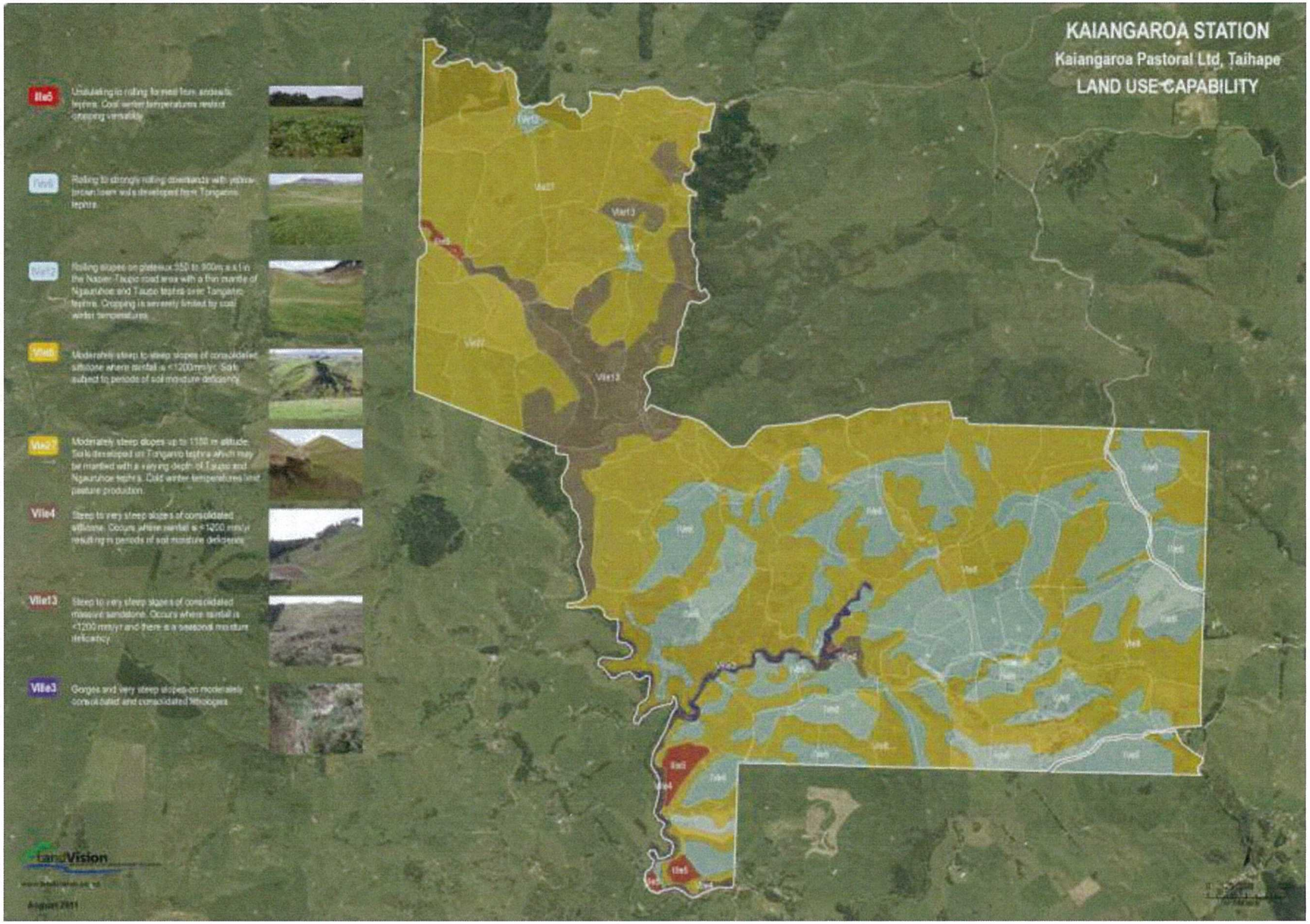
The permissible N loss for the irrigated area is 1,552 kg N (18 kg N/ha) for year one, decreasing to 1,121 (13 kg N/ha) for year 20. Overseer (Ver. 6.1.3) was used to determine the N loss from the irrigated areas. The N Loss for the irrigated land is 934 kg N (11 kg N/ha). Subsequently the proposed system under irrigation complies with Table 13.2.

7 Appendix 1: Maps

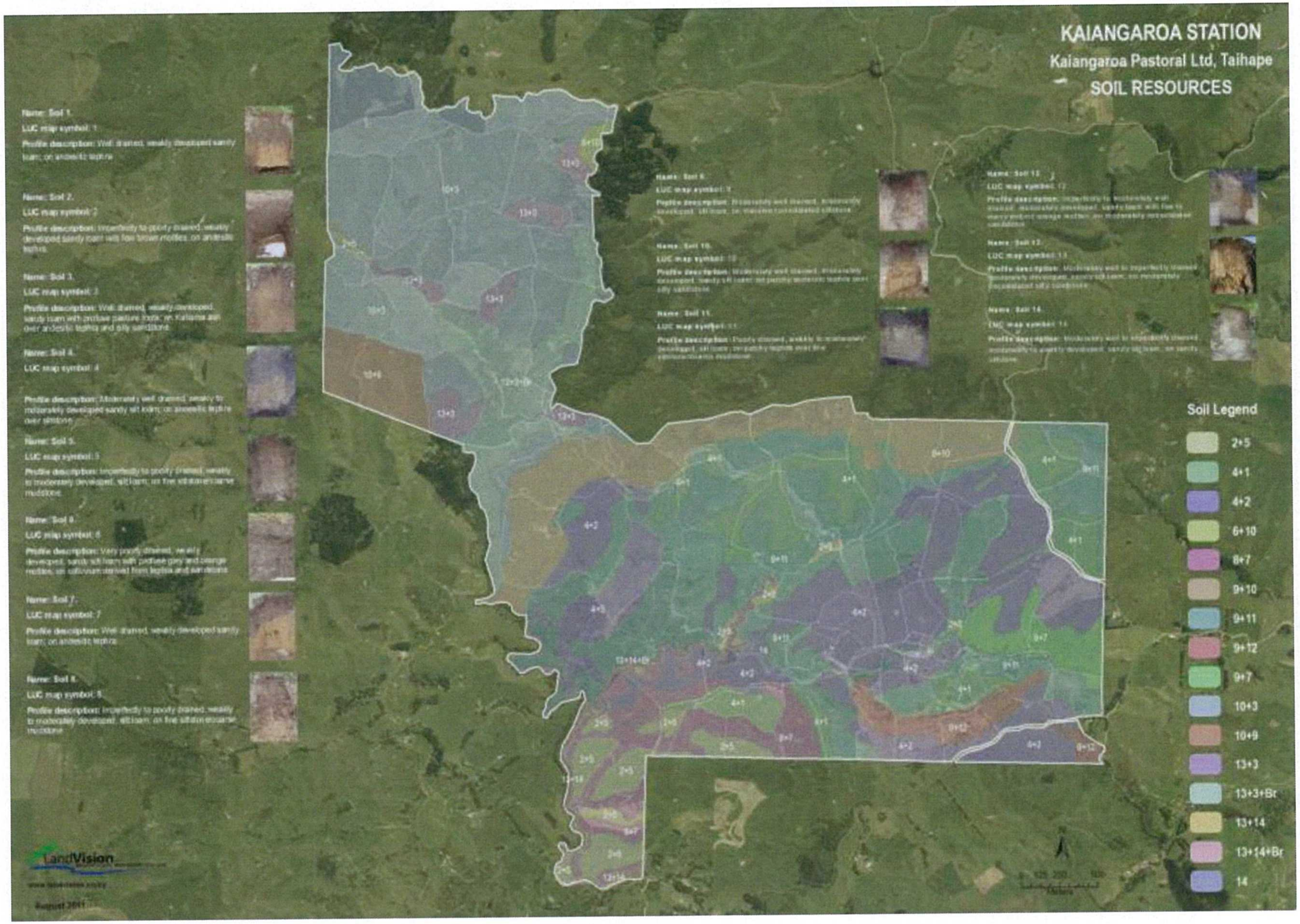
7.1 Subdivision Map



Landuse Capability Map

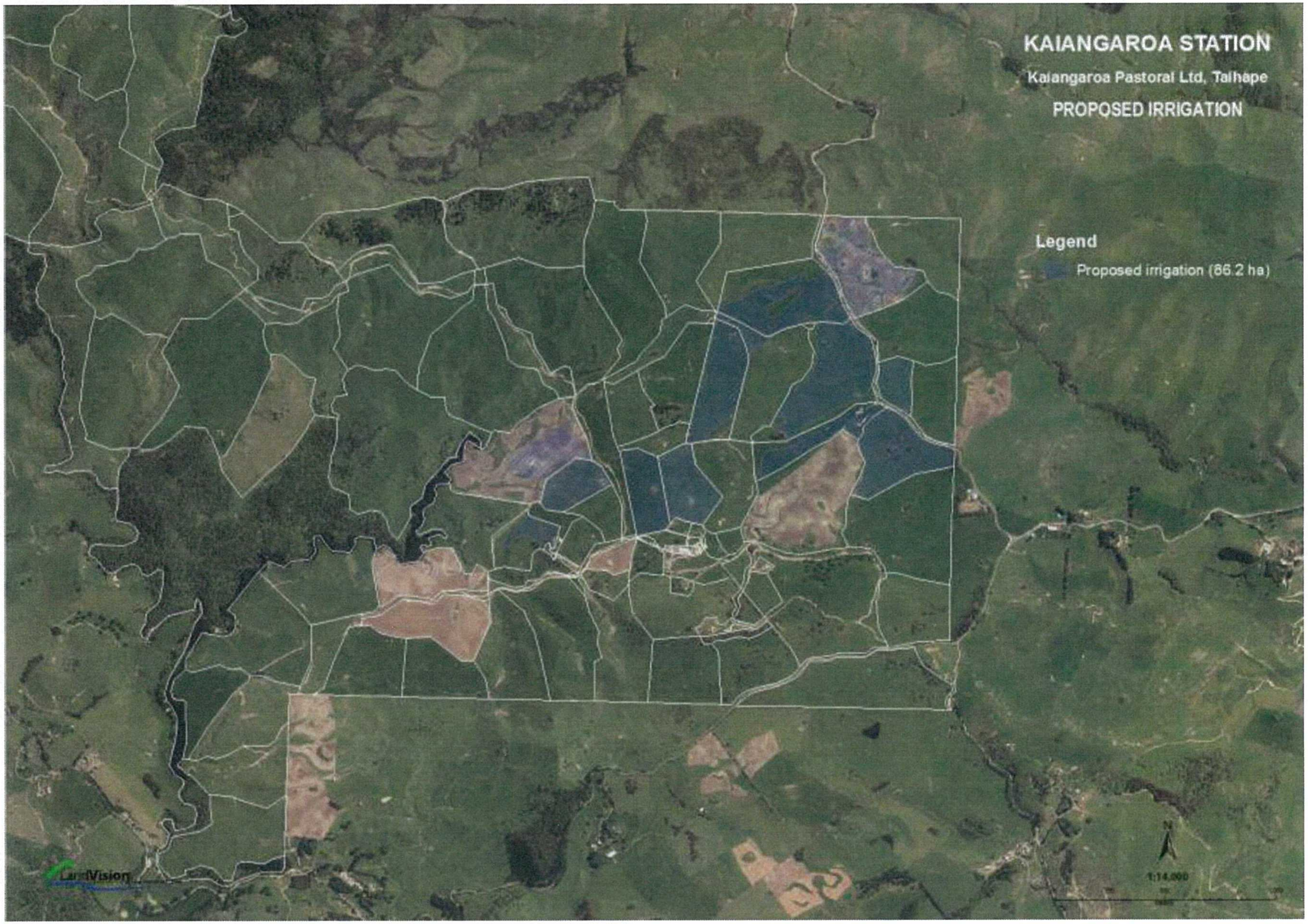


Soils Map



KAIANGAROA STATION
Kaiangaroa Pastoral Ltd, Taihape
SOIL RESOURCES
Soil Legend
2+5
4+1
4+2
6+10
8+7
9+10
9+11
9+12
9+7
10+3
10+9
13+3
13+3+Br
13+14
13+14+Br
14
LandVision

Irrigation Map



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McManaway Dairy Unit (McManaway) summary irrigation case study

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Report prepared as part of the

Rangitikei Strategic Water Assessment project,

jointly funded by Rangitikei District Council and the

Ministry for Primary Industries (Irrigation Acceleration Fund)

Rangitikei
Unspoilt...

Ministry for Primary Industries
Manatū Ahu Matua

Acknowledgements

The Catalyst Group wishes to thank the following for their contribution to the production of this report:

- Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund) for supporting the Rangitikei Strategic Water Assessment project
- John McManaway for allowing us to use his property as a case study for this project, and for giving of his time and farm enterprise data so freely
- Lachie Grant of Landvision Ltd and Greg Sheppard of Sheppard Agriculture for undertaking the case study analysis

Report No 2014/013(B)

17 November 2014

1 Introduction

The Rangitikei district is heavily reliant upon the primary sector for its economic and social well-being. This sector is founded upon the district's topography, soils, climate, water resources, and farmer innovation. However, the district's water resource is coming under increasing pressure from irrigators, and the impacts of droughts.

In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A summary case study has been prepared for the McManaway Dairy Unit, owned by John McManaway. The property is located on Te Hou Hou Road, south of Hunterville. This case study has been prepared to assess the opportunities, costs, and on-farm implications of having developed irrigation on the property.

The McManaway Dairy Unit is a 165 ha dairy farm, of which 155 ha are effective milking platform producing 240,000 kgMS/year from a total of 500 cows at peak season. In addition to traditional spring calving, the business operates a winter milk contract to supply 200 kgMS/day through June and July. Most of the farm (99%) is flat to undulating, with the remaining 1% steep river terrace faces.

The property is currently irrigating 156 ha of pasture, with 23 ha under a centre pivot and the remainder (83 ha) on a lateral system.

The case study is presented at Annex A.

3 Findings

Key findings from the McManaway Dairy Unit case study were:

1. The property is currently irrigating 156 ha of pasture, with 23 ha under a centre pivot and the remainder (83 ha) on a lateral system. Water is sourced directly from the Rangitikei River, and this take is supplemented by a 100m deep bore on the property.

2. Irrigation has enabled the McManaway Dairy Unit to run an additional 110 milking cows, and produce an additional 52,800 kgMS.

3. Financial analysis indicates irrigation has increased annual farm income by $343,200, and farm operating costs by $208,431. After adjustments for depreciation and the cost of capital, it is estimated business profitability has improved by $75,000-$100,000 per annum.

4. Modelling shows the predicted Nitrate loss from the property under irrigation as 34 kg N/ha/yr, against the One Plan permissible Nitrate losses of 27 kg N/ha in year one, reducing to 22 kg N/ha in year 20 (Table 13.2). As such, the current operation does not meet the permissible One Plan Nitrate loss limits, so a restricted discretionary activity resource consent will be required from Horizons Regional Council. Any such consent will include conditions regarding the adoption of various nutrient loss mitigation options. An assessment of nutrient losses from the farm without irrigation was not attempted as there were too many variables to factor in.

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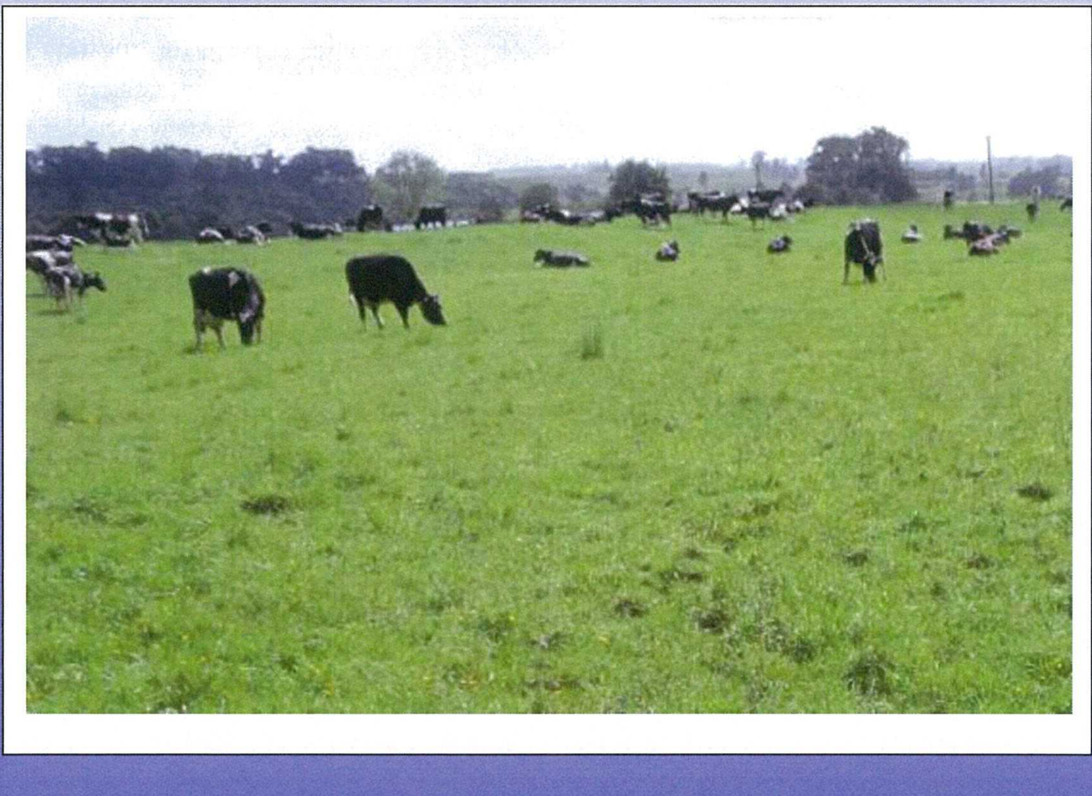
Irrigation Feasibility Assessment

McManaway Dairy Unit

Te Hou Hou Road

Rata



October 2014

1 Summary

This project has investigated the benefit irrigation provides to the McManaway Dairy Unit by looking at the likely performance of the business if it was un-irrigated. There is currently 105.6 ha of land irrigated from an effective area of 155.3 ha.

An assessment has been made based on the amount of pasture dry matter grown and utilised as a result of irrigation. From this it is possible to determine the approximate number of milking cows (and production) supported by irrigation. In the modelling process this feed is simply removed from the system along with the cows it is estimated to support. In this case a 22% drop in cow numbers (from 500 to 390) is likely to result if there was no irrigation in place.

From this it has been calculated that 52,800 kgMS would be lost from the current system representing a loss in income of $343,200. Associated with this drop in cow numbers is a decrease in farm operating expenditure (of $208,431) and capital invested in the business (estimated to be $736,100).

The effect of this (after taking into account the cost of capital and depreciation irrigation plant and equipment) is a net loss in business profitability estimated to be $75,090 annually. Additionally there is lost income which may range from $17,000 - $25,000 associated with winter milk production.

From an economic perspective it may be said that irrigation adds between $75,000 and $100,000 to the businesses financial performance.

With respect to environment, the system with irrigation does not, however, meet the permissible N loss limits under Table 13.2 of the Horizons Regional Council One Plan. Current N loss under irrigation has been calculated using Overseer at 34 kg N/ha/yr and the permissible N loss limits as determined from paddock scale LUC mapping are 27 kg N/ha for year 1 and reducing to 22 kg N/ha for year 20. This means that the proposed system under irrigation does not meet Table 13.2 of the One Plan and Horizons Regional Council. Any application for a land use resource consent for irrigation to Horizons Regional Council would be treated as a Restricted Discretionary activity. An assessment of nutrient losses from the farm without irrigation was not attempted as there were too many variables to factor in.

2 Table of contents

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3 Purpose

This Environmental Farm Plan (EFP) has been prepared for the McManaway Dairy Unit located on Te Hou Hou Road. It is part of the Rangitikei Strategic Water Assessment and aims to assess the benefit irrigation provides to the business.

4 Farm Overview

The McManaway Dairy unit is 164.9 ha of which 155.3 ha are effective milking platform producing 240,000 kgMS/year and milking a total of 500 cows at peak season. In addition to traditional spring calving the business operates a winter milk contract to supply 200 kgMS/day through June and July. This is achieved by calving approximately 130 cows in the autumn and 400 in the spring. During the spring and summer the peak number of cows milked is 500.

At 240,000 kgMS produced annually, farm production is considered above average at 1,548 kgMS/ha and 480 kgMS/cow. This is in part due to cows being milked year round with a target lactation length of 300 days (approximately 40 days longer than the national average).

The property is currently irrigating 105.6 ha of pasture, with 22.5 ha under a centre pivot and the remaining 83.1 ha on a lateral system.

A relatively large amount of supplementary feed is utilised on the farm with:

- 300 TDM of Palm Kernel and or Grain
- 400 TDM of Maize Silage
- 200 TDM of Pasture Silage

5 Farm Resources and Current Enterprise

5.1 Land Resources

The McManaway Dairy Unit covers a total of 164.9 ha of which 155.3 ha are estimated to be effective pasture, 2.1 ha are ineffective pasture or riparian areas, and the remaining 7.5 ha are non-productive laneways, yards, buildings or utility areas.

The underlying geology consists of tephra, volcanic loess or alluvium over gravels on the flats.

Approximately 99% of the property is flat or undulating with the remaining 1% being moderately steep inter-terrace margins. Twelve different soil types and nine different LUC units were recorded when mapped at a 1:6,000 scale. Three different soils were identified on the proposed irrigation block.

The effluent application area is 27.3 ha which is all classified as low risk for applying effluent. The property contains over 10.4 km of waterways.

6 Irrigation System

6.1 Irrigation System

The existing irrigation system of 105.6 ha includes 22.5 ha of Centre Pivot irrigation and 83.1 ha of Lateral irrigation.

A large water take of 5,000 m^3/day exists for the Bosch Lateral irrigation system with a further 2,000 m^3/day available for the Centre Pivot system. This would allow up to 7mm/day to be applied to the irrigated area.

The most used on the Bosch irrigated area is estimated to be 3,500 m^3/day representing an irrigation application level of 4.3 mm/day.

Water is secured through a direct take from the river augmented by 2 x 100 m deep bore's (only one of which is currently utilised).

Water restrictions do occur at times of low flow in the Rangitikei River typically during late January and February just when irrigation is most required.

6.2 Farm Performance in the absence of Irrigation

This assessment looks to identify the value irrigation provides to the business. In order to identify this a model has been developed to reflect the performance of the farm in the absence of irrigation.

Key assumptions include:

- Pasture water efficiency of 12 kg DM/mm of water
- 375 mm applied from mid-November to mid-April under the current operation
- Cow numbers and supplementary feed inputs are scaled back on a pro rata basis
- Milk production per cow is maintained at 480 kgMS
- Annual cow dry matter intake to achieve 480 kg MS/yr is 5,800 kg DM
- Cows spend 65 days off farm grazing
- Capital value of irrigation plant and equipment is set at $4,250/ha
- Area lost from irrigation is 105.6 ha
- Milk Solids price is $6.50/kgMS

With the removal of irrigation from the business, it is estimated that cow numbers would need to be reduced by approximately 22% or 110 head. Such a drop would correlate with calving 300 in the spring and 100 in the autumn with a peak milking number in December of 390.

Along with a reduction in cow numbers there is assumed to be a reduction in supplementary feed used. Supplementary feed inputs are calculated to drop by:

• Palm Kernel/Grain	65.34 T DM
• Maize Silage	87.12 T DM
• Pasture Silage	45.54 T DM

Associated with the calculated drop in cow numbers will be a significant decrease in milk solids production. Based on continuing to produce 480 kgMS/cow, this drop is estimated to be 52,800 kgMS to a total of 187,200 kgMS (1,207 kgMS/ha).

6.3 Capital invested in current Irrigation system compared to no irrigation

If irrigation development had not occurred on the property and fewer cows were milked, the total investment in capital would be significantly less than is the case. This capital amounts to:

- Livestock $297,500 (110 cows and replacement heifers)
- Irrigation system $438,600 (based on an estimated cost of $4,250/ha* irrigated)

That is, if irrigation had not been developed on the farm approximately $736,100 of capital could have been invested elsewhere. Based on a 6.5% interest cost, the cost of capital tied up in irrigation is approximately $47,850.

In addition to this cost of capital is depreciation on the irrigation system which over 20 years averages at approximately $11,800/year.

(*Based on current market establishment costs for irrigation)

6.4 Financial impact of no Irrigation on the farm

In this case, and under the parameters used, the removal of irrigation from the farm system is expected to have a significant financial impact on the business. The table below is based on partial budgeting methodology to evaluate the financial difference between irrigation and no irrigation. This methodology looks at the marginal changes in income and expenditure associated with a system change.

	Current – Irrigation	Without Irrigation
Milking Platform area (ha)	155	155
Irrigated Area (ha)	105.6	0
Peak cows (December 1)	500	390
Stocking Rate (cows/ha)	3.22	2.5
Milk Production (kgMS)	240,000	187,200
Milk Production (kgMS/cow)	480	480
Milk Production (kgMS/ha)	1,548	1,207
Drop in Milk Revenue ($6.50/kgMS)		**-$343,200**
Decrease in Operating Expenditure		-$208,431
Decrease in Capital Costs (6.5%)		-$47,846
Decrease in Annual Depreciation		-$11,833
Total Reduction in Costs		**$268,110**
Net Financial Impact from no Irrigation		**-$75,090**

Importantly, the actual cost of removing irrigation from the system is likely to be larger than noted in this table as the following factors noted have not been considered in this exercise for simplicity's sake:

- Winter milk premium price of $1.55
- Capacity adjustment of $0.52/kgMS for June, July, August and the period between January and May
- Manufacturing premium of $0.75/kgMS for June and half of July

Taking these factors into consideration indicates the actual loss in income from removing irrigation from the system may increase by a further $17,000 - $25,000 annually.

With the advent of Fonterra's "Trading Amongst Farmers (TAF)" scheme, the purchase and investment into shares becomes an investment decision rather than a necessity associated with supplying Fonterra. The TAF scheme allows farmers the financial flexibility to sell the Economic Rights of shares to the Fonterra Shareholders Fund. As such the capital cost associated with the shares required to supply the additional 52,800 kgMS (approximately $333,600) generated through irrigation has been excluded from the analysis above. For reference however, the annualised cost of capital potentially invested in these shares amounts to approximately $21,600. If considered in the table above, the Net Financial Impact from no irrigation drops to approximately -$53,500.

6.5 The permissible Nitrogen loss Limits

Conversion to dairying or introducing irrigation requires the change in land use to meet the permissible N loss limits under Table 13.2 of the Horizons Regional Council One Plan.

The following table summarises the permissible N loss limits for the McManaway Dairy unit with a total area of 164.9 ha (155.3 ha effective) and 105.6 ha under irrigation.

Year	Irrigated area	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	4517	27
5	4031	24
10	3792	23
20	3630	22

The quantity of N that the property is permitted to lose via leaching is 27 kg N/ha/yr (or 4,517 kg N) for year one and this decreases to 22 kg N/ha/yr (or 3,630 kg N) for year twenty.

6.6 N Loss calculations

The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3) for the different landuse options.

Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Irrigated Block	27	25	23	22	**34**

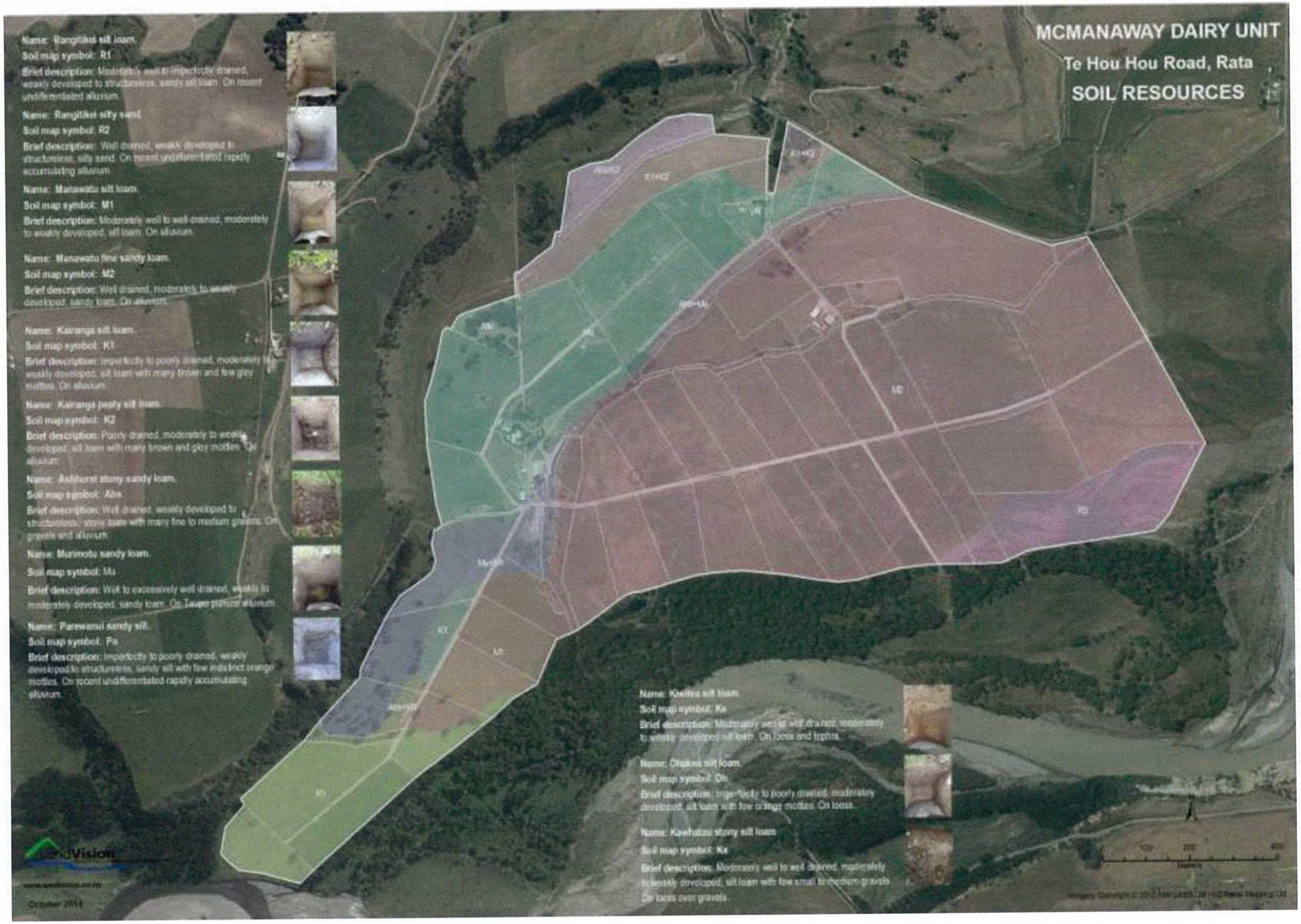
The permissible N loss for the irrigated area is **4,517 kg N (27 kg N/ha)** for year one, decreasing to 3,630 kg N (22 kg N/ha) for year 20. Overseer (Ver. 6.1.3) was used to determine the N loss from the whole property. It is estimated that the property is leaching **5,619 kg N/yr (34 kg N/ha/yr)**. Subsequently the current system under irrigation does not comply with Table 13.2 and Horizons Regional Council would treat any consent application as a Restricted Discretionary activity. An assessment of nutrient losses from the farm without irrigation was not attempted as it was considered there were too many variables to factor in.

7 Appendix 1: Maps

7.1 Farm Subdivision Map

7.2 Landuse Capability Map

7.3 Soils Map


MCMANAWAY DAIRY UNIT
Te Hou Hou Road, Rata
SOIL RESOURCES
Name: Rangitikei silt loam.
Soil map symbol: R1
Name: Rangitikei silty sand.
Soil map symbol: R2
Name: Manawatu silt loam.
Soil map symbol: M1
Brief description: Moderately well to well drained, moderately to weakly developed, silt loam. On alluvium.
Name: Manawatu fine sandy loam.
Soil map symbol: M2
Name: Kairanga silt loam.
Soil map symbol: K1
Name: Kairanga peaty silt loam.
Soil map symbol: K2
Name: Ashhurst stony sandy loam.
Soil map symbol: Abs
Name: Murimotu sandy loam.
Soil map symbol: Mu
Name: Parewanui sandy silt.
Soil map symbol: Pa
Name: Ohakea silt loam.
Soil map symbol: Oh
Name: Kawhatau stony silt loam
Soil map symbol: Ks
October 2013

7.4 Irrigation Map

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Robell Farming Limited (Robertson) detailed irrigation case study

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Report prepared as part of the
Rangitikei Strategic Water Assessment project,
jointly funded by Rangitikei District Council and the
Ministry for Primary Industries (Irrigation Acceleration Fund)

Rangitikei
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Acknowledgements

The Catalyst Group wishes to thank the following for their contribution to the production of this report:

- Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund) for supporting the Rangitikei Strategic Water Assessment project
- Alistair and Margo Robertson for allowing us to use their property as a case study for this project, for opening their farm as part of a series of field days, and for giving their time and farm enterprise data so freely
- Lachie Grant of Landvision Ltd and Greg Sheppard of Sheppard Agriculture for undertaking the case study analysis

Report No 2014/007
17 November 2014

1 Introduction

The Rangitikei district is heavily reliant upon the primary sector for its economic and social well-being. This sector is founded upon the district's topography, soils, climate, water resources, and farmer innovation. However, the district's water resource is coming under increasing pressure from irrigators, and the impacts of droughts.

In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A detailed case study has been prepared for Robell Farming Ltd., owned by a partnership, but farmed by the Robertsons. The property is located on Parewanui Road, west of Bulls, alongside the Rangitikei River. This case study has been prepared to assess the opportunities, costs, and on-farm implications of expanding the irrigated area on the property.

The Robell Farming Ltd property is a 238 ha dairy farm with an effective area of 222 ha. During peak season 620 Friesian cows are milked producing 275,000 kg MS (443 kg MS/cow/year, 2.8 cows/ha, 1,241 MS/ha/year). Approximately half the herd is grazed off over winter and all replacement stock are grazed-off following weaning and return just prior to calving.

The property is currently irrigating 99 ha through a centre pivot system (56 ha) and pods (43 ha), with water extracted from a shallow bore situated alongside the Rangitikei River. There is potential to irrigate a further 73 ha of pasture or crops with an additional centre pivot irrigator. Expansion of the irrigation system is estimated to cost between $275,000 and $345,000 of capital investment.

The case study is presented at Annex A.

3 Findings

Key findings from the Robell Farming Ltd. case study were:

1. Two set-ups were considered as part of an investigation to increase the irrigated land area by 50 ha. The first option involved construction of a new fixed centre pivot irrigator to be used in conjunction with the existing moveable centre pivot, at an estimated cost of $275,000. The second option involved the installation of two additional moveable centre pivot irrigators, to be used in conjunction with the existing irrigator, at a cost of $345,000. Both options would create overlaps with the existing Irrapod set-up, so relocating these assets could increase the irrigated area still further 24 ha. Relocating the Irrapods was not explored as part of this assessment.

2. The existing irrigation set-up produces an additional 5,100 kg DM/ha over dryland pasture on the property. Using this production benchmark, an additional 50 ha of irrigated land would allow the milking herd to be increased by 55 cows, provided all other things remain equal.

3. Financial analysis indicates investment in additional irrigation will be economically rewarding. After adjustments for depreciation and the cost of capital, it is estimated business profitability will improve by approximately $48,000 annually. This assessment is based on a $6.50/kg MS pay-out, from a production figure of 299,000 kg MS, at 443 kg MS/cow).

4. Modelling shows the predicted Nitrate loss from the property under an expanded irrigation set-up as 37 kg N/ha/yr, against the One Plan permissible Nitrate losses of 26 kg N/ha in year one, reducing to 21 kg N/ha in year 20 (Table 13.2). As the expanded irrigation proposal does not meet the permissible One Plan Nitrate loss limits, a restricted discretionary resource consent will be required. Any such consent will include conditions regarding the adoption of various nutrient loss mitigation options.

Although the case study did not investigate water availability, the volume of water required to meet the expanded irrigation scenario fits within the One Plan allocation framework for this part of the Rangitikei River. That is, the volume of water required is available. However, availability does not guarantee surety of supply during drier years or droughts. Surety of supply would need to be considered as part of any further investigation of the feasibility of irrigation for this property. Also not assessed was the capacity of the existing bore to meet the additional water requirements, although a previous analysis indicates it may have sufficient capacity.

4 Landowner response

The Robertson's made the following observations in response to the case study findings:

- They have contemplated expanded irrigation on their property for many years

- The financial analysis presented in the case study about the viability of an expanded irrigation proposal correlated with calculations they had done themselves previously. They are likely to expand the irrigable area in the near future for the productivity and profitability gains that can be realised, and the potential property capital value lift. The Robertson's are considering putting the property on the market in the short-medium term.

- The issue of nutrient losses and Horizons Regional Council's implementation of the One Plan nutrient management rules are an area of concern. The Robertson's pride themselves on the management of their property, and the steps they have taken to minimise their environmental footprint. To this end they have made their farm available for various studies in the past in an attempt to better understand their property, identify opportunities to improve how it is run, and generate knowledge that can be transferred to other organisations/properties/farmers. They have been working with Horizons Regional Council's on the One Plan's nutrient management provisions, and wish to be one of the first farms in the lower Rangitikei area to get a One Plan nutrient management resource consent.

LandVision Ltd INNOVATIVE LAND MANAGEMENT SOLUTIONS

SHEPPARD AGRICULTURE *creating profitable farms*

Irrigation Feasibility Assessment

Robell Farming Ltd

Alistair & Margo Robertson

Parewanui Road

BULLS

October 2014

1 Summary

This project has investigated the feasibility of extending the current irrigation system on Robell Farming Ltd on Parewanui Road near Bulls.

Robell Farming Ltd has the opportunity to expand the current irrigation scheme by a further 50 ha. This will involve the purchase of a new Centre Pivot irrigator and development of supporting infrastructure estimated to cost between $275,000 and $345,000 depending on final requirements selected.

With part of the farm already irrigated it has been possible for Robell Farming Ltd to determine that irrigated land produces an additional 5,100 kg DM/ha over dryland pasture. This provides a benchmark for future productivity as more land becomes irrigated to the same level. In this case it is estimated that a further 55 cows can be milked on the property provided all other things remain equal as a result of an additional 50 ha of irrigation.

Financial analysis using Partial Budgeting methodology (which considers additional marginal income and expenditure) indicates that further investment into irrigation is likely to be economically rewarding. After adjustments for depreciation and the cost of capital it is estimated that business profitability will be improved by approximately $48,000 annually. This is based on a $6.50/kg ms pay-out and the production of 299,000 kg ms (443 kg ms/cow).

Although economically viable, nutrient modelling of the expanded irrigation scenario indicates that it does not meet the N-loss targets set by Horizons Regional Council. The permissible N loss targets are 26 kg N/ha at year one, falling to 21 kg N/ha at year 20. The estimated N loss from the proposed system is 37 kg N/ha/yr. As such, a restricted discretionary resource consent will be required. As part of applying for this consent, various nutrient-loss mitigation measures will need to be assessed and agreed.

2 Table of contents

Disclaimer

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3 Purpose

This irrigation feasibility study has been prepared for Robell Farming Ltd located on Parewanui Road just west of Bulls. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm overview

The Robell Farming Ltd covers a total of 238.3 ha of which 221.6 ha are effective milking platform, 37.1 ha are stock excluded (un-grazed pasture, pine trees, native bush or scrub) and 7.9 ha are non-productive laneways, buildings or utility areas and 8.8 ha of stock excluded areas.

At peak milking a total of 620 Friesian cows are milked producing 275,000 kg MS (443 kg MS/cow/year, 2.8 cows/ha, 1,241 MS/ha/year). Approximately half the herd is grazed off over winter and all replacement stock are grazed off following weaning and return just prior to calving.

The property is currently irrigating 98.8 ha through a centre pivot system (55.6 ha) and pods (43.2 ha). There is the potential to irrigate a further 73.4 ha of pasture or crops. Water is extracted from a bore. Development of the surmised irrigation system is estimated to require between $275,000 and $345,000 of capital investment (US exchange rate dependant).

5 Farm resources and current enterprise

5.1 Land resources

The property covers a total of 238.3 ha of which 221.6 ha are effective. The property is located in the Coastal Rangitikei Catchment (Rang_4a & 4b) and borders the Rangitikei River. This is a high priority catchment under the Horizons One Plan.

The underlying geology consists of a combination of fine alluvium and alluvial gravels on low and intermediate terraces. On the eastern side (road) of the property recent wind-blown sands (less than 500 years old) may cover parts of the intermediate terrace.

Nearly all the property is flat to undulating. The inter-terrace margins are 15-25 degrees.

Ten different Land Use Capability (LUC) units and 12 dominant soil types were identified as part of the land resource survey. Approximately 27 % of the property is class I, 53% class II, and 13% class IV land. The rest is a combination of class III and VI land. The dominant soils include the Rangitikei, Parewanui, Manawatu, Karapoti, Hokowhitu, Kairanga series on the low terrace, the Ashhurst series on the intermediate terrace and the Foxton and Himatangi series formed from wind-blown sands. These soils provide a range of physical properties where the limitations of one soil type may be complimented by the strengths of another soil type.

5.2 The current farm operating system

The current milking system involves:

- 620 Friesian cows peak milked
- Calving commencing from 25 July with a mean calving date of August 14

- Producing 275,000 kg ms (443 kg MS/cow and 1,241 kg MS/ha)
- Replacement heifer calves (160) are grazed off farm from 1 month of age and return just prior to calving as R2yr olds
- The genetic value of the herd is noted as being:
    - BW = 96
    - PW = 110
    - Ancestry = 63%
- Supplementary feeding consists of
    - 250 T DM of Maize silage to the herd
    - 320 T DM of Palm Kernel
    - 150 bales of hay (10 bale equivalents)
- 20 ha of Chicory is established (primarily on un-irrigated land) in the spring. This is then over-drilled with ryegrass in autumn to push the longevity of the crop out to 2 – 3 years. It is estimated that chicory crops yield 11.2 TD M/ha
- Irrigated land currently totals 98.8 ha

5.3 Current irrigation system

The present irrigation system involves one moveable Centre Pivot servicing 55.6 ha and 43.2 ha of Irripods. It has been estimated that pasture production under the irrigation scheme has been lifted 5,100 kg DM/ha to 15,700 kg DM/ha (over dryland pasture producing 10,600 kg DM/ha).

Through the Centre Pivot 30 mm of water is applied/week whilst the Irripod system is able to supply pasture with 25 mm/week commencing from the start of November and running through until the end of March. Approximately 600 to 750 mm of irrigation water is applied annually through this system.

Water is sourced from a 23 m deep bore providing a flow rate of 62 litres/second. This is a riparian river take.

6 Proposed irrigation system

6.1 Potential irrigation system and cost

There is potential to extend the current irrigation system by a further 50 ha through the purchase of another Centre Pivot as detailed in a report completed by Waterforce in 2011 for Robell Farming Ltd. Options for system expansion include:

1. To construct a new Fixed Centre Pivot and utilise the existing movable Centre Pivot to operate from three separate sites
2. To construct a new movable Centre Pivot to operate from two new sites leaving the existing movable Centre Pivot to continue to operate from existing sites

With each of these options there will be some overlap with the existing Irripod scheme. Potentially this overlapped infrastructure can be relocated to new "corners" to extend the level of irrigation further. This option has not been considered in this evaluation.

The report provided provides costings for the two options noted above. The costs being:

- Option 1 = $275,000
- Option 2 = $345,000

These costs were based on a US exchange rate of $0.72 in 2011. Although the exchange rate has since improved to approximately $0.80, for the purposes of this analysis, these costings will be utilised in recognising that some of the other infrastructural costs may have risen to offset possible gains in the exchange rate.

6.2 Farm operating system to fully capture the benefit of irrigation

Based on the assessment that the current irrigation system contributes a further 5,100 kgDM/ha to pasture production it is expected that forage production will increase by approximately 255 TDM. This should be sufficient to support the milking of a further 55 cows (all things being equal). This is based on the assumption that imported supplement use is increased to:

- 348 TDM Palm Kernel
- 272 TDM Maize Silage

Other factors to note in this analysis include:

- The peak milking herd will consist of 675 cows (up from 620)
- The same number of cows are wintered on farm as the current situation (an additional 55 are wintered off farm)
- An additional 14 heifer calves will be reared for replacement purposes
- The same area of Chicory will continue to be grown as part of the overall pasture renewal programme
- The same 443 kgMS/cow production will be achieved

Partial Budget

The table below highlights the financial impact the investment into additional irrigation may have on the business. This partial budget looks at only the additional income and additional operating expenses associated with irrigation. That is it looks at the marginal income and marginal costs of the investment opportunity. With respect to the figures under the heading "$/kgMS", these represent the Dairy NZ, Dairy Base industry averages for owner operator dairy farm businesses located in the Southern North Island for 2013 (sufficient data for 2014 does not yet exist on Dairy Base).

Income		
Increase in Cow No.		55
Production per Cow (kg/MS)		443 kg/MS
Additional Production (kg/MS)		24,365 kg/MS
Milk Solids Price ($)		6.50
Additional Income		**$158,373**
Additional Expenditure		**Total $**
Animal Health		$4,629
Breeding		$3,411
Power	Farm	$3,167
	Irrigation	$12,500
Irrigation	R&M	$1,500
Supplement	Maize	$6,600
	Pke	$8,400
Grazing	Wnrs	$2,688
	Heifers	$6,552
	Cows	$11,050
Shed Expenses		$1,706
Calf Rearing		$731
Freight		$2,620
Fertiliser	Nitrogen	$2,924
	Pasture	$3,655
Wages		$5,628
Insurance		$1,000
Additional Farm Operating Expenditure		**$78,761**
EBIT* (Farm Surplus)		**$79,611**
Capital Invested		$345,000
Interest rate (%)		6.50%
Interest cost		$22,425
Depreciation Ave over 20 yrs @ 4%		$9,308
Adjusted return from irrigation		**$47,878**
ROI		13.9%
Payback period (years)		**7.2 years**

*EBIT = Earnings Before Interest and Tax

This table shows clearly that the investment into further irrigation is economically viable based on the assumptions noted previously. Even after taking into consideration the interest cost on capital and the average depreciation over a 20 year period, it appears the business will generate an operating surplus of approximately $48,000 and a Return on Investment (ROI) of 13.9 %.

6.3 Possible issues or risks associated with this irrigation scenario

The possible issues or risks associated with this scenario include:

- A substantial drop in the price received for Milk Solids
- A substantial drop in milk production
- Failure to comply with Horizon Regional Council N-Loss limits.
- Loss of water-take consent.
- Low flow rates in the Rangitikei River impacting on the amount of water able to be taken.
- Insufficient capacity of the current bore to provide sufficient water. This may require a deeper bore to be drilled adding cost to the investment opportunity.

6.4 Implications of irrigation on existing farm system

Economically the implications of investing in more irrigation appear to be positive with an improved level of profitability forecast. Further investigation is warranted with respect to N-Loss levels which are estimated to exceed the Horizons Regional Councils year 20 targets by a significant amount.

Also needing to be considered is the possible impact on existing infrastructure, management systems and labour with an additional 55 cows being milked.

6.4.1 Breakeven calculations

With any investment proposal it is useful to consider the breakeven levels of performance and or market prices as a means of evaluating the risk. The key breakeven triggers for this opportunity are:

- A drop in the payout from \$6.50/kgMS to \$4.53/kgMS (-\$1.97/kgMS)
- A production drop of 7,366 kgMS (from 299,025 to 291,659 kgMS)
- A drop in overall cow production of 10.9 kgMS/cow (675 cows) to 432.1 kgMS (compared to the current 443 kgMS/cow being achieved)
- A drop in cow numbers milked of 17 from the proposed 675 to 658
- A lift in the supplementary cost of \$0.08/kgDM purchased (from \$0.30 to \$0.38/kgDM)

6.5 The permissible Nitrogen loss limits

Dairying in the Lower Rangitikei Catchment needs to comply with the Horizons Regional Council One Plan Table 13.2 for permissible N loss limits. The following table summarises the permissible N loss limits under dairying for the property.

Year	Whole farm	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	6,227	26
5	5,652	24
10	5,131	22
20	4,901	21

The quantity of N that the irrigated land is permitted to lose via leaching is 26 kg N/ha/yr (or 6,227 kg N) for year one and this decreases to 21 kg N/ha/yr (or 4,901 kg N) for year twenty.

6.6 N loss calculations

The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3).

Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Dairying – extended irrigation	26	24	22	21	**37**

The permissible N loss for the irrigated area is 6,227 kg N (26 kg N/ha) for year one, decreasing to 4,901 (21 kg N/ha) for year 20. Overseer (Ver. 6.1.3) was used to determine the N loss from the irrigated areas.

In total it is estimated that the proposed system is leaching 8,749 kg total N (37 kg N/ha). This is above the permissible N loss limits of Table 13.2 of the One Plan. Consequently the proposed system under irrigation does not comply with Table 13.2, and will therefore require resource consent. Horizons Regional Council would treat any such consent application as Restricted Discretionary.

7 Appendix 1: Overseer Nutrient Budget Reports - Dairying

7.1 Nutrient block setup

The following nutrient management blocks were used in Overseer (v6.1.3) to determine the Nutrient Budget for the whole farm under irrigation.

Block name	Type	Effective area (ha)
2ei. Eff + Irrigation - Sandy-stony	Pastoral	7.7
3i. Irrigation - Mod well drained	Pastoral	59.7
1 Pastoral -Well Drained	Pastoral	28.8
Stock excluded	Trees and Scrub	7.9
4i. Irrigation - Poorly Drained	Pastoral	30.8
5i. Irrigation - Sand Plains	Pastoral	6.7
2 Pasture - Sandy-stony	Pastoral	6.9
3 Pasture - Mod well drained	Pastoral	5.9
4. Pasture - Poorly Drained	Pastoral	13.5
4ei. Effluent & Irrigation - Poorly ...	Pastoral	13.8
2e. Effluent	Pastoral	6.2
2i. irrigation	Pastoral	27.1
4e. effluent	Pastoral	9.8
6. inter terraces	Pastoral	4.7
Chicory	Fodder Crop	-

Select block type and add

Pastoral ▼ Add

Total farm area	238.3 ha
Total area declared as blocks	229.5 ha
Non-productive area (includes lanes, races and yards)	8.8 ha

7.2 Whole farm nutrient budget – with irrigation

The following Nutrient Budget was calculated using Overseer (v6.1.3) with the addition of an irrigation block.

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	145	31	4	37	102	0	0
Rain/clover N fixation	133	0	3	6	3	8	46
Irrigation	3	0	2	3	13	3	13
Supplements	50	10	29	8	3	5	3
Nutrients removed							
As products	97	17	22	6	24	2	6
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	104	0	0	0	0	0	0
To water	37	1.1	6	42	29	2	6
Change in farm pools							
Plant Material	31	2	-1	1	2	0	0
Organic pool	45	10	4	4	2	1	0
Inorganic mineral	0	3	-12	0	-4	-6	-7
Inorganic soil pool	17	10	20	0	70	17	57

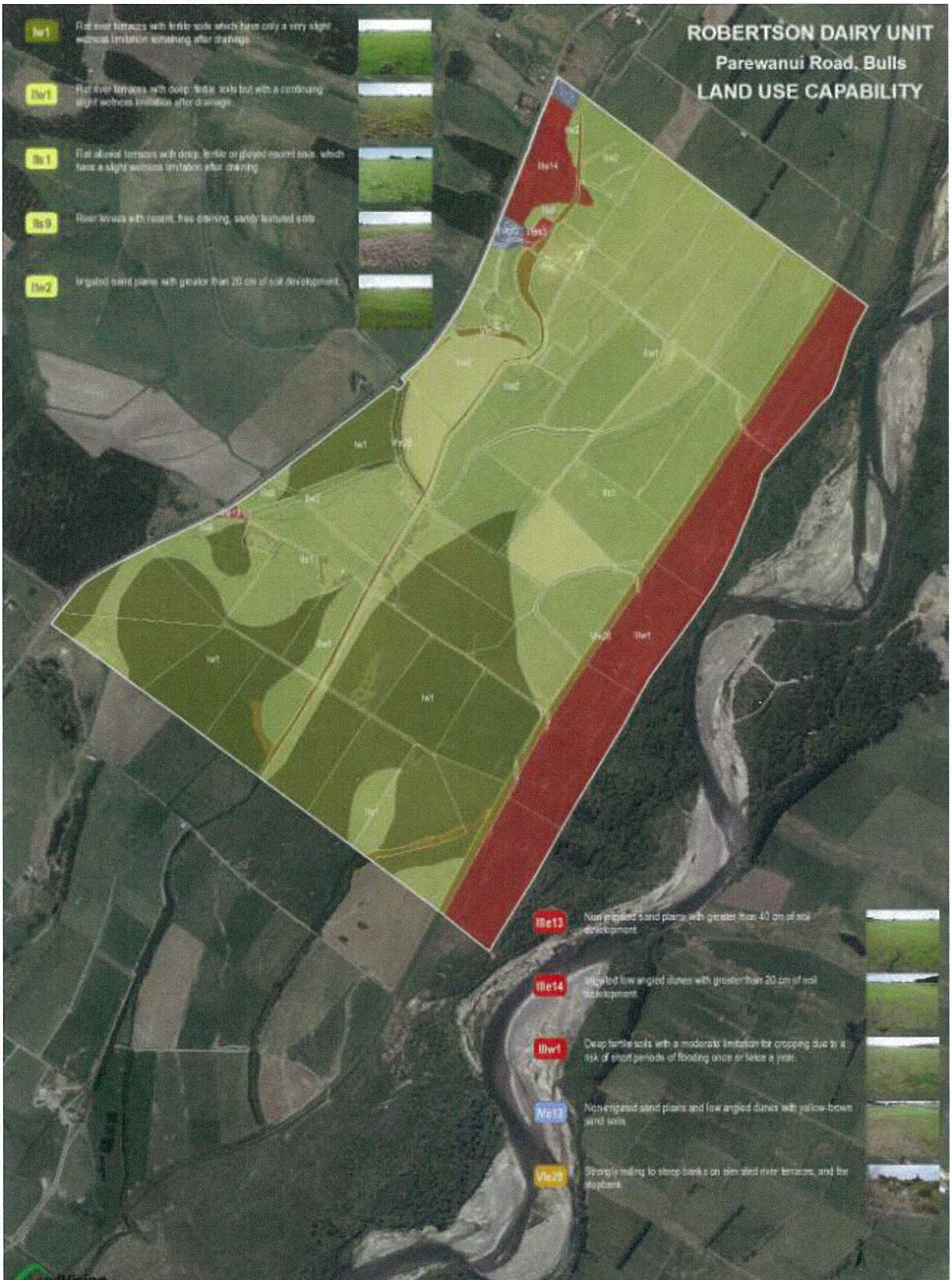
7.3 Nitrogen block report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
2ei. Eff + Irrigation - Sandy-stony	348	55	**20.2**	345	194
3i. Irrigation - Mod well drained	1192	24	10.7	304	194
1 Pastoral -Well Drained	409	17	9.2	271	194
Stock excluded	24	3	N/A		
4i. Irrigation - Poorly Drained	165	7	3.4	316	194
5i. Irrigation - Sand Plains	243	44	**17.7**	304	194
2 Pasture - Sandy-stony	197	35	**14.8**	243	194
3 Pasture - Mod well drained	88	18	9.5	271	194
4. Pasture - Poorly Drained	122	11	6.7	298	194
4ei. Effluent & Irrigation - Poorly Drained	100	9	4.2	359	194
2e. Effluent	276	54	**22.4**	341	194
2i. irrigation	1113	50	**19.1**	289	194
4e. effluent	92	11	6.4	355	194
6. inter terraces	285	61	**24.2**	285	194
Chicory	3834	96	**22.2**	375	112
Other sources	264				
Whole farm	8749	37			
Less N removed in wetland	0				
Farm output	8749	37			

8 Appendix 2: Maps

8.1 Paddock Map

8.2 Landuse Capability Map



8.3 Soils Map

ROBERTSON DAIRY UNIT
Parewanui Road, Bulls
SOIL RESOURCES
Name: Manawatu silt loam.
Name: Karapoti sandy loam.

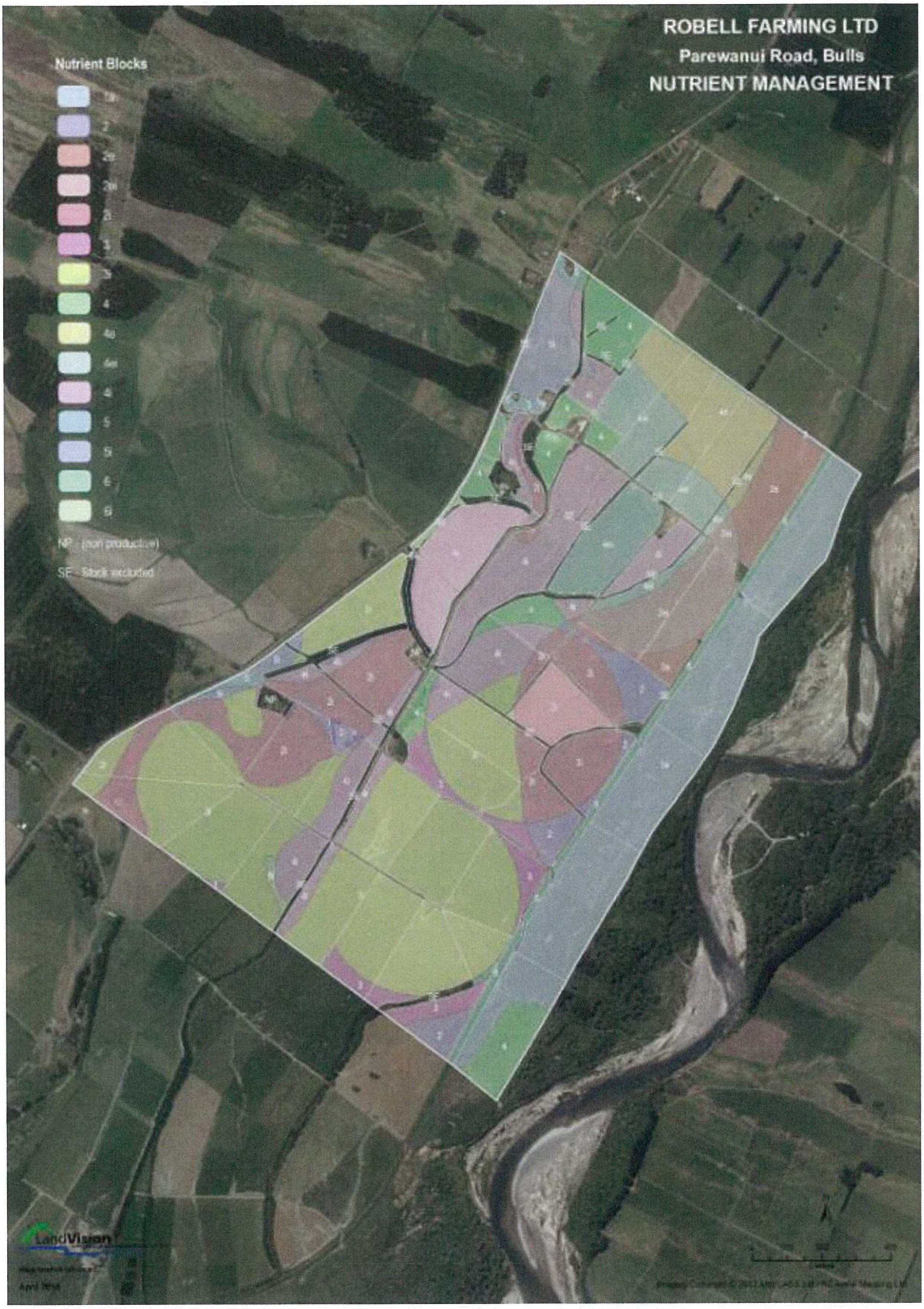
8.4 Irrigation Map - Current

8.5 Irrigation Map - Potential

8.6 Effluent Risk Map

16

8.7 Nutrient Block Map



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Rahia Land Company Limited (Totman) detailed irrigation case study

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Rangitikei
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Acknowledgements

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Report No 2014/015(B)
17 November 2014

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In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
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- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A detailed case study has been prepared for Rihia Land Co. Ltd., owned by the Totman family. The property is located on Omatane South Road southwest of Taihape, and straddles a ridge of land between the Rangitikei and Kawhatau rivers. This case study has been prepared to assess the opportunities, costs, and on-farm implications of developing an irrigation system on the property.

Rihia Land Co. Ltd. is a 995 ha summer-safe hill country property producing 7,400 kg of pasture dry matter/ha/yr and winters 8,154 stock units (71:29 sheep:cattle ratio) across an effective area of 875 ha (at 9.0 stock units/ha). The property has the potential to irrigate nearly 169 ha of pasture or fodder crops, with the development of a centre pivot and K-Line irrigation system with water abstracted from the Rangitikei River. Development of the proposed irrigation system is estimated to require up to $635,000 of capital investment.

The case study is presented at Annex A.

3 Findings

Key findings from the Rihia Land Co. Ltd. case study are:

1. The irrigation system considered most practical to develop the productive flats on the Rihia Land Co. Ltd. property is a combined Centre Pivot/K-Line solution, abstracting water from the Rangitikei River, with an estimated cost of between $545,000 and $635,000 to develop. The irrigable area if 160 ha. The higher cost estimate was used for financial forecasting purposes within the case study.

2. To maximise the return of the potential irrigation opportunity, alternate livestock management systems were considered. Lamb trading was considered the best system to maximise financial returns to the business whilst minimising the environmental footprint. In addition to incorporating the trading of 12,750 lambs and hoggets to the business, other recommended system changes included:
   - reducing the size of the ewe flock to 3,250 ewes and 960 ewe hoggets
   - maintaining the breeding cow herd at its current size but incorporating a balanced replacement policy with all cows mated to a terminal sire and heifer progeny sold as weaners
   - simplifying the finishing policy so that a herd of 215 R1 year steers are finished on the irrigated flats to 280 kg carcass weight at 18 months of age

3. The modelled irrigation system has the potential to substantially lift the volume of product sold from the farm, and farm cash flow, but comes at significant cost. The direct costs associated with developing/running an irrigation system are estimated at $223,900/year greater than the costs of running the existing farm system.

4. Gross Farm Income from the modelled irrigation farm system is estimated to be only $176,800 greater than the existing farm system, leading to a cash loss of approximately $47,100 per annum. Further, an average depreciation cost of $17,700 per year on the irrigation plant needs to be accounted for.

5. Calculations show the predicted Nitrate loss from the proposed irrigation land is 33 kg N/ha/yr and, against the One Plan permissible Nitrate losses that range from 25 kg N/ha in year one reducing to 19 kg N/ha in year 20 (Table 13.2). As such, the proposed irrigation farm system does not meet the One Plan requirements, so resource consent will be required from Horizons Regional Council. Conditions of consent are likely to include annual nutrient loss limit targets and associated nutrient loss mitigation measures (i.e. riparian fencing and bridges/culverts to keep stock out of waterways).

6. Using available information and current stock prices, development of an irrigation scheme on the Rihia Land Co Ltd property is not currently viable.

Although the case study did not investigate water availability, the volume of water required to meet the modelled irrigation scenario fits within the allocation framework for this part of the Rangitikei catchment. That is, the volume of water required is available, but availability does not guarantee surety of supply during drier years or droughts. Recent experience indicates a high likelihood of irrigation takes from the Rangitikei River being cut-off during drier years, and with further allocation of water for abstraction, the likelihood of cut-off is exacerbated. Surety of supply would need to be considered as part of any further investigation of the feasibility of irrigation for this property.

4 Landowner response

The Totman's made the following observations in response to the case study findings:

- They have contemplated irrigation on their property for many years, and have been in initial discussions with several irrigation companies over the last three years.

- The irrigation system proposed for the farm through the case study process is much larger than anything they have or would contemplate for their property. The Totman's have only ever considered a much smaller system, one that irrigates a greatly reduced area and relies on farm springs (via storage) as the water source. Such a system would be used to support fodder crops for lamb finishing.

- Their preference for a smaller (if any) irrigation system, is based upon their long association with their property and a sound understanding of what does and does not work on their property, and what the property can produce.

- They highly regard, and make considerable recreational use of, the Rangitikei River, and as such have made a conscious decision to not push their property beyond its natural limits. They recognise taking water from the river for irrigation to allow an increase in stock numbers (and the associated increase in nutrient losses) may negatively impact upon the river.

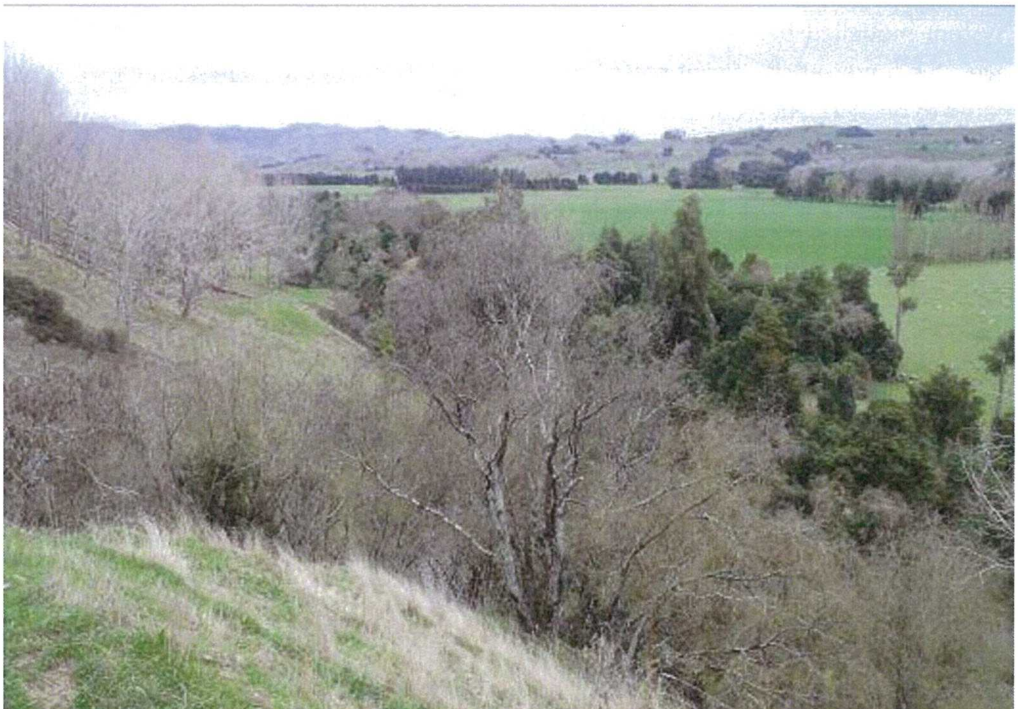
Irrigation Feasibility Assessment

Rihia Land Co Ltd

Andrew Totman

Omatane South Road

TAIHAPE



October 2014

1 Summary

This project has investigated the feasibility of developing an irrigation system totalling 160 ha on the highly productive flats of Rihia land Co Ltd.

The irrigation system considered most practical is a combination of Centre Pivot and K-Line which is estimated to cost between $545,000 and $635,000 to install and cover an area of 160 ha. In the financial assessment of this opportunity the higher of these two estimated values is used. It should be noted that the estimated costs are based on a desk top analysis. For accuracy and prior to any investment decision being made, it is highly recommended that an in depth irrigation system model be designed by a reputable irrigation specialist.

To maximise the opportunity from irrigation requires management to consider alternative livestock management systems. In this instance, the scenario investigated considers lamb trading as a reasonable system development to maximise the financial returns to the business whilst paying attention to the environment.

In addition to incorporating the trading of 12,750 lambs and hogget's to the business, other system changes include:

- A reduction in the size of the ewe flock to 3,250 ewes and 960 ewe hogget's
- Maintaining the breeding cow herd at its current size but incorporating a balanced replacement policy with all cows mated to a terminal sire and heifer progeny sold as weaners
- Simplifying the finishing policy such that a herd of 215 R1 yr steers are finished on the flats to 280 kg Cwt at 18 months of age

The system modelled has the potential to substantially lift the volume of product sold from the farm however this comes at significant cost. The direct costs associated with developing an irrigation system are estimated to be $223,900/year greater than the current system.

Gross Farm Income from the system developed is estimated to be just $176,800 greater than the current operation leading to a cash loss (associated with irrigation) of approximately $47,100 annually. Further, there is an average depreciation cost of $17,700 per year on the irrigation plant.

With respect to the N loss under the Horizons Regional Council One Plan, the property is in a non-priority catchment and if it does not meet Table 13.2 (the permissible N loss limits) then it would be treated as a restricted discretionary consent. Calculations using Overseer (Ver. 6.1.2) show that the predicted N loss from the proposed system is 33 kg N/ha/yr and the permissible N loss limit is 25 kg N/ha for year one, decreasing to 19 kg N/ha for year 20. This means that the proposed system under irrigation does not meet Table 13.2 of the One Plan and Horizons Regional Council may or may not grant the consent.

2 Table of contents

3 Purpose

This Environmental Farm Plan (EFP) has been prepared for Rihia Land Co located on Omatane South Road south west of Taihape. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm Overview

Rihia Land Co is a 994.7 ha summer-safe hill country property located on Omatane South Road near Taihape producing 7,400 kg of pasture dry matter/ha/yr and wintering 8,154 stock units (71:29 sheep:cattle ratio) across an effective area of 874.5 ha (9.0 su/ha).

The property has the potential to irrigate nearly 169 ha of pasture or crops, with the development of a centre pivot and K-Line irrigation system with water extracted from the Rangitikei River. Development of the surmised irrigation system is estimated to require up to $635,000 capital investment.

5 Farm Resources and Current Enterprise

5.1 Land Resources

Rihia Land Co covers a total of 994.7 ha of which 874.5 ha are effective, 24.9 ha is exotic forestry, 95.3 ha of indigenous bush, scrub and dams. The property is considered summer-safe in nature and is located in the Pukeokahu-Mangaweka Catchment which is part of the Rangitikei Catchment (Rang 2b). About 25 % is flat to undulating, 7% rolling to strongly rolling, 25% strongly rolling to moderately steep hill country, 40% moderately steep to steep hill country, and the remaining 3% steep to very steep hill country. Approximately 300 ha has suitable contour for cultivation.

The underlying geology of the hill country is predominately formed from moderately consolidated jointed and massive siltstone, mudstone, and silty sandstone. The easier hill country and downlands may be mantled with loess or tephra. The higher terraced flats are formed from loess whilst the lower terraces and wider gully systems are formed from alluvium, colluvium or gravels. The proposed irrigated block consists predominantly of loess or tephra.

Fifteen different Land Use Capability (LUC) units and 16 dominant soil types were identified as part of the land resource survey. Six soils were identified on the proposed irrigated block and dominant soils include the Ohakea silt loam and the Kawhatau series. The drainage characteristics range from excessively well drained (Kawhatau series) to poorly drained (Ohakea series).

The property contains over 34 km of waterways. These include 2.5 km of boundary with the Kawhatau River, 3.9 km boundary with the Rangitikei River, and 8.5 km of secondary streams. There are also a further 19.0 km of ephemeral waterways.

The Rangitikei River is currently under-allocated for water take and the property is in a Horizons Regional Council Non Priority Catchment.

5.2 The Current Farm operating System

Basic stock numbers, policies and performance levels of the current management system are outlined in the following table:

	Number	Comments
Sheep		
MA Ewes	3,400	Composite doing 135 – 140% lambing (survival to sale). Scanning 178% (2% dry, 19% single, 77% twin and 3% trip). Ram out 27/3 to main line (2700).TS ram our 15/3 to 900 B line ewes. Ram out to two tooths on 31/3
2 Tooth's	1,100	
Ewe Hogget's	1,400	All to ram, 350 dry, 650 single rest twin) lambing 105% to those in lamb. Lamb 27 Sept. Ram out 1/5.
Ram Hogget's	15	Kept for TS mating
Breeding Rams	50	
Cattle		
MA Cows	165	Angus, Hereford, Freisian 90% calving starting in August
R2yr Hfrs	15	A/H/F cross Bought in at 270 kgLWt in April to go to bull as yearlings
R1yr Hfrs	95	Progeny that are finished at 18 – 20 mnths (Feb to June) 260 kgCwt
R1yr Steers	65	Progeny
R2yr Steers	55	Progeny Sold Sep/Oct 300 kgCwt
R1yr Bulls (FR)	10	Bought in 4 day old to replace dead calves
R2yr Bulls (FR)	50	Additional bought in June 450 kgLwt (FR)
Breeding Bulls	3	

Lambs are predominantly sold prime as outlined:

- Nov – 600 = 18.3 kgCwt
- Dec – 830 = 17.2
- Jan – 900 = 18.14
- Feb – 1700 = 18.8
- Mar – 1220 = 17.1
- Apr – 600 = 16.4

The topography of the farm can be separated into three distinct areas:

- Flats – 222 ha estimated to be growing 8,783 kg DM/ha of which approximately 169 ha are considered suitable for irrigation and are located at the front of the farm where the majority of infrastructure has been established
- Medium Hill Country– 71.8 ha growing an estimated 8,872 kg DM/ha
- Steep Hill Country – 580.7 ha growing an estimated. 6,663 kg DM/ha

Current crops grown include:

- 10 ha of Kale for winter feed which is fed from 1 June to 15 Sept (10 – 14 TDM/ha) (R2yr Bulls and Steers)
- 5 ha of green feed Oats (5000 kgDM/ha) fed from 10 sept to 10 October (cows)
- 15 ha Pasja (7 TDM/ha) sown in the spring for lamb finishing over summer. This area is then sown into autumn pasture
- 5 ha of Rape/plantain for late finishing lambs (8TDM/ha) in the autumn. Once grazed by lambs this area is then shut up for the early lambing ewes (August feed). Plantain is sown in the spring on this area
- In total 15 – 20 ha of Plantain is sown in the spring. It is estimated that the Plantain produces 14 TDM/ha annually

Generally all crops and pasture are established by direct drilling.

Silage is harvested off the flats – 67.5 TDM as baleage (300 bales). This is all fed to cattle on the dryer flats (118 ha) during winter.

More specifically the flats identified for irrigation potential are utilised as follows:

- In August the heavy flats (80 ha) are set stocked with early lambing ewes at 10/ha (predominantly twinner's)
- Ewes and lambs are weaned at the end of November with the majority sold prime at 17.5 – 18 kgCwt. Lambs remaining are rotated on Plantain crops and finished over summer
- The MA ewes (which lamb on the hill country) are weaned about 10 December with lambs moved onto the flats (which have generally been spelled from grazing for a couple of weeks)
- Over the summer the heavy flats are grazed by lambs, yearling heifers and late finishing bulls
- In autumn the heavy flats are grazed by ewe lambs and weaners until set stocking of the early lambing MA ewes (B mob)
- Weaner cattle move off the heavy flats in mid-June and are put into cell blocks on the free draining flats
    - Steers – Plantain
    - Heifers - Pasture
- Stony flats are grazed by trading cattle from autumn right through winter
- In spring as cattle are sold they are replaced by the early lambing ewes and then lambs after weaning (November/December is considered the transition period)

6 Proposed Irrigation System

6.1 Potential Irrigation System

Mapping indicates that approximately 169 ha of flats have the potential to be irrigated. These flats can be separated into "Heavy" and "Stony" areas and represent two distinctly different requirements with respect to irrigation use and resource management.

There are numerous resource optimisation scenarios that could be adopted by the owners such is the flexibility offered by the soil characteristics, climate and irrigation of the flats. Not all of these scenarios can be modelled and presented in this document.

Essentially the scenario investigated looks at the potential returns from irrigating 160 ha of flats.

6.1.1 Farm Operating System to fully capture the benefit of irrigating the flats

It is suggested that the Stony Flats be established in Lucerne for intensive livestock finishing and the conservation of a small amount of baleage (approximately 26 TDM) for use as winter feed to a steer finishing operation.

The reasons for Lucerne establishment include:

- Volume of high quality forage able to be grown in the environment with the addition of irrigation
    - The potential may be to grow 25 TDM/ha/yr
    - In the model presented, utilisation of 16 TDM/ha is used
- The water use efficiency of Lucerne is approximately double that of pasture
- Lucerne as a forage is very palatable to all livestock due to its high digestibility, energy and protein levels
- Lamb liveweight gains on Lucerne typically range from 200 to 350 grams/hd/day enabling rapid turnover/finishing or trading of lambs to occur

Whilst it is possible for Lucerne stands to persist for 10 – 15 years under optimum conditions, for the purposes of this investigation it is assumed that Lucerne is renewed on a 7 year cycle. This allows the establishment of Pasja and green feed Oat crops for summer (lamb feed) and winter (feed for steers) grazing respectively.

The Heavy flats are better suited to perennial forage species such as Plantain which has been used by the owners to finish lambs and cattle to date. It is proposed in this investigation to "ramp up" significantly the extent to which Plantain is utilised under irrigation to approximately 67 ha with a further 22 ha (approximate) sown in Rape for winter hogget grazing. It is recommended that Plantain be renewed on a 4 year cycle (hence the Rape) to ensure the best possible performance is realised.

6.1.2 Livestock system on the flats under irrigation

The following table outlines the proposed stocking policy of the flats under irrigation.

Stock class	Comments
Steers	• 215 (75 of which may be sourced from the calves bred on the hill country block) R1yr steers to be purchased in the autumn at approximately 240 kg Lwt • Initially these cattle will be grazed on Plantain and Lucerne prior to spending 2 months on GF Oats. It is recommended that the 26 TDM of Lucerne baleage harvested be fed to these steers over this period • Once the GF Oats are finished (September), the steers can be grazed on Lucerne or Plantain with the aim being to have them finished at 280 kg Cwt in January to March
Winter Hogget's	• Purchase 2000 hogget's late June early July to graze the 22 ha of Rape sown (it is expected that some of these hogget's would graze Plantain over the winter period • These hogget's should all be finished by the start of October
Breeding ewes	• There should be sufficient feed available from the start of October to move 1000 ewes with their lambs at foot onto the flats • It is anticipated that the lambs will grow very quickly and to heavy weights on the Lucerne and Plantain forage such that all will be finished prime December, January and February • Breeding ewes will be returned to the hills following weaning in December

Lamb Trading	• The forage production system which combines Plantain and Lucerne should be capable of allowing management to trade/finish 17,000 lambs. Of this number
	  o 2,000 winter trade hogget's on Rape
	  o 4,250 lambs produced and "fed onto" the flats from the hill country block
	  o 10,750 lambs purchased and finished throughout the summer and autumn
	• With such a large volume of lambs capable of being traded, additional supply benefits are likely to be realised by the owners enhancing the systems profitability beyond that noted in this investigation
	• It is assumed that an average liveweight gain of 10 kg/hd is realised on lambs and that winter trade hogget's are sold at an average of 20 kg Cwt and summer lambs at an average of 18 kg Cwt

The feed budget for the flats contained in the appendices shows the monthly lamb totals (along with other stock numbers) for this system.

It should be noted that there are many different forage options and livestock policies for the flats with or without irrigation. The scenario detailed in this report is based on the owners desire to maintain a livestock business under irrigation and also takes into consideration the implications of Horizons Regional Council's One Plan regulations with respect to N leaching.

6.1.3 Hill country Block

Essentially the hill country block is considered a breeding unit which is comprised of approximately 652 ha of class IV to VII land. It is estimated that this hill country block produces an average of 6,900 kg DM/ha/yr. In addition, a further 21.6 ha of flat land located at the rear of the property are assumed to be managed as part of the breeding block (total area being 673.6 ha). This is due to their location and the lack of scale to warrant irrigation investment.

The hill country breeding system of:

Stock Class	Number	Notes
MA Ewes	2,350	Producing 135% lambing
Two Tooth Ewes	900	
Ewe Hogget's	960	Producing 90% lambing
Rams	50	
Sheep Stock Units	**3,962**	
MA Cows & R2yr Heifers	165	Producing 90% calving
R1yr Heifers	45	Purchased as weaners*
Breeding Bulls	5	
Cattle Stock Units	**1,200**	
Total Stock Units	**5,162**	
Stocking Rate (su/ha)	**7.7**	

* It is assumed that all heifer progeny produced are sold as weaner cattle (as terminal sires are used) whilst steers enter the steer finishing programme outlined for the irrigated flats.

6.1.4 Possible issues or risks associated with this irrigation scenario

The possible issues or risks associated with this scenario include:

- Livestock are known to suffer from bloat on Lucerne. However with sound grazing management practice (following best practice methods) it is possible to avoid this. In addition adding bloat oil to water troughs or using Rumensin capsules can be used to mitigate the risk
- Under poor management weed and insect pests can have a major influence on the forage quality and volume produced. Best management practices are recommended
- Grazing Lucerne in very wet conditions can lead to plant damage reducing the longevity of the crop

With such a large number of lambs being traded, careful attention to animal health and in particular internal parasite management is recommended. A close relationship with the owner's veterinarian is suggested. Taking time to identify lamb suppliers operating sound animal health programmes is warranted.

6.2 Irrigation Costs

In the modelling undertaken for the farm, the capital cost of irrigation establishment (dam, pump, feed pipes and K-line system) has been estimated to be up to $635,000. The annual operating expenses (maintenance, pump fuel, power) are predicted to be $82,500 ($515/ha).

For the purposes of this report, it is estimated that up to 600 mm of irrigation water will be applied annually, between November and April.

It is noted that in most cases farmers choose to irrigate the largest possible area whether this is their initial intention or as a result of the financial benefits identified from irrigating a smaller area to begin with. It is therefore recommended that infrastructure be established at the outset to ensure the entire area available is irrigated. This will avoid costly additional infrastructural expenditure in the future to extend an existing system.

Scenario: **Irrigation of 160 ha**

It is estimated that the cost to extract water from the Rangitikei River and develop the infrastructure to irrigate 160 ha will be approximately $150,000.

Given the geography of the flats it would appear appropriate to establish approximately 80 – 100 ha under a Centre Pivot ($250,000 - $300,000) and approximately 60 – 80 ha under a K-line system ($185,000). For the purposes of this investigation it is estimated that 160 ha will be irrigated.

Collectively the capital cost of investment is estimated to be approximately $545,000 - $635,000 (or $3,400 - $4,000/ha). Based on an interest rate cost of 6.5%, the annual capital cost of developing the irrigation system is likely to range from $35,425 ($220/ha) to $41,275 ($260/ha).

Ongoing operating irrigating expenditure is estimated to be $82,500/year. The costs of this include:

- Power $76,500
- Repairs & maintenance $6,000

The additional labour component (estimated to be $35,000) associated with irrigation is noted under wages in the accompanying financial budget.

No estimation of costs associated with re-subdivision or the re-reticulation of stock water on the flats has been made in this investigation. This cost may be significant and should form part of a further in-depth feasibility investigation.

6.3 Implications of Irrigation on Existing Farm System

Water for irrigation of the flats may be sourced from the Rangitikei River or a spring located on the edge of the flats. Whilst the spring provides a considerable volume of water for livestock supply, the amount available for irrigation is considered inadequate for a large scale area (at most 10 ha).

A balance between production and profitability levels must be reached with the nutrient restrictions imposed by the Horizons Regional Council's One Plan (Table 13.2). To this end the forage production system detailed seeks to find this balance.

Adoption of an irrigation system should not be considered a drought management tool (although it is very useful in droughts as a tool to protect baseline productivity), but rather an opportunity to develop and diversify the business for greater financial reward. Typically in order to derive an acceptable return on investment from irrigation development new and often novel farm systems need to be developed. These often require the acquisition of new skills and knowledge.

6.4 Financial Benefits of Irrigation

In this case, and under the parameters used, the addition of irrigation, is expected to have a negative impact on the Earnings Before Interest and Tax – EBIT/ha (otherwise known as the farm operating surplus). This is shown in the table below where the EBIT is expected to decrease by $47,100 ($54/ha).

The table below compares the key financial indices of the current farm system with the inclusion of 160 ha of irrigation. A full breakdown of costs and prices used in each scenario can be found in Appendix 1. The costs and revenues used in this report are generalised and not actual figures from the property.

	Current – no irrigation	With irrigation
Total farm area (ha)	874.5	874.5
Irrigated Area (ha)	0 ha	160
Total stock Units (June 30)	7,885	7,730
Stocking Rate (su/ha)	9.0	8.8
Gross Farm Income (GFI $)	$954,000	$1,130,800
GFI $/ha	$1,090	$1,292
Farm Working Expenses (FWE $)	**$398,600**	**$622,500**
FWE $/ha	$455	$711
Farm Surplus (EBITR)	**$555,400**	**$508,300**
EBITR/ha	$635	$580
Estimated capital cost for Irrigation		$635,000
Est. Capital cost/ha irrigated		$4,000
Est. Return on Investment %		**-7.4%**
Interest Cost at 6.5% p.a.		$41,275
Net Potential Benefit $		**-$47,100**
Depreciation on Plant (4% pa) – Average over 20 years		**-$17,700**
Adjusted Potential Benefit		**-$64,800**

Note: The June 30 winter stocking rate in the irrigation model is lower than the current system in this table. Under the model investigated it is assumed that in early July, 2,000 hogget's come onto the farm lifting the carrying capacity by 1,600 su and the stocking rate to 10.6 su/ha.

Including the depreciation on the irrigation plant at 4% per annum, the actual loss from investing in irrigation may be as much as $64,800 per year ($17,700 is the average amount of depreciation that occurs annually over 20 years).

Under a different management system the economics of developing an irrigation system may be viable. In addition there may be some benefit to the capital value of the property as a direct result of irrigation development.

6.4.1 Breakeven Calculations

The following table seeks to identify the trading margins required under the irrigation model to breakeven with the existing operation.

	Trade Margin Used ($/hd)	Break Even Trading Margin ($/hd)	Break Even Trading Margin ($/hd)
Winter Hogget's	$30.00	$35.08	NA
Summer Lambs	$24.40	$29.48	$30.43
Steer Trading	$520.00	NA	NA

In reality it is not considered practical or realistic to offset the loss through increased trading margins in the steer cattle enterprise. The first column highlights the existing trade margins whilst the second and third look at what is necessary firstly across all lambs and hogget's traded and then secondly just over the lambs traded.

Alternatively a further 2,655 lambs would need to be traded over the summer and autumn to break even (at the trading margin of $24.40/hd).

Whilst realising a higher trading margin on lambs and trading more lambs is possible, the level of management expertise required increases substantially.

Alternative management systems whereby irrigation development may become viable include:

- Replace breeding stock on the hill block with more finishing/trading stock which are grazed in a "holding condition" mode before being moved onto the flats for finishing
- Dairy farm conversion although this is likely to be constrained by HRC rules
- Cash cropping
- Sheep milking
- Goat milking
- Dairy support

6.5 The permissible N loss Limits

The permissible N loss limits under Table 13.2 of the Horizons Regional Council One Plan are calculated using the LUC (land use capability) classes as shown in the LUC map in Appendix 3. The following table summarises the permissible N loss limits under the irrigated area.

Year	Irrigated area only	
	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	4,271	25
5	3,838	23
10	3,427	20
20	3,258	19

The quantity of N that the irrigated land is permitted to lose via leaching is 25 kg N/ha/yr (or 4,271 kg N) for year one and this decreases to 19 kg N/ha/yr (or 3,258 kg N) for year twenty.

Under the One Plan, only the irrigated area needs to meet this table. If it does not meet this table then there is an opportunity to offset the N loss on the irrigated land by incorporating part or all of the whole property. If the non-irrigated parts of the property are incorporated then these areas must also meet the stock exclusion rules regarding waterways and crossings culverted or bridged. This may be impractical under a hill country farming regime.

6.6 N Loss calculations

The permissible N loss for the irrigated area is 4,271 kg N (25 kg N/ha) for year one, decreasing to 3,258 (19 kg N/ha) for year 20. Overseer (Ver. 6.1.2) was used to determine the N loss from the irrigated areas. In total it is estimated that the irrigated areas are leaching 5,537 kg total N (33 kg N/ha). This is well above the permissible N loss limits of Table 13.2 of the One Plan. Consequently the proposed system under irrigation does not comply with Table 13.2 and Horizons Regional Council would treat any consent application as Restricted Discretionary.

7 Appendix 1: Financial analysis – Comparison of Non Irrigated and Irrigated Farm Systems

Note: The following costs and revenues are generalised and not actual figures from the property.

Financial Analysis and Comparison		
	Current Farm no irrigation	**Current farm including Irrigation**
Total Area	994.6	994.6
Effective Area	874.5	874.5
Area Irrigated		160
Est. Pasture/forage Production	7,400	8,200
Stock Numbers	7,861	7,730
Stocking rate	9.0	8.8
Income:		
Sheep Sales	$640,980	$1,840,162
Wool Sales	$89,424	$90,104
Sheep Purchases	$12,500	$1,068,500
Net Sheep Return	$797,179	$915,264
Cattle Sales	$221,400	$299,550
Cattle Purchases	$64,600	$84,000
Net Cattle Return	$156,800	$215,550
Gross farm Income	$953,979	$1,130,814
GFI/ha $	$1090	$1,292
GFI/su $	$120.99	$146.02
Farm Working Expenses:		
Wages	$125,000	$160,000
Animal Health	$33,000	$38,500
Shearing	$40,000	$42,000
Electricity	$3,000	$3,000
Contractors	$5,000	$5,000
Cropping and Re-grassing	$31,250	$55,600
Freight	$5,000	$27,500
Fertiliser	$78,550	$86,000
Weed & Pest	$1,500	$2,500
Repairs & Maintenance	$12,500	$12,500
Vehicle Expenses	$18,000	$20,000
Irrigation Operating Expenses		$124,100
Rates, Insurance & ACC	$25,000	$25,000
Administration	$6,800	$6,800
Feed	$14,000	$14,000
Other Expenses		
Total Farm Working Expenses	$398,600	$622,500
FWE $/ha	$455	$711
FWE $/su	$50.55	$80.38

Earnings Before Interest Tax & Rent:		
EBITR $	$555,379	$508,314
EBITR $/ha	$635	$581
EBITR $/su	$70.43	$65.76
Return on Irrigation Investment %		-7.4%
Irrigation Analysis	**Current Farm**	**Current farm including Irrigation**
Irrigation Costs:		
Capital Interest cost		$41,275
Electricity/Diesel		$76,500
Additional Labour cost		$35,000
Maintenance		$6,000
Additional cropping cost		$24,350
Additional Freight cost		$22,500
Additional Other costs		$19,950
Total Additional Cash costs to irrigate		$225,575
Irrigation cost/kg DM extra grown		$0.32
Days Irrigating/year		120
Volume water applied mm/ha		600
Additional DM Produced kg DM/ha		800 kg DM/ha
Net Benefit of Irrigation $		$47,065
Net value of irrigation $/kg DM		$0.07/kg DM

8 Appendix 2: Feed Budget on Irrigated Area

Name:	Totman Flats									Date:	03-Aug		
Month		July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Number of days		30	31	31	30	31	30	31	31	28	31	30	31
Area		169	169	169	169	169	169	169	169	169	169	169	169
(A) Starting Cover (KgDM/ha)		2,000	1,750	1,447	1,549	1,245	1,423	1,477	1,713	1,951	2,096	2,061	2,106
Pasture Growth Rate (kgDM/ha/d)		-	-	-	-	-	-	-	-	-	-	-	-
Supplements (Total kg/month):													
	Lucerne	-	-	102,000	102,000	136,000	170,000	170,000	170,000	136,000	68,000	34,000	-
	Baleage	13,000	13,000	-	-	-	26,000	-	-	-	-	-	-
	GF Oats	38,400	38,400	-	-	-	-	-	-	-	-	-	-
	Pasja	-	-	-	-	-	14,000	28,000	28,000	14,000	-	-	-
	Plantain	20,100	20,100	33,500	67,000	134,000	134,000	134,000	134,000	134,000	100,500	33,500	20,100
	Nitrogen												
(B) Total Feed Supply (kgDM/ha/d)		**14.1**	**13.6**	**25.9**	**33.3**	**51.5**	**57.8**	**63.4**	**63.4**	**60.0**	**32.2**	**13.3**	**3.8**
FEED DEMAND:													
Ewes	Number				1,000.0	1,000.0	1,000.0						
	Intake (KgDM/hd/d)	1.8	2.8	3.7	3.7	3.5	2.5	1.1	1.2	1.5	1.5	1.3	1.1
	Liveweight (kg)	60.0											
	Intake (KgDM/ha/d)	-	-	-	**21.9**	**20.7**	**14.8**	-	-	-	-	-	-
2 tooths	Number												
	Intake (KgDM/hd/d)								1.3	1.5	1.5	1.3	1.2
	Liveweight (kg)												
	Intake (KgDM/ha/d)	-	-	-	-	-	-	-	-	-	-	-	-
Lambs (Bred)	Number				1,350.0	1,350.0	1,000.0	700.0	300.0	-	-	-	-
	Intake (KgDM/hd/d)	0.5	0.5	0.6	1.3	1.6	1.7	1.6	1.5	1.6	0.6	0.6	0.5
	Lwt Gain (g/hd/d)	150.0	150.0	200.0	280.0	300.0	300.0	250.0	220.0	220.0	200.0	200.0	150.0
	Liveweight (kg)				15.0	23.4	32.7	33.0	33.0	39.8			
	Intake (KgDM/ha/d)	-	-	-	**10.6**	**12.5**	**10.2**	**6.5**	**2.6**	-	-	-	-
Lambs (Trade)	Number	2,000	2,000	1,500	-	-	2,000	4,000	5,000	6,000	3,000	500	-
	Intake (KgDM/hd/d)	1.3	1.3	1.4	1.5	1.6	1.6	1.6	1.5	1.5	1.4	1.4	1.3
	Lwt Gain (g/hd/d)	150	150	200	220	250	250	250	220	220	200	200	150
	Liveweight (kg)	35	35	35	35	35	32	32	35	35	35	35	35
	Intake (KgDM/ha/d)	**15.2**	**15.2**	**12.8**	-	-	**18.4**	**36.9**	**44.7**	**53.7**	**25.7**	**4.3**	-
Rams	Number												
	Intake (KgDM/hd/d)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Liveweight (kg)												
	Intake (KgDM/ha/d)	-	-	-	-	-	-	-	-	-	-	-	-
(C) Total Sheep Demand (kgDM/ha/d)		**15.2**	**15.2**	**12.8**	**32.5**	**33.2**	**43.5**	**43.4**	**47.4**	**53.7**	**25.7**	**4.3**	-
MA Cows	Number												
	Intake (KgDM/hd/d)	7	9	12	15	15	13	12	12	10	7	7	6
	Liveweight (kg)												
	Intake (KgDM/ha/d)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
R2yr Hfrs	Number												
	Intake (KgDM/hd/d)	7	7	8	10	12	12	12	10	10			
	Liveweight (kg)	400											
	Intake (KgDM/ha/d)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
R1yr Hfrs	Number												
	Intake (KgDM/hd/d)	5	6	8	9	9	9	8	8	7	8	7	6
	Liveweight (kg)	250											
	Intake (KgDM/ha/d)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
R1yr Strs	Number										215	215	215
	Intake (KgDM/hd/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	5.9	5.8
	Lwt Gain (kg/hd/d)										0.8	0.7	0.6
	Liveweight (kg)										240	264.8	285.8
	Intake (KgDM/ha/d)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**7.6**	**7.5**	**7.4**
R2yr Strs	Number	215	215	215	215	215	215	215	150	20			
	Intake (KgDM/hd/d)	5.7	6.5	7.7	8.6	9.9	9.7	9.7	9.4	9.7	0.0	0.0	0.0
	Lwt Gain (kg/hd/d)	0.5	0.7	1	1.2	1.5	1.3	1.2	1	1			
	Liveweight (kg)	304.4	319.4	341.1	372.1	408.1	454.6	493.6	530.8	561.8			
	Intake (KgDM/ha/d)	**7.2**	**8.2**	**9.7**	**10.9**	**12.6**	**12.3**	**12.3**	**8.3**	**1.1**	**0.0**	**0.0**	**0.0**
Carry Over	Number												
	Intake (KgDM/hd/d)	8	7	7	8	10	10	10	8	8	10	10	8
	Liveweight (kg)	480											
	Intake (KgDM/ha/d)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
(D) Total Cattle Demand (kgDM/ha/d)		**7.2**	**8.2**	**9.7**	**10.9**	**12.6**	**12.3**	**12.3**	**8.3**	**1.1**	**7.6**	**7.5**	**7.4**
(E) TOTAL DEMAND (KgDM/ha/d)	**(E = C+D)**	**22.4**	**23.4**	**22.6**	**43.5**	**45.8**	**55.8**	**55.7**	**55.7**	**54.8**	**33.3**	**11.8**	**7.4**
(F) Surplus/Deficit (kgDM/ha/d)	**(F = B-E)**	-8.3	-9.8	3.3	-10.1	5.7	1.8	7.6	7.7	5.2	-1.1	1.5	-3.5
(G) Monthly Cover Change (kgDM/ha)	**(G = F * No. Days)**	**-249.7**	**-303.5**	**101.8**	**-303.8**	**177.8**	**54.0**	**236.5**	**237.9**	**145.1**	**-35.4**	**45.2**	**-110.0**
(H) MONTH END COVER (KgDM/ha)	**(H = A+G)**	**1,750**	**1,447**	**1,549**	**1,245**	**1,423**	**1,477**	**1,713**	**1,951**	**2,096**	**2,061**	**2,106**	**1,996**

Note: Enter your information into the Blue Cells only

Change the area on a monthly basis for the removal or addition of land for crops etc.

In order to start at different times of the year you will have to manually change the Month and No. of days

9 Appendix 3: Overseer Nutrient Budget Reports

9.1 Nutrient Block setup

The following nutrient management blocks were used in Overseer v6.1.2 to determine the Nutrient Budget for the whole farm under irrigation.

Block name	Type	Effective area (ha)
1. Tephra	Pastoral	5.9
2. Wet loess	Pastoral	98.9
3. Stony flats	Pastoral	3.0
4. Easy HC	Pastoral	396.3
5. Riparian	Pastoral	6.5
6. Steeper HC	Pastoral	195.3
i1. Irrigated tephra	Pastoral	3.6
i2. Irrigated wet loess	Pastoral	7.3
i3. Irrigated stone	Pastoral	22.8
Rape	Fodder Crop	-
Lucerne	Pastoral	68.0
Plantain	Pastoral	67.0
Pasja & Oats	Fodder Crop	-

9.2 Whole Farm Nutrient Budget – With Irrigation

The following Nutrient Budget was calculated using Overseer v6.1.2 with the addition of an irrigation block.

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	4	17	3	20	35	0	0
Rain/clover N fixation	71	0	2	3	2	4	13
Irrigation	1	0	0	1	3	1	3
Nutrients removed							
As products	33	7	2	4	13	0	1
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	22	0	0	0	0	0	0
To water	11	0.5	6	18	16	3	16
Change in farm pools							
Plant Material	-1	0	-3	0	0	0	0
Organic pool	8	6	0	2	0	0	0
Inorganic mineral	0	4	-8	0	-3	-5	-6
Inorganic soil pool	3	1	8	0	13	6	5

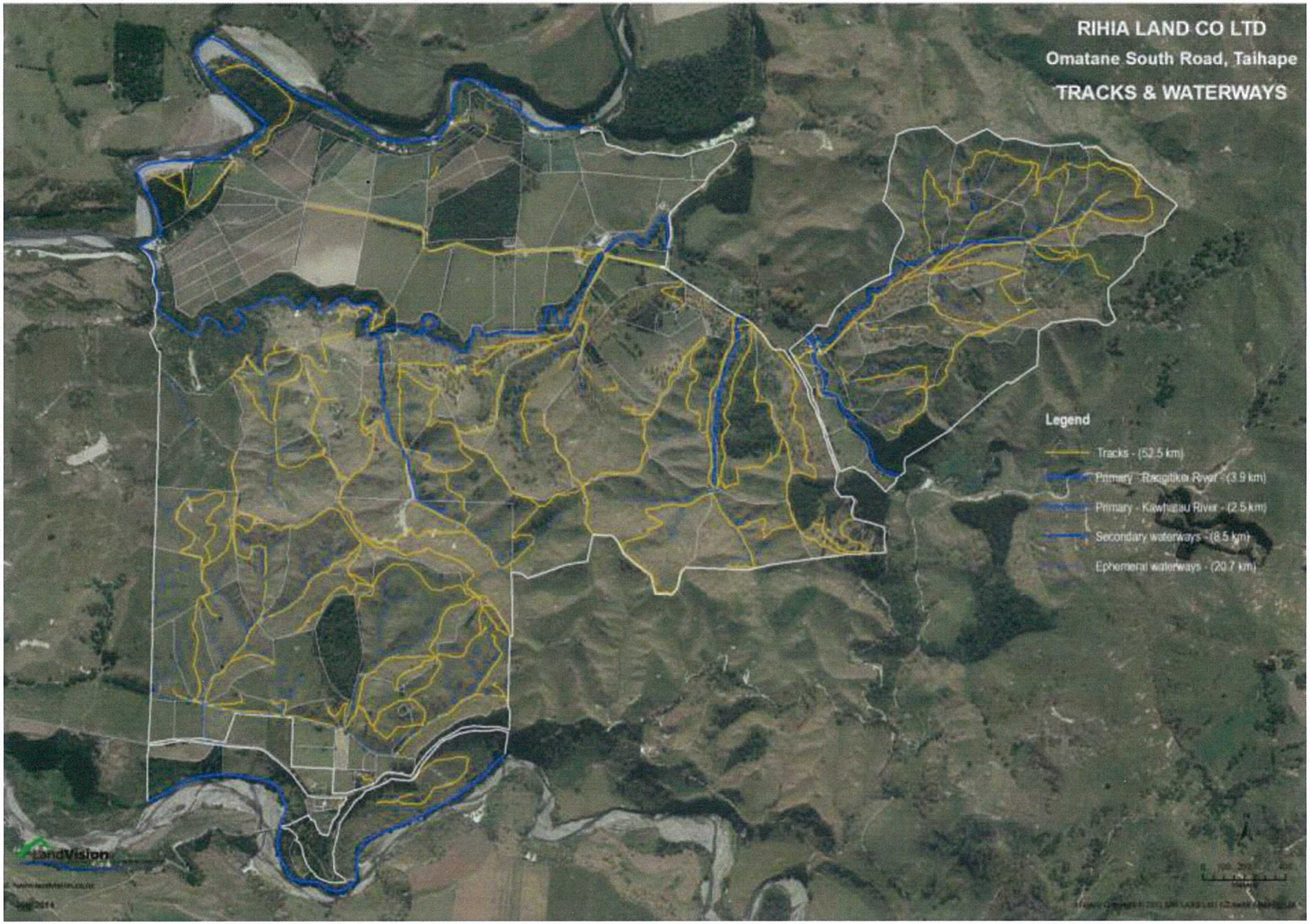
9.3 Nitrogen Block report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
1. Tephra	53	9	2.3	43	0
2. Wet loess	712	7	1.9	47	0
3. Stony flats	23	8	2.0	40	0
4. Easy HC	3142	8	N/A	40	0
5. Riparian	49	7	N/A	34	0
6. Steeper HC	1300	7	N/A	35	0
i1. Irrigated tephra	32	11	1.9	59	0
i2. Irrigated wet loess	52	9	1.6	67	0
i3. Irrigated stone	279	12	2.0	53	0
Rape	1499	68	10.7	206	48
Lucerne	1543	30	9.0	252	0
Plantain	547	11	1.8	-8	37
Pasja & Oats	1585	132	**15.8**	323	106
Other sources	171				
Whole farm	10987	11			
Less N removed in wetland	0				
Farm output	10987	11			

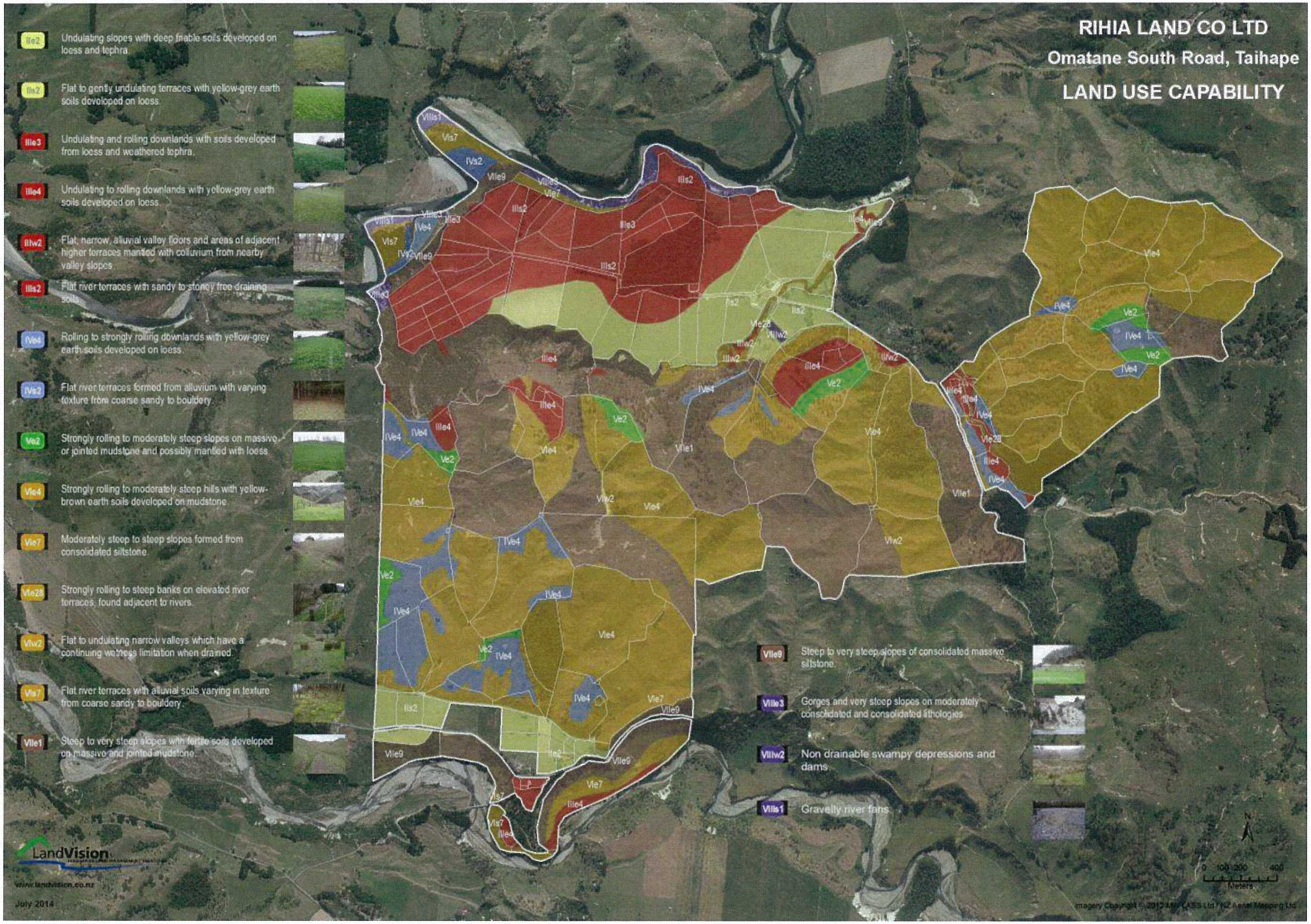
10 Appendix 4: Maps

10.1 Paddock Map

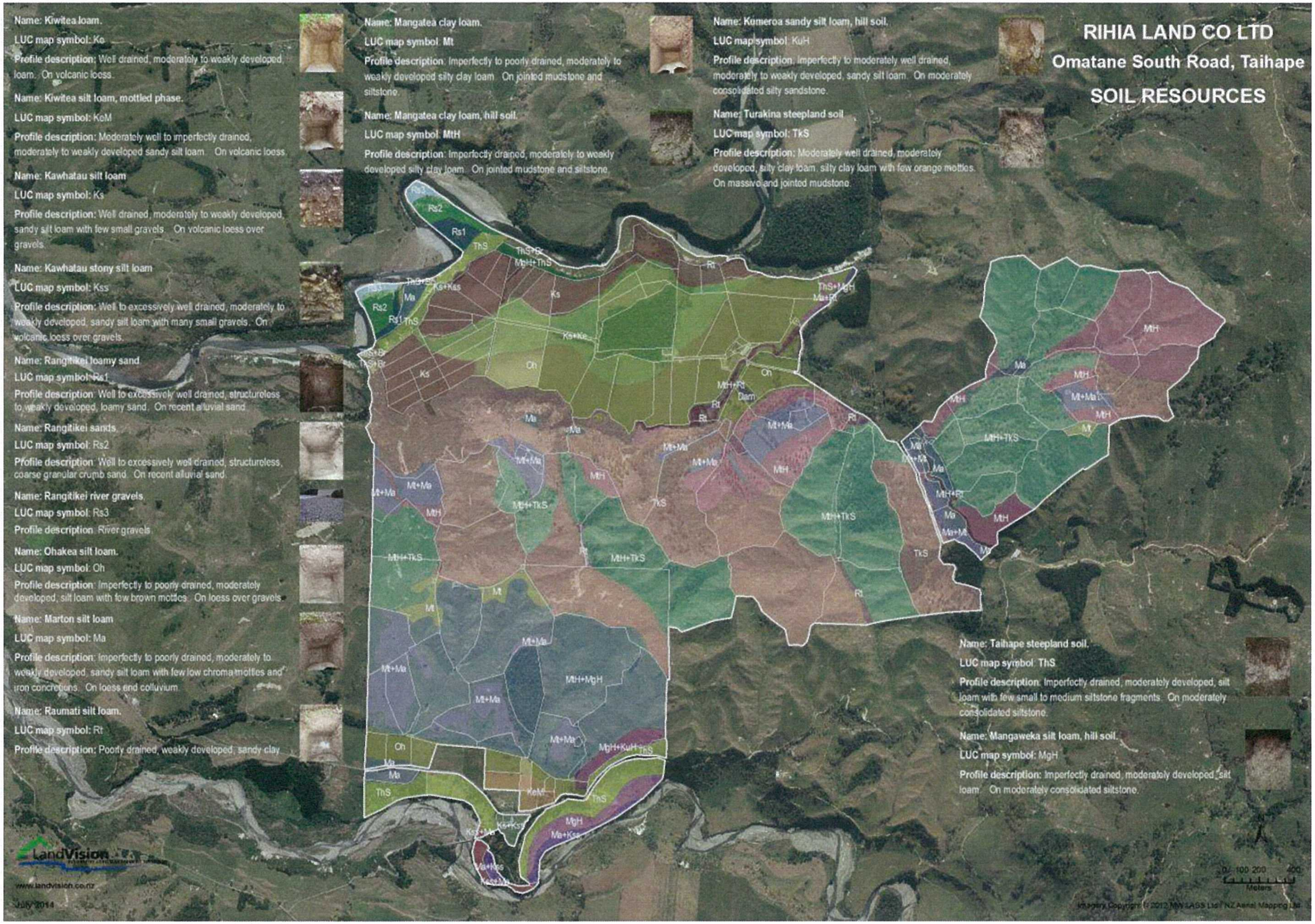
10.2 Tracks and Waterways Map



10.3 Landuse Capability Map

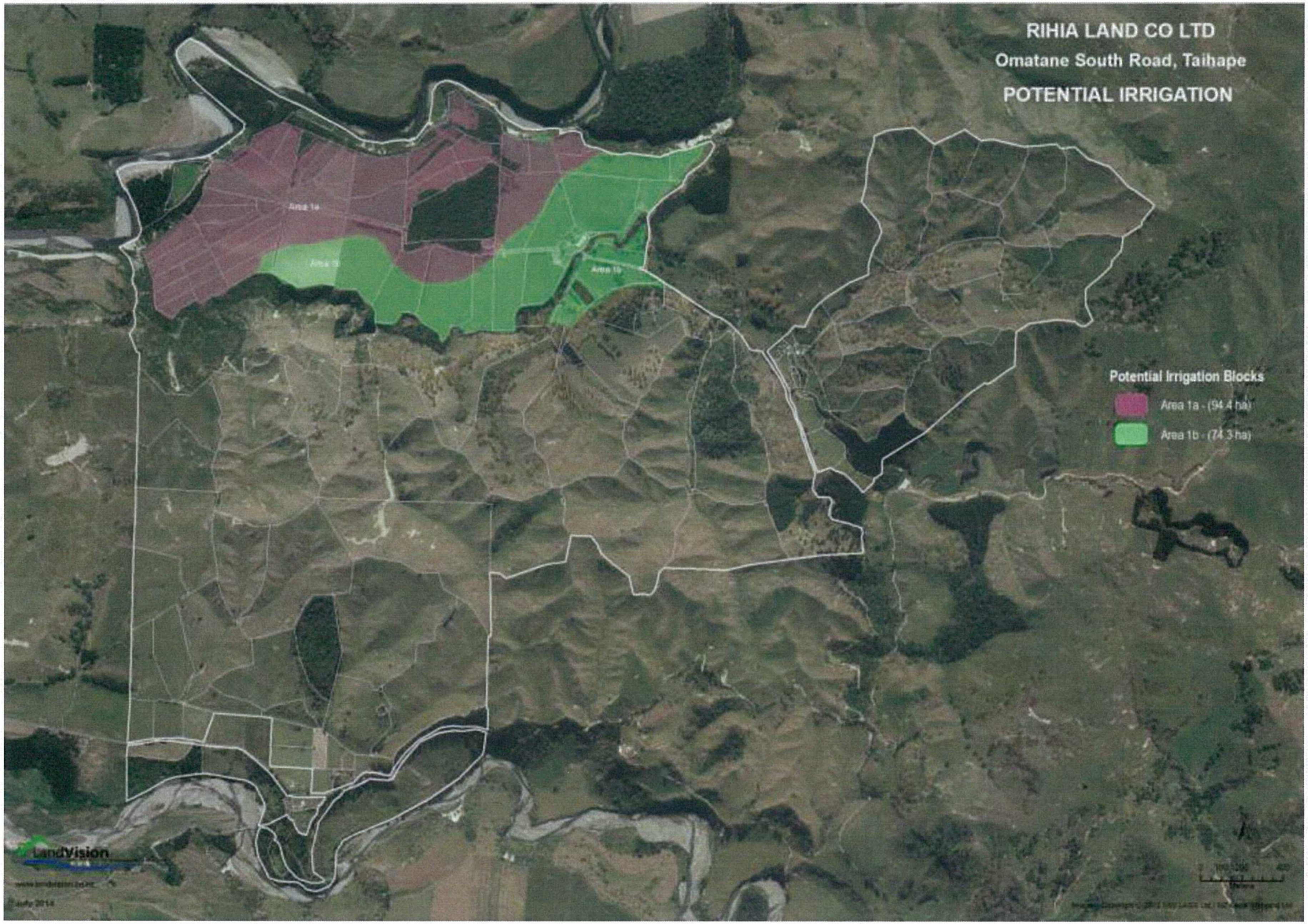


10.4 Soils Map

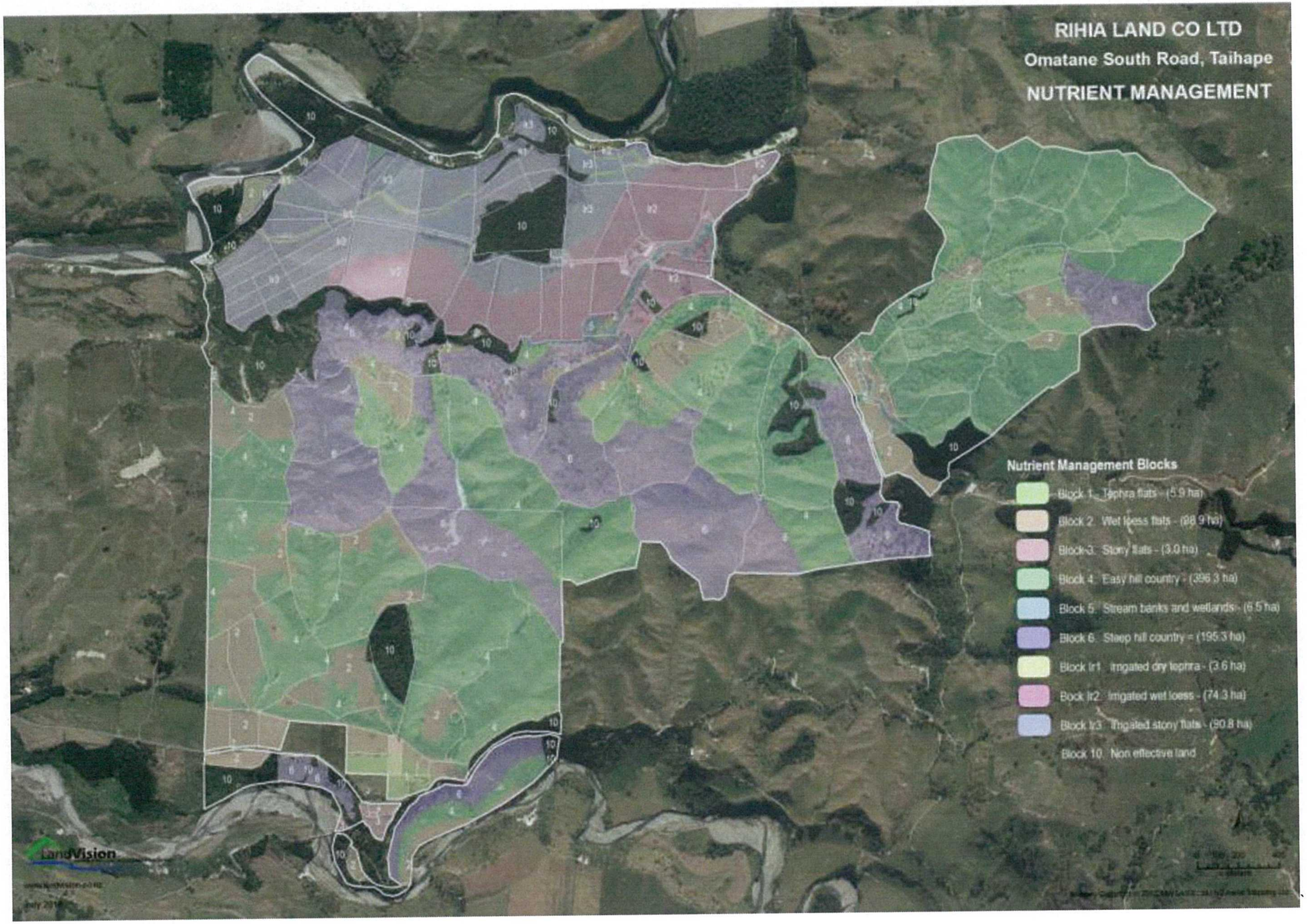


21

10.5 Irrigation Map



10.6 Nutrient Block Map



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Pencoed Trust (Williams) detailed irrigation case study

Report prepared as part of the Rangitikei Strategic Water Assessment project, jointly funded by Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund)

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Manatū Ahu Matua

Acknowledgements

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- Rangitikei District Council and the Ministry for Primary Industries (Irrigation Acceleration Fund) for supporting the Rangitikei Strategic Water Assessment project
- Brendon and Rachael Williams for allowing us to use their property as a case study for this project, for opening their farm as part of a series of field days, and for giving their time and farm enterprise data so freely
- Lachie Grant of Landvision Ltd and Greg Sheppard of Sheppard Agriculture for undertaking the case study analysis

Report No 2014/016

17 November 2014

1 Introduction

The Rangitikei district is heavily reliant upon the primary sector for its economic and social well-being. This sector is founded upon the district's topography, soils, climate, water resources, and farmer innovation. However, the district's water resource is coming under increasing pressure from irrigators, and the impacts of droughts.

In response to these challenges the Rangitikei District Council and Ministry for Primary Industries (via the Irrigation Acceleration Fund) are jointly funding The Catalyst Group to undertake a strategic water assessment for the district. This project will generate information about the:

- availability and certainty of water supply (surface and groundwater) in the district;
- efficiency of current water use, and opportunities for improvement;
- costs, benefits, on-farm implications, and regulatory and environmental considerations around irrigation, and
- alternative uses for irrigated land.

Such an assessment is a priority for Rangitikei District Council as this project will provide guidance on what additional benefits and opportunities could arise through smart use of the water resource, and identification of the costs of capitalising on these opportunities at a district and individual level.

A key task within the wider Rangitikei Strategic Water Assessment project was the development of a series of case studies for both irrigated and non-irrigated properties. The purpose of these case studies was to provide landowners contemplating the installation of irrigation for their own properties with real-life information about operating irrigated farms, and from modelled examples on non-irrigated farms, to assist their decision-making. Specifically, the case studies were developed to provide information on the following:

- Irrigated properties – the costs of developing and running irrigation, the farm systems developed to capitalise on irrigation, on-farm economics, and regulatory/environmental considerations, and
- Non-irrigated properties – identification of land area suitable for irrigation, estimated costs of developing and running irrigation, recommended changes to current farming systems, modelling the impacts on farm economics, and regulatory/environmental considerations.

The selected case study properties are distributed across the Rangitikei district and represented a range of farming types, as follows:

Owner	Farm Type	Location	Irrigation
Robertson	Dairy	Bulls	Yes
Totman	Sheep/beef	Utiku	No
Williams	Cropping	Marton	No
Marshall	Sheep/beef	Pukeokahu	No
Chrystall	Sheep/beef	Moawhango	No
McManaway	Dairy	Hunterville	Yes
Simpson	Sheep/beef	Santoft	No

Detailed case studies were completed for the Robertson, Totman and Williams properties, with the remaining properties receiving simplified versions of the detailed case study assessments.

A crucial component of the case studies was the assessment of regulatory considerations, namely compliance with the water allocation and water quality provisions of Horizons Regional Council's One Plan. Irrigation development triggers the need for resource consents under the One Plan - to abstract water (unless from off-line storage), and for non-point source contaminant discharges (namely nitrates and phosphate). Landowners contemplating irrigation for their properties need to consider:

- water availability (i.e. source, volume, restrictions on use, and surety of supply), and
- nutrient losses (i.e. nutrient loss rates, mitigation options, achievement of loss limit targets)

Either matter has the potential to prevent the development of irrigation, or restrict it to the point that irrigation becomes unfeasible and/or uneconomic.

2 Background

A detailed case study has been prepared for Pencoed Trust, owned by the Williams family. The property is located on Somersal Lane, north of Marton, in the upper Tutaenui Stream catchment. This case study has been prepared to assess the opportunities, costs, and on-farm implications of developing a more extensive irrigation system on the property.

Pencoed Trust is a 199.8 ha summer-safe flat to undulating mixed grazing and cropping property, with income streams from maize and barley grain and lamb/steer finishing. Typically the property winters 650-1000 ram hoggets, 67 R2yr steers, and 50 dairy heifers (for 6 weeks). 64 ha of maize and 32 ha of barley are grown annually. Crop yields and livestock performance levels on the property are at a very high level. The property can currently irrigate up to 5 ha.

For the purposes of this case study two scenarios were tested:

- Development of 86 ha of irrigation using two pivot irrigators to support conversion to a dairy platform, and
- Development of 64 ha of irrigation using a travelling irrigator to support maize cropping

A variety of potential water sources were considered as part of these scenarios. The estimated capital costs of installing these two irrigation scenarios ranged between $175,000 (travelling irrigator) and $385,000 (pivot irrigator).

The case study is presented at Annex A.

3 Findings

Key findings from the Pencoed Trust case study are:

1. Pencoed Trust is currently managed very effectively, with cropping and livestock performance levels well above average. As a consequence, future performance level gains from the existing business enterprise are likely to be limited.

2. Three water supply options were considered as part of this investigation – on-farm water harvesting and storage, bore development, and accessing surplus water from the Rangitikei District Council's bore located approximately 2 km from the farm. Of the three water sources, the most practical and cost effective water source appears to be the District Council bore. Access to this source would require a further discussion with Council to negotiate and agree supply terms (i.e. volume, rate, and cost).

3. Two farming system/irrigation models were investigated for the Pencoed Trust property to explore potential costs, production level lifts, and economic returns. These models were: (1) irrigated cropping and, (2) conversion to dairying.

4. The irrigation system considered most practical for delivering water to crops at critical stages of plant development was a travelling irrigator servicing 64 ha, with an estimated installation cost of between $175,000 and $258,000. After adjusting for the cost of capital and depreciation this system has the potential to improve business profitability by approximately $11,000 annually. This is based on lifting the maize yield by 2T/ha. This represents a Return on Capital (ROC) of approximately 5%.

5. Converting the property to a dairy platform, with two centre pivot irrigators servicing 84 ha, was estimated to cost approximately $4.1 million, with an irrigation development cost of $345,000-$385,000. A platform comprising 545 cows and producing 239,000 kgMS was estimated to generate an annual operating profit (after adjusting for the cost of capital and depreciation) approximately $26,000 greater than the current business. However, a Return on Capital of just 0.66% suggests dairy conversion is a marginal investment option. In saying that, the most significant aspect of this opportunity is the potential for capital gains, which could be in the range of $1.5 million as a result of converting.

6. Given the annual financial return for the irrigated crop system, and the potential capital gains from a conversion to dairying, both systems offer economically viable options for consideration by the owners.

7. Calculations show the predicted Nitrate loss from the proposed dairying system is 26 kg N/ha, and the irrigated cropping system is 20 kg N/ha, against the One Plan permissible Nitrate loss limits of 29 kg N/ha for year 1 declining to 23 kg N/ha for year 20 (Table 13.2). As such, the dairying system meets the year 5 targets, while the irrigated cropping system meets the One Plan permissible N loss limits. Both systems will require resource consent. The consent for the dairying system is likely to include annual nutrient loss limit targets and associated nutrient loss mitigation measures (i.e. riparian fencing and bridges/culverts to keep stock out of waterways).

The above scenarios are based upon sourcing water from the Rangitikei District Council bore, at a cost of \$0.14/m^3. Should this source not be available, then the establishment of a bore on the property is the next best option. Although this case study did not investigate groundwater availability, the volume of water required to meet the modelled irrigation scenarios fits within the groundwater allocation framework for this part of the Rangitikei catchment. That is, the volume of water required is available for allocation. However, what is unknown is whether the groundwater resource beneath the property is accessible i.e. is it present at a depth and in sufficient quantities to make it economic to develop.

4 Landowner response

The Williams' made the following observations in response to the case study findings:

- They were not overly interested in the dairy conversion option. Part of the farm was previously in dairying, but the William's said dairying wasn't for them and converted the entire farm to cropping/sheep/beef.

- The idea of converting to dairy for capital gains was not appealing as the Williams' have no intention of selling the property in the foreseeable property.

- The Williams' were very keen to explore the potential of using the Marton water supply for rural stockwater supply and/or irrigation.

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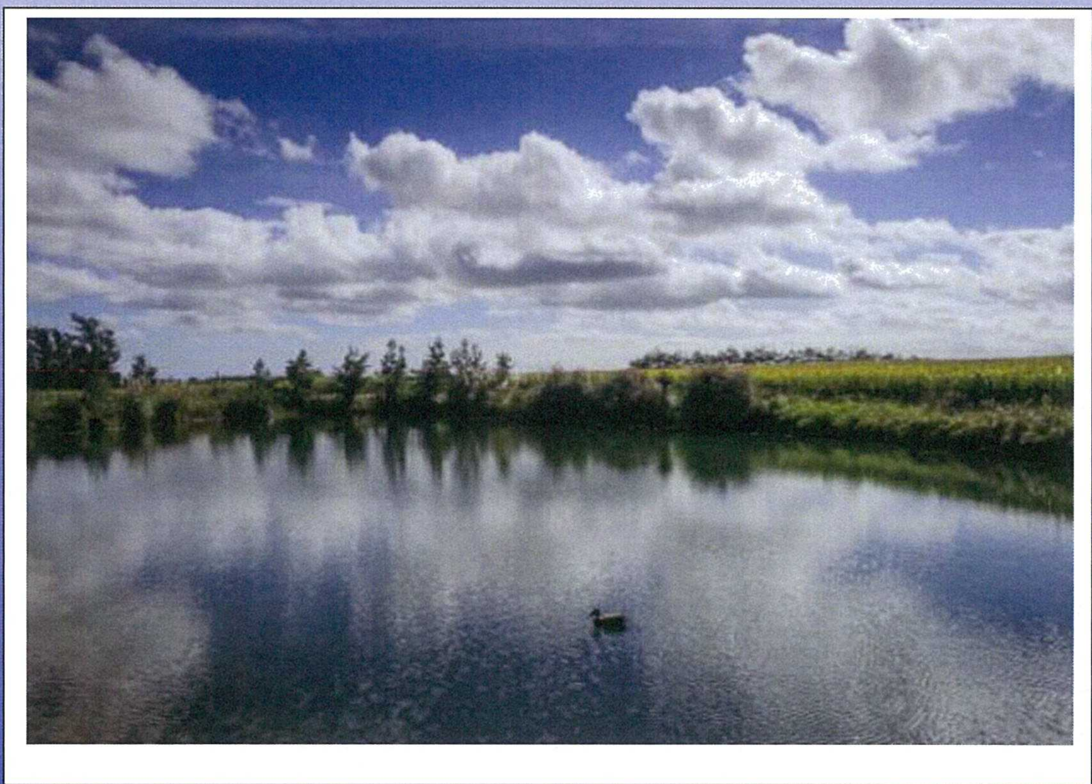
Irrigation Feasibility Assessment

Pencoed Trust

Brendon and Rachael Williams

Somersal Lane

MARTON



October 2014

1 Summary

This project has investigated the feasibility of developing irrigation for Pencoed Trust on Somersal Lane near Marton.

Pencoed Trust is currently managed very effectively with performance levels achieved in cash cropping and livestock grazing being well above average (estimated Return on Capital of 6.2% has been calculated). As a consequence future gains in performance levels achieved from the existing business enterprises are likely to be marginal.

Through this investigation into the viability of irrigation various methods of water take have been considered including:

- Water harvesting and storage on the farm
- Drilling a bore
- Accessing water from the Rangitikei District Council's bore located approximately 2 km from the farm

The most practical and cost effective water source appears to be that which could be supplied by the RDC. A further financial case model will need to be developed by the council to determine the viability of this for the community. The economic results of this investigation are based on the supply of water from RDC at a cost of $0.14/m^3$ (being the average cost of irrigation water supplied in NZ at the present time).

Two alternative irrigation models have been investigated to consider the implications of irrigating to underpin increased crop yields and conversion to dairy farming.

Irrigation for cropping

It is estimated that the capital investment required establishing an effective irrigation system capable of delivering water to crops at critical stages of plant development will be approximately $175,000 - $258,000. This estimate is based on the use of a travelling irrigator with the range in investment reflecting a variation in infrastructural costs which can only be clarified with on-site system design. After adjusting for the cost of capital and depreciation, this opportunity appears to improve the profitability of the business by approximately $11,000 annually and is based on lifting Maize yield by 2T/ha. This represents a Return on Capital (ROC) of 5.03%.

Irrigation for Dairy Conversion

Using two Centre Pivots it has been calculated that 86 ha can be irrigated to support dairy farming. Overall it is estimated that the cost to convert the property to dairying will require an investment of approximately $4.1 million (of which the irrigation cost will be $345,000 - $385,000). Operating 545 cows and producing 239,000 kgMS it is estimated that the business can generate an operating profit (after adjusting for the cost of capital and depreciation) which is approximately $26,000 greater than the current business. The ROC however is very low at just 0.66%. This would indicate that dairy conversion is a marginal investment option. However the most significant aspect of this opportunity is perhaps the potential for capital gain which may be in the range of $1.5 million as a result of conversion. Based on this opportunity for capital gain, conversion to dairying offers an economically viable option for the Trustees to consider.

One Plan Requirements

With respect to the N loss under the Horizons Regional Council One Plan, the property is in a priority catchment and needs to meet Table 13.2 (the permissible N loss limits) for either dairying or cropping irrespective of whether the property is irrigating. If the property cannot meet Table 13.2 for either activity then it would require a restricted discretionary consent. The permissible N loss limits as calculated using paddock scale LUC mapping are 29 kg N/ha for year 1 declining to 23 kg N/ha for year 20.

Calculations using Overseer (Ver. 6.1.3) show that the predicted N loss from the proposed dairying system is 26 kg N/ha. Under cropping the N loss is 20 kg N/ha. Therefore the cropping regime, even under irrigation, meets the permissible N loss limits of the One Plan whilst dairying would only meet year five targets.

2 Table of contents

3 Purpose

This irrigation feasibility study has been prepared for Pencoed Trust located on Somersal Lane 5 km north of Marton. It is part of the Rangitikei Strategic Water Assessment and aims to assess the opportunities, costs and on-farm implications of developing an irrigation system on the property.

4 Farm Overview

The Pencoed Trust covers a total of 199.8 ha of which 194.8 ha is effective, 2.1 ha are stock excluded (un-grazed pasture, pine trees, native bush or scrub) and 2.9 ha are non-productive laneways, buildings or utility areas. Of the 199.8 ha approximately 54.6 ha is a neighbouring block owned by the family. Without the addition of this block to the current system it is considered that many of the landuse options would not be possible. The descriptions and calculations within this report are based on the 199.8 ha.

Pencoed (145.2 ha) is currently run as a mixed grazing and cropping farm with income streams consisting of Maize and Barley grain and lamb and steer finishing. Upon review of the farm systems, crop yields and livestock performance levels, this business have been found to be operating at a very high level.

There is currently very limited irrigation on the property via a small dam. Depending on water availability there is the potential to irrigate the whole property. However for this study 86 ha were considered using two pivots to support a dairy farm conversion. An alternative scenario of using a travelling irrigator over 64 ha to apply water at critical stages of Maize development was also investigated.

The options for water would come from either the Rangitikei District Council bore approximately 2 km away or the property would need to put down its own bore. Water harvesting was not considered an option due to the amount of area needed for storage.

5 Farm Resources and Current Enterprise

5.1 Land Resources

Pencoed Trust covers a total of 199.8 ha of which 194.8 ha are effective. The property is located in the upper Tutaenui Stream catchment which is part of the Coastal Rangitikei Catchment (Rang_4d). This is a high priority catchment under the Horizons One Plan.

The underlying geology is predominantly loess or small patches of alluvium over gravels. The dominant soils are the Kiwitea or Kiwitea mottled silt loam soils on the freer draining areas and Marton soils on the poorly drained areas and depressions.

Nearly all the property is flat to undulating.

Three different Land Use Capability (LUC) units were identified. Approximately 61% of the property is class I, 38% class II, and the remaining class III land.

The property contains over 6.3 km of waterways. Of these approximately 180 m is classed as a secondary stream, and the remaining 6.1 km are classed as ephemeral waterways.

5.2 The Current Farm Operating System

The property receives approximately 1,000 – 1,200 mm of rain annually and historically is classed as summer safe although in the past few years an extended dry period has been experienced between January and March.

A small water storage dam (fed by winter drainage water) was built a number of years ago to enable 4 – 5 ha of Onions to be irrigated at critical times.

The property is 199.8 ha in size of which approximately 194.8 ha is deemed effective. This includes the 57.9 ha owned by I & K Williams.

Basic winter stock numbers, policies and performance levels of the current management system (for the 141.9 ha owned by the Pencoed Trust) are outlined in the following table:

	Number	Comments
Ram Hoggets	650 – 1,000	Number wintered varies depending on seasonal conditions and market prices
Dairy Cow Grazing	50	An irregular policy whereby cows are wintered for 6 weeks from 1 June to mid-July.
R2yr Steers	67	Purchased in autumn at 380 – 400 kg Lwt.

Lambs

Lambs are purchased in December/January at approximately 35 kg Lwt. These 1,500 – 1,600 lambs are grazed at a rate of 20 -22/ha and sold in March/April at approximately 47 kg Lwt (20 – 21 kg Cwt). A second crop of approximately 2500 lambs (30 kg Lwt) is purchased in May. These are initially stocked at 25/ha and as they are sold the stocking rate decreases to 20 – 22/ha over the winter months. These winter lambs (hogget's) are sold by the end of August at 23 – 24 kg Cwt.

Cattle

Approximately 250 R2yr steers (traditional breeds) are purchased in May at 380 – 400 kg Lwt and grazed on a green feed crop (at 10/ha) and/or Maize stubble over the winter period. In August a further 100 steers are purchased so that when the Maize stubble is finished at the end of August approximately pasture can be set stocked at 3.6/ha. All steers are finished to an average of 320 kg Cwt from October to the end of January.

Crop Policy

Maize is grown on contract ($420/T in 2013/14) and represents the major income stream for the business.

The basic six year cropping rotation involves:

1. 32 ha of Maize – first year paddock
2. 32 ha of Maize – second year paddock
3. 32 ha of Barley
4. 32 ha of Pasture – first year
5. 32 ha of Pasture – second year
6. 32 ha of Pasture – third year

As a paddock (or an area of approximately 16 ha) is readied for Maize production, it is removed from pasture and sown in to a winter green feed crop

The average Maize yield achieved over recent years has been 11.5T/ha.

Barley is sown in the first week of November and typically harvested in March with very good yields averaging 8.75 T/ha in 2014. Following harvesting, the area is sown into high performance grass and legume mixes.

Pasture silage is conserved (120 bales in 2014) for feeding to cattle over winter while they graze Maize stubble.

Topography

The topography of the farm can best be described as flat to gently rolling with almost the entire property capable of being cultivated. It is noted that the soils on the block on the south side of the road are heavier and less suited to Maize.

Crop Gross Margins

Maize - $2,330/ha

Barley - $1,510/ha

6 Proposed Irrigation System

6.1 Potential Irrigation System

Three water sources were considered for the property and include:

1. Water harvesting using a series of dams in the gully systems to collect water from tile drains and excess surface runoff.
2. Tapping into the Marton town water supply and utilising its excessive capacity. To gain access to this would require piping for 1.8 km to the Marton Water Supply Substation.
3. Installing a bore on the property.

Options to operate with irrigation have been limited to either dairy farming or to support greater Maize yields. Two centre Pivot Irrigators totalling 86 ha were considered most appropriate in this instance for dairying due to the water and labour use efficiency they provide. In the case of irrigating for increased Maize yields a Travelling Irrigator appears the most cost effective option where substantially less water is required compared to dairying.

6.2 Farm Operating System to fully capture the benefit of Irrigation

Two distinct farm operating systems were investigated for the property under irrigation. The first is a continuation of the current cropping regime and the second is the conversion to dairying. Each of these is investigated below.

6.2.1 Cropping

The performance level being achieved by the owners is currently well above average and as such the provision of irrigation may only have a marginal effect on crop yields and livestock performance. Under the current farming operation, irrigation is likely to be most rewarding when applied at critical stages of Maize and Barley plant development.

As such the volume of water required may be as little as 100 mm over the critical development stages of Maize. The volume of water thus required is estimated to be no more than 96,000m^3. This could be supplied by a water harvesting dam with dimensions of 4.8 ha with an average depth of 2 m. Alternatively supply could be sourced from the overflow of the RDC's water take.

An existing water harvesting dam with a volume estimated to be 16,560m^3 provides the business the capacity to irrigate 16 ha at a rate of 100 mm. As such a further 80,000 m^3 of water storage would be required. This would require a dam with an average depth of 2m and 4 ha in size (not allowing for evaporation loss). Based on a flow rate from winter drainage pipes of 3 m^3/hr, it would take 952 days for one pipe to fill the dam. Obviously this is unrealistic and up to 8 drainage pipes would need to be redirected to fill such a dam in approximately 120 days. Water harvesting appears to be impractical in this instance.

Furthermore the capital cost (and the associated annual interest cost) to construct the appropriate water storage dam and redirect the existing tile drains would need to be compared to the cost of sourcing overflow water from RDC. The annual water charge payable to RDC may be approximately $11,200 based on the 2014 New Zealand Irrigation report which assesses the average cost of irrigation water to be $0.14/$m^3$ (being the average cost of irrigation water supplied in NZ at the present time). On this basis the capitalised equivalent investment into dam construction amounts to approximately $170,000.

The most cost effective irrigation technique is likely to be that of using a travelling gun irrigator which can be relocated around the property to provide irrigation to crops.

It may be assumed that the average Maize yield could be increased by 2 T/ha (from 11.5 T/ha to 13.5 T/ha) as a result of managing soil moisture levels optimally.

The estimated financial performance of this scenario is set out in Section 6.6 below.

6.2.2 Dairy Conversion

Under Centre Pivot irrigation it should be possible to irrigate approximately 86 ha (assuming the land owned by I and K Williams is included) of the total 199.8 ha. Additional irrigation in the form of "K-line" or "Hard Set" could be established on the remainder of the property. Two pivots would be required in this scenario with water sourced from the Rangitikei District Councils water take overflow.

Feed production from this system is estimated to be:

- 15,000 kg DM/ha on the irrigated land (86 ha)
- 11,500 kg DM/ha on un irrigated land (109 ha) – estimated current production
- Total pasture production averaging 13,050 kg DM/ha

The increase in dry matter production is based on the application of 300mm of irrigation water and a 12:1 response (12 kg DM/1 mm of water applied).

It is estimated that 545 cows at a stocking rate of 2.8 cows/ha (Dairybase Lower Nth Island average) producing 440kgMS/cow (239,000 kg MS or 1,230 kg MS/ha) could be operated effectively under this irrigation scenario. This level of milk production is significantly higher than the Lower Nth Island average as recorded in Dairybase (353 kg MS/cow) and is based on:

- Utilisation of best management practices (the owners currently exhibit this within their current operation)
- Purchase of well bred (good genetic potential) cows
- Additional feed produced as a result of irrigation

The Milking System (assumptions)

- 545 cows calving from the 27th of July
- 110 replacement heifers retained and grazed off farm from December until calving
- Use of 110 TDM Pke and 230 TDM Maize Silage (623 kg DM/cow)
- Dry off date Mid to late May
- Best management practices ensuring
  - Optimal pasture cover throughout the year
  - Optimal pasture quality maintained throughout the year
- Application of 100 kg/ha of Nitrogen split over 3 – 4 dressings (spring and autumn)
- A pasture renewal programme involving 20 ha of Turnips as a summer forage crop (pasture – crop – pasture)
- The cost of conversion is estimated at $4.1 Million:
  - Milking shed $1,000,000
  - Irrigation (2 Pivots) $385,000

- Fonterra Shares $1,522,730
- Livestock $1,010,000
- Infrastructure $150,000

- Finance for the conversion is secured at 6.5%
- The cost of water supplied by RDC is $0.14/m^3$ (the average cost of irrigation water supplied in New Zealand at the present time). Costs associated with distributing the water from the RDC bore to the farm are not included

Financial Performance

The estimated financial performance of this scenario is set out in Section 6.6 below.

Value of Water – Payable to RDC

Based on the application of 300 mm of irrigation over 86 ha, 258,000m^3 of water is required to be supplied. The 2014 New Zealand Irrigation report assesses the average cost of to be $0.14/m^3 (being the average cost of irrigation water supplied in NZ at the present time). On this basis it could be assumed that the annual cost of water in this scenario would be in the vicinity of $36,000.

There are likely to be infrastructural costs borne by the RDC to make this water available to farmers in the district (such as piping water to the farm boundary). This infrastructural cost is likely to underpin the fee for water supplied.

6.3 Possible issues or risks associated with this irrigation scenario

The possible issues or risks associated with each of these scenarios include:

Cropping

- Failure to boost Maize yields above a breakeven level (13.08 T/ha)
- Mechanical breakdown of the irrigator at a critical time
- Damage to the irrigator in transit
- A substantial drop in the price received for Maize (to less than $387.43/T)
- Loss of water supply from RDC
- An increase in the cost of water from RDC above $0.25/m3

Dairying

- Future Milk Solids pay-out below $6.39/kg.
- Loss of water supply from RDC.
- An increase in the cost of water from RDC above $0.25/m^3.
- A drop in Milk Solids production by 4,094 kg or more.
- Meeting Horizons Regional Council's N-loss targets in 20 years.
- High interest rate charges given the amount of investment required to convert to dairying.
- Failure to meet conversion deadlines in the year of conversion resulting in below target production and higher conversion costs.

6.4 Irrigation Costs

It is noted that in most cases farmers choose to irrigate the largest possible area whether this is their initial intention or as a result of the financial benefits identified from irrigating a smaller area to begin with. It is therefore recommended that infrastructure be established at the outset to ensure the entire area available is irrigated. This will avoid costly additional infrastructural expenditure in the future to extend an existing system.

Scenario: Irrigation of 86 ha – Centre Pivots

The cost to source water from the Rangitikei District Council and supply it to the farm boundary is outside the scope of this project. It is however a very important aspect to consider with regards to the development of an effective irrigation scheme.

Given the geography of the farm it would appear appropriate to establish approximately 86 ha under two Centre Pivots requiring an investment of $345,000 - $385,000. Based on an interest rate cost of 6.5%, the annual capital cost of developing the irrigation system (excluding the supply infrastructure from RDC) is likely to range from $22,425 to $25,025.

Ongoing operating irrigating expenditure is estimated to be $18,400/year. The costs of this include:

- Power $16,000
- Repairs & maintenance $2,400

No estimation of costs associated with re-subdivision or the re-reticulation of stock water has been made in this investigation. This cost may be significant and should form part of a further in-depth feasibility investigation.

Scenario: Irrigation of 86 ha – Travelling Irrigator for cropping

The capital cost required to develop an effective irrigation scheme to optimise Maize yields is considerably less than if a dairy conversion is undertaken. Excluding the cost of sourcing water from RDC to the farm boundary, it is estimated that the capital cost to irrigate using a travelling irrigator will be approximately $175,000 - $258,000. The annual interest cost associated with this ranges from $11,375 to $16,770.

Ongoing operating irrigating expenditure is estimated to be $7,000/year. The costs of this include:

- Power $5,000
- Repairs & maintenance $2,000

6.5 Implications of Irrigation on Existing Farm System

A balance between production and profitability levels must be reached with the nutrient restrictions imposed by the Horizons Regional Council's One Plan (table 13.2). To this end the forage production system detailed seeks to find this balance.

Adoption of an irrigation system should not be considered a drought management tool (although it is very useful in droughts as a tool to protect baseline productivity), but rather an opportunity to develop and diversify the business for greater financial reward. Typically in order to derive an acceptable return on investment from irrigation development new and often novel farm systems need to be developed. These often require the acquisition of new skills and knowledge.

6.6 Financial Benefits of Irrigation

In this case, and under the parameters used, the addition of irrigation, is expected to have a negative impact on the Earnings Before Interest and Tax – EBIT/ha (otherwise known as the farm operating surplus). This is shown in the table below where the EBIT is expected to decrease by $47,100 ($54/ha).

The table below compares the key financial indices of the current farm system with the inclusion of 160 ha of irrigation. A full breakdown of costs and prices used in each scenario can be found in Appendix 1.

	Current – no irrigation	Irrigation for Crops	Dairy Conversion
Total farm area (ha)	195	195	195
Irrigated Area (ha)	0	86	86
Area Maize (ha)	64	64	NA
Maize Yield (T/ha)	11.5	13.5	NA
Area Barley (ha)	32	32	NA
Gross Farm Income (GFI $)		533,633	1,616,334
GFI $/ha		2,737	8,289
Cost of Irrigation Water (RDC)	NA	13,400	36,200
Irrigation Running Costs	NA	7,000	18,460
Farm Working Expenses net of crop costs (FWE $)		**152,940**	**935,939**
FWE $/ha		784	4,800
Farm Surplus (EBITR)		**380,693**	**680,394**
EBITR/ha		1,952	3,489
Estimated capital cost for Irrigation		216,000	365,000
Other Capital Infrastructure (excludes water supply to farm)			3,682,000
Additional Annual Interest Costs ($)		**14,075**	**263,000**
Est. Return on Capital %	**6.2%**	**6.7%**	**6.1%**
Net Potential Benefit $		**16,685**	**67,461**
Depreciation on Plant (4% pa) – Average over 20 years		**5,827**	**40,853**
Adjusted Potential Benefit		**10,858**	**26,608**
Adjusted Return on Investment		**5.03%**	**0.66%***

* this figure does not include any capital gain that may arise through the ownership of Fonterra shares or in the value of land once converted to dairying.

Crop and livestock performance and income levels are based on those currently being achieved by the business. Operating costs are based on industry average figures sourced from BLNZ Economic Service and Sheppard Agriculture Ltd.'s Profit Check accounts analysis database.

Interestingly the Return on Capital (ROC) calculated for these scenarios is estimated to be between 6.7% (cropping) and 6.1% dairying, which are both close to the estimated cost of borrowing (6.5%). This implies the introduction of irrigation to enhance profitability may be marginal.

Including the depreciation on the irrigation plant at 4% per annum (and dairy infrastructure in the case of the dairy conversion), the actual return from investing in irrigation may be considered moderate.

There is however the potential for capital gain in asset value from dairy conversion which must be considered. In this case it is estimated that there may be a capital gain of approximately $1.5 million from conversion of the farm to dairying over and above the status quo. Note this is based on the status quo Rateable Valuations and a value for Land & Buildings of $35/kg MS produced (excluding the share value) once converted.

Under a different management system the economics of developing an irrigation system (plus conversion to dairying) may be more rewarding. In addition there may be some benefit to the capital value of the property as a direct result of irrigation development which is not noted here.

6.6.1 Breakeven Calculations

The following key figures were used in in determining the breakeven analysis:

- An average Maize value of $400/T
- A Milk solids value of $6.50/kgMS
- RDC water fee of $0.14/m^3

With respect to irrigation to enhance crop yields, the marginal profit points (breakeven levels) are:

- 13.08 T/ha of Maize at $400/T
- $387.43 $/T of Maize at 13.5 T/ha produced
- Maximum water price of $0.25/m^3

With respect to irrigation to support dairy conversion, the marginal production and pay – out levels are:

- A production drop of 4,094 kgMS (a 1.7% drop)
- A drop in the milk price by $0.11/kgMS to $6.39
- Maximum water price of $0.24/m^3

It is important to note that the costs and returns used in this evaluation are estimates only and that further more robust investigation needs to be undertaken prior to determining the full merits of irrigation on this property.

7 The permissible Nitrogen loss Limits

Under the Horizons Regional Council One Plan both dairying and intensive cropping properties are required to meet the Table 13.2 for permissible N loss limits under Horizons Regional Councils One Plan. Permissible N loss limits are calculated on Landuse Capability Class (LUC) for the property.

The following table summarises the permissible N loss limits for the property under both dairying or intensive cropping.

Year	N limits by total area (kg N)	N limits per ha (kg N/ha)
1	5,755	29
5	5,232	26
10	4,877	24
20	4,678	23

Therefore the quantity of N that is permitted to be lost via leaching is 29 kg N/ha/yr (or 5,755 kg N) for year one. This decreases to 23 kg N/ha/yr (or 4,678 kg N) for year twenty.

7.1 N Loss calculations

The following table compares the permissible N loss limits with that determined using Overseer (Ver. 6.1.3).

Landuse Modelled	Permissible N loss limit (kg N/ha/yr)				Calculated N loss (kg N/ha)
	Year 1	Year 5	Year 10	Year 20	
Dairying	29	26	24	23	26
Irrigated cropping and finishing	29	26	24	23	20

In summary the calculations using Overseer (Ver. 6.1.3) show that the predicted N loss from the proposed dairying system is 26 kg N/ha. Under cropping the N loss is 20 kg N/ha. Therefore the cropping regime, even under irrigation, meets the year twenty permissible N loss limits of the One Plan whilst dairying would only meet year five targets.

8 Appendix 1: Overseer Nutrient Budget Reports - Dairying

8.1 Nutrient Block setup

The following nutrient management blocks were used in Overseer (v6.1.3) to determine the Nutrient Budget for the whole farm under irrigation.

Block name	Type	Effective area (ha)
M	Pastoral	47.8
M Eff	Pastoral	11.3
M Irri	Pastoral	26.6
Kw	Pastoral	26.2
Kw eff	Pastoral	22.6
Kw Irri	Pastoral	57.9
R	Riparian	2.2
Turnips	Fodder Crop	-

Select block type and add
Pastoral ▼ Add

Total farm area	199.8 ha
Total area declared as blocks	194.6 ha
Non-productive area (includes lanes, races and yards)	5.2 ha

8.2 Whole Farm Nutrient Budget – With Irrigation

The following Nutrient Budget was calculated using Overseer (v6.1.3) with the addition of an irrigation block.

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	69	19	3	22	36	0	0
Rain/clover N fixation	123	0	3	6	4	9	53
Irrigation	2	0	1	2	7	2	7
Supplements	25	5	16	3	2	3	2
Nutrients removed							
As products	92	16	21	5	22	2	6
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	64	0	0	0	0	0	0
To water	26	0.6	10	26	40	4	15
Change in farm pools							
Plant Material	3	0	-9	2	2	-1	0
Organic pool	17	6	2	0	0	0	0
Inorganic mineral	0	9	-9	0	-2	-3	-3
Inorganic soil pool	17	-9	8	0	-13	10	44

8.3 Nitrogen Block report

Block name	Total N lost	N lost to water	N in drainage *	N surplus	Added N **
	kg N/yr	kg N/ha/yr	ppm	kg N/ha/yr	kg N/ha/yr
M	587	14	4.1	139	110
M Eff	205	20	5.8	212	160
M Irri	377	16	4.7	155	127
Kw	475	20	6.1	128	110
Kw eff	684	34	10.1	276	270
Kw Irri	1131	22	5.7	90	0
R	7	3	N/A		
Turnips	1508	75	**12.3**	355	100
Other sources	266				
Whole farm	5240	26			
Less N removed in wetland	0				
Farm output	5240	26			

9 Appendix 2: Overseer Nutrient Budget Reports – Cropping & finishing

9.1 Nutrient Block setup

The following nutrient management blocks were used in Overseer (v6.1.3) to determine the Nutrient Budget for the whole farm under irrigation.

Block name	Type	Effective area (ha)
M	Pastoral	41.8
Kw	Pastoral	54.8
R	Riparian	2.2
Maize 1	Crop	32.0
Maize 2	Crop	32.0
Barley 2	Crop	12.0
Barley 1	Crop	20.0

Select block type and add
Pastoral ▼ Add

Total farm area	199.8 ha
Total area declared as blocks	194.8 ha
Non-productive area (includes lanes, races and yards)	5.0 ha

9.2 Whole Farm Nutrient Budget – With Irrigation

The following Nutrient Budget was calculated using Overseer (v6.1.3) with the addition of an irrigation block.

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	142	29	34	25	49	2	0
Rain/clover N fixation	48	0	3	6	4	9	49
Irrigation	2	0	1	2	6	1	6
Nutrients removed							
As products	171	32	27	21	29	14	4
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	7	1	19	2	4	1	1
To atmosphere	51	0	0	0	0	0	0
To water	20	0.7	8	15	45	6	16
Change in farm pools							
Plant Material	39	2	47	6	6	3	2
Organic pool	-93	-3	0	-11	0	0	0
Inorganic mineral	0	10	-10	0	-2	-3	-4
Inorganic soil pool	-4	-13	-54	0	-24	-8	36

9.3 Nitrogen Block report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
M	581	14	4.1	100	110
Kw	1155	21	6.4	91	110
R	7	3	N/A		
Maize 1	887	28	5.6	39	211
Maize 2	784	25	5.1	38	211
Barley 2	191	16	3.5	160	129
Barley 1	292	15	3.0	160	129
Other sources	33				
Whole farm	3930	20			
Less N removed in wetland	0				
Farm output	3930	20			

10 Appendix 3: Maps

10.1 Paddock Map

10.2 Landuse Capability Map

10.3 Soils Map

10.4 Irrigation Map – Potential for Dairying

22

10.5 Nutrient Block Map Dairying