Final Report

An Economic Evaluation of Water Quality Induced Changes in Rotorua and Rotoiti Catchments

Part A) Land Use Change Scenarios

Part B) Macro-Economic Implications

A report prepared for
Environment Bay of Plenty

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Nimmo-Bell & Company Ltd

Part A

Land use change scenarios

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Acknowledgement

Nimmo-Bell has previously undertaken work of a similar nature for Taupo Lake Care Inc. (TLC.) Components of this report rely on the work undertaken for TLC.

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1. Executive Summary

1.1. Introduction

Nimmo-Bell has previously undertaken land use change analysis for environment Bay of Plenty based on representative farm types in the Rotorua District and looked at the cost of land use change in the Lake Okareka catchment. This report builds on this original work and examines the cost of various land use change scenarios for the Lakes Rotorua and Rotoiti catchments. We have presented this analysis as a stand alone report. As such it relies heavily on work previously undertaken and is presented in a similar format.

1.2. Methodology

Any loss to land owners associated with a required reduction in N output from land uses will be made up of several components. Not all of these are able to be quantified however some of the more significant ones can be utilising a financial modelling approach. These include the loss of production ability and therefore income, loss in the potential to achieve productivity gains in the future, and loss of opportunity to pursue some alternative land use in the future.

These factors all impact on the productive value of the land. By assessing the future productive value of the land "with" and "without" restrictions we are able to determine the value loss that may result. To undertake such an analysis we have:

- Met with various landowner groups to identify land use types and levels of intensity in the Lakes catchments
- Developed economic farm surplus (EFS) or equivalent figures for 9 land use types, taking account of land use and intensity/scale
- Considered what productivity gains may be achieved in the future for each land use
- Assessed the potential for future land use change within the catchments without any restriction on nutrient output
- Developed, in conjunction with EBOP, various land use scenarios (i.e. changes in land use areas within the catchments) that have the potential to reduce nutrient output.
- Determined the cost to landowners of adopting these scenarios

We have considered the loss to land owners based on current technology and management practices. Future technology advances which may allow N output from current land uses to be reduced while maintaining existing productivity may reduce the requirement for land use change and therefore the loss to land owners.

1.3. Results

To consider the loss to landowners in the lakes Rotorua and Rotoiti catchments we have utilised the above analysis and considered various scenarios with and without restrictions. These scenarios are:

Without restrictions

- A moderate shift to more intensive land use
- A substantial shift to more intensive land use

With restrictions

- A cap on any increase in nutrient output (i.e. no further intensification or productivity gains allowed)
- Conversion of sufficient pastoral land to production forestry to achieve a reduction of 150T of N output (Lake Rotorua only)
- Conversion of sufficient pastoral land to production forestry to achieve a reduction of 200T of N output (Lake Rotorua only)
- Conversion of sufficient pastoral land to production forestry to achieve a reduction of 250T of N output (Lake Rotorua only)

We have then calculated and compared the productive value of the land under each scenario, taking account of current and potential land use under each. The difference in productive value between the with and without scenarios is the cost to landowners of the restrictions imposed. Results are shown in the following tables.

Assessed loss to landowners in the Lake Rotorua Catchment

	Land use change without restrictions	
Restriction	**Moderate**	**Substantial**
Cap on N output	$31.4m	$43.9m
150T reduction in N output	$59.4m	$71.9m
200T reduction in N output	$68.7m	$81.3m
250T reduction in N output	$78.1m	$90.6m

Assessed loss to landowners in the Lake Rotoiti Catchment

	Land use change without restrictions	
Restriction	**Moderate**	**Substantial**
Cap on N output	$2.5m	$2.9m

1.4. Comments/Conclusion

The above analysis shows a considerable loss to land owners in the lakes catchments associated with the various scenarios examined. In considering these losses account should be taken of factors as follows:

- The figure provided does not account for some of the less tangible factors that affect value as discussed in the report.
- Land use areas have been estimated based on the best available information. Actual losses calculated may differ when more accurate land use areas are available.
- The small land use areas in the Lake Rotoiti catchment area mean that there will be a greater chance that the calculated loss may be larger or smaller than that shown in this report.
- The required reduction in N output has been applied pro rata across all land uses. Removing those with higher N output may reduce the area to be planted in forestry (we note that initial analysis suggests that the cost of removing a unit of N output from sheep and beef land is not significantly different to removing it from dairy land given the relative returns of each).

2. Introduction

2.1. Background

Environment Bay of Plenty (EBOP) has contracted Nimmo-Bell to examine the loss in value to rural landowners in the Lakes Rotorua and Rotoiti catchments under various land use change scenarios which have the potential to reduce nutrient release to the Lakes.

Nimmo-Bell has previously undertaken land use change analysis for EBOP based on representative farm types in the Rotorua District and looked at the cost of land use change in the Lake Okareka catchment. This report builds on this original work and examines the cost of various land use change scenarios for the Lakes Rotorua and Rotoiti catchments. We have presented this analysis as a stand alone report. As such it relies heavily on work previously undertaken and is presented in a similar format.

Associated with this work is a separate report entitled "Revised Economic Impact on Rotorua District and Bay of Plenty Region of water quality induced changes to land use and tourism in Rotorua Lake catchments". This report builds on previous work examining the district and regional economic impacts of land use change and estimates the economic impact for various land use change scenarios in the Lake Rotorua catchment.

In addition to this work a contingent valuation study is currently being undertaken by Nimmo-Bell. This work focuses on estimating the intrinsic and aesthetic values of the lakes to the people of the district and the region.

2.2. Scope

2.2.1. Other value drivers

There are several components of land value, including the productive value. Other components will reflect factors such as location, potential alternative uses (including the potential to subdivide) and cultural and emotional factors. While we have highlighted some of the non-productive factors contributing to value in this report we have not attempted to quantify these. These factors are inherently difficult to quantify, however they do have a very real impact on value.

We have examined the impact on value of land use change, the inability to achieve future productivity gains and the inability to pursue an alternative or higher land use in the future where these may increase nutrient output.

2.2.2. Implementation

How any restriction/reduction on nutrient output is implemented will have an impact on the loss to land owners. Specific rules or methods are being worked through at present by EBOP. It has been necessary to make certain assumptions in conjunction with EBOP for the completion of this work. Changes to these assumptions may alter the estimated loss incurred by land owners.

2.2.3. Cost/benefit to individual land owners / farm properties

The costs/benefits calculated stop at the loss for each land use and rely on modal farms for each land use type. This work will need to be expanded on to determine the loss to individual land owners, taking account of the particular characteristics of each land holding.

2.3. Process/Methodology

In examining the cost of land use change (or imposing restrictions in nutrient output) it is important to consider several areas. These include the loss of production ability and therefore income, loss in the potential to achieve productivity gains in the future, and loss of opportunity to pursue some alternative land use in the future.

Taking account of these factors it is then necessary to consider and compare the "with" and "without" scenarios and calculate the value loss that may result. To undertake such an analysis we have:

- Met with various landowner groups to identify land use types and levels of intensity in the Lakes catchments
- Developed economic farm surplus (EFS) or equivalent figures for 9 land use types, taking account of land use and intensity/scale
- Considered what productivity gains may be achieved in the future for each land use
- Assessed the potential for future land use change within the catchments without any restriction on nutrient output
- Developed, in conjunction with EBOP, various land use scenarios (i.e. changes in land use areas within the catchments) that have the potential to reduce nutrient output.
- Determined the cost to landowners of adopting these scenarios.

3. Rationale for this approach

Any change in the value of land associated with land use restrictions will ultimately be determined by the market price for land in a before and after situation. The cost or benefit of an imposed land use change will ultimately be recognised by the market for the land subject to the change. There are however several reasons why a market assessment is not able to be used to determine the change in value in this way.

For a market to reflect a restriction on the land use it will need time and information. Without detail of what and how restrictions will be imposed there is little ability to use a market based approach.

Even if a market existed, there are several other factors that contribute to value and would make it difficult to isolate the impact of the restrictions imposed. Added to this is the fact that there are considerable areas of Maori owned land which seldom sells.

Utilising a financial modelling approach allows us to assess the change in the productive or potential productive value component of capital value which is a major component of the market price for land.

4. Assumptions made

In examining land use in the Rotorua Lakes District there are two significant issues for which we have had to make assumptions. These are discussed as follows:

4.1. Lifestyle blocks

"Lifestyle Blocks" are a significant land use in the Rotorua and Rotoiti Lake catchments. These blocks provide a rural way of life to the owners while the predominant source of income is from employment in wage/salaried positions. In general, the income generated from such blocks tends to be secondary to the non-financial benefits of the "lifestyle" that are able to be enjoyed.

The current and potential uses are many and varied as is the level of nutrient output. It is beyond the scope of this report to consider all of these uses and each will need to be treated on a case by case basis.

On a per hectare basis the value of the land associated with these blocks is generally well in excess of the value of similar land used for pastoral farming or forestry. This value is driven by supply and demand of blocks and the price of residential real estate. Supply is in turn governed by District Council planning and the ability to subdivide land that is suitable for lifestyle blocks.

The net effect is that where the potential exists for landowners to subdivide and sell lifestyle blocks, this becomes the determinant of the land value.

Rule 11 of the proposed Water and Land Plan that sets a cap on nutrient loss from a land-use activity does not impact on the ability to subdivide land apart from to ensure that the level of nutrient output is not increased. If this increases the cost of on site effluent treatment then this is likely to result in a drop in the value of these blocks by a corresponding amount.

We note that there appears to be two distinct types of lifestyle block in the catchments. There are those that are solely for lifestyle benefit, where the predominant factors in determining value are lake views, a good building site and reasonable contour. These blocks tend to be smaller (usually where rural B zoned land has been subdivided and range in size from 8000m2). The second category is of larger blocks (generally in the rural A zone) where there is the lifestyle component and also an income component. While there are many uses for these lifestyle blocks, intensive grazing is a significant use. These properties are often leased to existing pastoral farmers (often dairy farmers) and run as part of a larger property. Annual rentals of $500+ per hectare appear to be common for larger blocks. Smaller blocks where grazing is possible are often intensively grazed at zero rental in order to keep them tidy. Any restriction on nutrient output may impact on the value of blocks where a grazing rental is able to be achieved.

We have considered the impact on value by assuming that the returns per hectare on these larger blocks are the same as for the pastoral farms they are being run as part of.

4.2. Smaller Parcels of Maori owned land

We acknowledge that there are considerable areas of "smaller" parcels of land within the catchments that are not economic units on their own, and which are often farmed in conjunction (through a lease) with other properties and as part of an economic unit.

We have not considered these to be any different to the land owned by that economic unit. The loss in productive value (or potential productive value) through having restrictions imposed will be the same to this land as it would be to an economic unit. The loss will be experienced by the landowners through reduced lease income as opposed to economic returns. On this basis we have not considered these small parcels any differently to larger parcels that form an economic unit.

5. Value factors

5.1. Discussion

An enforced change in land use has the potential to impact on the value to landowners and others who enjoy the district in several ways. These impacts may be on individual landowners or the wider community who enjoy some of the less tangible features of the lakes areas. We have provided a brief discussion on some of the key factors as follows.

5.1.1. Loss of income (resulting in loss of value)

Where land has the benefit to generate income and this is removed or reduced then there will be a reduction in the productive value of the property. The impact on value is able to be found by capitalising the expected returns and comparing the before and after productive value.

5.1.2. Inability to achieve productivity gains

The key areas where income could potentially be lost is where a land use change is enforced on the land owner, or where productivity gains in existing land uses are unable to be achieved due to the inability to increase nutrient outputs.

5.1.3. Loss of ability to change to a higher land use

Where land has the potential (either now or in the future) to change to a higher land use and this potential is removed, then there is likely to be a loss in value also. The most vivid example of this is the prevention of a move from sheep and beef farming to dairy farming.

With technology and market changes there is the potential for an unknown land use or a land use that is not common in the area at present to become a viable farming alternative in the future. Recent examples of these in other regions are the introduction of farmed deer and the production of grapes where they were not previously considered. Owning land without restrictions may allow a shift to new land uses that are not at present considered as alternatives. A component of the land value is based on this flexibility in land ownership. The introduction of restrictions may well reduce this component of the value as future unknown land uses are not able to be undertaken.

5.1.4. Others

During discussions with landowners several factors were identified.

While the form and impact of restrictions is unknown, there is likely to be an impact on current land use and enjoyment. This is particularly so where future development is possible however the ability to benefit from this development is unknown due to the unknown impact a restriction in land use may have.

There may well be instances where the viability of smaller farm properties becomes marginal as a result of having to reduce land areas in production or limit production increases on existing areas. The impact of this will depend on how restrictions are imposed.

Many owners of land enjoy the ability to do as they wish with their land and the benefits associated with past effort. Any form of restriction that prevents this has the potential to remove or alter the cultural and emotional value of land ownership.

While many land owners are able to sell land and utilise capital elsewhere these opportunities may be more limited for Maori Land owners where the land will not be sold. While some payment may be received for utilising the land to less than its full potential, there is a lessor ability for Maori land owners to take the capital employed in stock and plant and utilise this in a similar way elsewhere as they will be more limited in their ability to purchase the land to do so.

5.2. Conclusion

The loss of future income, the inability to achieve productivity gains in the future and the loss of flexibility to change land use are factors that we are able to quantify through a financial modelling approach. The other factors outlined are likely to represent a very real cost in many cases however to attempt to quantify these is very difficult and we have not done so.

6. Land use in the Lakes catchments

6.1. Process

The methodology used requires representative land use systems to be defined. These systems need to consider and represent the land use activities (for example dairy, deer, sheep, cattle, (breeding and finishing), and forestry) within the lakes catchment area as well as the levels of performance (stocking rate, per head and per hectare production) being achieved in those systems. In addition the land use systems defined must take account of the business structures that exist across land in the region because factors such as scale, staff employed and capital structure will impact on the both the need for and ability of land owners to respond to changes in economic events.

A series of meetings was held with representative land owner groups to determine current and potential land use in the catchments.

In addition the research team had access to the farm data and information within the public domain – including the final report from the local Monitor Farm (The Carr property in the Meat and Wool Innovations Monitor Farm Programme), and MAF Farm Monitoring data, in particular the Central North Island Hill Country Model, the Waikato/Bay of Plenty Intensive model, North Island Deer Model and the Waikato/Bay of Plenty Dairy Model.

Forestry information was collected through discussion with foresters, the review of trial information from nearby Tikitere and discussions with Forest Research Institute staff.

6.2. Results

6.2.1. Representative Systems

After considering the available information it was concluded that the profitability of most pastoral farming activity within the Lakes Rotorua and Rotoiti catchments area could be represented by the same 400 ha sheep and beef farm at three levels of productivity that was used in the earlier Rotorua area report, a 200 ha dairy farm at two levels of productivity; and a 140 ha deer farm at two levels of productivity.

The actual farm size of various land holdings will vary around these representative farms but it is assumed that the profitability as defined here on a per hectare basis will be a reasonable assumption given the time and resource constraints of the study.

Details of each of the representative land use systems are presented in the EFS calculations contained in Appendix 4.

6.2.2. Sheep and Beef Farms (including Dairy Grazing)

The low production sheep farm system is characterised by a low stocking rate (9su/ha), low sheep performance (110% lambing) and a high proportion of breeding to finishing animals. Paddock size will be large, soil fertility will be low and some areas may still be partly covered in weeds.

The movement to moderate production involves a lift in stocking rate (12 su/ha) and increased per head sheep performance (125% lambing). This is associated with increased fertiliser use, weed clearance, extra fencing and in time a higher proportion of finishing beef animals.

High sheep and beef production involves further increases in stocking rate (14 su/ha just below where the Monitor Farm reached) and higher per head sheep performance (140% lambing), and further increases in the proportion of finishing cattle.

Some land previously used for sheep and beef production within the catchment is now used for dairy farm support. In particular this land will run dairy replacement heifers with other stock as needed. For the purpose of this study it is assumed that the profitability associated with this farm type does not differ significantly over time from sheep and beef farming.

6.2.3. Dairy Farms.

Moderate dairy farm performance is assumed to be 2.75 cows per ha, 310 kg Milksolids (MS) per cow and around 850 kg MS/ha. As a well established dairy farming area there has been a considerable amount of farm amalgamation. The model farm used here represents the majority of dairy farms in the catchment.

High dairy production is assumed to be 3.5 cows/ha and approximately 1350 kg MS/ha. This level of performance has already been shown to be achievable in the catchment provided that satisfactory on-farm management and off-farm feed support is provided.

6.2.4 Deer Farms

Deer farming is well established in the Lake Rotorua catchment. In fact the MAF Farm Monitoring North Island Deer Farm Model is assumed to be situated near Rotorua. Discussion with deer farmers during this study indicated that there has already been a move towards deer finishing and specialist velvet production in this district. Accordingly the representative deer farm used here is assumed to a mix of one and two year stag finishing and velvet production. The deer farm is assumed to be 140 ha. Moderate production is at 12.9 su/ha with about half of the stags finished in one year. High production is assumed to be at 17.1 su/ha with 75% of the stags finished in one year.

6.2.5 Forestry

There are a range of forestry regimes (species and tending) undertaken in the catchments. For the purposes of this analysis we have assumed that any future forestry will be a fully tended *Pinus radiata* forest with a 28 year rotation. While there may be other scenarios from time to time this is the most common and is likely to be the benchmark when considering other options.

We have utilised the "Green Solutions Software" developed by Forest Research and discussions with Forest Research staff to populate the model. Full details of the input variables and results are provided in appendix 4.

The model has been used to calculate an expected NPV over infinite rotations, which has then been used to calculate an equivalent EFS figure.

Native production and protection forest scenarios were considered in our previous report. While these may be options in these catchments also, it is unlikely to be a solely commercial decision. Any move towards encouraging establishment of forest blocks of these types will result in additional cost and for this reason we have not quantified it.

7. Financial modelling approach

7.1. Methodology

As outlined above, the methodology utilised relies on the comparison of the productive value of the land under "with" and "without" scenarios.

The productive value is determined by capitalising the future cashflows attributable to the land. It is therefore necessary to determine what these future cashflows are (based on existing cashflows and future productivity gains likely to be achieved). Using the future cashflows, a capitalisation rate (the rate of return that investors in such assets require) can then be applied to give the productive value of that land.

Having determined the productive value for each land use we can then calculate the total productive value of land in the catchments by multiplying the productive value by the area for each land use.

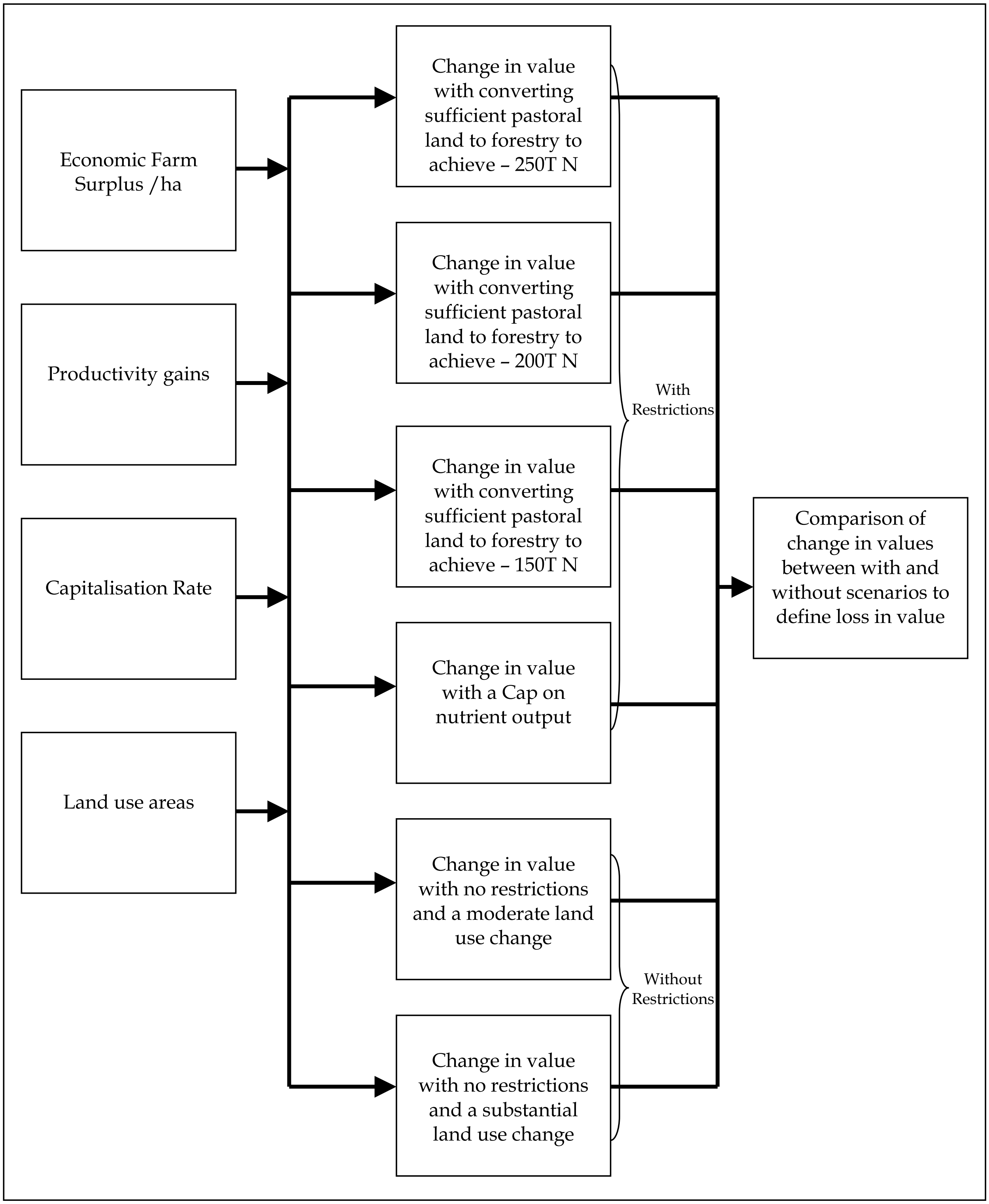
By examining various land use change scenarios we are able to determine the productive value of these and through comparing them calculate the loss in value associated with the various scenarios. For example, the "without" restrictions scenario may see additional land converted to dairying and intensification of sheep and beef farm systems. A "with" restrictions scenario may see this prevented and the requirement for an area of pastoral land to be planted in forestry. Comparing these two scenarios will allow the loss in value associated with the restrictions to be determined.

Table 1 below summarises the methodology used.

Table 1

See over

Summary of methodology used to determine change in value



7.1.1. EFS Calculations

EFS calculations have been provided for the land uses as outlined in table 2 below. These EFS figures represent the return to land and are after the deduction of a capital charge for the investment in livestock, plant, and in the case of dairy farms, shares in processing. A wages of management figure is also deducted to show a return to the management input. In calculating the return to fixed assets only it is assumed that landowners have the ability to employ all other assets associated with the farming business elsewhere. Where this is not possible then the total cost to landowners is likely to increase. Given that these figures have been deducted from the EFS figures below they may appear lower than EFS figures normally quoted.

Table 2

Land use	$EFS/ha p.a.
Pine Forest	$160
Low Intensity Sheep & Beef	$70
Moderate Intensity Sheep & Beef	$279
High Intensity Sheep & Beef	$319
Moderate Intensity Deer	$239
High Intensity Deer	$855
Moderate Intensity Dairy	$924
High Intensity Dairy	$1471
Higher unknown land use	$1,765

The EFS figure for forestry is calculated based on the NPV of infinite rotations multiplied by the discount rate to give an annual return per hectare.

7.1.1.1. An unknown higher land use

Given the contour and soil types of land in the Lakes catchments it is quite possible that at some stage in the medium term future there will be a suitable land use that achieves higher returns than the existing potential use. An example of this is deer farming, where 25 years ago this was not considered as a land use alternative. Where pursuing such a land use in the future would result in higher N output, this will be prevented. Flexibility to pursue alternative uses for land is a component of land value. We have included a higher unknown land use on the basis that it may be available in the future and the ability to achieve that use will be removed due to it increasing N output. The returns for this use have been assumed at 20 percent greater than the existing high intensity dairy system with a similar cost of conversion.

7.1.1.2. Product and input prices

Product prices used in the EFS calculations have been based on 5 year average prices adjusted to 2003 dollars (with the exception of the Milksolids price which has been based on a 10 year average). Full details of the prices used have been provided in appendix 1. Treating product prices in this way reduces the impact of one off highs or lows that may be evident if we were to take a single year only. Input prices have been based on 2003 dollar figures.

7.1.2. Productivity gains

For any particular land use there is the potential for future productivity gains based on greater or more efficient production. It can be reasonably assumed that production gains will be achieved outside of a shift in land use and that individual land owners will strive to increase productivity over time. Analysis of the productivity gains experienced by each land use over recent years has been undertaken. These productivity gains are those that are currently being achieved across the industry. A brief discussion on these has been provided in appendix 2. In summary, we have assumed productivity gains of 2 percent per annum for sheep and beef, deer and forestry units and 3 percent per annum for dairying.

7.1.3. Capitalisation rate

Capitalisation rates have been estimated based on the returns expected from various land uses. Further discussion on the rates used has been included in appendix 3.

Table 3below summarises the rates used.

Table 3

Land use	**Cap rate**
Sheep, Beef and Deer	6%
Dairy	9%
Forestry	9%
Unknown higher use	12%

These rates take account of the historical returns achieved by various land uses, the risks associated with each land use and the expected returns.

7.1.4. Existing Land Use Areas in the Catchments

Land use areas for the catchments has been based on data provided by EBOP staff.

We have compared data from a 1996 survey with a more current assessment of land use and discussions with EBOP, Land owners and Fonterra. The significant difference between 1996 data and current assessments of land use is the area in dairying in the Rotorua catchment. The area of dairy farming in the catchment as provided by Fonterra is 4,863 hectares as compared with a 1996 assessment of 3,909. For the purposes of this analysis we have assumed a dairy area of 4,863 hectares.

Accurately identifying land use areas is outside the scope of this report and is work that is currently being undertaken by EBOP. For the purposes of this report we have based our assessment on the land use areas for the two lakes catchments as shown in table 4 below. This assessment is based on a combination of the 1996 land use areas, updated land cover information provided in 2004, and discussions with Fonterra and land owners.

Table 4

Land use in the Catchments (hectares)				
	Lake Rotorua		Lake Rotoiti	
LAND USE	Ha	%	Ha	%
Sheep & Beef	11,288	40	1,888	29
Dairy Grazing	1,844	6	-	-
Dairy	4,863	17	-	-
Deer	1,632	6	-	-
Forestry	7,261	26	4,200	64
Scrub	1,490	5	405	6
Grand Total	28,378	100	6,493	100%

Note: The above table includes land areas used in pastoral and forestry production and land where there may be the potential for these uses in the future. It does not represent all land uses in the catchment.

7.1.5. Existing N Output

Utilising coefficients for each land use provided by EBOP we have derived the total N output for pastoral and forestry land uses as follows. These figures differ from those used by EBOP due to the changes in land use areas as outlined above. Further analysis by EBOP (currently being undertaken) will allow these figures to be updated.

Table 5 below shows the N output for each land use based on the areas shown in Table 4.

Table 5

N output by Land use in the Catchments			
	Kg N Output/ha	Total N Output (T)	
LAND USE		Lake Rotorua	Lake Rotoiti
Sheep & Beef	18	203	34
Dairy Grazing	18	33	-
Dairy	55	267	-
Deer	7	11	-
Forestry	2.5	18	11
Grand Total		533	45

7.1.6. Potential Land Use Areas in the Catchments

The land currently used for pastoral farming has a good mix of easier country (LUC class 3 and 4), good breeding country (LUC class 6 and some steeper breeding country (LUC class 7). The easier country is used with a mix of dairy farms, high performance sheep and beef systems (including dairy support grazing) and deer farming. Intensive sheep and beef and deer use the breeding country and the steeper country.

There are a considerable number of smaller land holdings (lifestyle blocks) across all land classes. It appears that these are often used for pastoral farming by being leased and farmed in conjunction with and as support units to larger farm holdings.

7.1.7. Land use change scenarios

To examine the change in value we need to look at "with and without" scenarios. To do this we need to firstly make an assumption of what land use in the catchment may look like in the future without any land use restrictions or purchase of entitlements. Our assessment of the land in the catchment, current land use and the economic drivers of these land uses allows us to make an assessment of the future land use in the catchment (or at least what it may look like all other things being equal).

We then need to compare the productive value of this against land use should restrictions be introduced. To do this we need to make an assessment of what land use would be under non-restrictive scenarios.

The scenarios we have considered for the Lake Rotorua catchment are as follows:

- A cap on any increase in nutrient output (i.e. no further intensification allowed)
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 150 T of N
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 200 T of N
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 250 T of N
- A moderate change in land use (increased intensity and therefore a likely increase in N output) without restrictions
- A substantial change in land use (increased intensity and therefore a likely increase in N output) without restrictions.

Table 6 below provides a summary of current and future land use in the Lake Rotorua catchment for each of the above scenarios.

For the Lake Rotoiti catchment we have considered only one restriction scenario and that is the prevention of any increase in N output. To assess a cost of this scenario we need to compare it with the two "without" restriction scenarios as outlined above.

Table 7 below shows the scenarios considered for Lake Rotoiti.

Table 6

Land use in the Lake Rotorua Catchment for the five scenarios considered

		Future Land Use Area (ha)					
Existing land use	**Change**	**Cap**	**-150T N**	**-200T N**	**-250T N**	**Mod**	**Subs**
Undeveloped land	None	1,490	1,490	1,490	1,490	1,015	440
	To S & B Med					350	700
	To Dairy Med					125	250
	To Higher use					0	100
Forestry	None	7,261	7,261	7,261	7,261	6,311	5,361
	To S & B Med					850	1,700
	To Dairy Med					100	200
	To Higher use					0	0
Low Int Sheep & Beef	None	1,970	1,304	1,082	860	0	0
	To Forestry		666	888	1,110		
	To S & B Med					1,470	1,070
	To S&B High					500	700
	To Dairy Med					0	200
	To Higher use					0	0
Med Int Sheep & Beef	None	9,849	6,519	5,410	4,300	4,849	849
	To Forestry		3,330	4,439	5,549		
	To S&B High					4,000	6,000
	To Dairy Med					1,000	2,000
	To Higher use					0	1,000
High Int Sheep & Beef	None	1,313	869	721	573	1,163	933
	To Forestry		444	592	740		
	To Dairy Med					150	250
	To Higher use					0	130
Med Int Deer	None	1,469	804	582	360	869	419
	To Forestry		665	887	1,109		
	To Deer High					600	900
	To Higher use					0	150
High Int Deer	None	163	89	65	40	163	163
	To Forestry		74	99	123		
	To Dairy Med					0	0
	To Higher use					0	0
Med Int Dairy	None	3,258	2,265	1,933	1,602	1,958	1,258
	To Forestry		994	1,325	1,656		
	To Dairy High					1,300	2,000
	To Higher use					0	0
High Int Dairy	None	1,605	1,115	952	789	1,605	1,605
	To Forestry		489	653	816		
	To Higher use					0	0
Total Area		**28,378**	**28,378**	**28,378**	**28,378**	**28,378**	**28,378**

Table 7

Land use in the Lake Rotoiti Catchment for the three scenarios considered

		Future Land Use Area (ha)		
Existing land use	**Change**	**Cap**	**Mod**	**Subs**
Undeveloped land	None	405	255	105
	To S & B Med		150	300
Forestry	None	4,200	3,600	3,000
	To S & B Med		500	1,000
	To Dairy Med		100	200
Low Int Sheep & Beef	None	283	0	0
	To S & B Med		213	153
	To S&B High		70	130
Med Int Sheep & Beef	None	1,416	716	166
	To S&B High		700	1,250
High Int Sheep & Beef	None	189	189	189
Total Area		6,493	6,493	6,493

Note: In the above tables the additional land areas for uses such as dairy and S&B may or may not be contiguous to existing operations. For the purposes of calculating the likely cost to landowners we have assumed that they are not. This may understate the cost to landowners (the cost of adding to an existing unit may be considerably lower and greater economies of scale able to be achieved) if these changes in land use were prevented.

7.1.8. Summary of N output under restriction scenarios

Table 8 below shows the resultant N output for the Lake Rotorua catchment under the restriction scenarios requiring a reduction in N output. Note that we have combined dairy grazing and sheep and beef land uses. This is done on the basis that the N output coefficient per hectare is the same, that the two land uses are often incorporated in the same farming system, and that the returns from dairy grazing are likely to be comparable to running beef cattle.

The reduction scenarios have been based on reducing N pro rata across all pastoral land uses based on existing N output. Likewise, while we have identified various intensities of farming for the various land uses we have assumed the N output coefficient is the same. For example, the N output data provided by EBOP assumes an N output for sheep and beef farming of 18 kg/ha regardless of intensity.

Table 8

Land use and N output in the Rotorua Catchment				
	Existing area (ha)	Restriction scenarios (T)		
LAND USE		-150T	-200T	-250T
Sheep & Beef (incl. dairy grazing)	13,132	8,692	7,213	5,733
Dairy	4,863	3,380	2,885	2,391
Deer	1,632	893	647	400
Forestry	7,261	13,923	16,143	18,364
Grand Total	26,888	26,888	26,888	26,888
	Existing N output (T)	Restriction scenarios (T)		
LAND USE		-150T	-200T	-250T
Sheep & Beef (incl. dairy grazing)	236	156	129	102
Dairy	267	186	158	131
Deer	11	7	4	3
Forestry	18	35	40	46
Grand Total	533	383	333	283

7.1.9. Timing of land use change

While we have made an assessment of what land use in the catchment may look like in the future, the timing of pursuing these land uses and the intensification of existing land use will be dependant on several factors. Changes will occur based on the assumption that long term profitability will have increased. Short term fluctuations in the relative profitability of land uses and the preferences of individual owners are likely to have a significant impact on when this change occurs. To allow for this we have assumed that land use change will occur over a 15 year period. Likewise, the timeframe over which restrictions occur may also have an impact. We have assumed in this case that restrictions are imposed over a three year period.

7.1.10. Conversion costs

Conversion costs have been allowed for where there is a shift from one land use to another. These have been spread over a likely conversion period and the income expected adjusted to allow for the delays likely to be experienced from newly converted properties. This includes conversion from one intensity of a land use to a higher intensity where there will be a capital expenditure requirement.

7.1.11. A combined discount rate

Because we are looking at a range of land uses and considering the change in value over time associated with these we need to use a common discount rate across all land uses. In this case we have assumed 8 percent as being an average of forestry, dairying and sheep and beef land uses in the catchments. The choice of this discount rate will have an impact on the results and accordingly we have provided a sensitivity analysis associated with the discount rate.

7.2. Results

Using the parameters discussed a range of loss in value has been calculated for each lake catchment and is summarised in tables 9 and 10 below. These losses in value show the impact of the various restriction scenarios when considered in the context of the potential for future intensification in land use.

Table 9 Lake Rotorua

(NPV $)	Land use change without restrictions	
Restriction	**Moderate**	**Substantial**
Cap Nutrient output	$31.4m	$43.9m
-150 T N	$59.4m	$71.9m
- 200 T N	$68.7m	$81.3m
- 250 T N	$78.1m	$90.6m

Table 10Lake Rotoiti

(NPV $)	Land use change without restrictions	
Restriction	**Moderate**	**Substantial**
Cap Nutrient output	$2.5m	$2.9m

The cost of the restriction scenarios shown is made up of several components as follows:

<u>Cap on nutrient output (Rotorua and Rotoiti)</u>

- The cost of not being able to pursue a higher landuse where this potential exists and it would cause a net increase in nutrient loss
- The cost associated with a halving of the productivity gains currently being achieved on existing pastoral land.

<u>150, 200, and 250 T reductions in N output (Rotorua only)</u>

- The cost of not being able to pursue a higher land use where this potential exists and it would cause a net increase in nutrient loss
- The cost associated with a halving of the productivity gains currently being achieved on remaining pastoral land
- The cost associated with the loss of all potential productivity gains on that land converted to forestry
- The reduction in income associated with forestry versus pastoral farming.

7.3. Sensitivity Analysis

A key variable is the discount rate used. We have run a sensitivity analysis over the capitalisation rate used to show the impact of this. We have undertaken this sensitivity analysis for the various restriction scenarios when considered against the substantial land use change scenarios for each lake. The results of this are presented in tables 11 and 12 below

Table 11 Lake Rotorua

	Change considered	Cap N Output	- 150 T N	- 200 T N	- 250 T N
Most Likely Loss		$43.9m	$71.9m	$81.3m	$90.6m
Capitalisation rates	All rates increased or decreased by 1 percent.	$34.4m-$57.0	$58.1m-$90.2m	$66.0m-$102.2m	$74.0m-$113.6m

Table 12 Lake Rotoiti

	Change considered	Cap N Output
Most Likely Loss		$2.9m
Capitalisation rates	All rates increased or decreased by 1 percent.	$1.8m-$4.5m

8. Comments/Conclusion

The above analysis shows a considerable loss to land owners in the lakes catchments associated with the various scenarios examined. In considering these losses account should be taken of factors as follows:

- The figure provided does not account for some of the less tangible factors that affect value as discussed in the report.
- Land use areas have been estimated based on the best available information. Actual losses calculated may differ when more accurate land use areas are available.
- The small land use areas in the Lake Rotoiti catchment area mean that there will be a greater chance that the calculated loss may be larger or smaller than that shown in this report.
- The required reduction in N output has been applied pro rata across all land uses. Removing those with higher N output may reduce the area to be planted in forestry (we note that initial analysis suggests that the cost of removing a unit of N output from sheep and beef land is not significantly different to removing it from dairy land given the relative returns of each).

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10. Appendices

Appendix 1 Product prices used

The prices used in the EFS calculations are based on a series of product prices averaged over the past 5 years and corrected for inflation (ref Nimmo-Bell).

The values used are as follows

Cull ewes	$40
Lambs (all grades)	$60
Ewe Hoggets	$75 (lamb price plus $15)
Rams	$420 (7x lambs)
Cull cows	$556 ($2.78/kg net on 200 kg CW)
Weaner heifers	$256 (cull cow less $400)
R3 yr bulls	$1008 ($3.36/kg net on 300 kg CW)
R2 yr bulls	$924 ($3.36/kg net on 275 kg CW)
Br Bulls (sell)	$1154 (R3 yr bull plus $200)
Br Bulls (buy)	$3597 (3x sale price)
Venison Price	$6.53/kg
Velvet Price	$90.00/kg
Dairy Payout	$4.25/kg MS (based on 10 yr average)
Wool Price	$2.89/ greasy kg net (based on 4 yr average reported for Central NI clip in MAF Farm Monitoring Reports)

Appendix 2 Productivity improvements

Sheepmeat:

Productivity gains through increased lambing percentages since 1990 have been spectacular. The national average is now at 120% - up from 100% in 1990. Improved technologies (e.g. scanning), pasture quality, management and breeding programmes have all played a part in this. The average annual increase in lambing percentage over the period has been 1.6%.

While total sheep numbers have declined since 1990, lambing percentages and higher carcase weights have partially offset the production decline from lower total numbers. While there are fluctuations between seasons, the average annual productivity improvement for carcase weights over the period was 1.5% per annum for lamb, and 1.2% per annum for sheep. For wool, the average gain was 0.7%.

Beef:

Beef carcass weights have increased over the period. We note that the increase in bull beef farming (and the higher average carcass weights associated with this) is likely to be partially responsible for the increased average weights over the period. The overall trend however is up, although volatility is linked to both market and climatic conditions (e.g. droughts). Annual average productivity gains for average carcase weights has been 0.6% over the period 1990-2003. Within the specific stock classes (e.g. bull, cow, steers) there will be gains however the data is not available to determine this on a national basis.

The productivity gains from improved calving percentage have been negligible over the period, recording an annual average gain of just 0.1%. This is likely to be a reflection of the increasing influence of dairy beef in total beef production and the fact that where the traditional breeding cow is still run it serves a dual purpose of assisting in grazing management.

We consider an average future productivity gain for sheep and beef farm properties is likely to be in the order of 2 percent per annum.

Dairy:

Detailed statistics are collected by Livestock Improvement. The average annual productivity gains in the dairy industry are around 2.6 percent for the 10 year period ending 2001/02. There have been very small gains made over the past two years and excluding these sees the average gain over the past 8 years at 3.4 percent per annum. There are several factors that may account for this including seasonal influences and the large numbers of new conversions. We believe that a long term average of 3 percent per annum is realistic. We note that this is below the industry targeted figure of 4 percent.

Forestry:

Productivity gains are achieved in the forestry sector through improved planting stock, husbandry and management. We have assumed these gains to be 2 percent per annum. As with other land uses, some of these gains are likely to be based on an increased N output and therefore may be prevented under restriction scenarios.

Appendix 3 Capitalisation rates

MAF farm monitoring data from 2000 onwards is used to determine productive earnings (expressed as Economic Farm Surplus (EFS) as a ratio of total capital invested in the farming enterprise. In this exercise it was not possible to go back earlier than 2000 as MAF had significantly changed the format of the information and it was not possible to make meaningful comparisons.

Sheep & beef

Sector:	**Sheep & beef**
Location:	Waikato/Bay of Plenty Intensive
Effective Area ha	300
Stock units wintered/ha	11.1

y.e. June	2000	2001	2002	2003	2004f
EFS total	$ 44,210	$ 100,460	$ 118,270	$ 88,550	$ 89,162
EFS/ha	$ 147	$ 335	$ 394	$ 295	$ 297
Total Farm Capital/ha	$ 4,521	$ 4,831	$ 5,217	$ 6,701	$ 6,723
EFS/total farm capital	3.3%	6.9%	7.6%	4.4%	4.4%

While the average figure calculated here is around 4.5 percent, this is strongly influenced by the 2003 and forecast years. Sustained profitability at this level may well see a realignment of capital values to reflect lower returns. We believe that a capitalisation rate of 6 percent is fair for sheep, beef and deer farming.

Dairy

Data released by DEXCEL shows the volatility in return on capital for dairy farming in the ten year period ending 2002. The range is from –3% to 26% with the average over the period 12%. It is felt that using the average as an indicator of discount rate is on the high side and that a figure half-way between the 12% and the 6% for sheep and beef is more appropriate.

Exotic Production Forest

Time and Risk

Because forests are long term investments there needs to be a way of assessing the current value which takes account of time and risk. Discounting the forest's future cashflows is the accepted technique. The discount rate is the interest rate per annum to the investor if he/she buys in at the valuation derived by discounting the future cashflows at that interest rate.

Crucial to the actual value derived is the discount rate used. The higher the discount rate the lower the value of the forest and conversely the lower the discount rate the higher the value. Also the longer the period until the forest is harvested the greater the impact of the discount rate chosen, particularly at higher discount rates.

Benchmark Risk and Return
The lowest risk on long term investments is given by the rate on long term government bonds, currently around 6%. The government bond rate sets the benchmark. It reflects country risk or more specifically the risk of investing in the government which is the lowest risk in New Zealand. It embodies investors' future expectations about the overall future performance of the economy and other external factors including global financial conditions. All other investments must yield an interest premium above this rate.

The higher the risk the higher the discount rate and the lower the risk the lower the discount rate.

Risks in Forestry
When considering an investment in forestry an investor will expect a higher rate of return than government bonds because the risk is higher. There are particular forestry industry risks such as fire and disease. The uncertainty about future market returns is higher than for many investments because of the greater period of time that often exists before sale.

Forestry investments in New Zealand fall into three broad categories each with a different expected level of return for the perceived level of risk. This risk is embodied in the discount rate.

The three categories are:
- listed forestry stocks e.g. Fletcher Challenge, Carter Holt Harvey, Evergreen
- issues to the public through professionally organised forest partnerships
- private investments which do not involve the issuing of a prospectus.

In general, listed forestry stocks or shares are perceived by investors to be lower risk than formal forestry partnerships which have a lower risk than individual private investments, however, each investment must be considered on its merits. Because of the variation in perceived risk forests in each of these categories will be valued at different discount rates. The reasons for these differences are elaborated below.

Listed Forestry Stocks
Listed forestry stocks are seen as the safest form of forestry investment. The advantages are:
- highly liquid, they can be cashed in immediately
- very flexible, small to very large investment possible
- in a share portfolio seen as counter cyclical.

The risk premium on listed forestry stocks has historically been between 1.5% and 3.5% depending on factors such as:
- the size of the company
- liquidity of the shares/units
- maturity of the forests
- management structure
- quality of the forest and
- distance from port

- diversification by age class and location.

This results in a real post-tax discount rate of between 5.5% and 7.5% based on a government bond rate of 6% and inflation of 2%. Recent sales activity in the forestry sector has seen values crystallised and resulting value write downs. . These sales indicate actual rates of around to 9 percent real post-tax.

Forest Partnerships
Offers to the public through unlisted floats including partnerships, trusts and qualifying companies have become popular over the last few years. They offer an entry to forestry for smaller investors not readily available prior to the more recent listing of specialist forestry companies. In today's market, prospectuses for these offers quote discount rates or internal rates of return (IRR) of between 8.5 and 9 per cent real post-tax.

Attractive features of the better new start partnerships include:
- well located on good land with a high site index
- easy extraction
- close to port
- outlet for sale of units to other partnership members
- professional management with good records of forest operations
- economies of scale through investor aggregation
- potentially better returns compared to private forests through increased marketing muscle
- no requirement for investor involvement
- direct tax benefits
- some liquidity through sell back provision to other partners.

On the other hand, partnerships have disadvantages:
- liquidity is lower than shares
- overheads are high through promotion fees, prospectus costs and statutory supervision costs compared to private investment
- there is little opportunity for hands on involvement
- time horizons are long compared with buying into say, a 10 to 15 year old block of trees
- risks are higher compared with buying into a well established forest
- flexibility is lower as payment schedules are set by the promoter.

Private Investments
The discount rate used to value private forest assets is likely to be higher than listed forest companies or unlisted public investments such as partnerships because investors see higher risks:
- there is a perception that liquidity is lower with no established market at present for smaller individual stands of immature trees
- there is usually less public information available about such forests and their management
- the quality of the forest may be more variable
- financing may be more difficult, particularly for immature forests with long periods of low or negative cashflows

- there is not the protection of a prospectus.

Most investors would therefore expect a discount rate up to several percentage points above those quoted for partnerships ie between 10 and 12 per cent real post-tax. A particularly good forest may well have a discount rate less than this range. Forests that are located far from a port, face access and harvesting difficulties or have been poorly looked after are likely to have discount rates much higher than these and as a result have much lower values.

Summary

The discount rate should be a good indicator of risk in a forest investment. It should reflect the risk to the investor and the degree of liquidity in the investment. Investment theory would lead to the view that listed forest investments should have lower discount rates than less liquid forest partnerships which in turn should have lower rates than individual private forest investments. Particular circumstances may override these norms and investors will look closely at the attributes they desire before making an investment decision.

Taking account of all the above factors we have chosen a discount rate of 9 percent per annum.

Source: New Zealand Forestry Exchange 1994 (updated)

Appendix 4 EFS calculations and discussion

The following tables show the EFS calculations for the various land uses considered. (See section 7.1.1 of the report for the methodology adopted in calculating these EFS figures)

Sheep and Beef LOW

Revenue				
Sheep Sales			125,745	
Cattle Sales			47,449	
Wool Sales			35,699	
Gross Farm Revenue				208,892
Gross Farm Revenue per Hectare				**522**
Expenditure		$/su		
Sheep Purchases			3,655	
Cattle Purchase			3,597	
Wages/ACC		$ 1.50	5,418	
Animal Health		$ 2.50	9,030	
Electricity		$ 0.65	2,348	
Feed		$ 0.40	1,445	
Fertiliser		$ 5.00	18,061	
Contract/Seed/Regrass		$ -	0	
Freight		$ 0.50	1,806	
Shearing	per ssu	$ 4.80	13,176	
Weed and Pest	per ha	$ 8.00	3,200	
Vehicles/Fuel	per ha	$ 29.00	11,600	
Repairs and Maintenance			14,150	
Administration			8,100	
Standing Charges			9,750	
Wages of management			40,000	
Cap charge for stock,plant	10%	$356,319	35,632	
Gross Farm Expenses				180,968
Gross Farm Expenses per Hectare				**452**
Economic Farm Surplus				27,924
Economic Farm Surplus per Hectare				**70**

Effective Area (ha)	400
Total Stockunits	3,612
Stockunits per Hectare	9.03

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	468	40	18,720
Ewe Hoggets / 2 ths	11	75	825
Ewe Lambs	560	60	33,600
Wth Hoggets	-	0	-
Wth Lambs	1,210	60	72,600
	2249		125,745

Cattle Sales	Number	Price/Hd	Total
Cull cows	27	556	14899
R3 yr hfrs	-	-	0
R2yr hfrs	-		0
R1yr hfrs	3	256	768
R3yr steers	31	999	30582
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	-	1,008	0
R2yr Bulls	-	924	0
R1yr Bulls	-		0
MA Bulls	1	1,199	1199
	61		47449

Stock Purchases	Number	Price/Hd	Total
Rams	9	430	3,655
Br Bulls	1	3597	3597
Bull calves	-	422	0
Steer Calves	-	-	0
	1		3,597

Lambing percentage	110%	
Wool Weight	4.50	kg/su
Total kg	12353	
Wool Price ($/kg)	$2.89	
Sheep Death Rate	6%	
Calving percentage	85%	
Cattle Death Rate	2%	

Stock Class	Numbers	Stockunit	Total			$/su	Total Value
Mixed Age Ewes	1,600	1.0	1,600				
2T Ewes	600	1.0	600				
Ewe Hoggets	650	0.8	520				
Wether Hoggets	-	1.0	-				
Rams	25	1.0	25	2,745	ssu's	$ 80	$ 219,600
MA Cows	75	6.0	450				
R2 Yr Hfrs	-	5.0	-				
R1 Yr Hfrs	29	4.0	116				
R2 Yr Strs	31	5.0	156				
R1 Yr Strs	32	4.0	128				
R2 Yr Bulls	-	5.0	-				
R1 Yr Bulls	-	4.0	-				
Br Bulls	3	6.0	18	867	csu's	$ 100	$ 86,719
			3,612				
							$ 306,319
						Ave/su	84.80

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	1,600		96		468		1,600	M A Ewes
2T Ewes	600		36				600	2T Ewes
Ewe Hogg	650		39		11		650	Ewe Hogg
Ewe Lbs		1210			560		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1210			1210		0	Wth Lbs
Rams	25		2	9		7	25	Rams
MA Cows	75		2		27		75	MA Cows
R2 Yr Hfrs			0					R2 Yr Hfrs
R1 Yr Hfrs	29		1				29	R1 Yr Hfrs
Hfr calves		32			3			Hfr calves
R2 Yr Strs	31		1		31		31	R2 Yr Strs
R1 Yr Strs	32		1				32	R1 Yr Strs
Str calves		32						Str calves
R2 Yr Bulls			0		0		-	R2 Yr Bulls
R1 Yr Bulls			0		0		-	R1 Yr Bulls
Bull calves								Bull calves
Br Bulls	3		0	1	1		3	MA Bulls
	3,045	2,484	176	10	2,310	7	3,045	(0)

Sheep and Beef MODERATE

Revenue				
Sheep Sales			138,285	
Cattle Sales			253,809	
Wool Sales			35,927	
Gross Farm Revenue				428,021
Gross Farm Revenue per Hectare				**1,070**
Expenditure		$/su		
Sheep Purchases			3,570	
Cattle Purchase			87,997	
Wages/ACC		$ 1.50	7,179	
Animal Health		$ 3.00	14,358	
Electricity		$ 0.65	3,111	
Feed		$ 0.75	3,590	
Fertiliser		$ 7.50	35,895	
Contract/Seed/Regrass		$ 0.60	2,872	
Freight		$ 0.50	2,393	
Shearing	per ssu	$ 4.80	12,696	
Weed and Pest	per ha	$ 8.00	3,200	
Vehicles/Fuel	per ha	$ 20.00	8,200	
Repairs and Maintenance			20,000	
Administration			9,171	
Standing Charges			9,750	
Wages of management			45,000	
Cap charge for stock,plant	10%	$ 475,700	47,570	
Gross Farm Expenses				316,551
Gross Farm Expenses per Hectare				**791**
Economic Farm Surplus				111,470
Economic Farm Surplus per Hectare				**279**

Effective Area (ha)	400
Total Stockunits	4,786
Stockunits per Hectare	12.0

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	474	40	18,960
Ewe Hoggets / 2 ths	11	75	825
Ewe Lambs	663	60	39,750
Wth Hoggets	-		-
Wth Lambs	1,313	60	78,750
	2460		138,285

Cattle Sales	Number	Price/Hd	Total
Cull cows	40	556	22484
R3 yr hfrs	-	-	0
R2yr hfrs	-		0
R1yr hfrs	3	256	768
R3yr steers	-		0
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	74	1,008	74768.4
R2yr Bulls	167	924	154589.8
R1yr Bulls	-		0
MA Bulls	1	1,199	1199
	286		253809

Stock Purchases	Number	Price/Hd	Total
Rams	9	420	3,570
Br Bulls	1	3597	3597
Bull calves	200	422	84400
Steer Calves	-		0
	201		87,997

Lambing percentage	125%	
Wool Weight	4.70	kg/su
Total kg	12432	
Wool Price ($/kg)	$2.89	
Sheep Death Rate	6%	
Calving percentage	90%	
Cattle Death Rate	1%	

Stock Class	Numbers	Stockunit	Total			$/su	Total Value
Mixed Age Ewes	1,500	1.0	1,500				
2T Ewes	600	1.0	600				
Ewe Hoggets	650	0.8	520				
Wether Hoggets	-	1.0	-				
Rams	25	1.0	25	2,645	ssu's	$ 80	$ 211,600
MA Cows	100	6.0	600				
R2 Yr Hfrs	-	5.0	-				
R1 Yr Hfrs	42	4.0	168				
R2 Yr Strs	-	5.0	-				
R1 Yr Strs	-	4.0	-				
R2 Yr Bulls	75	5.0	375				
R1 Yr Bulls	245	4.0	980				
Br Bulls	3	6.0	18	2,141	csu's	$ 100	$ 214,100
			4,786				
							$ 425,700

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	1,500		90		474		1,500	M A Ewes
2T Ewes	600		36				600	2T Ewes
Ewe Hogg	650		39		11		650	Ewe Hogg
Ewe Lbs		1312.5			662.5		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1312.5			1312.5		0	Wth Lbs
Rams	25		2	9		7	25	Rams
MA Cows	100		1		40		100	MA Cows
R2 Yr Hfrs	-		0		-		-	R2 Yr Hfrs
R1 Yr Hfrs	42		0				42	R1 Yr Hfrs
Hfr calves		45			3			Hfr calves
R2 Yr Strs	-		0		0		-	R2 Yr Strs
R1 Yr Strs	-		0				-	R1 Yr Strs
Str calves								Str calves
R2 Yr Bulls	75		1		74		75	R2 Yr Bulls
R1 Yr Bulls	245		3		167		245	R1 Yr Bulls
Bull calves		45		200				Bull calves
Br Bulls	3		0	1	1		3	MA Bulls
	3,240	2,715	172	210	2,746	7	3,240	(0)

Sheep and Beef HIGH

Revenue				
Sheep Sales			203,695	
Cattle Sales			414,113	
Wool Sales			48,119	
Gross Farm Revenue				665,927
Gross Farm Revenue per Hectare				**1,665**
Expenditure		$/su		
Sheep Purchases			3,696	
Cattle Purchase			232,050	
Wages			27,000	
Animal Health		$ 3.50	19,583	
Electricity		$ 0.75	4,196	
Feed		$ 1.00	5,595	
Fertiliser		$ 10.00	55,950	
Contract/Seed/regrass		$ 1.00	5,595	
Freight		$ 0.60	3,357	
Shearing	per ssu	$ 4.80	15,984	
Weed and Pest	per ha	$ 8.00	3,200	
Vehicles/fuel	per ha	$ 25.00	10,000	
Repairs and Maintenance			25,000	
Administration			10,100	
Standing Charges			9,750	
Wa ges of Management			50000	
Cap charge for stock,plant	10%	$ 570,900	57,090	
Gross Farm Expenses				538,146
Gross Farm Expenses per Hectare				**1,345**
Economic Farm Surplus				127,781
Economic Farm Surplus per Hectare				**319**

Effective Area (ha)	400
Total Stockunits	5,595
Stockunits per Hectare	14.0

Sheep Sales	Number	Price/Hd	Total
Cull Ewes	538	40	21,520
Ewe Hoggets / 2 ths	5	75	375
Ewe Lambs	1,140	60	68,400
Wth Hoggets	-	0	-
Wth Lambs	1,890	60	113,400
	3573		203,695

Cattle Sales	Number	Price/Hd	Total
Cull cows	-	-	0
R3 yr hfrs	-	-	0
R2yr hfrs	-	-	0
R1yr hfrs	-	-	0
R3yr steers	148	999	148202
R2yr steers	-		0
R1yr steers	-		0
R3yr Bulls	74	1,008	74768.4
R2yr Bulls	207	924	191143.3
R1yr Bulls	-		0
MA Bulls	-	-	0
	429		414113

Stock Purchases	Number	Price/Hd	Total
Rams	9	420	3,696
Br Bulls	-	0	0
Bull calves	285	420	119700
R2 steers	150	749	112350
	435		232,050

Lambing percentage	140%	
Wool Weight	5.00	kg/su
Total kg	16650	
Wool Price ($/kg)	$2.89	
Sheep Death Rate	6%	
Calving percentage	85%	
Cattle Death Rate	1%	

Stock Class	Numbers	Stockunit	Total				
Mixed Age Ewes	2,000	1.0	2,000				
2T Ewes	700	1.0	700				
Ewe Hoggets	750	0.8	600			$/su	Total Value
Wether Hoggets	-	1.0	-				
Rams	30	1.0	30	3,330	ssu's	$ 80	$ 266,400
MA Cows	-	6.0	-				
R2 Yr Hfrs	-	5.0	-				
R1 Yr Hfrs	-	4.0	-				
R2 Yr Strs	150	5.0	750				
R1 Yr Strs	-	4.0	-				
R2 Yr Bulls	75	5.0	375				
R1 Yr Bulls	285	4.0	1,140				
Br Bulls	-	6.0	-	2,265	csu's	$ 100	$ 226,500
			5,595				
							$ 492,900

STOCK RECONCILIATION

Class	Open No	Natural Inc	Deaths	Purchase	Sales	Killed	Close No	Class
M A Ewes	2,000		120		538		2,000	M A Ewes
2T Ewes	700		42				700	2T Ewes
Ewe Hogg	750		45		5		750	Ewe Hogg
Ewe Lbs		1890			1140		0	Ewe Lbs
Wth Hogg	-		0		-		-	Wth Hogg
Wth Lbs		1890			1890		0	Wth Lbs
Rams	30		2	9		7	30	Rams
MA Cows	-		0		0		-	MA Cows
R2 Yr Hfrs	-		0		-		-	R2 Yr Hfrs
R1 Yr Hfrs	-		0				-	R1 Yr Hfrs
Hfr calves		0			0			Hfr calves
R2 Yr Strs	150		2	150	148		150	R2 Yr Strs
R1 Yr Strs	-		0				-	R1 Yr Strs
Str calves								Str calves
R2 Yr Bulls	75		1		74		75	R2 Yr Bulls
R1 Yr Bulls	285		3		207		285	R1 Yr Bulls
Bull calves		0		285				Bull calves
Br Bulls	-		0	-	-		-	MA Bulls
	3,990	3,780	214	444	4,002	7	3,990	-

Deer - Moderate

Revenue			
Deer Sales		142,417	
Velvet		96,480	
Gross Farm Revenue			238,897
Gross Farm Revenue per Hectare			**1,706**
Expenditure	$/su		
Stock Purchases		87,200	
Wages			
Animal Health	$2.70	4,873	
Electricity	$1.25	2,256	
Feed	$4.37	7,887	
Fertiliser	$6.00	10,829	
Seed/Regrassing	$1.00	1,805	
Freight	$0.57	1,029	
Weed and Pest	$0.57	1,029	
Vehicles	$2.54	4,584	
Repairs and Maintenance per ha	$57.00	7,980	
Administration per ha	$40.00	5,600	
Standing Charges per ha	$49.00	6,860	
Wages of Mngt		30,000	
Cap Charge for Stock,Plant		33,488	
Gross Farm Expenses			205,419
Gross Farm Expenses per ha			1,467
Economic Farm Surplus			33,477
Economic Farm Surplus per ha			239

Effective Area (ha)	140
Total Stock Units	1805
Total Stockunits Per Hectare	12.9

Stock Sales	Number	Price/Hd	Total
Breeding Hinds	-		-
1 Year Hinds	-		-
Hind Fawns	-		-
Velvet Stags	80	392	31,407
2 Year Stags	100	392	39,180
1 Year Stags	200	359	71,830
Weaner Stags	-		-
	380		142,417

Velvet Sales		kg/hd	Price/kg	Total
Velvet Stg	400	2.20	90.00	79,200
2 Year Stg	192	1.00	90.00	17,280
	592			96,480

Stock Purchases	Number	Price/Hd	Total
Stag Fawns	400	218	87,200
	400		87,200

Fawning percentage	85%
Death Rate	2%
Export Venison	$ 6.53

Stock Class	Numbers	Stockunit	Total
Breeding Hinds	0	1.9	-
2 Year Hinds		1.8	-
1 Year Hinds	0	1.2	-
Velvet Stags	400	2.2	880
2 Year Stags	192	1.9	365
1 Year Stags	400	1.4	560
	992		1,805

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sale	Closing No	Class
Breeding Hinds	0		0				Breeding Hinds
1 Year Hinds	0		0				1 Year Hinds
Hind Fawns	0	0					Hind Fawns
Velvet Stags	400		8		80	400	Velvet Stags
2 Year Stags	192		4		100	192	2 Year Stags
1 Year Stags	400		8		200	400	1 Year Stags
Stag Fawns		0		400			Stag Fawns
	992	-	20	400	380	992	-

Deer - High

Revenue			
Deer Sales		233,264	
Velvet		215,424	
Gross Farm Revenue			448,688
Gross Farm Revenue per Hectare			**3,205**
Expenditure	$/su		
Stock Purchases		143,880	
Wages	$2.00	4,796	
Animal Health	$2.70	6,474	
Electricity	$1.25	2,997	
Feed	$7.50	17,984	
Fertiliser	$10.00	23,979	
Seed	$2.50	5,995	
Freight	$0.57	1,367	
Weed and Pest	$0.57	1,367	
Vehicles	$3.50	8,393	
Repairs and Maintenance per ha	$65.00	9,100	
Administration per ha	$40.00	5,600	
Standing Charges per ha	$49.00	6,860	
Wages of Mngt		45,000	
Cap Charges for Stock, Plant		45,167	
Gross Farm Expenses			328,959
Gross Farm Expenses per ha			2,350
Economic Farm Surplus			119,728
Economic Farm Surplus per ha			855

Effective Area (ha)	140
Total Stock Units	2398
Total Stockunits Per Hectare	17.1

Stock Sales	Number	Price/Hd	Total
Breeding Hinds	-		-
1 Year Hinds	-		-
Hind Fawns	-		-
Velvet Stags	63	392	24,630
2 Year Stags	120	392	47,016
1 Year Stags	450	359	161,618
Weaner Stags	-		-
	633		233,264

Velvet Sales		kg/hd	Price/kg	Total
Velvet Stg	500	4.00	90.00	180,000
2 Year Stg	197	2.00	90.00	35,424
	697			215,424

Stock Purchases	Number	Price/Hd	Total
Stag Fawns	660	218	143,880
	660		143,880

Fawning percentage	85%
Death Rate	2%
Export Venison	$ 6.53

Stock Class	Numbers	Stockunit	Total
Breeding Hinds	0	1.9	-
2 Year Hinds		1.8	-
1 Year Hinds	0	1.2	-
Velvet Stags	500	2.2	1,100
2 Year Stags	197	1.9	374
1 Year Stags	660	1.4	924
	1,357		2,398

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sale	Closing No	Class
Breeding Hinds	0		0				Breeding Hinds
1 Year Hinds	0		0				1 Year Hinds
Hind Fawns	0	0					Hind Fawns
Velvet Stags	500		10		63	500	Velvet Stags
2 Year Stags	197		4		120	197	2 Year Stags
1 Year Stags	660		13		450	660	1 Year Stags
Stag Fawns		0		660			Stag Fawns
	1,357	-	27	660	633	1,357	-

Dairy - Moderate Production

Revenue				
Milk Sales			724,625	
Dairy Cattle Sales			84,490	
Other				
Gross Farm Revenue				809,115
Gross Revenue per Hectare				**4,046**
Expenditure		$/cow		
Stock Purchases			3,000	
Wages	per kg MS	$ 0.30	51,150	
Animal Health		$ 65.00	35,750	
Breeding		$ 28.00	15,400	
Dairy Shed Expenses		$ 21.00	11,550	
Electricity		$ 32.00	17,600	
Feed costs on farm		$ 75.00	41,250	
Feed costs off farm		$ 188.00	103,400	
Fertiliser	per ha	$ 135.00	27,000	
Seed		$ 15.00	8,250	
Freight		$ 10.00	5,500	
Weed and Pest		$ 7.00	3,850	
Vehicles		$ 55.00	30,250	
Repairs and Maintenance			20,000	
Administration			15,000	
Standing Charges			18,000	
Wages of Management			65,000	
Capital charge stock, plant and shares			152,415	
Gross Farm Expenses				624,365
Gross Expenses per Hectare				**3,122**
Economic Farm Surplus				184,750
Economic Farm Surplus per Hectare				**924**

Milking Area (ha)	200
Milking cows/ha	2.75
Milking Cows (in milk 15 Dec)	550
Total Stock Units	4960
Total Stockunits Per Hectare	24.8
Milksolids per Hectare (kg/ha)	853
Total Milk Production (kgMS)	170,500
Milksolids Payment	$4.25

Stock Sales	Number	Price/Hd	Total
Cull Cows	119	500	59,650
Heifer Calves	108	63	6,773
Bull Calves	248	73	18,068
	474		84,490

Stock Purchases	Number	Price/Hd	Total
Bulls	2	1500	3,000
	2		3,000

Calving percentage	90%
Milk solids kg prod/cow	310
Death rate	3%

Stock Class	Numbers	Stock Units	Total
Cows	550	8	4400
Rg1Yr Hfr	140	4	560
			4960

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sales	Close No	Class
Cows	550		17		119	550	Cows
Rg1Yr Hfr	140		4			140	Rg1Yr Hfr
Hf Calves	0	248			108	0	Hf Calves
St Calves	0	248			248	0	St Calves
Br Bulls	4			2	2	4	Br Bulls
	694	495	21	2	476	694	0

Dairy - High Production

Revenue				
Milk Sales			#######	
Dairy Cattle Sales			106,190	
Other				
Gross Farm Revenue				1,254,540
Gross Revenue per Hectare				**6,273**
Expenditure		$/cow		
Stock Purchases			3,000	
Wages	per kg MS	$ 0.30	81,060	
Animal Health		$ 65.00	45,500	
Breeding		$ 28.00	19,600	
Dairy Shed Expenses		$ 21.00	14,700	
Electricity		$ 32.00	22,400	
Feed costs on farm		$ 70.00	49,000	
Feed costs off farm		$ 390.00	273,000	
Fertiliser	per ha	$ 185.00	37,000	
Seed		$ 15.00	10,500	
Freight		$ 10.00	7,000	
Weed and Pest		$ 7.00	4,900	
Vehicles		$ 60.00	42,000	
Repairs and Maintenance			25,000	
Administration			15,000	
Standing Charges			18,000	
Wages of Management			70,000	
apital charge stock, plant and shares			222,600	
Gross Farm Expenses				960,260
Gross Expenses per Hectare				**4,801**
Economic Farm Surplus				294,280
Economic Farm Surplus per Hectare				**1,471**

Milking Area (ha)	200
Milking cows/ha	3.5
Milking Cows (in milk 15 Dec)	700
Total Stock Units	6300
Total Stockunits Per Hectare	31.5
Milksolids per Hectare (kg/ha)	1351
Total Milk Production (kgMS)	270,200
Milksolids Payment	$4.25

Stock Sales	Number	Price/Hd	Total
Cull Cows	149	500	74,375
Heifer Calves	140	63	8,820
Bull Calves	315	73	22,995
	604		106,190

Stock Purchases	Number	Price/Hd	Total
Bulls	2	1500	3,000
	2		3,000

Calving percentage	90%
Milk solids kg prod/cow	386
Death rate	3%

Stock Class	Numbers	Stock Units	Total
Cows	700	8	5600
Rg1Yr Hfr	175	4	700
			6300

STOCK RECONCILIATION

Class	Open No	Natural Inc	Death	Purchase	Sales	Close No	Class
Cows	700		21		149	700	Cows
Rg1Yr Hfr	175		5			175	Rg1Yr Hfr
Hf Calves	0	315			140	0	Hf Calves
St Calves	0	315			315	0	St Calves
Br Bulls	4			2	2	4	Br Bulls
	879	630	26	2	606	879	0

	Input Variable	Mean	±
Land & Livestock	Land Value ($/ha)	0	
	Livestock Carrying Capacity (LSU/ha)	0	
	Livestock Capital Value ($/LSU)	0	
	Livestock Gross Margin ($/LSU/yr)	0	
	Grazing (Y/N)	n	
Financial	Annual Fixed Costs ($/ha)	100	
	Establishment Costs (cents/tree)	60	
	Logging Cost ($/m^3)	37	
	Labour Cost ($/hr)	22	
	Labour Supervision (%)	15	
	Discount rate (%)	9	
Growth & Quality	300 Index / Site Index	1	0.1
	Site Index (m)	32	
	Conversion (%)	85	
	B.H. Outerwood Density (kg/m^3)	410	
	Outerwood Measurement Age (yrs)	15	
Silviculture	Rotation (yrs)	28	
	Final Crop Stocking (stems/ha)	300	
Log Prices	Log Prices global adjustment (%±)	0	
	Pruned Log PLI unit increase	15	
	Pruned (price for PLI = 4)	135	
	S1	97	
	S2	88	
	S3	63	
	L1	68	
	L2	68	
	L3	64	
	Pulp	40	

I300 / SI	EFGM $/LSU	IRR %	NPV $/ha	Cost $/m^3	Value $/m^3	Labour hr/ha	Grazing % of ha
0.9	#DIV/0!	10.23	1,099	41.5	105.8	93.2	0.0
0.95	#DIV/0!	10.56	1,456	41.3	107.1	93.2	0.0
1	#DIV/0!	10.85	1,802	41.1	108.3	93.3	0.0
1.05	#DIV/0!	11.12	2,142	40.9	109.2	93.3	0.0
1.1	#DIV/0!	11.37	2,479	40.7	110.0	93.3	0.0

I300 / SI	Initial SPH	Thin SPH	Volume m^3/ha	DBH cm	MTH m	BIX cm	Juv. %	SED mm	Density kg/m^3	PLI
0.9	832	312	833	51.1	42.0	5.4	48.4	354	415	6.5
0.95	832	312	881	52.5	42.0	5.8	48.8	363	415	6.7
1	832	312	929	53.9	42.0	6.1	49.2	370	415	6.9
1.05	833	312	976	55.2	42.0	6.3	49.5	378	415	7.1
1.1	833	312	1,023	56.4	42.0	6.6	49.9	385	415	7.3

I300 / SI	Log Grade Volumes (m^3/ha)								
	Pruned	S1	S2	S3	L1	L2	L3	Pulp	Total
0.9	241	36	134	90	40	75	37	56	708
0.95	259	38	121	73	60	97	45	55	749
1	276	39	108	59	83	118	52	54	789
1.05	292	38	94	46	108	138	58	54	830
1.1	308	37	81	36	134	155	62	55	870

*** Value outside recommended range**

Registered to *Nimmo-Bell Ltd, Wellington* NZ FFA Membership number *47384*

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Part B

Macro-Economic Implications

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Executive Summary

An initial estimate of the macro-economic implications of declining lake water quality was undertaken by Nimmo-Bell (2003a) in October 2003 based on Rotorua District and Bay of Plenty Region economic models and land use data generated in an economic evaluation of land use change options for Lake Okareka (Nimmo-Bell, 2003b). This report updates this analysis using data generated in the analysis of land use in the much larger Rotorua and Rotoiti catchments (Nimmo-Bell, 2004).

The Rotorua District and Bay of Plenty Region economic models generated for this study are based on a national inter-industry model for 2000/01, the national distribution of industry and an assessed level of district and regional self-sufficiency in 2001. All the information and assumptions are updated and incorporated into separately estimated District and Region input-output models.

The analysis shows that total district output and employment impacts per thousand hectares of different land use activities vary considerably, with:

- $0.85m output and 7 FTEs in low sheep and beef farming with none of the meat being processed in the district; to
- $2.3m output and 24 FTE in medium deer with all processing in the region; to
- $9.0m output and 42 FTEs in forestry (of which 24 are in processing, and 90 % of the jobs do not occur until harvesting); to
- $18.3m output and 56 FTEs in high dairy farming with all milk processing occurring in the district.

The effects of declining lake water quality on tourism could be considerable. But these effects need to be put into the context of the potential effects of land use changes associated with a requirement to reduce nutrient output over the areas of land likely to be affected. We have put these impacts into perspective by estimating the number of visitors that need to be saved to offset the loss in value added from converting a particular area of farming to forestry.

If there is a reduction in water quality in the lakes so that there is a 10% decline in tourism numbers this results in the loss of $29 million value added which is 0.5% of Gross Regional Product.

High producing dairying (including processing) has a value added of $8.3 million per ‘000 Ha per annum. Forestry (including processing) has a total value added per annum of $2.2 million per ‘000 Ha (on an annual annuity basis). Thus there would be a net loss of $6.1 million per annum per ‘000 Ha converted ($8.3m - $2.2m).

This means that 4,750 ha of dairy farming (almost all in the lake catchments) would need to be converted to forestry for the loss in value added from farming to be equivalent to a 10% loss from tourism. To put this another way, if 4,750 hectares of dairy land had to be converted to forestry to improve the quality of lake water then this would need to save at least 10% or 605 of

tourism jobs in the region to justify the loss in value added from dairying (and loss of 211 dairy jobs).

Based on dairy N run-off of 55kg/ha and the need to reduce N by 250 tonne this implies a reduction in dairying of 4,545 hectares – 93% of the total area in dairying and 199 dairying jobs. To justify this there would need to ensure there was at least a saving of 7% in tourist numbers and 436 jobs, most of which are significantly lower paying on average than in the dairy industry.

It should also be noted that converting any land use that has a total economic value added per thousand hectares less than forestry will result in a net gain in value added. While all three sheep and beef activities plus medium deer have a lower total value added than forestry we need to take into account the switching cost, including social costs, of moving from one land use to the other before deciding if the region would be better off. The fact that all sheep and beef land has not already converted to forestry implies that the total cost exceeds the benefits.

Taking the land use change scenarios developed we have calculated the change in total economic value added (TEVA) assuming each farming type is reduced proportionately to achieve the needed reduction in N. There is a reduction in value added of $37.8 million per annum under the substantial land use change to achieve a reduction of 250 tonne of N. Under the capped scenario and moderate land use change the loss is $13.7 million per annum. These figures are after the adjustment has been made in land use and do not take into account the cost of making the change.

Reduction in total economic value added from land use change (per annum)

	Mod	Subs
Cap	-$ 13,716,500	-$ 36,119,300
-150T	-$ 14,751,600	-$ 37,154,400
-200T	-$ 15,102,800	-$ 37,505,600
-250T	-$ 15,445,900	-$ 37,848,700

These values are based on the regional economic multipliers, but reflect land use change decisions made on the farm. A farmer may decide to move from low sheep and beef (TEVA $600/ha) to high sheep and beef (TEVA $1,600/ha) when the figures on economic value added would indicate a shift to forestry (TEVA $2,200/ha). The decisions farmers make are based on a number of reasons including personal preference, the resource base of the farm, the prices they receive at the farm gate and such things as the need for current income compared with waiting 26 years for a forest to mature. The effect of this in the model is to reduce the margin between the various scenarios. The full calculations are shown in the Appendix.

When compared to value added by agriculture and food processing the losses to the local economy could be considerable. At the 250 tonne N reduction level and substantial land use change the policy accounts for the equivalent of 25%

off the value added from agriculture and food processing on an annual basis (-$37.8 m compared with $153.7m).

Other factors need to be taken into account.

1. There is the question as to how long it would take for the tourism market to revive once the lake quality starts to improve, this could be 30 years or more.
2. Also important is whether conversion of agriculture to forestry is the most efficient way of achieving the goal of improving water quality.
3. Most people do not want to see dairy land converted to forestry – rather the goal should be to achieve the highest value/best economic option while retaining a low N signature.
4. Other mitigation measures, such as using nitrogen binding compounds like Eco-N may achieve the goal at lower cost.
5. Priorities need to be set so that the most cost affective measures are implemented first.
6. Activity based rules stifle innovation whereas effects based rules provide incentives to find better ways of doing things.
7. It is critical to ensure that the policy is technology open so that improvements in technology are encouraged and the cost of achieving the goal is continuously reduced.

1. Terms of reference

The terms of reference require us to apply data from the land use scenarios in the Rotorua and Rotoiti catchments to the macro-economic models already presented to demonstrate the revised impact at a macro-economic level.

2. Introduction

An initial estimate of the macro-economic implications of declining lake water quality was undertaken by Nimmo-Bell (2003a) in October last year. This was based on economic models of the Rotorua District and Bay of Plenty Regions and data generated from a study of land use options under different policy scenarios for Lake Okareka (Nimmo-Bell, 2003b).

The previous study presented estimates of the changes in output, household income, value added and employment associated with potential land use changes. These impacts were expressed on a "per '000 ha" basis so that a range of scenarios could be examined for a given catchment by keeping total catchment land area constant and changing the proportion used for each of the various land uses. All impacts were assessed on both a district and regional basis to show the total effects including flow-on effects on other industries in the district or region. Impacts were separated into farming, forestry and tourism.

This report updates this analysis using data generated in the analysis of land use in the Rotorua and Rotoiti catchments.

The structure of the local economy was assessed using information generated from input/output tables. This showed that the sum of value added in Rotorua District amounts to a Gross Product of $1.5 billion which is 26% of the Bay of Plenty Regional total of $5.8 billion and relates to the GDP for New Zealand of $112 billion. Agriculture in the district accounts for $120 million (7.9%) of gross Product and forestry $64 million (4.2%) of Gross Product. When processing is added to primary production these sectors account for $154 million (10.1%) and $162 million (10.6%) respectively of Gross Product. The value added of tourism was estimated to be around $180 million, which is 12% of Gross District Product.

The data showed that over the last 15 years employment has been virtually static in the district. While employment in agriculture, forestry and manufacturing had declined, this was offset by increases in business and professional services with changes in tourism related sectors somewhat mixed. At the regional level a similar picture emerged, but with overall growth of 18% over the period.

The level of changed economic activity due to the land use changes was measured by using models based on the Statistics New Zealand national inter-industry model for 1995/96. This was updated to 2000/01 and information incorporated about the national distribution of industry and assessed level of district and regional self-sufficiency in 2001.

Multiplier analysis was used to measure total economic impacts (output, employment, value added and gross household income). This analysis extended the direct effects to include indirect effects that arise from spending by businesses to buy additional inputs to increase production. Subsequently, the induced effects that were generated from the increased household income being spent and leading to a further ripple effect of increased output, employment and income were included. Combining these three effects (direct, indirect and induced) generated the assessed total economic impact.

3. New information generated from the Rotorua/Rotoiti study

The land area in primary production in the Rotorua and Rotoiti catchments is 34,871 hectares, which is 50 times the area in primary production in the Okareka catchment. Land use is also more varied with forestry (11,461 ha), dairy (4,863 ha) and deer (1,632 ha) as well as undeveloped (1,895 ha) and sheep and beef (14,751 ha).

The changes that have been made relate to the addition of dairy and deer to the enterprise mix. Dairy farming is a significant activity in Rotorua catchment and the farm size bigger and estimated productivity higher than previously used in the district estimates. We have included moderate and high intensity dairying enterprises as representative of the district. Also, deer farming is a significant activity and we have included it at a moderate and high intensity level.

Sheep and beef farming are similar to that of the previous study and we have utilised the same estimates of low, moderate and high intensity activities.

Forestry and tourism returns are unchanged from the previous study.

The land use change scenarios we have considered for the Lake Rotorua and Rotoiti catchments are as follows:

- A cap on any increase in nutrient output (i.e. no further intensification allowed)
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 150 T of N
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 200 T of N
- Conversion of sufficient pastoral land to production forestry to allow a reduction of 250 T of N
- A moderate change in land use without restrictions (increased intensity and therefore a likely increase in N output)
- A substantial change in land use without restrictions (increased intensity and therefore a likely increase in N output).

Land use under the various scenarios is shown in Table 1 below.

Table 1: Land use in Rotorua and Rotoiti catchments under the various scenarios (hectares)

	Capped	N Restriction Scenarios			Without Restrictions	
		-150 T	-200 T	-250 T	Moderate	Substantial
Undeveloped land	1,895	1,895	1,895	1,895	1,270	545
Forestry	11,461	18,123	20,344	22,564	9,911	8,361
S&B Low	2,253	1,587	1,365	1,143	0	0
S&B Medium	11,265	7,935	6,826	5,716	9,098	5,938
S&B High	1,502	1,058	910	762	6,622	9,148
Deer Mod	1,469	804	582	360	869	419
Deer High	163	89	64	40	763	1,063
Dairy Medium	3,258	2,264	1,933	1,602	3,433	4,412
Dairy High	1,605	1,116	952	789	2,905	3,605
Higher land use	0	0	0	0	0	1,380
	34,871	34,871	34,871	34,871	34,871	34,871

Note: the higher land use category allows for a future change in land use that is assumed to have a 20% higher return than the existing high intensity dairy system.

4. Generation of Rotorua District and Bay of Plenty Region Economic Models

The Rotorua District and Bay of Plenty Region economic models generated for this study (and Okareka) are based on a national inter-industry model for 2000/01, the national distribution of industry and an assessed level of district and regional self-sufficiency in 2001.

The data on the likely direct spending patterns of farming, forestry and tourism gives only the first round of indirect impacts. To estimate the further impacts caused by the spending of businesses further down the chain, an estimate of the probable pattern of their expenditure was developed, on the basis of information that already exists about national average expenditure patterns of businesses of this type and the regional location of businesses that supply those inputs.

All the information and assumptions are incorporated into separately estimated District and Region input-output models. These models are generated using an existing national input-output model, information about the regional distribution of employment and output, and a relatively simply mathematical technique called GRIT 1 (Generation of Regional Input-output Tables - which estimates the source of inputs into District industries). This

1 Developed in Australia and widely used there and in New Zealand. See West et al (1982), or Butcher (1985).

model is then adjusted by incorporating into it information about the likely expenditure patterns of farming and forestry in the district and region. The resultant input-output models can be used to calculate the total effects on all sectors of an increase in output of any single sector. These total effects include the original effect and all the consequential rounds of indirect and induced effects.

In the case of the land uses being considered, estimates of employment and operational financials have been developed. These estimates are used as the basis of inputs into the economic models for the District and Region. Approximations were made as to where the businesses will purchase their goods and services from, and this was based on knowledge of the farming operations in the area. With regard to labour it has been assumed that all farm and forestry labour will live locally, and hence spend locally. Generally, not all household spending is done locally because people sometimes choose to shop and holiday outside the district or region, and some members of small communities use outside professional assistance in order to preserve their privacy. The district and regional economic model takes these factors into account.

4.1. Estimates of Multipliers for Farming and Forestry

Once the farming and forestry expenditure information had been incorporated into the District and Region models, employment, output, value added and household income multipliers for each geographic entity can be estimated using matrix algebra[2]. Type II multipliers were calculated. It is clear that the increased direct household income from farming and forestry stimulates household spending and hence economic activity in the district, and for this reason it is believed to be appropriate to use Type II multipliers to calculate total economic impacts of land use change.

The multipliers estimated from the District and Region economic models are applied to estimates of the direct employment, output, value added and household income arising from each land use. This generates estimates of total employment, output, value added and household income arising from the land use.

4.2. Estimates of Multipliers for Tourism

We have used the Lincoln University tourism multipliers which they developed for Rotorua district. To get Bay of Plenty regional tourism multipliers we have rated up the district multipliers by factors of 1.05 – 1.13 which reflect the difference between district and regional multipliers in the key tourism sectors of retail trade, accommodation, restaurants and recreation and culture.

2 Readers who wish to know more should consult a text on input - output models. Customised software (e.g. IO7) which undertakes the matrix manipulation is readily available.

4.3. Direct Economic Impacts of various land uses

This section contains a summary of the estimated direct economic impacts per thousand ha for each land use. In the context of this report, "District" refers to the Rotorua district and "Region" refers to the Bay of Plenty region. The impacts are based on the representative farm types and intensities developed. The results outlined here include eight land uses, including three intensities of sheep and beef farming, two intensities of dairying, two intensities of deer, and production forestry.

4.3.1. Farming Impacts

All land use impacts are assessed once a land area is in full production. Any change in land use will have an interim period where there may be significant capital investment and where productivity is moving towards the long-term average. Table 2 below shows the direct impacts of farming per '000 hactares.

Table 2: Direct Economic Impacts of Farming per annum per '000 Ha

	Deer		Dairying		Sheep and Beef		
	Med	**High**	**Med**	**High**	**Low**	**Med**	**High**
Output ($m / year)	1.71	3.2	4.05	6.27	0.52	1.07	1.66
Employment (FTEs)	10.7	12.0	16.0	21	4.3	4.5	6.2
Gross HHI ($m / year)	0.21	0.36	0.58	0.76	0.11	0.14	0.19
Value added ($m / year)	0.69	1.53	2.27	3.34	0.27	0.52	0.65

4.3.2. Forestry Impacts

Showing the economic impacts of forestry is particularly problematic in that there is a modest impact during planting, then a more significant impact during pruning and thinning from years 5 – 10, and then no further impact until harvesting and processing in year 28. For forestry we have shown the effects in an average year, with one twenty-eighth of the total rotation impact occurring in each year.

Forestry impacts are based on expenditure of around $0.60 per stem to clear the ground, buy the tree, plant it and release spray it. At 800 stems per Ha this cost is $480 / Ha, and it takes around 2.3 person days (including employment in the nursery). The costs of pruning are around $300 / prune / Ha, and of thinning are around $150 / thin / Ha giving a total of $1,200 / Ha (3 prunes and 2 thins). Total time taken is around 8.2 days / Ha. Logging is a highly variable cost depending on the terrain. Costs can vary from $10 (easy land with highly mechanised operation) to more than $50 on very steep land. We have assumed an average cost of $24 / tonne for the 795 tonnes of logs per Ha being harvested at age 28 years, or a total cost per Ha of $19,100.

We have also assumed productivity of around 30 tonnes per person per day, or 10.5 days / Ha. Freight is expected to cost $8,600 per Ha, with logs being transported 60 km at an average cost of $0.18 per tonne-km. Employment in road freight averages around 5.4 FTEs per $million of turnover, so the employment per Ha is around 10.5 days. Management and overheads are costed in at $100 per Ha per year, and with direct employment at around 10 FTEs / $million this implies 6.4 days over the 28 year rotation.

All employment figures in Table 3 are converted to person-years assuming 200 working days per year for in-forest operations and 230 days in freight and forest management. Figures are expressed per '000 Ha for the full rotation of 28 years (Table 3), and per '000 Ha per year averaged over the rotation (Table 4).

Table 3: Direct Economic impacts of Forestry per '000 Ha (TOTAL over 28 year rotation)

	Forest Owner	Prep &Plant	Prune Thin	Log	Transport	Mgt	Total (rounded)
Output ($m)	73.40	0.48	1.2	19.10	8.60	2.80	106
Employment (job-years)	0	11.50	41.00	132.50	45.10	28.00	258
Gross Household Income ($m)	0	0.38	0.96	5.18	2.09	1.15	9.76
Value Added ($m)	41.20	0.36	0.91	9.54	3.69	1.15	56.90

Table 4: Direct Economic impacts of Forestry per '000 Ha (AVERAGE per year over rotation)

	Forest Owner	Prep & Plant	Prune Thin	Log	Transport	Mgt	Total (rounded)
Output ($m / year)	2.62	0.02	0.04	0.68	0.31	0.10	3.80
Employment (FTEs)	0	0.41	1.46	4.73	1.61	1.00	9.20
Gross Household Income ($m / year)	0	0.01	0.03	0.19	0.07	0.04	0.35
Value Added ($m / year)	1.47	0.01	0.03	0.34	0.13	0.04	2.00

Note that during forest establishment (planting, pruning and thinning) total output, employment, gross household income and valued added per annum is considerably lower than the average over the whole rotation. This is because all logging and transport occur only in year 28. In Table 5 below we assume all planting and tending are undertaken in the first 10 years (and therefore average the total impact over 10 years), take out logging and transport, and take the 28 year average of forest ownership and management to give the total impact per annum during establishment.

Table 5: Direct Economic impacts of Forestry per '000 Ha per annum averaged over establishment (first 10 years)

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Total (rounded)
Output ($m / year)	2.62	0.05	0.12	0.10	2.89
Employment (FTEs)	0	1.15	4.10	1.00	6.25
Gross Household Income ($m / year)	0	0.04	0.10	0.04	0.18
Value Added ($m / year)	1.47	0.04	0.09	0.04	1.64

4.3.3. Conclusion

There are significant differences in the economic impacts associated with various land uses. Direct employment impacts per thousand hectares range from 4.3 FTEs in low productivity sheep and beef farms to 9.2 FTEs in forestry to 21 FTEs in high intensity dairy farms. Direct value added per '000 Ha per year ranges from $0.3 m in low productivity sheep and beef to $2.0 m in forestry to $3.3 million in high productivity dairying (see Tables 2 and 4).

There are significant differences in economic impacts for forestry depending on the stage of the rotation. Averaged over the whole rotation the annual employment impact is 9.2 FTEs per '000 Ha (Table 4), during establishment the average is 6.3 FTEs (Table 5), but most of the impact is during logging and transport in year 28 at 177.6 FTEs (Table 3).

4.4. Direct economic impacts of tourism

4.4.1. Strategic Value

A great deal of commercial tourism in New Zealand is dependent on providing food and accommodation to visitors. However, food and accommodation are generally what are termed "derived demands". That is, they are demanded by visitors primarily because the visitors are in the vicinity for some reason, and the reason is not generally to stay in a particular hotel or eat at a particular restaurant. The primary demand by visitors is to see things and to undertake activities, and if New Zealand tourism is to continue to expand, the quality of experiences must be maintained, which means maintaining the quality of the resource base.

Discussions with tourism operators has shed little light on the likely impacts of changes in water quality or on land use on the visitor experience. Work by Fairweather et al (2000) revealed that visitors were quite accepting of a wide range of land uses. Different visitors appreciated different things, but there was, for example, little evidence that visitors disliked plantation forestry, or preferred one form of farming over another.

A change in water quality can lead to disagreeable odours, health impacts on swimmers, algal blooms and resultant smells, a loss in the quality of the fishery, and health hazards from consuming food caught in the water. Anecdotal evidence suggests that a sufficient decline in water quality does lead to a decline in tourism. Operators on Lake Rotorua felt that there was a significant loss of revenue at the low point of water quality in the early 1990s prior to the commissioning of a new sewage treatment plant. More recently, camp operators at other lakes, such as Rotoiti, have said that the decline in water quality there led to a significant decline in the number of guest-nights.

A review of visitor activities suggests that only a small proportion of international visitor activities are actually based on the lake, which on the face of it might suggest that a decline in water quality would have little impact on visitor numbers. However, if water quality declines to a point where smell can be noticed beyond the lake boundary itself, or if the area gets a reputation for being an unhealthy place, the impacts on visitor numbers could be severe. The position for domestic visitors is believed to be very different, with anecdotal evidence suggesting that large numbers of bach owners and campers in particular use the lakes extensively.

We have no way of knowing how bad water quality would have to become for visitors to be dissuaded from coming to Rotorua. For this reason, we have chosen to consider a range of visitor impacts, ranging from a 2 per cent decline for a significant deterioration of water quality and 20 per cent for very bad water quality. These figures are intended to demonstrate the significance of tourism impacts to changes in water quality compared to the impacts associated with changes in land use to improve water quality.

Of course at the extreme, impacts could be even greater. There are certainly those who recall the situation in early 1990 who believe that had the water quality at the time not been improved, tourism in Rotorua could easily have collapsed (which we take to mean a decline of 50 % or more). We have not quantified a collapse as we believe water quality will not be allowed to reach that state.

4.4.2. Direct Impact on Tourism Sales

Given the uncertainty of impacts on tourism, we have considered impacts of 2 %, 5 %, 10 % and 20 % of total tourism, with this being the sort of range that could be affected (see Table 6). Note that this is an effect spread across all affected lakes. If only one lake has poor water quality, the effects on the district will probably be quite small because people can transfer to other lakes.

However if all lakes are affected, then the potential for transfers is lost and the total impact is likely to be at the upper end of the scale.

Table 6: Direct Rotorua Tourism Impacts Associated with a change in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Rotorua Tourism
Output ($m / year)	8.1	20.2	40.3	80.6	403
Employment (FTEs)	83.0	206.0	413.0	826.0	4,130
Gross Household Income ($m / year)	2.2	5.4	10.8	21.6	108
Value Added ($m / year)	3.2	8.2	16.4	32.8	164

4.4.3. Conclusion

It is very difficult to assess the direct tourism impacts of a decline in water quality in a particular lake as visitors are likely to transfer to other lakes. We have therefore estimated tourism impacts over a range from 2% to 20% decline in tourism numbers over the whole district. If a district wide decline in water quality led to a 2% reduction in tourism numbers this implies a loss of 83 jobs and $3.2 million in value added. A 20% decline in tourism numbers implies a loss of 826 jobs (which is 3% of total jobs in the district) $32.8 million in value added.

5. Multipliers and total economic impacts

5.1. Estimates of Farming and Forestry Multipliers and Total Impacts

Once the basic district model had been expanded to incorporate the financial and employment estimates for farming and forestry, it was possible to calculate employment, output, value added and household income multipliers. Multipliers have been applied to the direct impacts (see Table 3 and Table 5) in order to estimate the total impacts, as shown in the following tables. Multipliers for the district are slightly smaller than for the region because of the less diverse manufacturing and services bases of the district.

Farming and Forestry also have "forward linkages" through processing of livestock, milk and logs. We have converted the direct farm and forestry production figures into output of the processing plants, and we have assumed that all milk and venison, half the logs and none of the sheep and beef are processed in the district. (We acknowledge that a small proportion of deer processing takes place outside the region however we have not considered it material for this exercise. Also, there is probably some milk going out of the region for processing, but this will be offset by some coming back the other way). We have also assumed that the balance of the logs are exported in log form and that half of the meat is processed elsewhere in the region (at Rangiuru) and the balance is processed outside the region.

The assumption for sheep and beef processing location is based on advice from livestock agents in the district, and reflects the fact that there is no sheep and beef processing plant within the district, and that abut half of all stock are slaughtered outside the region. In regard to deer, there are two well established plants in Rotorua district and only a small proportion of deer from the region go north for processing in the Waikato. The total economic impacts for farming in the District are shown in Table 7 and for the Region in Table 8.

Table 7: Total Economic Impacts in Rotorua District per annum per '000 Ha of Farming (including Processing)

	Deer		Dairying		Sheep and Beef		
	Med	**High**	**Med**	**High**	**Low**	**Med**	**High**
Output ($m / year)	2.3	4.1	11.8	18.3	0.85	1.5	2.2
Employment (FTEs)	24	33	39	56	7	8	11
Gross HHI ($m / year)	0.63	1.03	1.5	2.1	0.21	0.24	0.36
Value added ($m / year)	1.5	2.9	4.0	5.9	0.43	0.73	0.9

Table 8: Total Economic Impacts in Bay of Plenty Region per annum per '000 Ha of Farming (including Processing)

	Deer		Dairying		Sheep and Beef		
	Med	High	Med	High	Low	Med	High
Output ($m / year)	4.6	8.7	17.6	27.3	1.6	3.0	4.6
Employment (FTEs)	24	35	60	87	10	13	19
Gross HHI ($m / year)	0.8	1.3	1.6	2.3	0.31	0.46	0.67
Value added ($m / year)	1.6	3.1	5.6	8.3	0.6	1.1	1.6

The assumption about wood processing is based on current data for the region[3]. However, there is enormous uncertainty as to what sort of processing will take place in another 28 years when seedlings planted now will come to maturity. We have assumed that the wood will go to processing in a medium-sized MDF plant, where there is 1 FTE employed for every 900 m3 logs per annum. A large scale MDF plant would use considerably less labour (around 1 FTE per 1,600 m3 of logs), while a large scale sawmill would use 1 FTE per 2,000 m3 of logs, and really large scale saw mills with limited processing can have as little as 1 FTE per 20,000 m3. From this perspective the processing impact is the upper level of what is likely, and it is quite possible that the impacts will only be half as great or even less. The total economic impacts for forestry in the District are shown in Table 9 and for the Region in Table 10. Tables 11 and 12 show the total economic impact during the first 10 years of forestry establishment for the District and Region respectively.

Table 9: Total Economic impacts in Rotorua District per annum per '000 Ha of Forestry (including processing)

	Processing	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total Rounded
Output ($m / year)	4.40	2.62	0.03	0.08	0.97	0.62	0.20	9.00
Employment (FTEs)	27.10	0	0.61	1.60	7.10	3.80	1.70	42.00
Gross Household Income ($m / year)	1.00	0	0.02	0.04	0.27	0.15	0.07	1.60
Value Added ($m / year)	1.60	1.50	0.02	0.05	0.48	0.28	0.09	3.90

3 Gerard Horgan, FRI, *pers. comm.*

Table 10: Total Economic impacts in Bay of Plenty region per annum per '000 Ha of Forestry (including processing)

	Proc-essing	Forest Owner	Prep & Plant	Prune Thin	Log	Trans-port	Mgt	Total Rounded
Output ($m / year)	3.70	2.62	0.03	0.08	0.94	0.59	0.19	8.20
Employment (FTEs)	24.00	0	0.40	1.60	6.90	3.70	1.60	38.00
Gross Household Income ($m / year)	0.80	0	0.02	0.04	0.26	0.15	0.07	1.40
Value Added ($m / year)	1.30	1.50	0.02	0.05	0.46	0.27	0.08	3.60

Note: Forestry output per '000 hectares in the region is lower than in the district because the concentration of processing is lower in the region.

Table 11: Total Economic impacts in Rotorua District per annum per '000 Ha of Forestry (establishment phase – first 10 years)

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Total Rounded
Output ($m / year)	2.62	0.08	0.22	0.20	3.1
Employment (FTEs)	0	1.71	4.48	1.70	7.9
Gross Household Income ($m / year)	0	0.06	0.11	0.07	0.2
Value Added ($m / year)	1.50	0.06	0.14	0.09	1.8

Table 12: Total Economic impacts in Bay of Plenty region per annum per '000 Ha of Forestry (establishment phase – first 10 years)

	Forest Owner	Prep & Plant	Prune Thin	Mgt	Total Rounded
Output ($m / year)	2.62	0.08	0.22	0.19	3.1
Employment (FTEs)	0	1.12	4.48	1.60	7.2
Gross Household Income ($m / year)	0	0.06	0.11	0.07	0.2
Value Added ($m / year)	1.50	0.06	0.14	0.08	1.8

In order to compare farming with forestry on an equivalent basis we need to take into account the fact that forestry income from a newly established forest is not received until 28 years later. We do this by converting the forestry value added over time into an annual figure. When this is done the total value added for forestry in the Region is $2.2 million per annum per '000 hectares. This takes into account the timing of the various forestry operations including processing over 28 years by discounting the cashflows to an NPV then turning this into an annuity at 9%. It also assumes a high degree of wood processing when the forest is milled. As stated earlier this is by no means guaranteed and relies on decisions made some time in the future. Given these caveats, forestry including processing has a higher total value added than sheep and beef and medium deer, but lower than high deer and medium and high dairy.

5.2. Estimates of Tourism Multipliers and Total Impacts

As only a small proportion of international visitor activities are based on the lakes the greatest impacts are likely to be on domestic visitors and in particular bach owners and campers. Table 13 shows the total impacts of visitor number changes in the Rotorua District and Table 14 the Region.

Table 13: Total economic impacts in Rotorua District of changes in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Rotorua Tourism
Output ($m / year)	12	30	62	120	620
Employment (FTEs)	115	290	575	1,150	5,750
Gross Household Income ($m / year)	3	8	16	33	163
Value Added ($m / year)	5	13	26	52	260

When indirect and induced effects are added to direct effects a 2% decline in tourism numbers in the district is estimated to lead to a loss of 115 jobs, which is 0.5% of total jobs in the district. A 20% decline implies the loss of 1,150 jobs, which is 5% of total jobs.

Table 14: Total economic impacts in Bay of Plenty region of changes in visitor numbers

	2 % decline	5 % decline	10 % decline	20 % decline	Total Region Tourism
Output ($m / year)	14	35	70	140	700
Employment (FTEs)	120	300	600	1,210	6,040
Gross Household Income ($m / year)	4	9	18	36	178
Value Added ($m / year)	6	15	29	58	290

5.3. Conclusions

The total economic impacts associated with different land uses vary by much more than do the direct impacts. The total district output and employment impacts per annum per thousand hectares vary from:

- $0.85m output and 7 FTEs in low sheep and beef farming with none of the meat being processed in the district; to
- $2.3m output and 24 FTE in medium deer with all processing in the region; to
- $9.0m output and 42 FTEs in forestry (of which 24 are in processing, and 90 % of the jobs do not occur until harvesting); to
- $18.3m output and 56 FTEs in high dairy farming with all milk processing occurring in the district.

The effects of tourism could be considerable, but these effects need to be put into the context of the potential effects of land use changes over the areas of land likely to be affected.

One way of putting these impacts into perspective is to estimate the number of visitors that need to be saved to offset the loss in value added from converting a particular area of farming to forestry. No one has been able to quantify the relationship between water quality and tourist numbers, but we use scenario analysis to illustrate the possible impacts.

6. Value Added

If there is a reduction in water quality in the lakes so that there is a 10% decline in tourism numbers this results in the loss of $29 million value added which is 0.5% of Gross Regional Product.

High producing dairying (including processing) has a total value added of $8.3 million per '000 Ha per annum at the regional level.

Forestry (including processing) has a total value added per annum of $2.2 million per '000 Ha (on an annual annuity basis).

Thus there would be a net loss of $6.1 million per annum per '000 Ha converted ($8.3m - $2.2m).

This means that 4,750 ha of dairy farming (almost all in the lake catchments) would need to be converted to forestry for the loss in value added from farming to be equivalent to a 10% loss from tourism. To put this another way, if 4,750 hectares of dairy land had to be converted to forestry to improve the quality of lake water then this would need to save at least 10% or 605 of tourism jobs in the region to justify the loss in value added from dairying (and loss of 211 dairy jobs).

Based on dairy N run-off of 55kg/ha and the need to reduce N by 250 tonne this implies a reduction in dairying of 4,545 hectares – 93% of the total area in dairying and 199 dairying jobs. To justify this there would need to ensure there was at least a saving of 7% in tourist numbers and 436 jobs, most of which are significantly lower paying on average than in the dairy industry.

It should also be noted that converting any land use that has a total economic value added per thousand hectares less than forestry will result in a net gain in value added. While all three sheep and beef activities plus medium deer have a lower total value added than forestry we need to take into account the switching cost, including social costs, of moving from one land use to the other before deciding if the region would be better off. The fact that all sheep and beef land has not already converted to forestry implies that the total cost exceeds the benefits.

Taking the land use change scenarios developed we have calculated the change in total economic value added (TEVA) assuming each farming type is reduced proportionately to achieve the needed reduction in N. Table 15 below shows that there is a reduction in value added of $37.8 million per annum under the substantial land use change to achieve a reduction of 250 tonne of N. Under the capped scenario and moderate land use change the loss is $13.7 million per annum. These figures are after the adjustment has been made in land use and do not take into account the cost of making the change.

Table 15: Reduction in total economic value added from land use change (per annum)

	Mod	Subs
Cap	-$ 13,716,500	-$ 36,119,300
-150T	-$ 14,751,600	-$ 37,154,400
-200T	-$ 15,102,800	-$ 37,505,600
-250T	-$ 15,445,900	-$ 37,848,700

These values are based on the regional economic multipliers, but reflect land use change decisions made on the farm. A farmer may decide to move from low sheep and beef (TEVA $600/ha) to high sheep and beef (TEVA $1,600/ha) when the figures on economic value added would indicate a shift to forestry (TEVA $2,200/ha). The decisions farmers make are based on a number of reasons including personal preference, the resource base of the farm, the prices they receive at the farm gate and such things as the need for current income compared with waiting 26 years for a forest to mature. The effect of this in the model is to reduce the margin between the various scenarios. The full calculations are shown in the Appendix.

When compared to value added by agriculture and food processing the losses to the local economy could be considerable. Table 16 below shows the value added agriculture and food processing, forestry and wood processing, and tourism (the full breakdown of sectors is shown in table 17).

At the 250 tonne N reduction level and substantial land use change the policy accounts for the equivalent of 25% off the value added from agriculture and food processing on an annual basis (-$37.8 m compared with $153.7m).

Table 16 Value added by key sectors Rotorua District 2000/2001

	Value added $ million	%
Agriculture and food processing	153.7	10.1
Forestry and wood processing	161.9	10.6
Tourism	215.0	14.3
Total (Gross Product)	1,520.9	100.0

The above analysis is a static analysis and in reality the job market and value added is dynamic. So the outcome may be very different due to the interplay of other factors not considered here.

Other factors need to be taken into account.

1. There is the question as to how long it would take for the tourism market to revive once the lake quality starts to improve, it could be 30 years or more before lake water quality improves.
2. While it is recognised that there is not an established link between water quality and tourist numbers what we have tried to do is use these examples to illustrate the possible impacts.
3. Also important is whether conversion of agriculture to forestry is the most efficient way of achieving the goal of improving water quality.
4. Most people do not want to see dairy land converted to forestry – rather the goal should be to achieve the highest value/best economic option while retaining a low N signature.
5. Other mitigation measures, such as Eco-N may achieve the goal at lower cost and priorities need to be set so that the most cost affective measures are implemented first.
6. Activity based rules stifle innovation whereas effects based rules provide incentives to find better ways of doing things.
7. It is critical to ensure that the policy is technology open so that improvements in technology are encouraged and the cost of achieving the goal is continuously reduced.

Table 17: Value Added by Sector (2000/01) - $ million

	Rotorua District $m	% of Rotorua	BOP Region $m	% of BOP	Rotorua as % BOP
Agriculture	120.0	7.9	674.8	11.6	17.8
Forestry	63.9	4.2	167.4	2.9	38.2
Other Primary	7.5	0.5	48.3	0.8	15.5
Food Manufacturing	33.7	2.2	208.9	3.6	16.1
Wood and Wood Products	98.0	6.4	478.2	8.2	20.5
All Other Manufacturing	97.0	6.4	393.7	6.8	24.6
Electricity, Gas & Water	13.3	0.9	51.5	0.9	25.8
Construction	57.6	3.8	266.0	4.6	21.6
Wholesale & Retail Trade	231.8	15.2	782.6	13.5	29.6
Restaurants	16.5	1.1	48.1	0.8	34.4
Accommodation	33.0	2.2	50.5	0.9	65.4
Air Transport	24.7	1.6	124.9	2.2	19.8
Other Transport	50.9	3.3	246.2	4.2	20.7
Communications	24.5	1.6	85.7	1.5	28.6
Business & Prof Services	237.9	15.6	844.5	14.5	28.2
Housing	96.3	6.3	375.8	6.5	25.6
Recreation & Cultural Services	58.6	3.9	152.5	2.6	38.4
Health & Education	191.2	12.6	614.1	10.6	31.1
Other Government Services	64.2	4.2	191.8	3.3	33.5
Gross Product	1,520.9	100.0	5,805.4	100.0	26.2

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Appendix

Total Economic Value Added
Rotorua and Rotoiti Catchments
200T and 250T N Reductions

				Resultant area				
			2003 Area	Cap	Red 2 -200T	Red 3 -250T	Potent 1	Potent 2
Undeveoped land			1895	1,895	1,895	1,895	1,270	545
	To forestry							
	To S & B (Mod)						500	1000
	To dairy Med						125	250
	To higher land use						0	100
Forestry			11461	11,461	11,461	11,461	9,911	8,361
	To S & B (Mod)						1350	2700
	To dairy (med)						200	400
	To higher land use						0	0
S&B Low Int		15%	2253	2,253			-	-
	Red 2				1,365			
	Red 3					1,143		
	To dairy med						0	200
	To moderat int						1683	1223
	To high int						570	830
	To Forestry				888	1,110		
	To higher land use						0	0
S&B Medium Int		75%	11,265	11,265			5,565	1,015
	Red 2				6826			
	Red 3					5716		
	To dairy med						1000	2000
	To high int						4700	7250
	To forestry				4,439	5,549		
	To higher land use						0	1000
S&B High Int		10%	1,502	1,502			1,352	1,068
	Red 2				910			
	Red 3					762		
	To dairy med						150	304
	To forestry				592	740		
	To higher land use						0	130
Deer Mod		90%	1469	1,469			869	419
	Red 2				582			
	Red 3					360		
	To Forestry				887	1,109		
	To deer high						600	900
	To higher land use						0	150
Deer - High		10%	163	163			163	163
	Red 2				64			
	Red 3					40		
	To Forestry				99	123		
	To dairy medium						0	0
	To higher land use						0	0
Dairy - Medium		67%	3,258	3,258			1,958	1,258
	Red 2				1,933			
	Red 3					1,602		
	To Forestry				1,325	1,656		
	To dairy high						1300	2000
	To higher land use						0	0
Dairy - High		33%	1605	1605			1605	1605
	Red 2				952			
	Red 3					789		
	To Forestry				653	816		
	To higher land use						0	0
Total			34,871	34,871	34,871	34,871	34,871	34,871

Summary		TEVA	Cap	Red 1	Red 2	Red 3	Potent 1	Potent 2
	Undeveoped land	-	1,895	1,895	1,895	1,895	1,270	545
	Forestry	2,200	11,461	18,123	20,344	22,564	9,911	8,361
	S&B Low Int	600	2,253	1,587	1,365	1,143	0	0
	S&B Medium Int	1,100	11,265	7,935	6,826	5,716	9,098	5,938
	S&B High Int	1,600	1,502	1,058	910	762	6,622	9,148
	Deer Mod	1,600	1,469	804	582	360	869	419

Total Economic Value Added
Rotorua and Rotoiti Catchments
200T and 250T N Reductions

TEVA

			$ 550,000	$ 1,100,000
			$ 700,000	$ 1,400,000
			$ -	$ 996,000
$ 25,214,200	$ 25,214,200	$ 25,214,200	$ 21,804,200	$ 18,394,200
			$ 1,485,000	$ 2,970,000
			$ 1,120,000	$ 2,240,000
$ 1,351,800				
	$ 819,000			
		$ 685,800		
			$ -	$ 1,120,000
			$ 1,851,300	$ 1,345,300
			$ 912,000	$ 1,328,000
	$ 1,953,600	$ 2,442,000		
$ 12,391,500			$ 6,121,500	$ 1,116,500
	$ 7,508,600			
		$ 6,287,600		
			$ 5,600,000	$ 11,200,000
			$ 7,520,000	$ 11,600,000
	$ 9,765,800	$ 12,207,800		
			$ -	$ 9,960,000
$ 2,403,200			$ 2,163,200	$ 1,708,800
	$ 1,456,000			
		$ 1,219,200		
			$ 840,000	$ 1,702,400
	$ 1,302,400	$ 1,628,000		
			$ -	$ 1,294,800
$ 2,350,400			$ 1,390,400	$ 670,400
	$ 931,200			
		$ 576,000		
	$ 1,951,400	$ 2,439,800		
			$ 1,860,000	$ 2,790,000
			$ -	$ 1,494,000
$ 505,300			$ 505,300	$ 505,300
	$ 198,400			
		$ 124,000		
	$ 217,800	$ 270,600		
$ 18,244,800			$ 10,964,800	$ 7,044,800
	$ 10,824,800			
		$ 8,971,200		
	$ 2,915,000	$ 3,643,200		
			$ 10,790,000	$ 16,600,000
$ 13,321,500			$ 13,321,500	$ 13,321,500
	$ 7,901,600			
		$ 6,548,700		
	$ 1,436,600	$ 1,795,200		
$ 75,782,700	$ 74,396,400	$ 74,053,300	$ 89,499,200	$ 111,902,000

	Mod	Subs
Cap	-$ 13,716,500	-$ 36,119,300
-150T	-$ 14,751,600	-$ 37,154,400

Total Economic Value Added
Rotorua and Rotoiti Catchments
200T and 250T N Reductions

TEVA/Ha		$/ha
Undeveoped land		
	To forestry	$ 2,200
	To Mod S & B	$ 1,100
	To dairy	$ 5,600
	To Higher use	$ 9,960
Forestry		
	Existing	$ 2,200
	Cap	$ 2,200
	Red 1	$ 2,200
	Red 2	$ 2,200
	To Mod S & B	$ 1,100
	To dairy	$ 5,600
	To Higher use	$ 9,960
S&B Low Int		
	Present	$ 600
	Cap	$ 600
	Red 2	$ 600
	Red 3	$ 600
	To dairy	$ 5,600
	To medium	$ 1,100
	To high	$ 1,600
	To Forestry	$ 2,200
	To Higher use	$ 9,960
S&B Medium Int		
	Present	$ 1,100
	Cap	$ 1,100
	Red 2	$ 1,100
	Red 3	$ 1,100
	To dairy	$ 5,600
	To high	$ 1,600
	To forestry	$ 2,200
	To Higher use	$ 9,960
S&B High Int		
	Present	$ 1,600
	Cap	$ 1,600
	Red 2	$ 1,600
	Red 3	$ 1,600
	To dairy	$ 5,600
	To forestry	$ 2,200
	To Higher use	$ 9,960
Deer Mod		
	Present	$ 1,600
	Cap	$ 1,600
	Red 2	$ 1,600
	Red 3	$ 1,600
	To Forestry	$ 2,200
	To deer high	$ 3,100
	To Higher use	$ 9,960
Deer - High		
	Present	$ 3,100
	Cap	$ 3,100
	Red 2	$ 3,100
	Red 3	$ 3,100
	To dairy med	$ 5,600
	To Forestry	$ 2,200
	To Higher use	$ 9,960
Dairy - Medium		
	Present	$ 5,600
	Cap	$ 5,600
	Red 1	$ 5,600
	Red 2	$ 5,600
	To dairy high	$ 8,300
	To Forestry	$ 2,200
	To Higher use	$ 9,960
Dairy - High		
	Present	$ 8,300
	Cap	$ 8,300
	Red 1	$ 8,300
	Red 2	$ 8,300
	To Forestry	$ 2,200
	To Higher use	$ 9,960
Higher land use		$ 9,960

Total Economic Value Added
Rotorua and Rotoiti Catchments
150T N Reduction

			Resultant area				
		2003 Area	**Cap**	**Red 1**	**Red 2**	**Potent 1**	**Potent 2**
				-150T	-200T		
Undeveoped land		1895	1,895	1,895	1,895	1,270	545
To forestry							
To S & B (Mod)						500	1000
To dairy Med						125	250
To higher land use						0	100
Forestry		11461	11,461	11,461	11,461	9,911	8,361
To S & B (Mod)						1350	2700
To dairy (med)						200	400
To higher land use						0	0
S&B Low Int	15%	2253	2,253			-	-
Red 1				1,587			
Red 2					1,365		
To dairy med						0	200
To moderat int						1683	1223
To high int						570	830
To Forestry				666	888		
To higher land use						0	0
S&B Medium Int	75%	11,265	11,265			5,565	1,015
Red 1				7935			
Red 2					6826		
To dairy med						1000	2000
To high int						4700	7250
To forestry				3,330	4,439		
To higher land use						0	1000
S&B High Int	10%	1,502	1,502			1,352	1,068
Red 1				1058			
Red 2					910		
To dairy med						150	304
To forestry				444	592		
To higher land use						0	130
Deer Mod	90%	1469	1,469			869	419
Red 1				804			
Red 2					582		
To Forestry				665	887		
To deer high						600	900
To higher land use						0	150
Deer - High	10%	163	163			163	163
Red 1				89			
Red 2					64		
To Forestry				74	99		
To dairy medium						0	0
To higher land use						0	0
Dairy - Medium	67%	3,258	3,258			1,958	1,258
Red 1				2,264			
Red 2					1,933		
To Forestry				994	1,325		
To dairy high						1300	2000
To higher land use						0	0
Dairy - High	33%	1605	1605			1605	1605
Red 1				1116			
Red 2					952		
To Forestry				489	653		
To higher land use						0	0
Total		34,871	34,871	34,871	34,871	34,871	34,871
Summary			**Cap**	**Red 1**	**Red 2**	**Potent 1**	**Potent 2**
Undeveoped land			1895	1895	1895	1270	545
Forestry			11461	18123	20344	9911	8361
S&B Low Int			2253	1587	1365	0	0
S&B Medium Int			11265	7935	6826	9098	5938
S&B High Int			1502	1058	910	6622	9148
Deer Mod			1469	804	582	869	419

Total Economic Value Added
Rotorua and Rotoiti Catchments
150T N Reduction

TEVA

			$ 550,000	$ 1,100,000
			$ 700,000	$ 1,400,000
			$ -	$ 996,000
$ 25,214,200	$ 25,214,200	$ 25,214,200	$ 21,804,200	$ 18,394,200
			$ 1,485,000	$ 2,970,000
			$ 1,120,000	$ 2,240,000
$ 1,351,800				
	$ 952,200			
		$ 819,000		
			$ -	$ 1,120,000
			$ 1,851,300	$ 1,345,300
			$ 912,000	$ 1,328,000
	$ 1,465,200	$ 1,953,600		
$ 12,391,500			$ 6,121,500	$ 1,116,500
	$ 8,728,500			
		$ 7,508,600		
			$ 5,600,000	$ 11,200,000
			$ 7,520,000	$ 11,600,000
	$ 7,326,000	$ 9,765,800		
			$ -	$ 9,960,000
$ 2,403,200			$ 2,163,200	$ 1,708,800
	$ 1,692,800			
		$ 1,456,000		
			$ 840,000	$ 1,702,400
	$ 976,800	$ 1,302,400		
			$ -	$ 1,294,800
$ 2,350,400			$ 1,390,400	$ 670,400
	$ 1,286,400			
		$ 931,200		
	$ 1,463,000	$ 1,951,400		
			$ 1,860,000	$ 2,790,000
			$ -	$ 1,494,000
$ 505,300			$ 505,300	$ 505,300
	$ 275,900			
		$ 198,400		
	$ 162,800	$ 217,800		
$ 18,244,800			$ 10,964,800	$ 7,044,800
	$ 12,678,400			
		$ 10,824,800		
	$ 2,186,800	$ 2,915,000		
			$ 10,790,000	$ 16,600,000
$ 13,321,500			$ 13,321,500	$ 13,321,500
	$ 9,262,800			
		$ 7,901,600		
	$ 1,075,800	$ 1,436,600		
$ 75,782,700	$ 74,747,600	$ 74,396,400	$ 89,499,200	$ 111,902,000

	Mod	Subs
Cap	-$ 13,716,500	-$ 36,119,300
-150T	-$ 14,751,600	-$ 37,154,400
-200T	-$ 15,102,800	-$ 37,505,600

Note: 200T is a duplication of previous model
Per annum figure once land use change achieved

Total Economic Value Added
Rotorua and Rotoiti Catchments
150T N Reduction

TEVA/Ha		$/ha	
Undeveoped land			
	To forestry	$	2,200
	To Mod S & B	$	1,100
	To dairy	$	5,600
	To Higher use	$	9,960
Forestry			
	Existing	$	2,200
	Cap	$	2,200
	Red 1	$	2,200
	Red 2	$	2,200
	To Mod S & B	$	1,100
	To dairy	$	5,600
	To Higher use	$	9,960
S&B Low Int			
	Present	$	600
	Cap	$	600
	Red 1	$	600
	Red 2	$	600
	To dairy	$	5,600
	To medium	$	1,100
	To high	$	1,600
	To Forestry	$	2,200
	To Higher use	$	9,960
S&B Medium Int			
	Present	$	1,100
	Cap	$	1,100
	Red 1	$	1,100
	Red 2	$	1,100
	To dairy	$	5,600
	To high	$	1,600
	To forestry	$	2,200
	To Higher use	$	9,960
S&B High Int			
	Present	$	1,600
	Cap	$	1,600
	Red 1	$	1,600
	Red 2	$	1,600
	To dairy	$	5,600
	To forestry	$	2,200
	To Higher use	$	9,960
Deer Mod			
	Present	$	1,600
	Cap	$	1,600
	Red 1	$	1,600
	Red 2	$	1,600
	To Forestry	$	2,200
	To deer high	$	3,100
	To Higher use	$	9,960
Deer - High			
	Present	$	3,100
	Cap	$	3,100
	Red 1	$	3,100
	Red 2	$	3,100
	To dairy med	$	5,600
	To Forestry	$	2,200
	To Higher use	$	9,960
Dairy - Medium			
	Present	$	5,600
	Cap	$	5,600
	Red 1	$	5,600
	Red 2	$	5,600
	To dairy high	$	8,300
	To Forestry	$	2,200
	To Higher use	$	9,960
Dairy - High			
	Present	$	8,300
	Cap	$	8,300
	Red 1	$	8,300
	Red 2	$	8,300
	To Forestry	$	2,200
	To Higher use	$	9,960
Higher land use		$	9,960