

## MyLand - Land Use Decision Tool



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# EXECUTIVE SUMMARY

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## The problem

A land use decision support tool “MyLand” had been developed to the prototype stage and required further enhancement before it could be fully evaluated of its potential.

## Client Initiatives

This project is to develop a beta version (one stage before production) of a web based strategic land use decision support tool. In particular the geospatial viewing functionality (mapping, measuring, and recording) that will allow Regional Councils to evaluate a near-production version, undertake some user testing, gauge end-user interest, and provide feedback.

## Key Results

The prototype tool has been restructured and better engineered to industrial standards with improved database design and user interface.

The key results are:

1. Modified the user interface to be easier to use and accommodate both farming and forestry land uses.
2. Integrate a national set of high resolution aerial imagery and display public domain GIS layers, eg altitude, temperature, slope, and aspect.
3. Facilitate user logins to provide data security and sharing options on case studies, GIS layers, and modelling outcomes.
4. Provision of the ability to easily label spatial features, draw lines, create polygon boundaries, and store these in the database for reuse or editing.
5. Provision high resolution printing options to create physical copies of outputs.
6. Provision of a user manual and one day training course for staff from several Regional Councils.

## Implications of Results for Client

Regional Council Land Management advisors will be provided with an early version of a web base tool, training in its use, and interaction with the scientists that built the system. Trade-offs between profitability and environmental impacts will be made transparent with the new MyLand tool and this should facilitate better interaction with land owners.

Decisions on land use for low producing erosion prone hill country are likely to be better evaluated and lead toward more sustainable options.

The benefit should be in the next 5 years, depending on uptake, web deployment facilities, and ongoing development.

## Further Work

After one month of evaluation, feedback on the useability and utility of MyLand will be collated from those attending the training course. This will be presented at a stakeholder meeting in August to evaluate the next stage of the tool’s development. It has been proposed that a formal group be setup to fund the development of MyLand over the next 4 years.

# ***MyLand - Land Use Decision Tool***

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New Zealand

29 June 2012

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## Introduction

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MyLand was developed between 2009 to 2011 as a prototype strategic land use decision tool, as a joint initiative of Scion and AgResearch, that was funded by Ministry of Agriculture and Forestry (now Ministry of Primary Industries, MPI). The purpose of this tool is to assist land owners to improve the long term profitability and sustainability of their land by integrating science outputs into an easy to use web based system. Currently MyLand consists of a web enabled interface that provides geospatial functionality and an initial modelling framework that is designed to model the production, economic, and environmental factors for a range of land uses. As a prototype MyLand has not reached a stage where it can be evaluated by the various stakeholders and users for commercial purposes. Key stakeholders have provided considerable support for this system at a meeting held on 20 December 2011 at MAF, Wellington. They also indicated that the mapping and viewing capabilities of MyLand is of high priority for the beta release. The system, when fully completed, is intended to provide strategic decision making through the modelling of multiple land use scenarios. The geospatial interface, scalable down to the stand/paddock level, provides access to a Geographical Information Systems (GIS) database. (West, 2012, West *et al*, 2012)

## Materials and Methods

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### Envirolink Deliverables

The objectives provide the direction for executing the project:

1. Modify the User interface to be easier to use and accommodate Farming and Forestry. Allow entity names and inputs to be changed with the land use. – eg Land unit entity - farming has Paddocks, forestry has Stands
2. Display a national set of high resolution aerial imagery licensed from Terralink. Display public domain GIS layers, eg Altitude, Temperature, Slope, Aspect, LUC, LENZ, LCDB2, with clearly labelled and coloured legends, for each layer, graduated for easy use.
3. To allow groups to share information eg Case studies, GIS layers, modelling functionality, a hierarchy of logins and associated password security system will be enabled. Regional Councils will each have one or more group logins that convey rights to data entered or stored. Details on how this is best structured will be discussed with Hawkes Bay RC.
4. Ability to easily label features, draw lines, create polygon boundaries, and store these in the database for reuse or editing.
5. Provide high resolution printing options to create physical copies of outputs. Providing three half day training courses to initiate appropriate Regional Council staff with the capability of the Beta MyLand system.

### Project Mission Statement

The mission of this project is to develop and release a Beta Version of a web-based strategic land use decision support tool that will allow key stakeholders to evaluate a semi-functional system, undertake user testing, gauge end-user interest, and provide initial publicity. (West, 2012)

### Project Objectives

The objectives provide the direction for executing the project:

1. To develop and release an easy-to-use web-based land use decision support tool used for exploring various sustainable land uses.
2. To develop and release an easy-to-use web-based geospatial viewer with standard spatial tools.
3. To release high resolution aerial imagery and spatial layers that supports the land use decision support tool and associated models.

### Expected Benefits

The following were identified as expected benefits to be gained through the development of the MyLand (Beta Version):

1. Easy access, via the web, to a functional integrated tool that enables land owners and users to explore scenarios for various sustainable land uses and the impact it will have on marginal land.
2. Assist regional council's in promoting and implementing regional sustainable land use initiatives.
3. Improve the social uptake of sustainable land management.

## Project Deliverables

The following list defines the deliverables for this project:

1. Integrated Sheep and Forestry Model to be accessed via one Geospatial Viewer.
2. Geospatial Viewer that provides the standard drawing, measurement and printing tools.
3. Display high resolution aerial imagery and required spatial layers displayed via a geospatial viewer.

## Project Work Plan

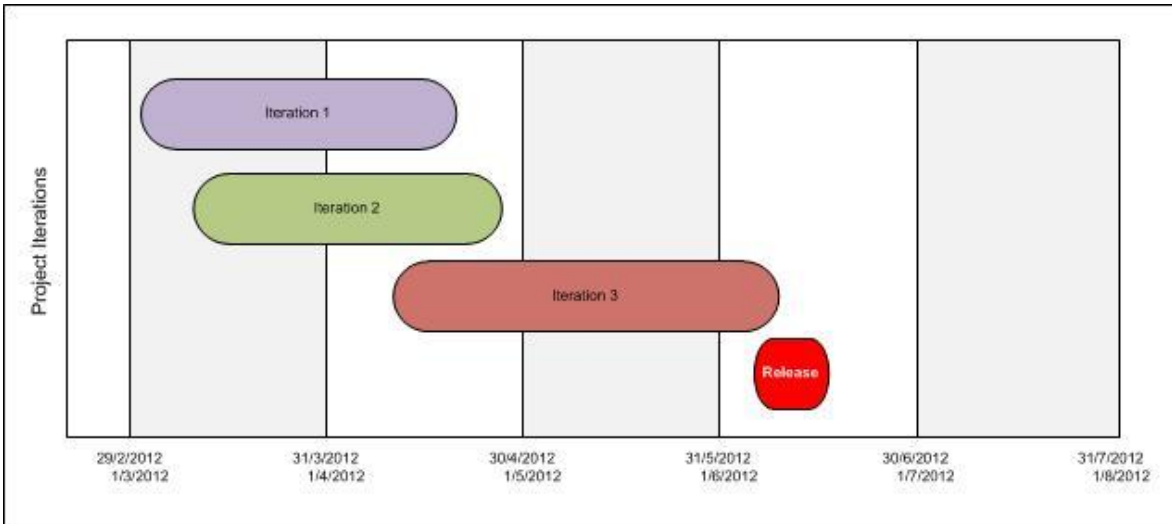
The table below defines the major stages for this project:

Project Stage	Description	Completion Date
Iteration 1	<ol style="list-style-type: none"> <li>a. Amalgamate Sheep and Forestry Model of MyFarm with the Forestry Model of Climate Change System to form one framework.</li> <li>b. Implementation of the selected geospatial viewer and configure to MyLand requirements.</li> <li>c. Develop group login and security function.</li> <li>d. Develop drawing and labelling function.</li> <li>e. Develop printing function.</li> </ol>	1/5/2012
Iteration 2	<ol style="list-style-type: none"> <li>a. Upload high resolution aerial imagery and selected spatial layers.</li> </ol>	3/5/2012
Iteration 3	<ol style="list-style-type: none"> <li>a. Incorporate the user interface of the Climate Change System with MyLand.</li> <li>b. Develop MyFarm user interface to Climate Change System's user interface standards and incorporate with MyLand.</li> </ol>	29/6/2012

**Table 1:** MyLand (Beta Version) Project Work Plan

## Project Timeline

The diagram below displays the key tasks with their related time frames:



**Figure 1:** MyLand (Beta Version) Project Timeline

## Project Budget

The table below defines the budget for this project:

Project Stage	Envirolink Objectives	Project Cost (\$)
Iteration 1	1, Part 3, Part 4, Part 5	44,957
Iteration 2	2	21,667
Iteration 3	Part 3, Part 4, Part 5	27,641
<b>Total Project Cost</b>		<b>94,265</b>

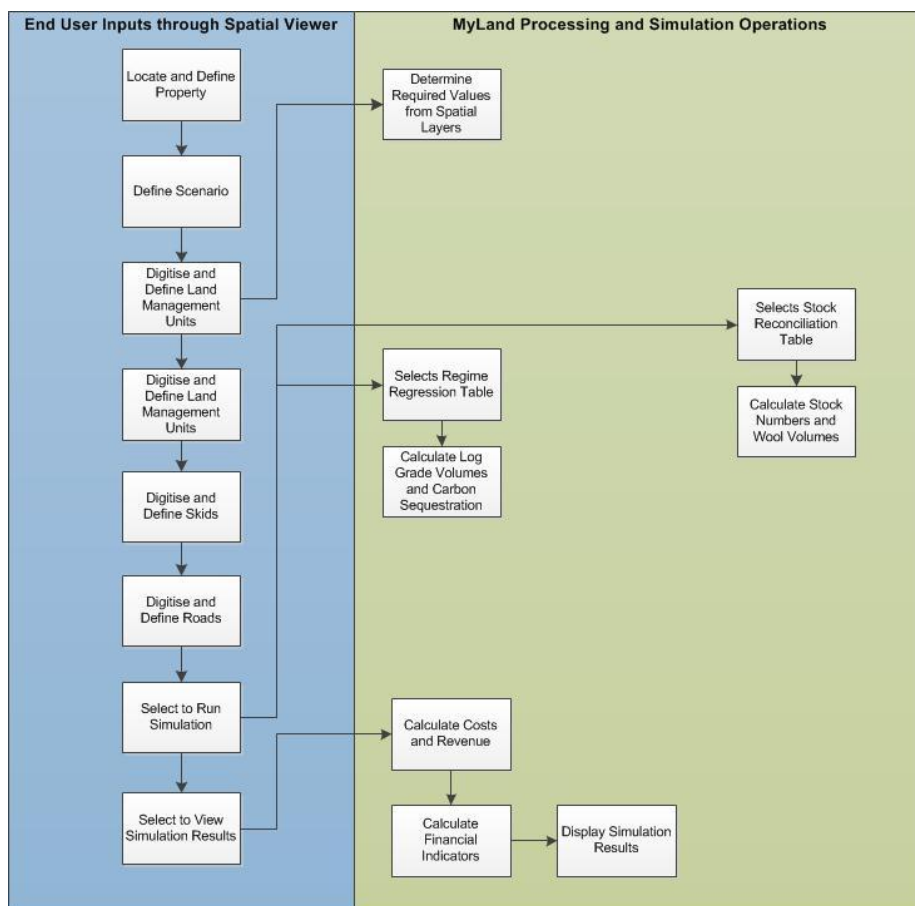


## Results and Discussion

The MyLand is a web-based tool that enables users to set-up multiple scenarios to predict current and future landuse outcomes. The spatial user interface makes it an intuitive and easy to use system and requires minimal input from the user. Information derived from both the underlying spatial layers and the data entered by users are the inputs to the various landuse scenarios. The simulation outcomes of these scenarios enable the user to determine and compare the impact various landuse options will have on cost structures, and profitability for a particular area. These outputs help users determine the most optimal landuse for a particular scenario to take advantage of arising economic and market opportunities.

### MyLand Functionality

Various models are applied by the MyLand through a sequence of events to simulate various landuse scenarios (Figure 2). The MyLand is dependent on a number of inputs from the user to activate these sequences of events.



**Figure 2:** Processing and Simulation Operations executed by MyLand.

Users are expected to locate and define a property, set-up a number of landuse scenarios against the property and digitise and define land management units, skids and roads associated with each of these scenarios. The user is also expected to enter operation costs, prices and production parameters for each landuse. These costs and prices form the basis for the calculation of the

economic and financial outcomes by the economic model. To assist and guide users with the above the MyLand provides default costs, prices and production parameters that could be overwritten with user defined values. Finally the user will be able to run simulations for a single or multiple scenarios for a defined period.

Running a simulation prompts the MyLand to populate the regression tables of the forest model with the annual log grade volumes and carbon sequestration rates while the stock reconciliation table for the sheep model gets populated with the number of stock per stock age classes. These values are transferred to the economic model which together with the defined costs and prices calculates costs and revenue for carbon, wood and sheep products, and the financial indicators for each scenario.

The carbon revenue and costs represents (i) the carbon credits multiplied by the prevailing carbon price and (ii) the costs associated with participating in the ETS. Log products revenue and costs is (i) the log yield by grade multiplied by the log grade price and (ii) the costs associated with forest management, silviculture, harvesting and cartage. These values are used to represent the annual cashflow for each scenario. Lastly the forest economic model also calculates the Nett Present Value (NPV), Land Expectation Value (LEV) and Internal Rate of Return (IRR) as financial indicators for each scenario.

## MyLand Outputs

The outcomes of the landuse scenarios are displayed either as a table or graphical format. These outputs enable users to easily compare various landuse scenarios. The table format is used for presenting the (i) cash flow and (ii) financial indicators for each landuse scenario as per defined simulation period. The cash flow report displays the annual nett income, expenses and balance for a given year while the financial indicators report indicates the NPV, LEV and IRR for each scenario, as shown in Figure 3.

The image shows two screenshots of reports generated by MyLand. The top screenshot is the 'Financial Indicators Report' and the bottom is the 'Scenario Cash Flow Report'.

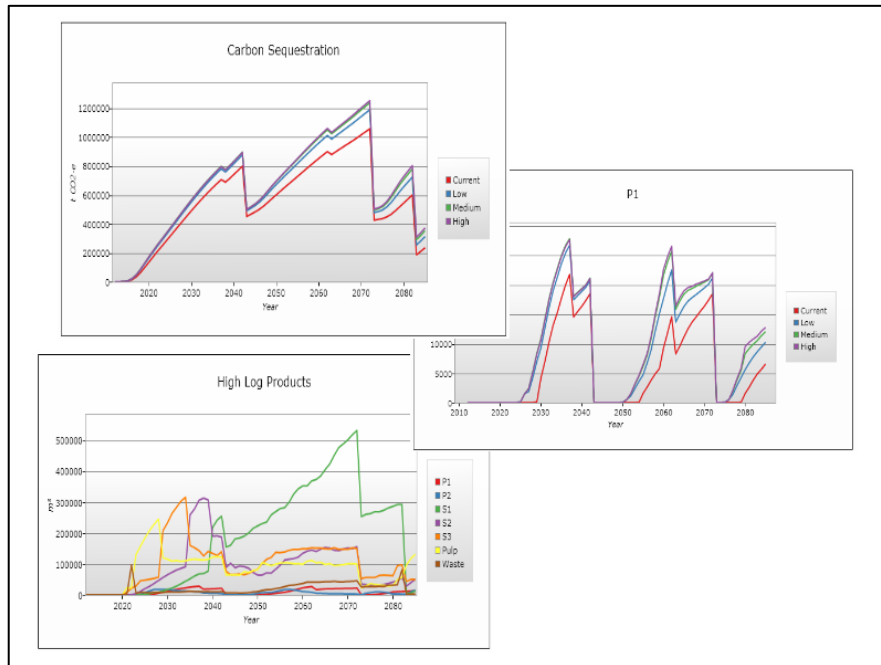
Scenario	NPV	LEV	IRR
Current	\$1,105,810.43	\$1,109,541.09	10.70 %
Low	\$2,492,320.94	\$2,500,929.93	12.72 %
Medium	\$2,644,218.28	\$2,653,139.04	12.95 %
High	\$2,647,541.58	\$2,656,473.56	12.93 %

Scenario	Year	Income	Expenses	Balance
Current	2012	\$0.00	\$1,146,302.65	-\$1,146,302.65
Current	2013	\$0.00	\$194,437.34	-\$194,437.34
Current	2014	\$0.00	\$80,935.26	-\$80,935.26
Current	2015	\$0.00	\$81,485.26	-\$81,485.26
Current	2016	\$0.00	\$123,402.28	-\$123,402.28
Current	2017	\$0.00	\$80,935.26	-\$80,935.26
Current	2018	\$0.00	\$124,914.80	-\$124,914.80
Current	2019	\$0.00	\$80,935.26	-\$80,935.26
Current	2020	\$1,356,263.08	\$274,775.22	\$1,081,487.86
Current	2021	\$0.00	\$80,935.26	-\$80,935.26
Current	2022	\$0.00	\$80,935.26	-\$80,935.26
Current	2023	\$0.00	\$80,935.26	-\$80,935.26
Current	2024	\$0.00	\$80,935.26	-\$80,935.26
Current	2025	\$1,789,426.62	\$116,221.80	\$1,673,204.82
Current	2026	\$0.00	\$80,935.26	-\$80,935.26
Current	2027	\$0.00	\$80,935.26	-\$80,935.26
Current	2028	\$0.00	\$80,935.26	-\$80,935.26
Current	2029	\$0.00	\$80,935.26	-\$80,935.26
Current	2030	\$1,752,612.42	\$116,221.80	\$1,636,390.62
Current	2031	\$0.00	\$80,935.26	-\$80,935.26
Current	2032	\$0.00	\$80,935.26	-\$80,935.26
Current	2033	\$0.00	\$80,935.26	-\$80,935.26
Current	2034	\$0.00	\$80,935.26	-\$80,935.26
Current	2035	\$1,583,831.00	\$116,221.80	\$1,467,609.20

Figure 3: Examples of the reports generated by MyLand.

The graphical format of reporting is used for presenting the (i) carbon sequestration and related revenue, (ii) log volumes and revenue per grade, (iii) number of sheep stock sold and related revenue and (iv) wool production and related revenue for each scenario as per defined simulation period. These values are displayed in a number of line graphs, as shown in Figure 4.



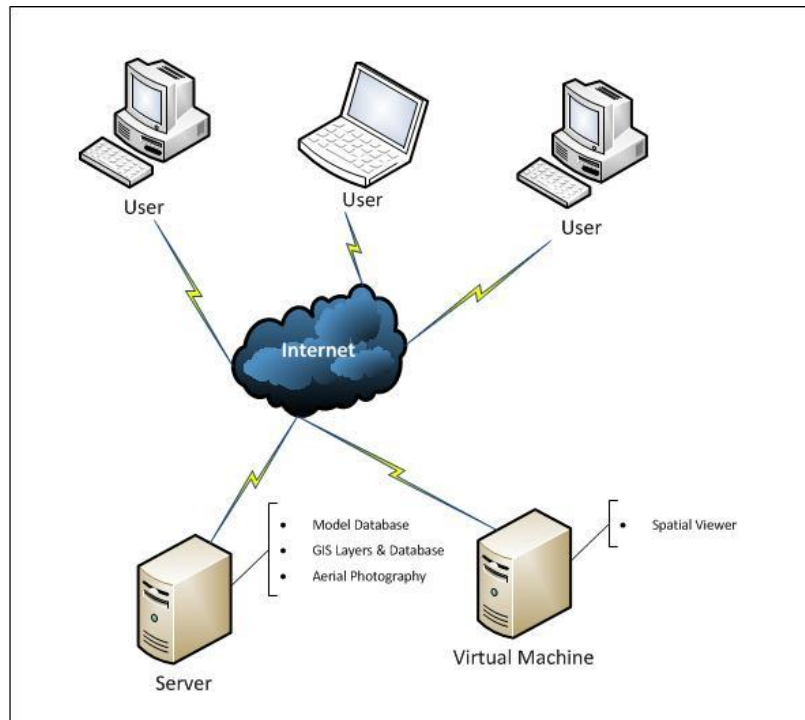
**Figure 4:** Examples of the graphs generated by MyLand.

## MyLand Models

The MyLand includes a number of models such as the (i) forest model, (ii) sheep model and (iii) economic model. The forest model represents the regression tables for the various species and associated regimes such as (i) plant and leave (carbon), (ii) pruned (clearwood) and (iii) un-pruned (sawlog). It provides log volumes per grade as well as the carbon sequestered over time based on the 300 Index and Site Index values derived from the productivity spatial layers. The sheep model represents the stock reconciliation table for the sheep breeding regime. The economic model calculates the cost and revenue associated the timber and sheep production and carbon forestry to provide outputs such as the (i) annual cash flow and (ii) financial indicators. The financial indicators define the NPV, LEV and IRR derived from discounted cashflow analysis.

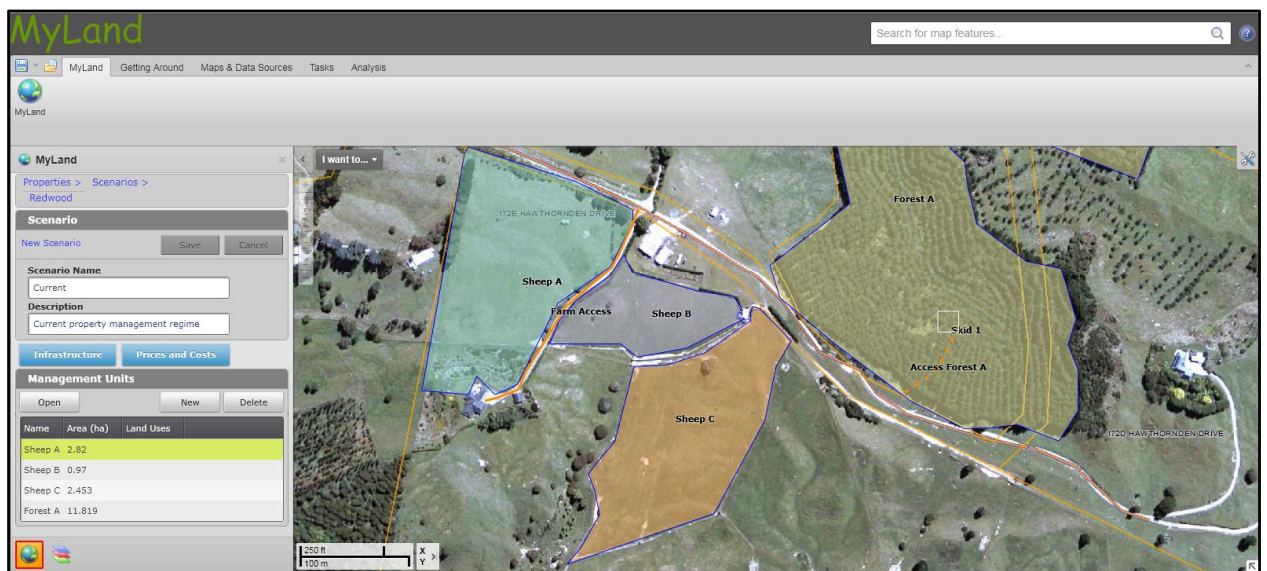
## MyLand Architecture

The MyLand was developed as a web-based tool to provide users easy access via the internet, without the need to install an application on their personal computers. The system as shown in Figure 5 is hosted on a central server that stores the (i) spatial viewer, (ii) GIS layers and database, and (iii) modelling database.



**Figure 5:** Architecture for Decision Support System.

The user interacts with the GIS layers and modelling database by making use of the spatial viewer as shown in Figure 6. The spatial viewer is a unique feature to the MyLand in that it allows users to visually interact with the system. Information is captured through user input forms and deriving values from underlying spatial layer. The MyLand database was developed to provide a flexible framework to easily accommodate other species and regimes in the future.



**Figure 6:** User Interface for MyLand.

The MyLand was developed using the latest available development technologies to ensure that it is current with market development and software trends. The following were used for developing the MyLand:

- (i) Silverlight 4 for the rich graphical user interface;
- (ii) ArcGIS Server 10 for the GIS database;

- (iii) SQL Server 2008 R2 for the storage of the modelling database; and
- (iv) .NET 4 for services to access the databases.

## Summary

The MyLand was developed as a web-based tool to provide users easy access to various scientific models such as the (i) forest model, (ii) sheep model and (iii) economic model. The spatial viewer user interface, which is a unique feature of the MyLand, makes the MyLand an easy to use and intuitive tool for digitising and capturing information on stands, skids and roads and associated information. Each model plays an important part in predicting the outcomes of current and future landuse scenarios. The forest model determines the annual log grade volumes and carbon sequestration rates. The sheep model determines the number of stock for sheep per stock age class as well as wool production. These are then used by the economic model to calculate the cashflow and the financial indicators. Based on the above information the user is able to make an informative decision on the most productive and profitable landuse for a specific area and provides the user with the opportunity to take advantage of the arising economic and market opportunity

## Recommendations and Conclusions

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Regional Council Land Management advisors will be provided with an early version of a web base tool, training in its use, and interaction with the scientists that build the system. Trade-offs between land use profitability and environmental impacts will be made transparent with the MyLand tool and this should facilitate better interaction with land owners. While this is a major step forward, MyLand is only at the Beta stage and further functionality is needed to make it more universal, eg modelling more sheep management options, dairy farming, and environmental modelling of emissions.

Decisions on land use for low producing erosion prone hill country are likely to be better evaluated but further work on modelling erosion and the effects of high intensity rainfall events needs further development to make this aspect more useful.

After one month of evaluation, feedback on the useability and utility of MyLand will be collated from the folk attending the training course. This will be presented at a stakeholder meeting in August to evaluate the next stage of the tools development.

Long term underpinning funding is needed to maintain and support this tool. Considerable costs are involved to license data, license database software, and purchase web hosting services. It has been proposed that a formal group be setup to fund the development of MyLand over the next 4 years.

## Acknowledgements

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The software engineering skills of Luke Bettis and Wayne Schou have been essential to creating the success of this project and are gratefully acknowledged. The management of 34,000 files of aerial imagery into the GIS database and the subsequent caching and tiling has been achieved with the skills of Andrew Dunningham and is gratefully acknowledged. The support and trust from Campbell Leckie from Hawkes Bay Regional Council in getting the funding and managing the co-ordination with other councils has been great and is gratefully acknowledged.

## References

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