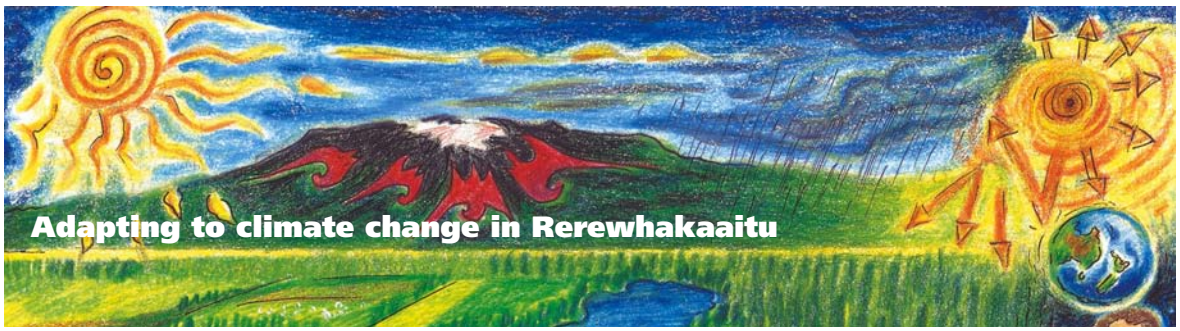
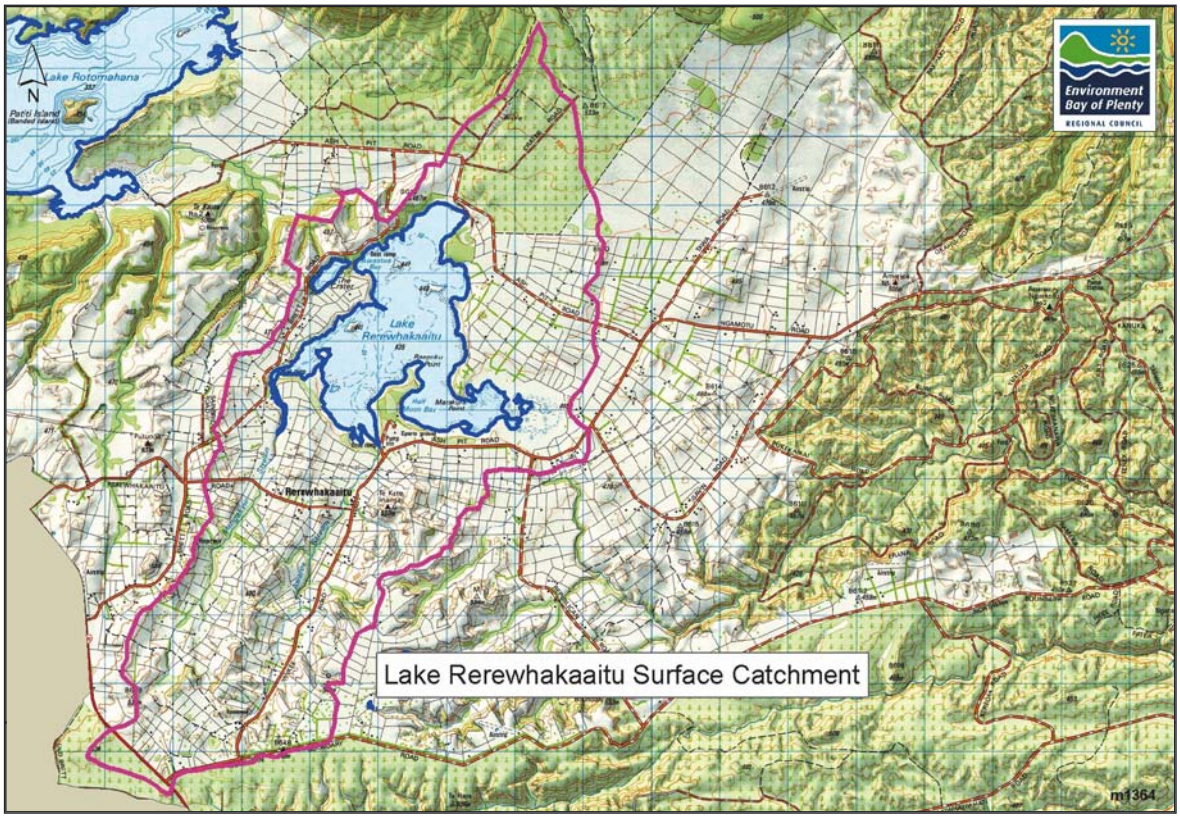


A history of change at Rerewhakaaitu

400,000 years (at least)	of volcanic activity, geological changes, and climate changes
ca 17,600 years ago	Volcanic activity and climate change
ca 800 years ago	Maori settlement in New Zealand
700 years ago	Lake Rerewhakaaitu formed from the Kaharoa eruption of Mt Tarawera
140 years ago	First recorded European settlement
120 years ago	Most recent Tarawera eruption
60 years ago	Post-war farm ballots and development of Rerewhakaaitu
40 years ago	Local flooding and erosion problems
The last 60 years	Development (1950s and 60s), consolidation (1970s), and progressive intensification (1980s to present) of farming
The future	?

Background

Lake Rerewhakaaitu lies within the Okataina Volcanic Centre where volcanic eruptions have featured for at least the last 400,000 years (see Nairn, http://www.gns.cri.nz/what/earthact/volcanoes/nzvolcanoes/okatbookprint.htm). Volcanic activity has been and will continue to be a huge factor in shaping the landscape, land use and water features in this area. Concurrently, past climate changes have also had a strong influence. Evidence of the end of the last glaciation and onset of the current interglacial period is found in the Rerewhakaaitu Tephra, arising from a Tarawara eruption about 18,000 – 17,400 years ago (Newham et al, 2003).



The most recent volcanic eruption, from Tarawera in 1886, has strongly influenced the present environment at Rerewhakaaitu. There are three clearly defined soil zones in the area. Two were formed from the 1886 eruption of Mt Tarawera and Lake Rotomahana, ash and mud soils respectively. The third is an ash soil formed from earlier volcanic activity.

'Development of farming at Rerewhakaaitu has occurred with deepening understanding by farmers of both the potential and limitations of their environment. Dominant features are the volcanic soils and the presence of the lake.'

Lake Rerewhakaaitu is part of Te Arawa's historical holdings, with the lakebed vested in Te Arawa along with those of 12 other Rotorua lakes. The first significant human influence in the vicinity of Lake Rerewhakaaitu began in the 1860s. The area was used as a high country run, administered by Lands and Survey until the discovery of cobalt in 1946. This began the intensification of farming in the area with soldier settlement beginning in 1952-53 and continuing until 1965. The development of forestry in the neighbouring Kaingaroa plateau began in the 1930s. Anecdotal evidence from farmers in the Rangitaiki Plains suggests that the development of the Kaingaroa forest has had a moderating influence on the climate of eastern Bay of Plenty.

In the early years of soldier settlement the climate of the area was quite severe. This appears to be due to the exposure of the area particularly during winter months. Early settlers recall 'the extremes of climate, the freezing temperatures and the "very hard frosts".' Planting shelter was a priority as was the introduction of earthworms which were lacking in the soil (Rerewhakaaitu and Districts Reunion Committee, 1993).

Localised flooding and erosion problems were experienced in the 1960s and 1970s which is documented in correspondence from the time. These problems resulted from the combined effects of some very wet years (experienced in 1962, 1967, 1971) and the consolidation of farming in an area that was devoid of tree cover as a result of the 1886 eruption. The principal concern from farmers at the time was erosion and degradation along the upper reaches of the Mangaharekeke Stream. This first became an issue after high rainfall in 1962. A proposal was developed by the then Bay of Plenty Catchment Commission to 'use Lake Rerewhakaaitu as a storage basin'. After a period of consultation a decision was made to increase the size of the lake outlet into the Mangaharekeke Stream and lower the level of the lake. This work was completed in 1967/68 with further works completed in 1974. Concurrent with these discussions was a proposal from the Conservator of Wildlife, Department of Internal Affairs, to plant reserve land around the margins of the lake, principally with native vegetation. Some native and exotic plantings of the lake margin were completed in 1972. Other plantings have been made subsequently but weeds are a problem. The high incidence of weeds, particularly blackberry, around the lake margins is an on-going issue.

Climate was a challenge in early years. The exposure of the area and effects of high rainfall events were the main challenges. There was a

Lake Rerewhakaaitu Kindly provided by Environment Bay of Plenty.

major drought in 1967/68 with stock shifted out of the district. However, climate extremes don't seem to have had as great an impact since the 1970s. Local farmers attribute this to increased topsoil depth and establishment of trees. There was also a general shift in New Zealand's climate at the end of the 1970s, with the 1980s and 1990s characterised by a greater frequency of El Niño events. There is evidence that our climate has shifted again, with increased potential for the high rainfall events that were experienced in the 1960s and 1970s.

Rerewhakaaitu Valley Kindly provided by Chris Sutton.

Development of farming has occurred with a deepening understanding by farmers of both the potential and limitations of their environment, dominant features being the volcanic soils they are working with and the presence of the lake. Progressive intensification has been a feature over the last two decades, which has led to greater demand on water resources.

Current situation

The biggest concern over the last decade has related to water quality in the lake. This concern has arisen from intensification of dairy farming. The Lake Rerewhakaaitu catchment is unique in the Rotorua Lakes area with a high percentage (nearly 80 percent) of the land in pasture. The local community and Environment Bay of Plenty (EBOP) have been proactive in working together to address concerns over lake quality. EBOP have completed a benchmark study on the lake and catchment (McIntosh et al., 2001). Key summary points are:

1. Large fluctuations in lake levels can impact on water quality.
2. Current land management is sufficient to maintain lake quality.
3. Improved management techniques are needed for the future to offset the potential impacts of further intensification of farming.
4. There is potential for catchment protection work, with conservation species, on public and private land.
5. On-going monitoring of rainfall, lake levels and aquatic plants is needed.

Rerewhakaaitu farmers have been proactive by initiating involvement in a Northland study on 'Best Management in Pastoral Catchments of Shallow Lakes' and the subsequent development of 'Project Rerewhakaaitu' (http://www.maf.govt.nz/sff/about-projects/pastoral-farming/). Both of these projects are aimed at identifying practical measures that can be implemented to reduce impacts of farming on lake quality.

Fluctuations in lake levels are clearly important, particularly in terms of maintaining water quality. The maximum lake level is less than it was before the development of farming as a result of the work completed in the 1960s. The more recent concern has been with low lake levels rather than the high lake levels which were a cause for concern in the past. While there were lower rainfall extremes over the last 20 years, there is a possibility of higher rainfall extremes over the next two decades (see the Macro Changes chapter for information on the 20-30 climate cycle known as the IPO). Fluctuations in lake levels are managed to a degree. At present there is a weir that intercepts drainage from the south-east and directs it back to the lake when the lake is not overflowing. However, if the lake filled and discharged over the weir it would take the drainage with it.

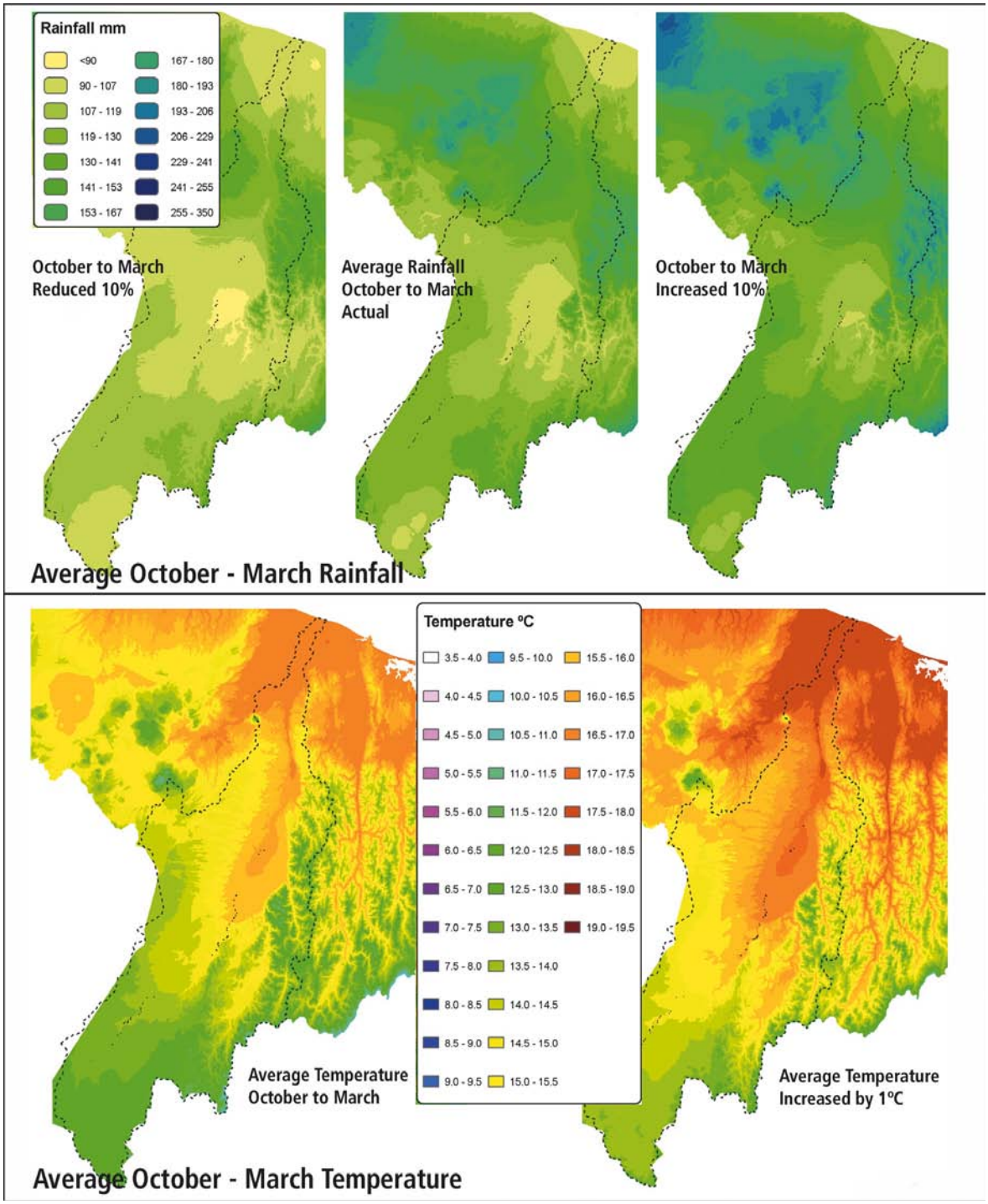
There is a dynamic relationship between the immediate lake catchment and the Rangitaiki River, influenced by changes in rainfall and groundwater. Water generally flows to groundwater from the lake (White et. al., 2003) with the implication that increased demand for groundwater could also impact on lake levels. There is some surface flow (via the

Mangaharekeke Stream when there is discharge from the lake) and groundwater flow (via the Rangitaiki Ignimbrite Aquifer) to the Rangitaiki River catchment. Some farms are in the surface catchment of Rerewhakaaitu but in the groundwater catchment of the Rangitaiki River. This physical connection to the Rangitaiki is reflected in the rating of Rerewhakaaitu farmers for flood protection on the Rangitaiki Plains.

The above information provides a difficult situation for local farmers and for the ongoing management of the lake. More water in the lake is desirable from a water quality point of view, but on the other hand less water to the lake would, in theory, offset local obligations to flood protection in the Rangitaiki Plains.

Another important characteristic of Rerewhakaaitu is the very strong sense of community, developed through the pioneering years in the 1950s and strengthened through to the present. This provides a strong capacity to proactively address issues, such as the work on lake quality, and to deal with times of stress, which may arise from climate extremes or other factors.

These maps show changes in average temperature and rainfall in the Rangitaiki River catchment for the October to March period. They are derived from data obtained from Landcare Research, Private Bag 3127, Hamilton.



Possible effects of climate change

There are a number of important changes that could arise with climate change:

- Changes in both rainfall and temperature will have impacts on the lake. There is greater uncertainty over future rainfall, but with a possibility of more dry and wet extremes. Higher temperatures will increase the potential for aquatic weeds and the sensitivity of the lake to nutrient loading.
- Any increase in dry years would clearly have negative effects, given the growing demand for water and the sensitivity of the lake. Increased fire risk in neighbouring forests would also be a concern.
- Increased rainfall would increase the potential for on-farm water storage as well as increase lake levels and ground water. Higher lake levels and ground water would increase outflow into the Rangitaiki River catchment, thus contributing to a potential increased flood risk in the Rangitaiki Plains.
- Invasive plant and animal pests could become more of a problem in the area. Animal pests such as rabbits could become more of a problem, particularly with any increase in drought. Insect pests and weeds could also become more of a problem.
- There would be potential for increased pasture production with higher atmospheric carbon dioxide (CO2), but also potential for increased incidence of less-productive sub-tropical grass species.
- Warmer average conditions would increase opportunities for horticultural production, particularly on the free-draining ash soils. Average temperatures are presently about 1.5˚C lower than Te Puke and comparable to Hastings. A crop such as kiwifruit could become increasingly viable.

Other possible changes

At present land around Lake Rerewhakaaitu, aside from the Department of Conservation reserve, is open to subdivision. This could see further changes in land use in coming decades (eg rural lifestyle subdivision and development of horticulture), with the potential for further increases in the demand for water and pressure on the lake.

Community thoughts on adaptation

There are two key priorities for the future:

1) Retain the lake
2) Carry on dairy farming

Farming

Farming needs to be attractive to new farmers. Market forces will be the biggest influence on the future. There is a need for continuing agricultural/technological/environmental research in support of the community.

The lake and water management

Retain more water in the lake, the feasibility of which should be investigated by EBOP. Water reservoirs could be developed in higher ends of the lake catchment. Maintain riparian enhancement and protection.

Wind

Develop shelter along the western side of the lake for water conservation purposes, based on the possibility of increased westerlies in the future. There is potential for development of wind farming, to give the community an independent electricity supply.

Biosecurity

Animal and plant pests will require more control, with assistance needed from EBOP. There needs to be better maintenance and enhancement of

There are two key priorities for the future: retain the lake and carry on dairy farming.

riparian and public reserve areas. EBOP assistance is needed with this as the Department of Conservation lacks funds.

Land use change

Conversion to horticulture is a possibility with the proximity to Rotorua. Peas are a potentially suitable annual crop, as could be kiwifruit. Rural lifestyle subdivision is a future option.

The pace of change

Gradual change is already happening. The general expectation is for things to be more-or-less the same as the last 50 years, with practical adjustments to gradual changes. If the climate becomes more like Kaitaia, lessons can be learnt from farmers further north.

Overall, the 2050 vision is for things to be pretty much as they are now, agriculturally based with things further advanced and a tendency for more diversification. Key ingredients are a healthy lake, resilient farming, a good crop of young farmers, infrastructure to provide technical support to the community, the whole community taking responsibility for environmental issues, recycling and alternative energy.

Priorities for a resilient future:

- Maintain the lake and the farming community with a focus on sustainability.
- Agriculture will adapt to climate change.
- Plant shelterbelts to promote microclimates.
- The role of EBOP working with the community is important (scientific and technical support).
- Camping opportunities could be developed giving people from outside the district the opportunity to increase their understanding of rural life. They shouldn't have the freedom to roam, but increased recreational opportunities on the lake will bring value to the community.

• Need to speed things up in making decisions that require input from the district and regional councils and others. The time taken to make decisions is too long. Give ideas a go, accept and learn from mistakes.

• Locally relevant research is needed to address present and future issues identified here. Use farmer knowledge as a foundation.

Implementation:

- Better relations between farmers, EBOP and the wider community are needed. The role of the media is important in this regard. Farmers need to be given positive press. The use of language is very important in conveying information.
- Information should be made available through schools.
- Positive promotion of the district is needed.
- There is enough capacity to deal with crisis. For example, the dairy industry has a huge infrastructure and support capability.
- EBOP has an important role to play, to facilitate the sharing of information.

The 2050 vision is for things to be pretty much as they are now, agriculturally based with things further advanced and a tendency for more diversification.