

December 2009

Lake Taupo Erosion and Flood Strategy





Foreword

This Strategy has been jointly developed by Environment Waikato and Taupo District Council with contributions from other parties including the Tuwharetoa Maori Trust Board and Mighty River Power. It provides a set of principles to guide future decision making and an action plan showing how we intend to manage the flood and erosion risks around the Lake.

The advice we have been given by technical experts commissioned to look at the likely causes of erosion, is that an absence of long term monitoring makes it impossible to establish the extent to which any single factor is contributing to the problem. Both Councils acknowledge that further monitoring and analysis is needed to give clarification and guide our actions and responses with regard to erosion.

"Lake Taupo is a precious tāonga for the local communities and the wider regional and national communities. It is critical that we work together to find solutions for managing these flood and erosion risks that are fair and equitable. This is even more important where there is uncertainty over the degree to which different causes are contributing to the erosion taking place. We must focus on solutions that will be sustainable for our communities in the long term."

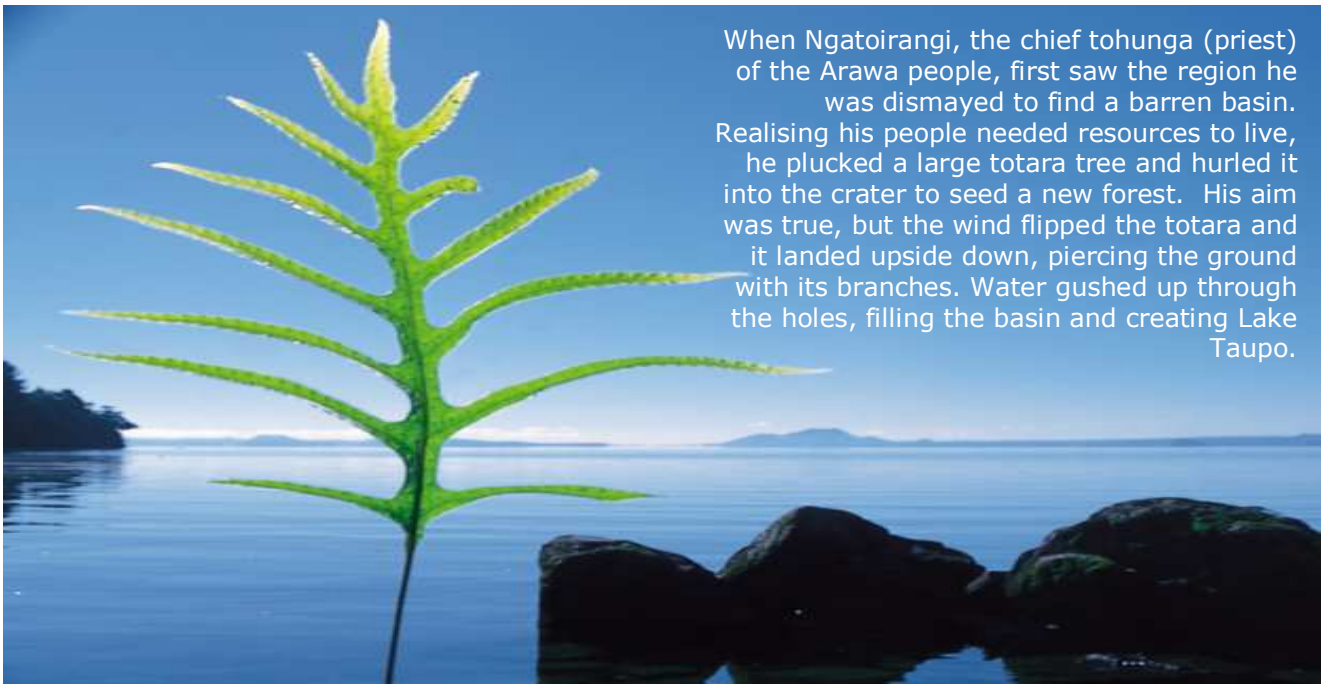
Peter Buckley, Chairman, Environment Waikato



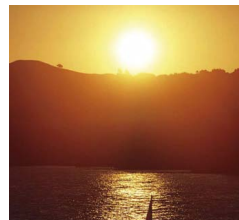
"While flooding and erosion occur naturally, there is no doubt that Lake Taupo is part of a managed system. Water is diverted into the Lake, sediment is trapped behind dams and structures, and lake levels are managed through the use of the control gates. We need to find ways to ensure that our actions around the Lake don't accelerate erosion. Changing our actions is going to take time and a lot of discussion, however putting the fence at the top of the cliff has got to be better than parking the ambulance at the bottom."

Rick Cooper, Mayor, Taupo District Council





When Ngatoirangi, the chief tohunga (priest) of the Arawa people, first saw the region he was dismayed to find a barren basin. Realising his people needed resources to live, he plucked a large totara tree and hurled it into the crater to seed a new forest. His aim was true, but the wind flipped the totara and it landed upside down, piercing the ground with its branches. Water gushed up through the holes, filling the basin and creating Lake Taupo.



Ngati Tuwharetoa hold mana whenua and kaitiakitanga over the Central North Island plateau. The Tuwharetoa Maori Trust Board, on behalf of Nga Hapu o Ngati Tuwharetoa, is the legal owner of the bed of Lake Taupo-nui-a-Tia and its tributaries.

As kaitiaki, Ngati Tuwharetoa has an intrinsic duty to ensure that the Mauri and the physical and spiritual health of the environment is maintained, protected and enhanced.

Holistically, whānau, hapū and tribal history surround Ngati Tuwharetoa, the tangata whenua. Tipuna histories along with surrounding landforms are at the forefront of thoughts of Tuwharetoa people. They are part of everyday life, in speech, song and writings. The hills and valleys, the rivers and streams the mud pools and geysers, the pure water and waterfalls, the cliff faces and shorelines, the headlands and swamps and the food cultivations and bird catching places, are all associated with "ngā mata kua ngaro atu" (the faces of our tipuna who have departed). The whenua and ana (caves) hold their koīwi (bones).



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Executive summary

This strategy has been jointly developed by Environment Waikato and Taupo District Council. The strategy will help ensure that the management efforts of each council are coordinated

The development of the strategy has been underpinned by scientific research into the extent and nature of the flood and erosion risks around the

Lake. That research is available from the councils.

Planning for these risks is a critical part of the councils' roles under the Resource Management Act 1991 and the Civil Defence Emergency Management Act 2002.

Guidance from the Government, international best practice and rulings from the

Environment Court all suggest that we should be planning for a 1 in 100 year event. This is certainly a more risk adverse approach compared to the past, when we tended to design for 1 in 50 year events. For this reason there will be new parts of our Community affected by these hazards.

1. Take a long term approach to management of flood and erosion risks, including taking account of climate change, residual risk, and having a precautionary approach.

2. Respect environmental limits and natural processes, including river and catchment processes, and also protect the life-supporting capacity of water, soil, and ecosystems, including protecting and restoring natural defences.



3. Maintain and enhance the natural and landscape values of the lakeshore and tributaries through the protection and enhancement of the natural features and processes, including indigenous biodiversity.

4. Recognise and protect people's cultural and spiritual relationship with the land, water, and species that live within it, particularly with respect to waahi tapu, waahi taonga and mahinga-kai.

5. Take a management approach based on a hierarchy of responses with the most favoured being avoiding the risk in the first instance, retreating where practicable, adapting, and then protecting existing communities through physical works.



6. Where possible adopt management options in the first instance that address and seek to correct the human interventions which contribute to erosion.

7. When physical works are necessary favour soft structural options over hard structures.

8. Ensure consideration is given to the reversibility and permanency of management options especially where information about the natural processes and causes of the hazard is limited and the natural and landscape character is valued.

9. Encourage people and organisations to be responsible for structures they build in areas that are prone to flood and erosion risks, and to maintain those structures in a manner which will not increase the risk from flooding and erosion.



10. Individuals and communities are encouraged to take primary responsibility for their safety and livelihoods.





Guiding decision making

It is clear that the management of the flood and erosion risks will be an ongoing task using a range of methods. To help guide their implementation, the strategy has identified 10 principles.

Underlying the principles and proposed action plan is the need for a precautionary approach to managing these risks.

Research to date has shown that there are gaps in the existing knowledge of the very complex interaction of natural processes and human interventions. Until there is a better understanding of the implications of people's actions a cautious approach should be adopted.

Strategic approach to flooding

The response to flooding is focused on making people aware of where those risks are, and planning appropriately for new development and infrastructure.

While the design flood levels are very similar to those experienced in 1998, it is important to take into account likely changes in the future. The consequences of decisions made in coming years about where people build and what services go in will remain for a long time. As a result, the design flood levels include provision for future climate change, and areas that are experiencing tectonic subsidence.

In due course, it is anticipated that the identified flood areas will be incorporated into the Taupo District Plan with appropriate rules. This will give clarity about how the flood risk can be managed. That process will involve further Community

consultation, a formal hearings process and the ability to appeal Council decisions to the Environment Court.

Strategic approach to erosion

The approach to managing erosion is focused on preventing further accelerated erosion rather than simply mitigating its effects. This is very much about placing a fence at the top of the cliff rather than relying on an ambulance at the bottom.

This will involve looking at how lake levels are managed, better managing structures that prevent sediment getting to the Lake or inhibit its movement once there, settlement patterns and land use practices. These measures aimed at prevention may take some time to put into place.

In the short term there are a couple of locations where it is prudent to undertake some works to hold the lakeshore in place, while the longer term preventative options discussed above are implemented. In those areas the intention is to use more natural options like beach replenishment and planting. They work with the natural processes and can be reversed if unintended consequences are subsequently identified.

Strategic approach to monitoring

Research to date has identified the need for a much better monitoring record to show what the longer term trends are. This in turn will help better inform future decision making.

One area that is critical to both the flooding and erosion risks is the effects of wave activity. Coordinated monitoring of wind and wave activity will help us to develop more site specific knowledge.

Also of critical importance is a better understanding of the movement of sediment down rivers into the Lake, along the lakeshore, and the on and off shore patterns.

Fortunately some of this monitoring is already being undertaken by a range of power companies, government agencies and local groups. Environment Waikato's ongoing role coordinating these efforts will be important.

Funding

Because there are no plans to undertake protection works to address lake flooding, the question of funding is focused on erosion.

The strategy has identified a range of actions which contribute to the accelerated erosion around the Lake. Similarly, there are a range of groups who benefit from management of the erosion risks.

The next step will be for the two councils to initiate a negotiation process with those parties who have a role to play as contributors and beneficiaries. This period of negotiation should be undertaken in advance of the formal adoption of funding policies.

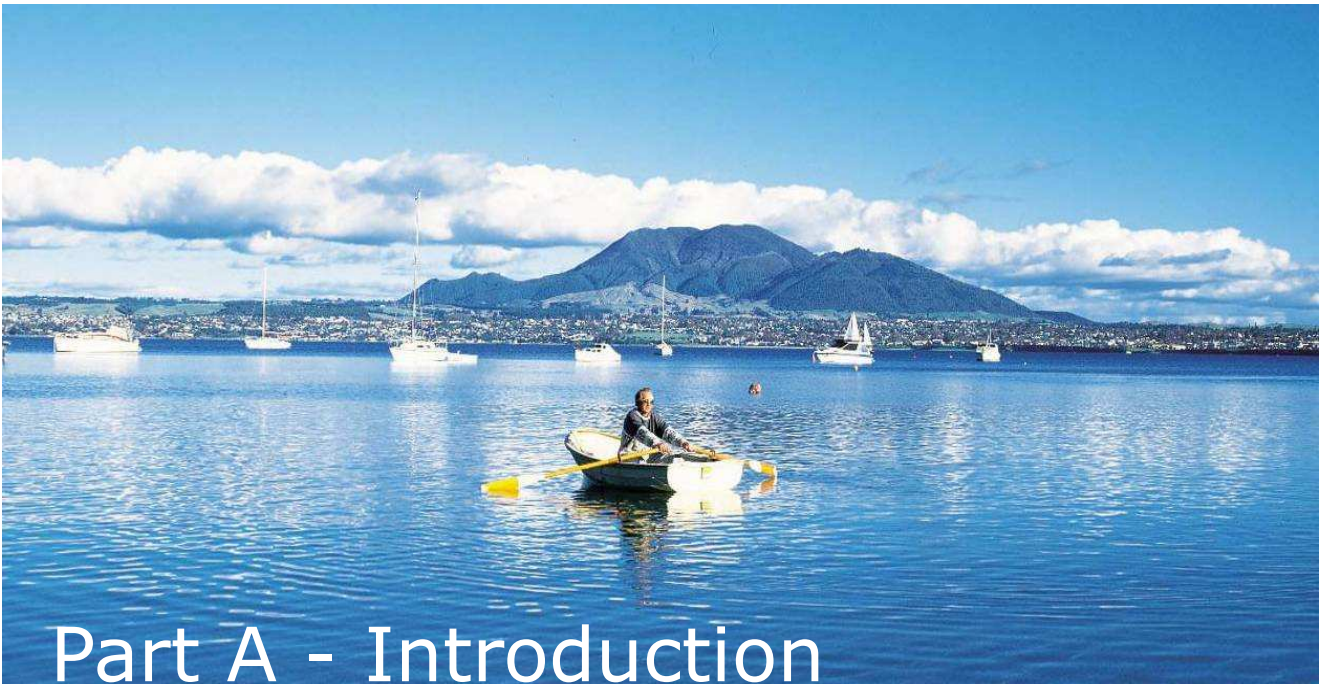
Action plan

Many of the methods for managing both erosion and flooding will take time to put in place as they will require significant discussions with those involved.

In the short term there is an emphasis on avoiding physical works where there is uncertainty around the potential consequences. Where erosion is very serious combinations of planting and beach replenishment are proposed.

To ensure robust decision making in the future a coordinated monitoring programme is also proposed.

The other key area of action is through better planning to avoid these risks in the future.



Part A - Introduction



The key objectives of the strategy are to:

- Explain the processes that influence lakeshore erosion and flooding
- Identify the location and extent of erosion and flood risks and issues
- Decide what level of erosion and flooding risk communities should be planning for
- Establish principles to determine how erosion and flood risks and issues should be managed
- Guide how agencies, stakeholders and the community will collectively work together to manage risk
- Set out what actions will be taken and who will be responsible
- Describe what will be done when new issues arise over time

“We need to focus our energy on the future, on avoiding new development and people living where they can be adversely affected by flooding and erosion risks”



Background

Lake Taupo is of national importance. It is recognised as a valuable tourism draw card, a source of water for communities and a wonderful place to swim, fish and have a great time.

The Lake, its tributaries, and landscape also provide important habitat for many of New Zealand's unique indigenous plants and animal species.

The landscape around Lake Taupo is relatively young and dynamic with over 28 eruptions in the last 27,000 years. Of most significance was the eruption in 186 AD which resulted in the formation of the crater that was subsequently filled to form Lake Taupo. As a result of this volcanic history, much of the southern and eastern parts of the lakeshore are made of looser pumice and ash which are more susceptible to erosion.

Like coastal situations, the shoreline around the Lake is also subject to natural processes of erosion and accretion. These processes are particularly noticeable around river mouths which can be very dynamic environments.

Historically, people have settled close to the Lake and river mouths. While this close proximity has not traditionally been a significant issue, accelerated erosion patterns in some locations in recent years have increased the level of risk.

Similarly, the knowledge of the potential flood risks in the future has also improved, placing a greater emphasis on planning for these.

There is no doubt that people's actions are having a significant impact on where and how bad flooding and erosion risks are. These influences come from where houses and infrastructure is built, how structures in and along the Lake are designed and maintained, and how lake levels and river flows into the Lake are managed.

Purpose

The communities who use and enjoy Lake Taupo will face a number of challenges in the coming years. These include:

- ✦ Making sure that lakeside communities can manage the risks to property and infrastructure from future flooding and erosion

- ✦ Making sure building takes place in areas not at risk from flooding and erosion

- ✦ Appreciating that the Lake will need to continue to be used as a storage reservoir for the Waikato River Hydro electricity scheme for the national good

- ✦ Appropriately balancing economic, social and cultural values of communities with the environmental values and processes in and around the lakeshore

- ✦ Building strong relationships with key partners to manage the risks

- ✦ Allocating costs to those exercising resource consents, where it can be shown that they are contributing to erosion and flood risks

This strategy describes the level of flood and erosion risk communities will need to plan for, and sets out the principles that will guide future decisions about how best to plan for those risks and meet the above challenges.



Scientific information

The strategy is informed by a range of technical reports looking at the erosion and flooding risks. These can be accessed on the Environment Waikato and Taupo District Council websites.

In addition to the reports commissioned by the Councils, Mighty River Power, Genesis Energy, TrustPower and King Country Energy have all commissioned reports for their respective resource consent processes, and to generally inform their decision making. Although commissioned by other parties these reports collectively add to the overall understanding of the erosion and flood hazards. The input from the Community in the process of developing this strategy has also highlighted areas which merit further scientific investigation in the coming years.



Who is this strategy for?

This strategy is intended to guide future decision making by Environment Waikato and Taupo District Council. Those decisions will include where priorities lie, what action to take, and what changes might need to be made to planning documents to manage the risks.

There are other people involved in managing these risks, and this strategy will help all those involved head in the same direction.

The strategy will also provide more certainty for local communities about what action the Councils will take to manage the erosion and flooding risks now, and the principles that will guide how future decisions will be made

Status of this strategy

This is a guiding document to inform decisions by the Councils and other organisations. Those decisions will be made in the context of other processes like the long term council community plans, reserve and asset management plans.

One of the key areas where this strategy will provide guidance is for future changes to planning documents like the Regional and District Plans. These are important tools allowing the Councils to control how land and water are used, and how natural hazards are planned for.

Until those changes are made, this strategy is simply one of many things that need to be taken into consideration when making decisions under the Resource Management Act 1991.

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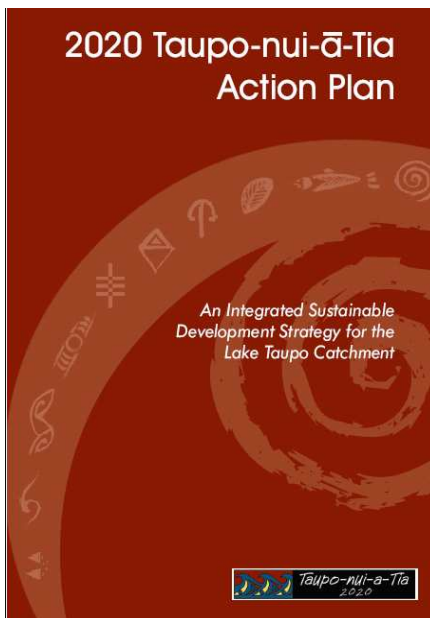




Community values

The Community around Lake Taupo has identified a set of values they want to protect for the future of Lake Taupo. These values, under the headings listed below, are important to remember in the context of dealing with erosion and flooding issues.

- Commercial opportunities
- Clear water
- Ngati Tuwharetoa values
- Diverse plants and animals in lakes and rivers
- Foreshore reserves
- Geological features
- Good trout fishing
- High quality inflowing water
- Outstanding scenery
- Recreational opportunities
- Safe swimming
- Safe drinking water
- Weed-free Lake
- Wilderness areas



Key partners

Tuwharetoa Maori Trust Board

The bed of Lake Taupo and the tributaries are vested in the Trust Board who manage it on behalf of the hapu of Ngati Tuwharetoa. This makes the Trust Board the key partner with the Councils in addressing these risks.

The ongoing management of the erosion and flood risks will involve actions that will impact on the Lake bed. As such, it will be critical that the Trust Board is involved in ongoing discussions about how best to manage these risks, particularly when they affect their land.

Department of Internal Affairs

The Department has an ongoing role managing recreational activities on the Lake as well as managing the many boat ramps.

Building on the strong working relationship with the Department will be important given the impact that structures they manage can have on localised sediment movement.

Department of Conservation

Similar to Taupo District Council, the Department of Conservation owns and manages a range of reserve areas around the edges of Lake Taupo. They also manage the Taupo fishery.

Power companies

There are a range of power companies involved in and around Lake Taupo, each with their own areas of influence.

Mighty River Power manage the level of Lake Taupo within consented limits to provide seasonal water storage for the balance of the Waikato hydro system downstream of Lake Taupo. They also work closely with Environment Waikato to ensure that their management decisions can help to reduce the impact of potential flooding both around the lakeshore and downstream.

Genesis Energy manage the Tongariro Power Development which diverts water into Lake Taupo. They also have an important part to play during high flows when they stop those diversions.

On the Hinemaiaia and Kuratau Rivers, TrustPower and King Country Energy respectively operate hydro electric dams. Those dams have been identified as having a significant impact on sediment flows down stream making ongoing dialogue around sediment management important.



Part B – Natural processes and peoples actions



The Lake Taupo environment is dynamic, driven by natural process and influenced by the actions of people. An understanding of these processes and actions is important if the effects of lakeshore erosion are to be managed and the risks of future flooding minimised.

When erosion and flooding occur in relatively isolated areas of the lakeshore the risks are minimised. However over time both historic Maori settlements and more recent urban areas have been built near the lakeshore and close to river mouths. This close proximity of people, sites of cultural significance and valuable residential property to the lakeshore increases the risks associated with erosion and flooding.



Erosion

Much of the shoreline of Lake Taupo is made up of unconsolidated sediment, particularly along the eastern shore.

The sands and sediment that make up the shorelines around Lake Taupo are continually moving. Strong winds on the Lake cause waves which break on the shore at an angle carrying sediment along the beach. This is known as littoral drift.

Sediment also moves on and off shore, depending the nature of regular wave activity and storm events.

Sediment is supplied predominantly from rivers and streams, however when that supply is restricted, erosion invariably occurs along the lakeshore. If the littoral drift cannot carry all the sediment coming from those rivers and streams then accretion occurs. This transfer of sediment from river and stream mouths along the shore is a highly complex process.

Because the timing of strong waves and sediment coming down rivers do not always coincide, the shoreline will naturally change. These changes can appear as periods when the shoreline erodes and then later recovers as accretion occurs.

These cycles of erosion and accretion occur naturally, however research shows that people's actions also impact on these processes. Hydro dams on the Hinemaiaia and Kuratau Rivers impound significant amounts of sediment, land use practices can also have some impact, while management of lake levels can influence the coincidence of higher lake levels and strong winds, which impact on rates of erosion.

Around the Lake there are a range of structures like boat ramps and groynes which also inhibit sediment altering the natural process of littoral drift. There is also the legacy of houses which have historically been built in close proximity to the lakeshore and river mouths.

The technical reports identify that the range of contributing factors vary considerably from site to site around the Lake.

There are some factors that cannot be influenced like the wind, so the focus for this strategy is on ensuring management of the human actions so that the erosion hazard is avoided, remedied or mitigated.

In the 2004 flood event the inflows into the Lake from the Tongariro River peaked at 1400 cubic metres per second

The Lake level rose a total of 22cm over the duration of the flood event with a maximum rate of 11cm per day



Based on the survey plans from 1963 compared to the 2006 surveys, the average erosion rates at the north end of the beach near the river mouth at Kuratau have been between 0.2m and 0.5m per year with up to 20m of land lost from the reserve.

For the period between 2004 and 2006 the surveyed erosion rate was significantly increased, with erosion in excess of 4m occurring in a year

Flooding

On a daily basis the levels of Lake Taupo are managed by Mighty River Power between a lower and an upper level set by their resource consent.

Originally the natural outlet of the Lake allowed for a maximum outflow of approximately 214 m³ per second. Because of the channel widening and installation of the control gates in 1941 the outflow capacity has increased to a maximum of approximately 315 m³ per second (for a Lake level of 357.55masl).

This increase and the ongoing management have helped to reduce the occurrence of extremely high lake levels. Despite this, there are times during storms when there is significantly more water coming into the Lake than can flow through the control gates. As an example, during some recent floods the cumulative inflows from tributaries has reached approximately 3000m³ per second.

At such times, lake levels will rise (as they did before the installation of the control gates). In extreme climatic events lake levels will rise above the maximum operating levels of the Lake, as they did during the 1998 flood event.

Resource consent conditions require the lake levels to be managed (including the levels before storms) so that there is no increase in the probability of flood levels beyond those which would have occurred naturally.

Along with the water level, the flood risk around the shore is also strongly influenced by wave run up. The differences in beach shape and wind direction mean that some areas like Waitahanui are more affected than more sheltered areas like Acacia Bay. Understanding these wave effects is an important part of identifying which areas are at risk.



Contributing factors

The following factors have been identified as influencing where and how much erosion and flooding takes place around Lake Taupo. It is the combination of all the different factors operating in different ways around the Lake that makes the processes so complex.

Land use

Over the last 100 years land use has radically changed throughout the Lake catchment, for example the removal of native trees and draining of swamps for pastoral farming and residential development.

At times this land use change has increased the amount of sediment going into the Lake such as when much of the land was cleared for farming following World War II. Conversely, the more recent emphasis on erosion control, planting of forestry and better land use practices has restricted sediment flows.

Geology and geography/terrain

Sand or pumice shorelines are more likely to erode than areas made of hard rock. As a result much of the eastern and southern shorelines of the Lake are at greater risk of erosion.

Low lying land is vulnerable to flooding. Sometimes waves can also wash water over the top of banks where it can pool behind or push the water inland (wave run-up).

Wind

The dominant wind direction is from the west across the Lake causing the largest waves to occur mainly on the north eastern lakeshore.

During severe climatic events it is likely that wind and rain will both occur during which time wind generated waves can push water further inland. Wind generated waves can also move sediment around, especially finer sediments like sand.

This pattern of westerly winds makes the softer sediment beaches along the eastern lakeshore more vulnerable.

Tectonic movement

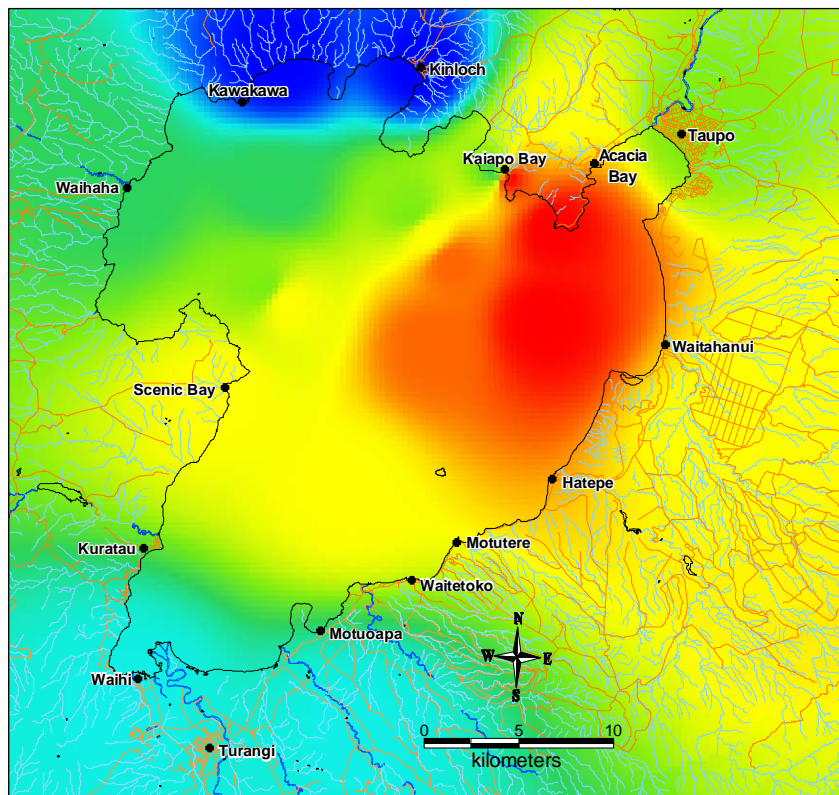
The Taupo area is geologically young with a number of active earthquake faults. Uplifting of the ground and subsidence (dropping of the ground) can affect erosion and flooding.

Current information tells us that the impact of uplift and subsidence is currently being offset by adequate sediment supplies and littoral drift resulting in only a minor impact on erosion in most areas. Depending on the availability of sediment and the longer term trends in the future, the potential for this to change remains.

In contrast the tectonic movement is predicted to have a greater affect on flooding particularly in those areas which are subsiding. The Kinloch area is the most severely affected with the shore there expected to drop by approximately 600 mm over the next 100 years.

The areas that are expected to experience uplift and subsidence have been identified by looking at the trends since 1979. These trends will need to be taken into account when calculating the future flood levels for areas that are expected to experience subsidence over the coming 100 years.

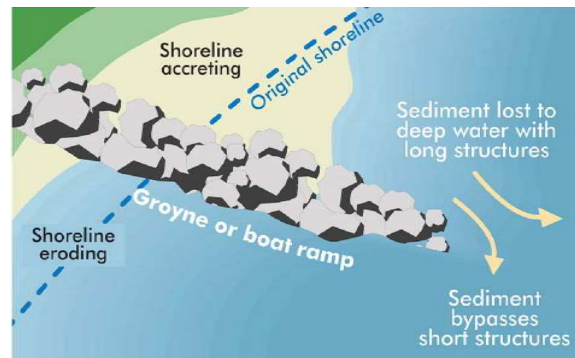
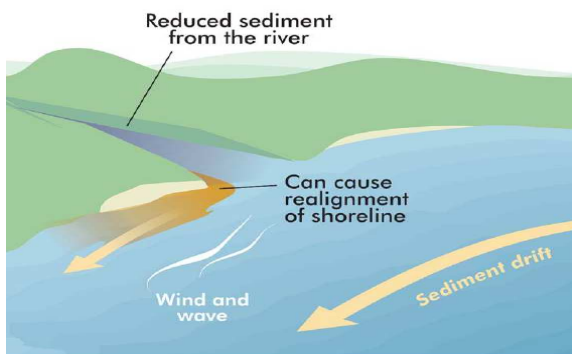
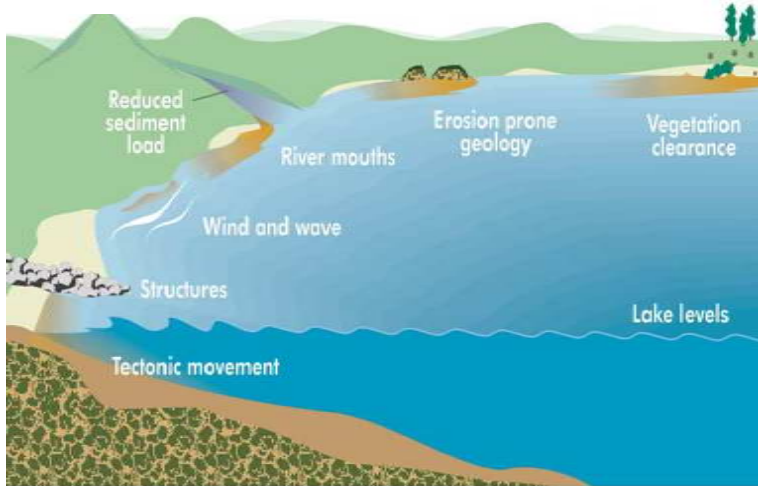
Rates of tectonic deformation for Lake Taupo



Tectonic Deformation (mm/yr)



Causes of erosion



Lake level

Lake Taupo's water levels are managed as the primary store of water for the Waikato hydro scheme that generates electricity for the nation. They are managed within a 1.4m regime that is authorised by resource consent.

The Tongariro Power Scheme is operated to provide water to the Tokaanu and Rangipo power stations and uses a series of lakes, canals and tunnels to do so (refer to Appendix 3). The scheme ultimately discharges water diverted from other catchments into Lake Taupo. During periods of high flow those additional discharges are required to be stopped to prevent flooding being exacerbated.

Although the annual average lake levels are closely matched to what would have happened naturally, the managed regime has resulted in the Lake spending more time at higher levels than it would have naturally.

The management of the Lake levels has been identified as contributing to accelerated lakeshore erosion during periods of strong winds

Despite the fact that the Lake is managed there are times during storm events when there is more water coming into the Lake than can flow through the control gates. As an example, during some recent floods the cumulative Lake inflows from tributaries has reached approximately 3000m³. At such times, high lake levels will continue to occur (as they did before the installation of the gates) to levels beyond the maximum level that the gates are allowed to be used to control lake levels.

Sediment

Sediment inputs into the Lake are a major factor in terms of erosion and accretion cycles. Historically, sediment has been fed into the Lake by the tributaries like the Tauranga-Taupo River. A number of hydroelectric power stations have been established on the Hinemaiaia and Kuratau Rivers. These schemes hold back significant quantities of sediment that would have naturally flowed into the Lake, feeding long shore drift and contributing to making beaches more stable.

In the Lake itself there are a range of other structures that have localised impacts in terms of inhibiting sediment flows along the shoreline. Boat ramps have been identified along with stormwater pipes and groynes, including the one that protects the entrance to the Kinloch marina.

It is also recognised that other land use practices have had an impact on sediment flows into the Lake. Historically logging contributed to periods of large sediment input into the Lake, while in more recent years planting and better catchment management practices have actually reduced sediment inputs.



Climate Change

Climate change is a global issue that is also affecting our local climate. The Lake Taupo catchment is predicted to experience more extreme heavy rain events and stronger westerly winds, increasing the risk of flooding and erosion.

Legislation and the need to take a precautionary approach means that the Councils need to take climate change into consideration despite the present uncertainty. In the context of future flooding this is likely to add 180 mm on top of historic flood levels over the coming 100 years.

Lakeshore development

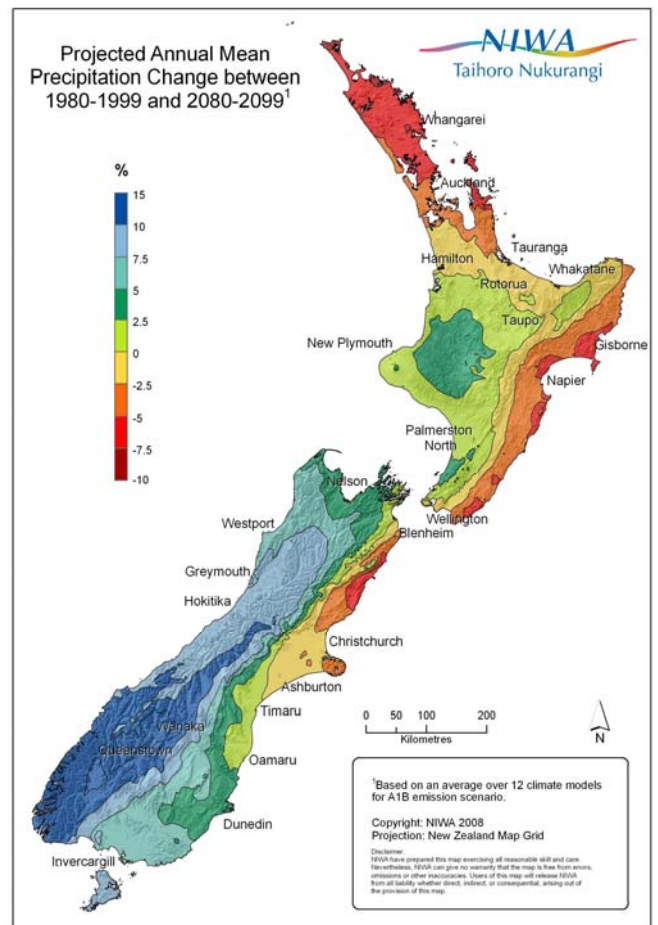
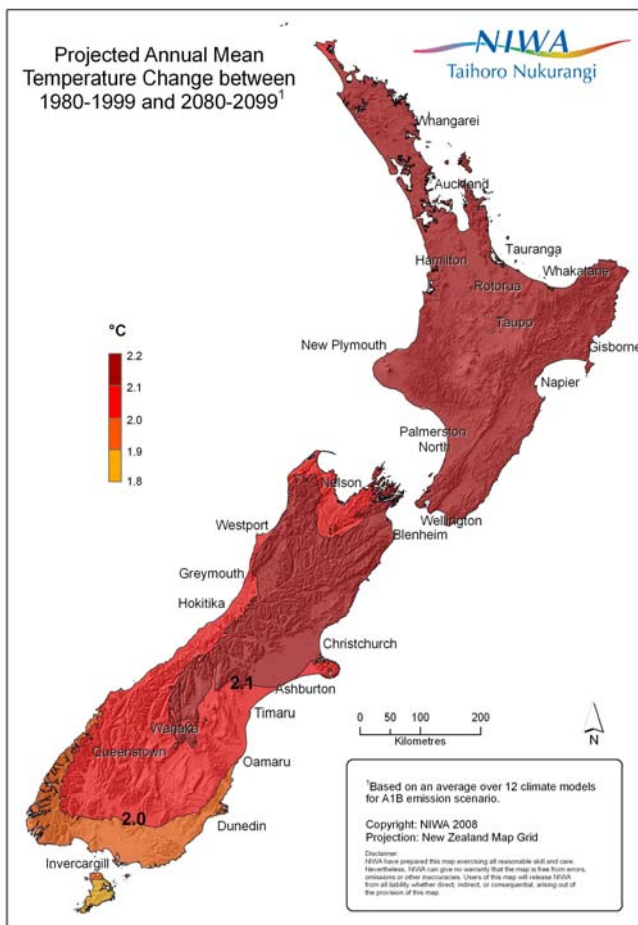
Some residential areas in the Taupo District are situated in close proximity to the lakeshore.

Because people enjoy playing in and around the Lake and like to live on the margins, some of their actions can increase the risks of erosion and flooding, for example

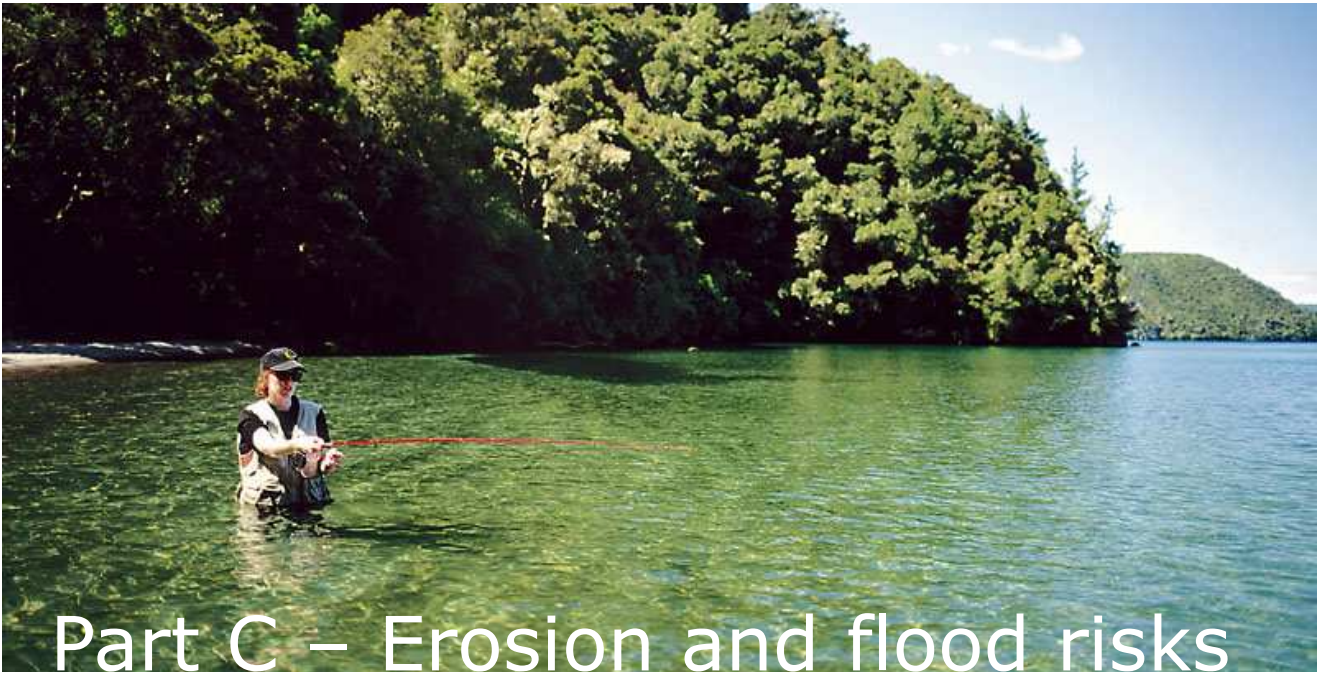
- The design of boat ramps and jetties
- Rock walls and hard structures that are put in place to stop erosion can actually cause more erosion if they are not designed properly
- The removal of vegetation for views, vehicle access, plant pests removal and lakeside recreation

In some areas attempts have been made to redirect rivers and reclaim wetland areas and then build on these areas. These areas are more at risk from flooding because the land may still be low lying. In big storms the Lake and rivers can overtop structures put in place to reduce flood risks.

As part of the development of Taupo District 2050, the Taupo District growth management strategy, the Taupo District Council made a conscious decision to direct future urban growth away from the margins of the Lake. This met a range of landscape and natural values objectives. However it also means that there is a significantly reduced chance of future lakeshore development taking place in locations that might further increase the risks from erosion and flooding.







“The implications of our decisions now, about where development takes place and new infrastructure is built, will be around for many decades”



Flood risk

The flooding risk around Lake Taupo is influenced by the relativity between the inflows and outflows. Lake levels prior to significant rainfall and winds during a flood event also influence the flood hazard.

Mighty River Power's resource consent conditions for the operation of Lake Taupo, require lake levels to be managed (including the levels before storms), so there is no increase in the probability of flood levels beyond those which would have occurred naturally.

During flood events Environment Waikato works closely with Mighty River Power to utilise the Waikato hydro system, including Lake Taupo, to mitigate flooding in the lower Waikato River and around Lake Taupo, where practicable. Manipulation of the flow out of Lake Taupo provides Environment Waikato with the ability to avoid the flood peaks of the Waikato and Waipa rivers coinciding.

Looking to the future it is considered prudent to take into account climate change and tectonic subsidence. This is because the implications of our decisions now, about where development takes place and new infrastructure is built, will be around for many decades.

Direction from the Government, and international best practice, suggest that planning should be based on a 1 in 100 year flood event. This approach has also been reinforced by decisions from the Environment Court.

The historical records for the water levels of Lake Taupo have been based on a still water level measured in a special chamber which cuts out the effects of waves. This gives a static water level.

When working out where the future 1 in 100 year flood might go there must be some allowance for wave activity added to the static water level.

Further complicating the picture is the fact that different wind patterns mean that there tends to be different wave activity around the Lake on any given day. As a result, the Lake has been broken into areas to reflect these differences.

359.29 Kinloch 100 year wave hazard zone (based on the effective water level data set)

358.65 Waitahanui 100 year wave hazard zone (based on the effective water level data set)

357.79 Waitahanui 100 year flood level (including climate change, seiche and tectonic movement)

357.72 Highest static water level recorded (1909)

357.63 Simulated natural 100 year static water level

357.50 Lake wide 100 year static water level

357.49 July 1998 flood static water level

357.39 Lake Taupo Compensation Claims Act 1947

357.35 February 2004 flood static water level

357.25 Maximum control level

Normal operating regime

355.85 Minimum control level

Note: all heights are in metres above sea level



Calculating future flood levels

There are different building blocks that make up the design flood levels:

- ☞ Static water level
- ☞ Wave run-up
- ☞ Tectonic movement
- ☞ Climate change
- ☞ Seiche

These building blocks can be combined together in different ways producing different results.

To address the complexities caused by these different combinations, one combined data set has been created. It includes all of the relevant static water levels from the historical record together with the wave run-up data derived from historical wind records. This approach produces a set of effective water levels, and avoids any issues of combined probabilities.

For the future, this strategy recommends that two zones are identified to assist with planning for the different risks associated with Lake flooding.

The first zone would identify the areas likely to be affected by the lake level rising during a flood. The second zone

would identify those areas potentially affected by wave run-up during a flood event.

Two zones have been recommended for a number of reasons. Firstly, the effects of the lake level rising are felt around the entire Lake, where as the effects of wave run-up are very site specific. Secondly, the effects of the lake level rising are more difficult to manage compared to localised wave run-up. Thirdly, because the wave run-up environment is likely to vary significantly over short distances it is impractical to collect very accurate information for each property. This means that there needs to be the flexibility to assess properties on a case by case basis.

Zone 1, which identifies the flood hazard, should be defined by using the 1 in 100 year static lake level (357.50 masl) plus allowances for climate change seiche, tectonic movement.

Zone 2, which identifies the wave run-up hazard, should be identified by using the 1 in 100 year effective water level as identified by Opus.

It is also recommended that different management

approaches are taken through the District Plan for the two Zones.

It will be necessary to map the flood zone and identify the relative depth of flood waters. Obviously the effects of 50mm of water on a property will be significantly different to 500mm. This information on depth will allow for the accurate setting of flood levels and management responses for properties.

The management of the wave run-up hazard should be more flexible, to reflect the greater range of options available to manage those risks. Management should also reflect the need for site specific analysis, to assess the likely wave run-up effects for a particular property.

It is intended that the Taupo District Plan will be updated to reflect these identified flood and wave run-up hazard zones around the Lake. The Council may choose to combine this with an update on river flood hazards.

The table and diagram on the following page show the future flood levels calculated for the different areas around the Lake.





Flood Areas of Lake Taupo



Future flood levels – Zones 1 & 2

Area	Flood hazard zone (masl) Includes a static water level of 357.5 plus climate change, seiche and allowances for tectonic subsidence	Wave run-up hazard zone (masl) Based on 100 year event from the Effective Water Level data set
Acacia Bay	357.79	358.01
Taupo foreshore	357.88	358.80
Five Mile Bay	357.79	358.80
Waitahanui	357.79	358.65
Hatepe	357.79	358.87
Te Rangaiita	357.92	358.78
Waihi	358.05	358.76
Kuratau	357.89	358.81
Whanganui	357.91	358.59
Kinloch	358.47	359.29



Erosion risk

Erosion and accretion are natural processes that occur in Lake Taupo. The Lake environment is naturally dynamic subject to changing climatic conditions, river inflows and geology.

Management of this environment also impacts on the rates of erosion and accretion. Lake levels are managed, sediment supplies are reduced by dams on rivers, and local structures like boat ramps trap or irretrievably divert sediment.

There is limited scientific research on how much these human interventions are adversely influencing the natural erosion and accretion cycles.

Research has identified a number of sites around the lakeshore that are considered to be at a higher risk from erosion. There is, however, significant uncertainty over the potential extent of future erosion at these sites given the limited historical monitoring.

The uncertainty over short term events and long term trends makes it very hard to identify how far future erosion might extend.

The uncertainty surrounding lakeshore erosion processes also means that there is a strong focus on ongoing monitoring (see the proposed monitoring schedule in the action plan).

Where possible erosion protection works will be avoided until there is a better understanding of how local systems are working. This will help to avoid unintended consequences.

Where physical works are considered necessary, the emphasis will be on works that are potentially reversible and reflect natural processes, like planting and beach nourishment.

High Risk Erosion areas (Lake Taupo Erosion Study – Stage 4, Beca)





Part D – Management approach



The key focus for the long term management of erosion issues around the Lake is addressing human actions.

These range from where houses are built and the design of boat ramps through to managing lake levels and sediment impoundment behind dams.

Changing these actions can take time so in the interim it may be necessary to undertake beach replenishment in the worst affected locations.

In this way the strategy seeks to address the things affecting erosion that can be controlled while protecting the most vulnerable shorelines in the short term.

“We can’t have a hui with the wind, we can’t have a hui with the soils, we can’t have a hui with the water, the only factors we have an impact on are those that are controlled by people”



Key principles for decision making

The implementation of this strategy will take place through a variety of mechanisms such as asset management plans, plans prepared under the Resource Management Act 1991 and physical works.

The following principles help to both underpin this strategy and guide decision makers when they are looking at the detail of implementing the strategy through those other processes and plans.

“Better put a strong fence 'round the top of the cliff than an ambulance down in the valley”

--Joseph Malinas

1. Take a long term approach to management of flood and erosion risks, including taking account of climate change, residual risk, and having a precautionary approach.

2. Respect environmental limits and natural processes, including river and catchment processes, and also protect the life-supporting capacity of water, soil, and ecosystems, including protecting and restoring natural defences.



3. Maintain and enhance the natural and landscape values of the lakeshore and tributaries through the protection and enhancement of the natural features and processes, including indigenous biodiversity.

4. Recognise and protect people’s cultural and spiritual relationship with the land, water, and species that live within it, particularly with respect to waahi tapu, waahi taonga and mahinga-kai .

5. Take a management approach based on a hierarchy of responses with the most favoured being avoiding the risk in the first instance, retreating where practicable, adapting, and then protecting existing communities through physical works.



6. Where possible adopt management options in the first instance that address and seek to correct the human interventions which contribute to erosion.

7. When physical works are necessary favour soft structural options over hard structures.

8. Ensure consideration is given to the reversibility and permanency of management options especially where information about the natural processes and causes of the hazard is limited and the natural and landscape character is valued.

9. Encourage people and organisations to be responsible for structures they build in areas that are prone to flood and erosion risks, and to maintain those structures in a manner which will not increase the risk from flooding and erosion.



10. Individuals and communities are encouraged to take primary responsibility for their safety and livelihoods.





A lake wide approach

It is clear that the natural lake processes and human interventions are interrelated. An action in one place invariably results in consequences elsewhere. This makes an integrated approach to dealing with flood and erosion risks essential. The challenge is finding the right mix of short, medium and long term solutions as part of this holistic Lake wide approach.

The key focus of this strategy is taking a precautionary approach, trying to reduce the level of risk by addressing human interventions that make the erosion and flooding worse. This is very much about placing a fence at the top of the cliff rather than relying on an ambulance at the bottom.

This precautionary approach will help to address issues right around the Lake.

Strategic approach to flooding

The response to flooding is focused on making people aware of where those risks are and planning appropriately.

It is simply not feasible to look at building protection structures around the Lake to prevent flooding. Instead focus is on ensuring that new development in severely affected areas will be avoided.

For less affected and already developed areas, the focus will be on making sure that buildings and services are designed to deal with future flooding.

While the design flood levels are very similar to those experienced in 1998, it is important to take into account likely changes in the future. The decisions made in coming years about where people build and what services go in will remain for a long time. As a result, the flood levels include provision for climate change and areas that are experiencing tectonic subsidence.

In due course, it is anticipated that the identified flood prone areas will

be incorporated into the Taupo District Plan, with appropriate rules giving clarity about how the flood risk can be managed. That process will involve further Community consultation, a formal hearings process and the ability to appeal Council decisions to the Environment Court.

Strategic approach to erosion

Erosion and accretion are natural processes which go through cycles; however it is clear that people's actions impact on these processes.

A focus on addressing those actions which are accelerating erosion will help to reduce the impact of erosion around the Lake.

In the short and medium term there are actions that can be taken to try and minimise the effects of erosion. These include planning responses, like looking at where new houses are built and the placement of new infrastructure. Sediment around structures in and along the shores of the Lake can also be better managed.

Changing things like lake level management, the design of structures and management of sediment impounded behind dams may involve significant and sometimes formal processes to change resource consents that have already been granted. The review of resource consent conditions can be a costly exercise, and must be justified by appropriate evidence. Despite the difficulties associated with such changes, they are important to long term management of erosion.

In a few situations the rate of erosion is causing immediate concern. In those limited cases some action will be taken to hold the present position, while work is undertaken on the longer term solutions.

Where it is necessary to undertake some physical works it is anticipated that more natural solutions like beach replenishment and planting will be used. These options work with the natural processes and can be reversed if it becomes clear that they might be having unintended effects

Strategic approach to monitoring

More monitoring has been identified as critical to developing a better and more informed picture of what is going on around the Lake, and exactly how human interventions are contributing to the flood and erosion risks.

Although there is an excellent record of the static water level of the Lake, the understanding of the wave effects is more limited. A computer model has been developed to describe how big waves are expected to get in certain places depending on the wind speed and direction.

Collecting more actual wave information is important for improving the accuracy of this computer model. A better understanding of wave activity is also a key part of understanding erosion rates.

Much of the proposed monitoring for erosion is focused on gaining a better understanding of sediment movement. It is clear that sediment is impounded behind dams and structures like boat ramps, however it is less clear how much sediment is involved, where it comes from and where it ends up.

The other area where further research and monitoring is required is around the effects of lake level management on erosion. Research to date has identified that it is having an effect. However, that same research suggests that there needs to be more monitoring to establish how much of an effect it is having.

The last element in the approach to monitoring is recognition of what others are doing. A number of the power companies involved in and around the Lake are already undertaking various monitoring, some of which is independently monitored. Similarly, there are other local interest groups also monitoring their local environments.

The key will be ensuring that these efforts are coordinated, a role that Environment Waikato will take.

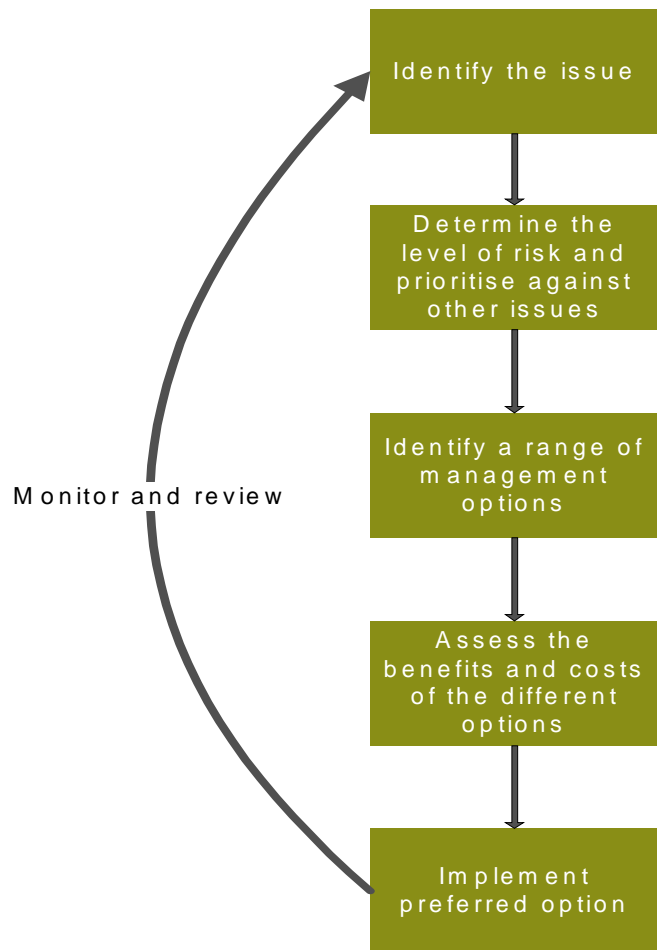


Emerging issues

It is clear that new erosion and flood issues will arise over time. When they do it is anticipated that the process shown below will be used to address those issues.

Given Taupo District Council's presence in the local Community, it is anticipated that the District Council will receive any concerns from the community about new or emerging erosion issues.

This is likely to be done within the context of either the Annual Plan or Long Term Council Community Plan processes. These allow for effective prioritisation of the new issue with existing issues. That decision making will need to reflect the principles of this strategy.





Roles and responsibilities

Lake Taupo is unique in New Zealand with a number of organisations having an ongoing role in its management, and the management of the land around its shores. The following roles outline what each of the major stakeholder groups are responsible for in managing flood and erosion risks around the Lake.

Environment Waikato

- ☞ Sets the direction for hazard management through the Regional Policy Statement
- ☞ Collects information on erosion and flood risks through ongoing monitoring and investigation
- ☞ Controls how water can be used, the taking or depositing of sediment, and the placement of structures in and on the Lake through the Waikato Regional Plan
- ☞ Manages the flood protection schemes on the Tongariro and the Tauranga Taupo Rivers through Project Watershed
- ☞ Advises Genesis Energy on inflows and Mighty River Power on management of the lake levels in Lake Taupo during flood events as part of the High Flow Management Plan

Taupo District Council

- ☞ Controls how land is used and where subdivision takes place in relation to natural hazards through the Taupo District Plan
- ☞ Provides and manages community infrastructure like stormwater and wastewater services, roading, playgrounds and public toilets
- ☞ Provides and manages public reserves along the lakeshore which often have Community facilities on them

- ☞ Owns and manages a range of erosion protection assets around the lakeshore
- ☞ Provides information about natural hazards to people looking to build through project information memoranda. Where significant these natural hazards can impact on the Council's ability to grant building consents
- ☞ Provides information about natural hazards to people looking to buy property through land information memoranda
- ☞ Manages the construction or implementation of erosion control works on public land and to protect public assets

Both Council's

- Agree the priorities, actions and monitoring that needs to be undertaken with respect to erosion
- Agree the details of annual work programmes to address erosion
- Collect money from regional and district ratepayers to meet some of the costs of erosion works
- Provide civil defence and emergency management services in the case of significant erosion or flood events

Tuwaharetoa

- ☞ Ngati Tuwaharetoa hold mana whenua and kaitiakitanga over the Central North Island plateau
- ☞ As kaitiaki, Ngati Tuwaharetoa has an intrinsic duty to ensure that the Mauri and the physical and spiritual health of the environment is maintained, protected and enhanced

- ☞ The Tuwaharetoa Maori Trust Board, on behalf of Nga Hapu o Ngati Tuwaharetoa, is the legal owner of the bed of Lake Taupo-nui-a-Tia and many of its tributaries
- ☞ Make decisions as land owner through the Taupo-nui-a-Tia Management Board about structures on the Lake bed, gravel extraction from rivers and the deposition of sediment

Department of Internal Affairs

- ☞ Manage boating and recreational activities on the Lake
- ☞ Provide and maintain boat ramps around the Lake

Department of Conservation

- ☞ Provide and manage scenic and recreational reserves along the lakeshore like Whakaipo Bay
- ☞ Manage the Lake Taupo trout fishery

Power generation companies

- ☞ Mighty River Power manage the levels of Lake Taupo using the control gates
- ☞ Genesis Energy contribute significantly to the inflows to Lake Taupo through the Tongariro Power Development
- ☞ King Country Energy operate the hydro electricity dam on the Kuratau River
- ☞ Trustpower operate several hydro electric dams on the Hinemaiaia River

Land owners and individuals

- ☞ Are expected to look after their own property when it is threatened by erosion
- ☞ Are responsible for planning for their own safety in the case of flood events





Part E – Implementation, monitoring and review



As a matter of principle Taupo District Council and Environment Waikato will work together to implement the strategy by:

- Sharing resources, knowledge and know-how
- Respecting each others views and working together towards realistic solutions while forging long-term relationships
- Understanding the need to involve those affected by hazards, including tangata whenua, in decision making processes
- Making decisions openly and transparently
- Making decisions on a case by case basis while guided by the principles of this strategy
- Undertaking agreed actions
- Recognising the decision making role of Ngati Tuwharetoa as owners of the Lake bed

“Solutions for managing flood and erosion risks lie in people working collectively and collaboratively”



Review and reporting

The proposed actions in this strategy are a mix of the short, medium and long term measures to manage the erosion and flood risks. Over time some will be completed, others will become less relevant, and new actions will be identified.

To ensure that this strategy remains relevant it will be jointly reviewed by Environment Waikato and Taupo District Council not less than every six years or as required.

In between reviews, it is expected that Taupo District Council and Environment Waikato will note progress on implementing the action plan through their respective Annual Reports.

Each year the Annual Plan process that both councils go through will provide ongoing opportunities to reconsider the anticipated projects for the coming year, and reassess priorities in the light of new information or new issues as necessary.

Action plan

The following action plan details the tools that Taupo District Council and Environment Waikato intend to use to address the identified erosion and flooding risks.

The physical works component of the action plan will need to involve a range of parties to be successful. Proposed works may require resource consent approvals from either or both Taupo District Council and Environment Waikato depending on the nature of the proposed works.

Of critical importance is the ongoing relationship with the Tuwharetoa Maori Trust Board. As owners, their approval will be required for physical works on the Lake bed.

Ownership of the bed of Lake Taupo

In 1992 agreement was reached between the Crown and Ngati Tuwharetoa regarding ownership of the bed of Lake Taupo.

The bed of the Lake and the Waikato River extending down to and including Huka Falls, as well as the beds of certain rivers and streams flowing into the Lake were vested in the Tuwharetoa Maori Trust Board (TMTB).

The Board hold the Lake bed in trust on behalf of all the Board's beneficiaries, while the beds of the streams and rivers were held on behalf of the hapu who adjoin them.

Under the agreement everyone maintains the right to access the Lake for non-commercial recreational use and enjoyment.

The ongoing management of the Lake bed is undertaken by the Taupo-nui-a-Tia Management Board which is a partnership between the Crown and the Board. The core functions of the Management Board are to:

- Consider all applications to use the beds of Taupo waters for any purpose or development allowed under law;
- Forward applications, which are supported by the Board to the landowner for final decision. Conversely, if not supported, the Board to advise the applicant and the landowner that the application has been declined;
- Consider and advise on the merits of any proposal referred by the Minister of Conservation to release any area of the beds of Taupo waters from the Deed;
- Make submissions to the TMTB, Taupo District Council, Environment Waikato, or any other agency as appropriate, regarding conditions or restrictions that the Board considers necessary from time to time; and
- Provide services or facilities for public use of the beds where necessary.

Note: At present all commercial applications go directly to the Tuwharetoa Maori Trust Board





Monitoring

A key finding of the research done to date is that, while current monitoring information can help identify what the causes of erosion are, it is not sufficient enough to identify with any degree of precision how much each cause is contributing. Where there are monitoring records looking at beach processes they are short. Similarly, with regard to flooding, there is an excellent record for the static water levels of the Lake, however, there is little information on actual wave activity.

The following monitoring programme has been developed to answer these questions:

1. To what extent does lake level management affect erosion?
2. How is sediment movement around the Lake impacted by structures?
3. How do the shape of beaches around the Lake change over time and what causes this?

This programme will also help to:

- Assess the effect of storm events around the Lake
- Track the future effects of climate change
- Provide information to assess and/or review resource consents conditions
- Enable appropriate design of specific works in high risk areas
- Provide a range of information for use in other projects

Elements of the monitoring programme considered to be absolutely critical have been **highlighted**.

What	Lead agency	When	Estimated cost (2009 \$)
<p>Lake-Wide monitoring, evaluation and analysis of:</p> <ul style="list-style-type: none"> ▪ storm/wind trends ▪ lake levels ▪ tectonic movement <p>This monitoring is already being undertaken; however there is no formalised process for collecting and analysing it all.</p>	<p>Coordinated by Environment Waikato</p> <ul style="list-style-type: none"> ▪ National Institute of Water and Atmospheric Research ▪ Met Service ▪ GNS Science ▪ Ministry for the Environment ▪ Power Companies 	<p>First analysis in 2011/12 then every two years</p>	<p>Actual monitoring costs already covered by other agencies.</p> <p>\$50,000 every 2 years to cover the costs of analysing the collective results</p>
<p>Site specific monitoring of beach profiles on an annual basis at:</p> <ul style="list-style-type: none"> ▪ Kuratau ▪ Te Rangiita, ▪ Hatepe, ▪ Five Mile Bay ▪ Whareroa ▪ Mighty River Power is currently undertaking beach profiles at Waitahanui, Kuratau, Hatepe and eastern shoreline of Tapuaeharuru Bay ▪ Monitoring is also required at these locations after significant storm events 	<p>Coordinated by Environment Waikato.</p>	<p>On an annual basis</p>	<p>\$21,000</p> <p>\$8,000</p> <p>\$8,000</p> <p>\$8,000</p> <p>\$16,000</p>
<p>Site specific monitoring of beach profiles once every two years at:</p> <ul style="list-style-type: none"> ▪ Kinloch ▪ Whakaipo Bay ▪ Motutere Bay, ▪ Mighty River Power is currently monitoring profiles at Waitahanui and the western shoreline of Tapuaeharuru Bay 	<p>Coordinated by Environment Waikato</p>	<p>On a biennial basis starting 2010/11</p>	<p>\$3,600</p> <p>\$3,600</p> <p>\$24,000</p>



What	Lead agency	When	Estimated cost (2009 \$)		
Site specific bathymetric surveys at: <ul style="list-style-type: none"> ▪ Kuratau River Mouth ▪ Hinemaiaia River Mouth. 	Coordinated by Environment Waikato	At same time as annual profiles	\$5,000 per year \$5,000 per year		
Site specific sediment sampling analysis at: <ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Hatepe, ▪ Waitahanui, ▪ Five Mile Bay, ▪ Whareroa <p>to allow more accurate assessment of littoral transport rates & help define requirement for any beach nourishment sources.</p>	Coordinated by Environment Waikato	Kuratau top priority in 2010/11 then followed by other sites	\$1000 \$3250 \$6250 \$3750 \$2500 \$1750 \$2500 \$2500		
Site specific wave analysis at: <ul style="list-style-type: none"> ▪ Tapuaeharuru Bay, ▪ Waitahanui, ▪ Kuratau <p>to verify wave height calculations for the model of the Lake, calibrate wave run-up and estimate wave energy.</p>	Coordinated by Environment Waikato	2010/11	\$15,000 per year \$15,000 per year \$15,000 per year		
Site specific asset surveys at: <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, ▪ Te Moenga Bay </td> </tr> </table> <p>to assess effectiveness of erosion control structures & maintenance programme requirements etc</p>	<ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, 	<ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, ▪ Te Moenga Bay 	Coordinated by Taupo District Council	As part of the next review of asset management plans in 2010/11	Included as part of the overall review of existing assets and future requirements.
<ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, 	<ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, ▪ Te Moenga Bay 				
Site specific sediment budget analysis at: <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, </td> </tr> </table> <p>to understand shoreline processes & any constraints on shoreline management.</p>	<ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, 	<ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, 	Coordinated by Environment Waikato	Kuratau top priority in 2010/11 then followed by other sites	\$12,000 per site
<ul style="list-style-type: none"> ▪ Kinloch, ▪ Kuratau, ▪ Eastern shoreline of Tapuaeharuru Bay, ▪ Western shoreline of Tapuaeharuru Bay, ▪ Te Rangiita, ▪ Hatepe, 	<ul style="list-style-type: none"> ▪ Waitahanui, ▪ Five Mile Bay, ▪ Motutere Bay, ▪ Whareroa, ▪ Whakaipo Bay, 				
Establish a wind recording station at Kuratau (noting that a private weather station is already established there) and better utilisation of the Turangi Weather station in future analyses	Environment Waikato		Included in current budgets		



Physical works

What	Lead agency	When	Estimated cost (2009 \$)
<p>Kuratau</p> <p>Asset management – detailed identification of assets at risk e.g. sewer pipe, car park. Investigate possible relocation of key assets over time and appropriate placement of new assets.</p>	Taupo District Council	As part of the next plan review	Included within current budgets
<p>Physical Works – Design and obtain consents for beach replenishment and planting. This will involve consultation with the local community and Tuwharetoa Maori Trust Board approval</p>	Taupo District Council to project manage design and consenting processes with support from Environment Waikato	Begin 2010/11	<p>Approximately \$170,000 for investigation, design, consenting, project management and site setup.</p> <p>Approximately \$500,000 for the replenishment</p>
<p>Investigate in conjunction with King Country Energy options to better manage sediment trapped behind the hydro dam.</p>	Environment Waikato	Begin 2010/11	No cost implications
<p>Five Mile Bay</p> <p>Physical works - Trial planting programme as already approved</p>	Taupo District Council to project manage with support from Environment Waikato	2009/10	Included within current budgets
<p>Whareroa</p> <p>Investigate re-contouring of the beach and potential for replanting</p>	Taupo District Council to project manage design and any consenting processes required with support from Environment Waikato	Begin 2010/11	\$50,000
<p>Discuss the operation and design of the boat ramp with the Department of Internal Affairs to establish whether changes can reduce erosion effects</p>	Environment Waikato	Begin 2010/11	No cost implications
<p>Tapuaeharuru Bay</p> <p>Develop a management plan to identify desired shoreline characterisation and prioritisation for different areas taking into account high public and cultural amenity values, recreation & tourism values, the number of properties and assets at risk and existing control structures. This will involve consultation with the local community and Tuwharetoa Maori Trust Board approval</p>	Taupo District Council	2011/12	Included within current budgets
<p>Kinloch</p> <p>Address with the Kinloch Marina Company compliance issues (including the outlet structure), and matters inhibiting the implementation of their beach replenishment consent.</p> <p>If the Company does not implement that consent then beach replenishment works by the councils should be investigated.</p>	Environment Waikato	2010/11	No initial cost implications, however beach replenishment costs would need to be reconsidered if works are required by the councils



Planning response

What	Lead agency	When	Estimated cost (2009 \$)
Erosion risk identification of cultural sites - Undertake a site visit with Ngati Tuwharetoa representatives (including Kaumatua and kuia) to identify areas of cultural significance that might be adversely affected by erosion.	Taupo District Council	2010/11	Included within current budgets
District Plan - Amend flood maps to reflect the new flood information around the Lake and review the planning provisions to ensure their appropriateness.	Taupo District Council	Begin 2009/10	Included within current budgets
Develop best practice development guidelines for buildings already sited within hazard areas.	Taupo District Council	As part of the future District Plan Change process	Included within current budgets
District Plan - Review the provisions related to the Foreshore Protection Area to establish whether it is an appropriate tool for managing erosion risks.	Taupo District Council	Begin 2009/10	Included within current budgets
Structure Plans - When preparing structure plans, ensure that they reflect the known flood and erosion hazards.	Taupo District Council	Ongoing	Included within current budgets
Reserves Management Plans - When developing or reviewing reserve management plans ensure that they protect/enhance foreshore areas including natural buffers to hazards, make provision for public access, and plan for infrastructure management and placement.	Taupo District Council	Ongoing	Included within current budgets
Reserve provision - Ensure that strategic planning for reserve acquisition recognises the role of reserves in risk mitigation.	Taupo District Council	Ongoing	Included within current budgets
Asset/Infrastructure Plans - Identify existing foreshore erosion protection assets, assess their value and determine long-term maintenance and cost programme.	Taupo District Council	As part of the next plan review	Included within current budgets
Asset/Infrastructure Plans - Assess current and future operation and placement of infrastructure (roads, walkways, sewerage, water supply and stormwater) in relation to hazard risks.	Taupo District Council	As part of the next plan review	Included within current budgets
Regional Policy Statement - Regional policy direction for natural hazards clarified through review of RPS (approach will reinforce avoidance and risk reduction consistent with principles in Part d of this strategy).	Environment Waikato	2009/10	Included within current budgets
Regional Plan - Review rules and other methods to implement regional direction for natural hazards as identified in the Regional policy Statement.	Environment Waikato	After the RPS review	Included within current budgets
Regional Plan - Review of policy, rules and other methods in relation to sediment management in river and lake beds. The objective of this review is to ensure that the Regional Plan supports good proactive sediment management around structures like boat ramps and for river training works.	Environment Waikato	After the RPS review	Included within current budgets



What	Lead agency	When	Estimated cost (2009 \$)
Design guidelines and good practice with an emphasis on sediment management for structures in foreshore areas e.g.: <ul style="list-style-type: none"> ▪ stormwater outlets, ▪ walls, ▪ reefs, ▪ marinas ▪ Boat ramps 	Environment Waikato	As part of the review of the Regional Plan	Included within current budgets
Liaise with the Tuwharetoa Maori Trust Board with regard to the ongoing development of their Lake bed management strategy and its interrelationship with this strategy	Environment Waikato to coordinate	2009/10	Included within current budgets
Consideration of a review of the resource consents that relate to the operation of the dams on the Hinemaiaia and Kuratau Rivers. These reviews should identify whether the consents have adequate conditions to: <ul style="list-style-type: none"> ▪ Monitor the rate of sediment impoundment behind the dams ▪ Monitor the rate of sediment discharge to the Lake ▪ Monitor the rate of littoral drift along the lakeshore 	Environment Waikato	2011	Review process costs are charged back to the consent holder. Individuals and groups participating bear their own costs
Undertake flood assessments for each of the major tributaries into Lake Taupo.	Existing Opus contract coordinated by Environment Waikato	Ongoing	Included within current budgets

River, catchment and sediment management

What	Lead agency	When	Estimated cost (2009 \$)
Understanding flood event implications on lake levels and shoreline interactions.	Environment Waikato	2010/11	Included within current budgets
Investigate options & suitability for placement of river channel sediment dredgings onto foreshore.	Environment Waikato in conjunction with the Tuwharetoa Maori Trust Board	Begin 2010/11	Included within current budgets
Discuss with the Department of Internal Affairs about best practice sediment management around structures	Environment Waikato with support from Taupo District Council	Begin 2010/11	Included within current budgets
Provision of information where available on: <ul style="list-style-type: none"> ▪ River cross sections (bed load movement) as part of Lake Taupo Zone Work Programme ▪ Hazard information ▪ Environmental Information 	Environment Waikato	Ongoing	Included within current budgets



Education and awareness

What	Lead agency	When	Estimated cost (2009 \$)
Identify and inform where properties are subject to natural hazards through Land Information Memoranda and Project Information Memoranda.	Taupo District Council	ongoing	Included within current budgets
Targeted education campaign with landowners within identified hazard zones.	Environment Waikato with support from Taupo District Council	2010/11	\$15,000

Emergency management

What	Lead agency	When	Estimated cost (2009 \$)
Emergency response and recovery plan developed and/or updated.	Taupo District Council	2010/11	Included within current budgets
Provision of warning systems.	Environment Waikato	2009/10	Included within current budgets



Part F - Funding



“Underlying the different approaches to funding is the recognition that there are some significant costs involved. Often those need to be shared to enable things to be done.”



Funding the cost of action

There are a variety of proposed actions which aim to achieve sustainable management of the lakeshore. There are also a range of responsibilities across various agencies, for example statutory planning (including resource consents), reserve management, monitoring and erosion protection works. Successful implementation of the strategy will involve collective action and long term investment of time, effort and money.

The costs identified in this strategy for lakeshore erosion management are the best estimates based on present knowledge. They will be subject to change in the future as more detailed planning for their implementation is undertaken.

While the understanding of the erosion process and human influences will continue to grow over time, it is the responsibility of Taupo District Council and Environment Waikato to make the best possible decisions on funding with the information available.

Funding of erosion management

Prior to the development of this strategy all erosion management works were funded through Project Watershed on an interim basis.

When Project Watershed was established in 2002, the funding process for foreshore erosion was identified as interim due to limited information being available at that time. It was recognised that more work needed to be done to establish a more equitable split of funding responsibilities.

In providing funding to undertake management of erosion both Councils must have regard to the Local Government Act 2002 and the Local Government (Ratings) Act 2002.

Section 101 of the Local Government Act 2002 states that the funding needs of a local authority must be met from those sources that the local authority determines to be appropriate, following consideration of;

- The community outcomes to which the activity primarily contributes
- The distribution of benefits between the community as a whole, any identifiable part of the community, and individuals
- The period in or over which those benefits are expected to occur
- The extent to which the actions or inaction of particular individuals or a group contribute to the need to undertake the activity
- The costs and benefits, including consequences for transparency and accountability, of funding the activity distinctly from other activities
- The overall impact of any allocation of liability for revenue needs on the current and future social, economic, environmental, and cultural well-being of the community

Project Watershed

Project Watershed was approved in 2002. The project involves the integrated and coordinated delivery of river and catchment services across the Waikato River Catchment. Most of this work is focused on managing river flooding and erosion issues. For the purposes of funding, the Waikato catchment was divided into five management areas.

When Project Watershed was developed the issues around foreshore erosion around Lake Taupo were not well understood. As a result an interim funding policy was put in place. This provided for the ongoing funding of maintenance of existing erosion protection assets, and made some limited provision for new capital works. Much of the funding was directed toward the development of this strategy.

It was always anticipated that while Project Watershed as a whole would not be reviewed at this time, those parts which related to foreshore erosion in the Lake Taupo management zone would be reviewed. This strategy is the basis for that review.



Who is contributing to the need for action

The Lake Taupo Shoreline Erosion Study (December 2008) and the Lake Taupo Erosion Study – Stage 4 (Beca, March 2008), provide the most up to date analysis of the erosion issues around the Lake.

The Beca work builds on the earlier NIWA analysis in *Lakeshore geomorphic processes, Lake Taupo* (Hicks 2000). This work provides the direction for establishing which parties' actions contribute to accelerated erosion.

The following analysis of contributors has been split into sediment compartments given the variability around the Lake. These compartments are the areas where physical works are most likely to be required in the future.

An analysis has also been provided on the role of lake level management as a contributing factor. This is a factor which applies to multiple sediment compartments.

This analysis will provide direction about who should bear the significant cost for physical works in different locations

Kuratau sediment compartment

Some of the observed erosion and accretion, particularly close to the river mouth, is likely to be associated with the natural fluctuations and river mouth dynamics. However, it is clear that there is accelerated long term erosion beyond these fluctuations.

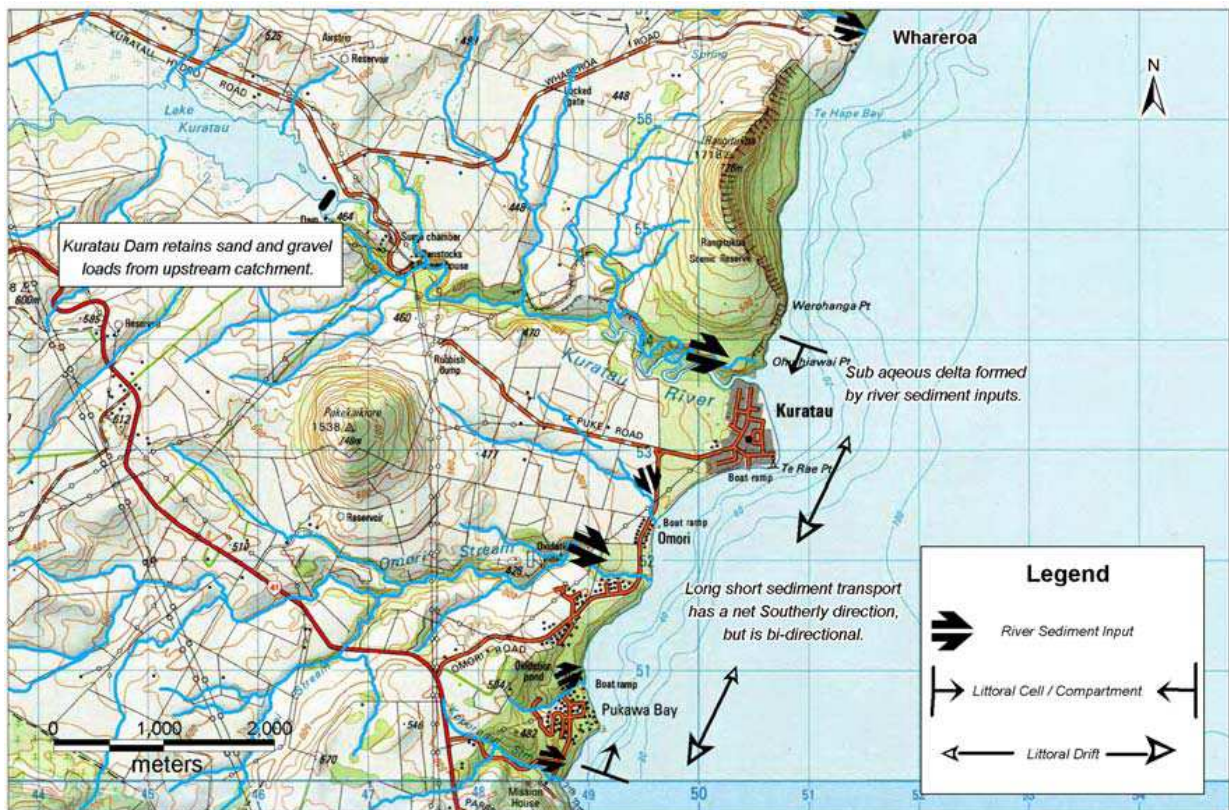
Based on the location of the erosion and the predominant wind generated wave direction, there is clear evidence that the current erosion is predominantly the result of reduced sediment supply coming from the Kuratau River.

It has been suggested that the shoreline may be realigning itself to adjust to a new equilibrium position based on the new sediment supply rate.

There is concern that this new equilibrium state will at best significantly reduce the public reserve and at worst threaten private property.

This concern is supported by previous analysis by NIWA (Hicks 2000) which has identified that the Kuratau River is the main sediment source for the sediment compartment. Following the construction of the dam in 1962 the loss of sediment to the lakeshore has been estimated at 69% on an annual basis. Erosion at Kuratau is thus inevitable in the long term as the foreland continues to adjust to reduced sediment supply.

On the basis of the technical information, the impoundment of sediment behind the dam on the Kuratau River is considered to be an important factor in the accelerated erosion taking place at Kuratau.



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Kuratau Compartment



Eastern shore sediment compartment

This sediment compartment stretches from the mouth of the Hinemaiaia River at Hatepe northwards and westwards to the mouth of the Waikato River, including Waitahanui, Five Mile Bay and Tapuaeharuru Bay.

Erosion in this compartment has largely been attributed to a lack of sediment from the Hinemaiaia River and the White Cliffs. It has been suggested that the effects of the dam have been masked by a major erosive phase of the White Cliffs, which has now stabilised, together with a large influx of sediment from the Waitahanui Stream during land development in the area.

Since the Hatepe foreland owes its origin mainly to Hinemaiaia River sediment, it is inevitable that the

reduced sediment supply due to the river damming will impact the lakeshore downstream from a sediment transport point of view.

A report by Tonkin and Taylor (2004) for Mighty River Power indicated that the most critical factor causing erosion at Waitahanui was a reduction in sediment supply. The reduction of sediment was partly attributed to the (estimated 84%) reduction from the Hinemaiaia River as a result of the dams. As with Kuratau, this reduced sediment supply will continue every year, unless mitigation measures are taken.

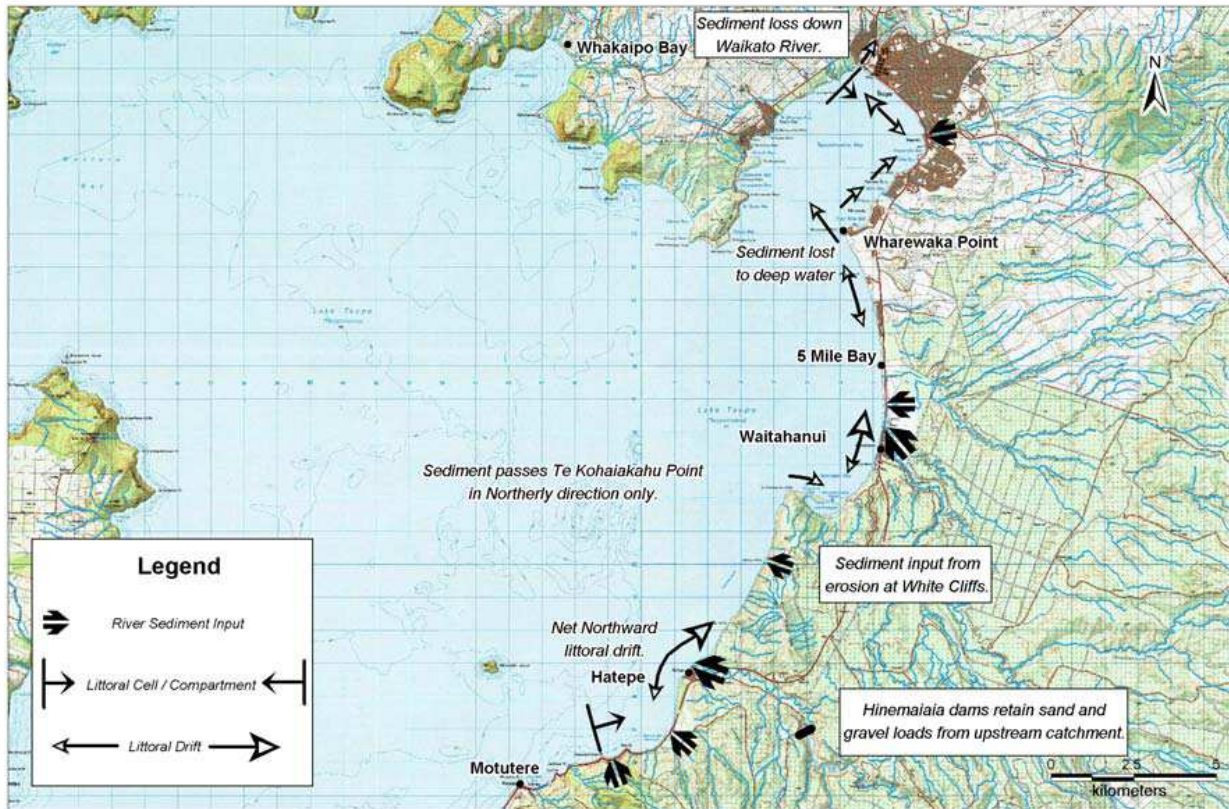
The impoundment of sediment behind the dams on the Hinemaiaia River is considered to be an important factor in the accelerated erosion taking place in this sediment compartment.

Whareroa sediment compartment

There have been limited site specific investigations or analysis undertaken historically for this area.

The erosion that has taken place to the north of the boat ramp has largely been attributed to effects the boat ramp is having on the long shore sediment movement.

This is consistent with earlier work (Hicks 2000) which suggested there was a net pattern of northwards littoral drift in this sediment compartment.



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Eastern Shore Sediment Compartment



Whangamata Bay (Kinloch) sediment compartment

There is a significant build up of sediment behind the western side of the groyne constructed to protect the entrance to the marina. To the east of the groyne the shoreline has suffered from ongoing erosion.

There is also an outlet structure from the marina, which is impacting on erosion on the eastern side of the marina groyne.

The overriding cause of erosion in this compartment is considered to be the marina groyne impeding the eastward littoral drift of sediment. The groyne is also responsible for the partial loss of sediment out into deeper water.

The lake wide influence of lake level Management

There have been a number of previous investigations into lake level regime comparing the current regime to a simulated uncontrolled regime. There appears to be general consensus for the analysis undertaken up to 2000 that the lake level regime of recent times has been operated close to the simulated natural conditions. Any variations have been considered

minor and have not been assessed as contributing significantly to erosion.

In addressing the influence of the lake level regime Beca undertook comparative assessments of the managed and simulated uncontrolled regimes over the last 10, 5 and 3 year periods. For the 5 and 3 year periods it is apparent that the recorded maximum levels were higher than the simulated uncontrolled maximum levels by about 100mm.

As the time periods reviewed were made shorter and more recent the difference between seasonal regimes became more apparent with summer recorded levels remaining high. Over the 3 year period the actual recorded level exceedence was up to 200mm higher than the natural simulated regime for most the level ranges.

From historical analysis it appears that this timing of holding the lake levels higher during late summer does not coincide with the time of year having high average wind speeds. However, analysis of the highest wind events has shown that they do tend to occur during this time.

Over recent years, there is some evidence that lake level management may be having more

of an influence on lakeshore erosion. However the short timeframes of only a few years will not necessarily be reflective of the longer term trends, and are likely to be more susceptible to short term variations such as weather patterns for those particular years.

On the basis of the evidence presented, the management of lake levels is considered to be a lake wide factor in accelerated erosion, in combination with the factors identified for the different sediment compartments.

Other contributing factors

Some localised factors have contributed to accelerated erosion, including:

- the removal of vegetation along the shoreline, or
- localised structures like walls protecting private property
- privately owned boat launching facilities

However the effects attributed to these factors are considered to be minor compared to the factors identified for the sediment compartments and lake level management above.

Kinloch marina showing sediment trapped behind the groyne





Who will benefit from physical works to address accelerated erosion

The community downstream of the control gates benefits from the ability to manage the levels of Lake Taupo leading up to, during and after flood events. That manipulation of lake levels to reduce downstream flooding has been linked to periods of significant lakeshore erosion.

The hydro generators and their customers benefit from the ability to generate electricity through the manipulation of the flows of tributaries and the level of Lake Taupo. The mitigation of accelerated erosion would facilitate the continued use of the Lake and its tributaries.

The historic construction and ongoing operation of the control gates and dams on the tributaries around the lake, for hydro generation, has provided significant economic benefits. One of the unintended consequences of these structures has been the effects on foreshore erosion.

Central Government benefits from the ability to maximise the use of Lake Taupo and its tributaries for the generation of renewable electricity (mainly through dividends paid to the government by two of the hydro generators

which are state owned enterprises). This is consistent with the renewable energy goals of the New Zealand Energy Strategy and the Country's international commitments in relation to climate change.

The Kinloch Marina Company and the users of the marina facilities, benefit from the ongoing ability to maintain a clear channel from the marina into the lake.

The Department of Internal Affairs and other owners of lake access structures, which intercept sediment movement along the foreshore, benefit from the ongoing ability to access the lake.

In contrast, the national, regional, district and local communities have a reasonable expectation that these activities do not result in accelerated erosion of the shores of Lake Taupo which threatens:

- ☞ The landscape and natural values of the lakeshore
- ☞ Public access and recreational assets and opportunities around the Lake
- ☞ The national, regional and district economic benefits derived from the lake as an iconic tourism and recreation resource
- ☞ Private property



Principles for funding

It is anticipated that the existing funding principles that underpin Project Watershed will continue to be relevant.

As previously noted, the councils also act within a legislative framework which has requirements and considerations.

In addition, the principles below have been identified to assist the councils with the subsequent reviews of funding policies. They reflect the technical and local knowledge collected through the development of this strategy.

Principle 1

The primary focus should first be on sustainability by avoiding adverse environmental effects where practical.

Principle 2

Funding policies should consider the balance of administrative efficiency with the need for a fair distribution of costs. The cost of collecting funds and associated administrative costs should not outweigh the benefits of carrying out the work itself.

Principle 3

Where accelerated erosion is the result of human intervention ideally the cost of its mitigation should be met by those responsible for that intervention.

Principle 4

Lake Taupo and its tributaries will continue to play an important role in the sustainable generation of electricity into the foreseeable future. However there are currently significant unsustainable, unmitigated adverse environmental effects of that generation which are not being accounted for and should be.

Principle 5

The value of any relevant monitoring undertaken as a result of resource consent requirements should be recognised.

Principle 6

Environment Waikato should collect, through Project Watershed, any regional ratepayer contribution for the purposes of managing foreshore erosion. When setting any contribution from district ratepayers, the councils should ensure that those ratepayers are not charged by both councils.





The cost of physical works

Human intervention has interrupted the natural processes which were otherwise in a state of natural equilibrium in human time terms.

On this basis, it is considered that the costs of any mitigation works should predominantly be the responsibility of those contributing to the need for action.

The costs of undertaking physical works like beach replenishment or offshore reef construction are the most significant. Some costs will be one off upfront costs, and others such as beach replenishment may be ongoing annual costs. These costs will vary significantly depending on the location and actual work undertaken.

The other challenge with the physical works is that they will vary significantly around the Lake reflecting the site specific causes. From a funding perspective this means that the fairest way to allocate costs is on a case by case basis. The assessments of sediment compartments and lake level management should be used as a guide as to the contributors.

The cost of maintenance

The nature of physical works undertaken to manage lakeshore erosion will be reflected in the ongoing maintenance requirements. When considering which physical works to implement, an assessment of both the upfront and ongoing maintenance costs should be made.

Some works like beach replenishment may have lower upfront costs but require a commitment to significant ongoing maintenance costs.

To avoid future debate, the same funding split used to fund physical works for a particular area, should also be used for the ongoing maintenance costs associated with those works. This will avoid debates on whether low upfront and high maintenance mitigation works are preferable to high upfront and low maintenance cost works. By taking this approach the focus will be on the most sustainable mitigation works.

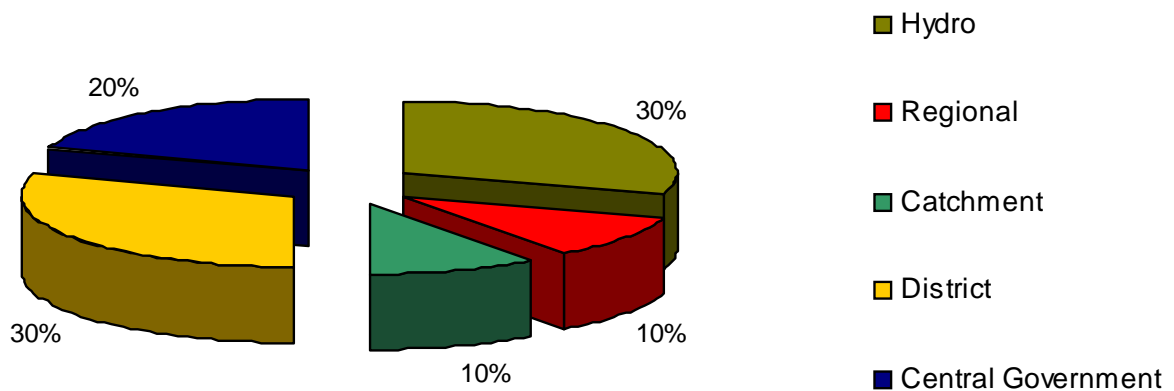
The cost of monitoring

Unlike the physical works and maintenance costs, which tend to have site specific variations, monitoring provides benefits that can be treated as more universal.

The improved knowledge base generated from monitoring (identified in the Action plan) benefits all communities and lake sediment compartments. As a result, funding for all the monitoring and analysis work should be allocated across all parties on a fair and equitable basis as identified below.

If it proves impossible to secure a government contribution, the unaccounted for 20% should become part of the regional contribution. Alternatively, the work programme could be scaled back accordingly.

Proposed funding apportionments for monitoring





Responsibilities for implementation

Delivering the physical works, maintenance and monitoring will be a shared responsibility between the two councils.

Funding

- Environment Waikato and Taupo District Council will collect all funding associated with managing foreshore erosion.

Physical works

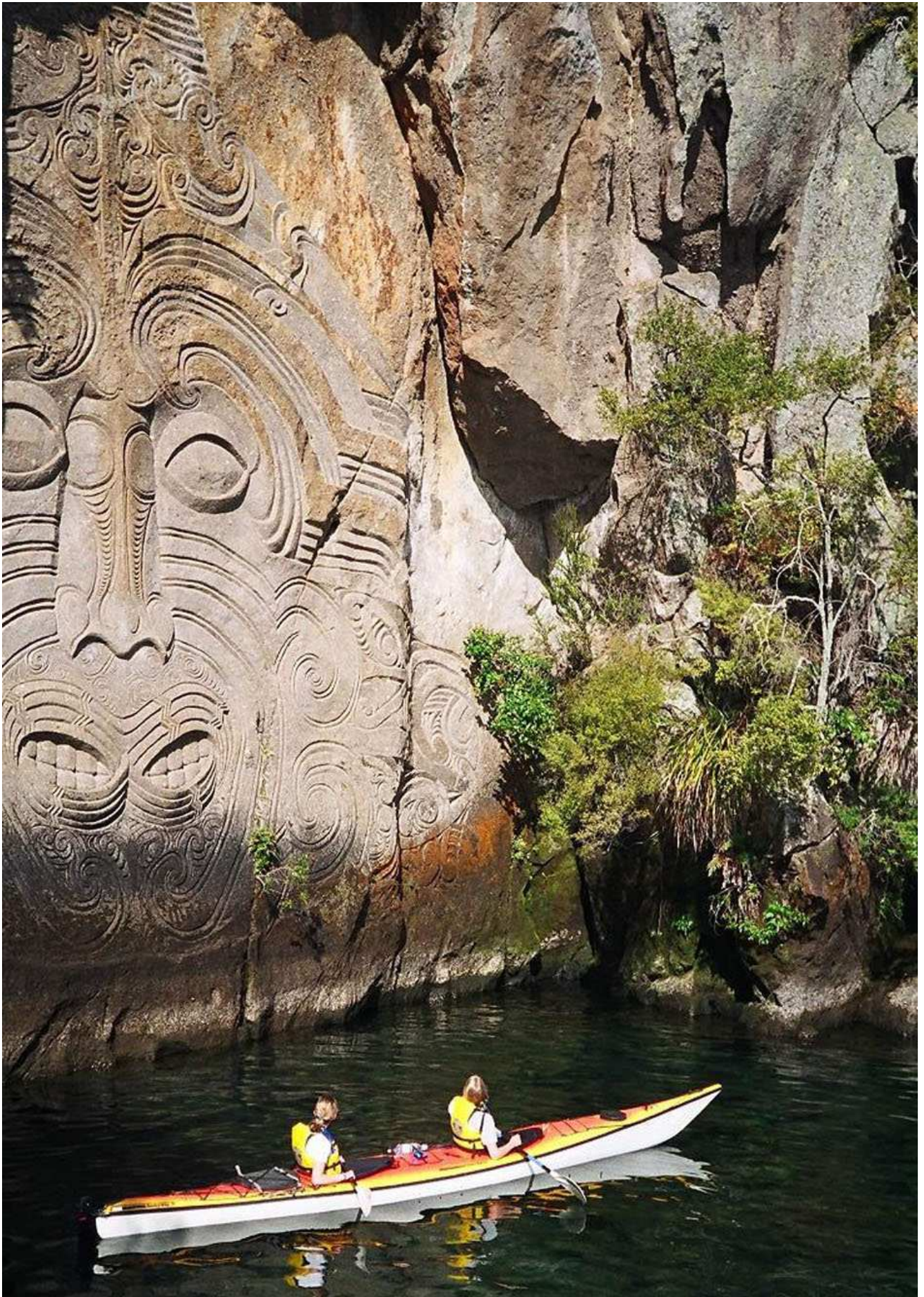
- Taupo District Council will prepare an annual works programme listing areas where physical works are required and associated costs. Those works and their priorities must be agreed between both Councils before works proceed.
- Taupo District Council will coordinate all aspects of the physical works including consenting and site management.

Maintenance

- It is anticipated that Taupo District Council will be the asset owner for the erosion protection works and will therefore be responsible for ongoing asset management.
- Taupo District Council will prepare an annual maintenance programme that identifies costs (including depreciation), service standards, responsibilities, and resource consent status. This programme must be agreed between both Councils before work proceeds.
- Taupo District Council will coordinate all aspects of the physical works including consenting and site management.

Monitoring

- Environment Waikato will identify and prioritise all monitoring requirements and associated costs. This programme must be agreed between both Councils before work proceeds.





Glossary

Accretion Accumulation of sediment which builds up land. May be the result of either natural (e.g. action of wind and littoral drift) or artificial activity (e.g., human actions).

Erosion condition in which the earth's surface is worn away by the action of water and wind.

Accelerated erosion is erosion that is caused or accelerated by human activity so that it occurs at rates greater than would naturally be the case.

Kaitiakitanga guardianship

Hazard a source of, or a situation with the potential to cause harm or loss

Impoundment the trapping of sediment behind a structure such as a dam.

Littoral drift the movement of beach material in the littoral zone by waves and currents. Includes movement parallel (long shore transport) and perpendicular (onshore-offshore transport) to the shoreline

Long Term Council Community Plan 10 year plan prepared by both regional and district councils to identify what activities they will undertake and how much they will cost. Prepared in accordance with the Local Government Act 2002

Mana whenua territorial rights, power from the land - power associated with possession and occupation of tribal land. The tribe's history and legends are based in the lands they have occupied over generations, and the land provides the sustenance for the people and to provide hospitality for guests.

MASL metres above sea level

Maximum and minimum operating levels set by the resource consents granted to Mighty River Power by Environment Waikato. Provide lower and upper

limits for the day to day operation of Lake Taupo

Precautionary principle a moral and political principle which states that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action.

Project Watershed The Waikato River Catchment Services Project began in 1999 and was known by its shorter name 'Project Watershed'. The Project was set up to address the issues of flood protection, soil conservation, and river management in the greater Waikato catchment

Residual risk the risk or danger of an action or an event, a method or a (technical) process that, although being abreast with science, still conceives these dangers, even if all theoretically possible safety measures would be applied (scientifically conceivable measures).

Resource consent the authorisation given to certain activities or uses of natural and physical resources required under the Resource Management Act (the "RMA"). Some activities may either be specifically authorised by the RMA or be permitted activities authorised by rules in Regional or District plans. Any activities that are not permitted by the RMA, or by a rule in a plan, require a resource consent before they are carried out. Resource consents are often subject to conditions which can be subsequently reviewed where provided for within a resource consent.

Return period also known as a recurrence interval is an estimate of the interval of time between events like an earthquake, flood or river discharge flow of a certain intensity or size. It is a statistical measurement denoting the average recurrence interval over an extended period of time, and is usually required for risk analysis.

Reversibility used in the context of erosion protection works, reversibility means that the proposed works are able to be removed or altered so that the shoreline returns to its original state prior to the works being undertaken.

Risk the chance of something happening that will impact on objectives.

- i. A risk is often characterised in terms of an event or circumstance and the consequences that may flow from that event.
- ii. Risk is measured in terms of a combination of consequences of an event and their likelihood.

Seiche a standing wave in an enclosed or partially enclosed body of water. Seiches and seiche-related phenomena have been observed on lakes, reservoirs, swimming pools, bays and seas. The key requirement for formation of a seiche is that the body of water be at least partially bounded, allowing natural phenomena to form a standing wave

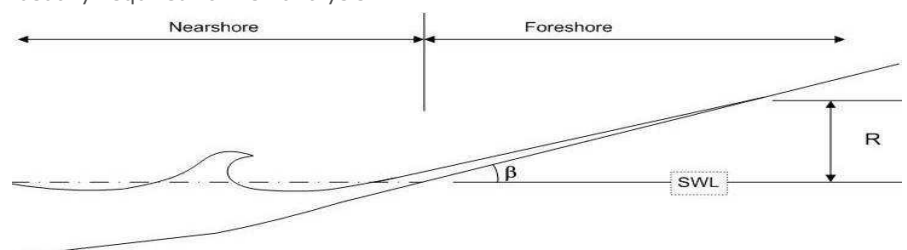
Static water level represents the lake level measured in a well which removes the waves and seiche effects

Tectonic movement changes in the landscape caused by tectonic (internal to the earth) stresses

Tributary a stream or river that flows into a larger stream or other body of water.

Waahi tapu sacred place

Wave run up the maximum vertical extent of wave up rush on a beach or structure above the still water level (SWL). This definition is depicted in the figure below where R represents the wave run up height.





Appendix 1 – Legislative context for Council roles and responsibilities

How the hazard risks identified can be managed by Environment Waikato, Taupo District Council and the Community is influenced by various pieces of legislation that confer responsibilities at strategic and operational levels. Under the Resource Management Act 1991 (RMA), management of hazard risk is a joint responsibility of Environment Waikato and Taupo District Council.

Given that Environment Waikato and Taupo District Council as consent authorities have duties to consider hazards as part of making decisions on land use and resource consent applications, there is an expectation that applicants will consider these matters when developing hazard prone areas such as the shoreline of Lake Taupo.

The Soil Conservation and Rivers Control Act 1941 (SCRC)¹ retains a number of operational functions and powers for Regional Councils including powers to construct, alter, repair and maintain works to minimise and prevent damage by floods and erosion (s126); and undertaking afforestation and other planting and the destruction of animals that are likely to damage vegetation for soil erosion and flood purposes.

Individuals are empowered to initiate their own measures provided they operate within legislative frameworks. Individuals are allowed to develop and promote flood and

erosion management proposals, to apply for and hold the necessary resource consents, and to privately fund works and services should they wish to do so.

A range of methods can be used by the Councils and the Community to manage hazard risks, for example:

- The duty of both Environment Waikato and Taupo District Council to gather information on natural hazards and make such information publicly available.
- The obligations of Environment Waikato and Taupo District Council in land use and natural resource planning through Regional and District Plans (RMA).
- The matters to be considered by Environment Waikato and Taupo District Council when taking decisions on planning for water use, works in waterways, land use and proposals to subdivide land (RMA) and building development (Building Act) which influence Community exposure to natural hazards.
- Controls on activities, including structural measures that affect flooding risk, and the requirement to consider effects on the environment (RMA). This applies irrespective of whether such measures are undertaken by Taupo District Council, Environment Waikato or the Community. The RMA places restrictions on certain uses of beds of rivers and lakes.
- The joint responsibilities and obligations of Environment Waikato and Taupo District Council regarding planning, preparing and responding to natural hazard events individually, together and with other agencies through the Civil Defence Emergency Management Act (CDEM).
- The obligations of Taupo District Council as a lifeline utility provider (CDEM) arising from its ownership and operation of community water supply and sewage collection and treatment systems.
- The obligations of lifeline utility operators, in addition to Taupo District Council, regarding emergency preparedness, response and recovery planning (CDEM).
- The powers of Environment Waikato to undertake works and services where appropriate to manage hazard risk (SCRC).

Both Councils can achieve their respective statutory functions through a variety of complementary methods including regulation, education and awareness, and works and services. The legislation provides for the avoidance of new or additional risks as well as reduction of existing risks. There are however constraints on what can practically be achieved through consideration of environmental effects and funding mechanisms.

The legislation provides for a high degree of Community participation, which helps to shape the form that hazard mitigation takes.

¹ A number of regulatory powers in the SCRC were repealed and replaced by plan and rule making powers contained in the RMA.



Appendix 2 – The national importance of renewable electricity generation

As described in Appendix 3, the Lake serves as a storage reservoir for the Waikato hydro system and also allows for the discharge of the Tongariro Power Development. At a more local scale there are dams on the Hinemaiaia and Kuratau Rivers.

The use of these water resources for the generation of renewable electricity is important to the nation for a number of reasons:

- New Zealand has made international commitments with regard to climate change. Generating electricity from renewable resources is an important way of helping to meet those obligations

- The national grid has some limitations when it comes to moving electricity from the South Island to the North Island. At those times the Waikato hydro system takes on elevated importance in terms of supplying the electricity demands of the North Island

- The generation of electricity from renewable energy sources is also important in helping to make New Zealand more energy efficient and thus less susceptible to the social and economic impacts associated with oil shortages

- The provision of electricity is a critical part of helping communities to meet their social and economic needs

In recognition of the importance of renewable electricity generation the Government has proposed the National Policy Statement for Renewable Electricity Generation. This policy statement is still progressing through the process under the Resource Management Act 1991, however its promotion by the Government clearly signals that electricity generation like that from hydro schemes is very important at a national level.

Waikato hydro scheme dams



Tongariro hydro electric scheme





Appendix 3 – Management of the Lake for hydro electricity

Since 1941, the Lake has been managed. The Lake is the key to the effective running of the Waikato hydro scheme, a series of 8 dams down the Waikato River. The lakes behind those dams have little effective storage so the hydro scheme relies on the ability to store water in Lake Taupo and then release it in a controlled way to produce hydro electricity.

The generation capacity of the Waikato hydro scheme was significantly upgraded by 1985 with the completion of the Tongariro Power Development which diverted water into the southern end of Lake Taupo from other catchments to the south.

Resource consents require the Lake to be kept above a minimum set level. Mighty River Power operates the Lake within a 1.4 metre range, using the control gates to manage the water storage in response to inflows and energy demand patterns.

With the control gates fully open a maximum of 315m³ per second can be discharged from the Lake. This is significantly more than was possible prior to the installation of the gates and the widening of the channel. However in periods of significant rainfall the flow of water from the wider catchment into the Lake can be closer to 3,000m³ per second. This means that the Lake can rise quickly but take much longer to lower even with the gates open. While the Lake is clearly a managed system, its size means that Mighty River Power's influence is limited when there are large inflows into the Lake.

In times of extreme rainfall, the Taupo Gates can be used to hold back water to help reduce the severity of flooding in the lower Waikato.

Genesis Energy owns and operates the Tongariro Power Scheme. The scheme and its structures extend from the southern flanks of Mount Ruapehu in the south, to the southern point of Lake Taupo in the north, and along either side of the mountain range formed by Ruapehu, Ngauruhoe and Tongariro. The scheme taps a catchment area of more than 2600 sq km.

The scheme is operated to provide water to the Tokaanu (240MW), Rangipo (120MW) and Mangaio (2MW) power stations and uses a series of lakes, canals and tunnels to do so. Tokaanu Power Station is located on the slopes of Mount Tihia, near the township of Turangi, south of Taupo. Rangipo Power Station is situated underground in the Kaimanawa Forest Park, on the eastern side of the Tongariro Power Scheme. The scheme produces on average approximately 1450 GWh of electricity per year, which is enough electricity to power some 190,000 households.

The scheme contributes on average an additional 28 m³/s inflow into the Lake Taupo catchment from its diversion of water from the Whanganui, Moawhango and Whangaehu Catchments, also known as the "foreign water diversions". Resource consents for the ongoing operation of the scheme were made operative on 1 December 2004.

Genesis Energy works closely with Environment Waikato and Mighty River Power to assist with flood management within the Taupo catchment. Resource consent conditions require Genesis to stop diverting "foreign water" into Lake Taupo when the level of Lake Taupo exceeds or is clearly likely to exceed its maximum control level.

In dry conditions, the Taupo Gates are used to conserve water in Lake Taupo, while meeting generation and minimum flow requirements for the Waikato River.

Along with the generation of electricity for the nation, one of the major benefits of the Lake being managed has been the reduction in the number of extreme lake levels. Modelling of what would have happened if Lake Taupo was not managed through the control gates shows that there would be more periods where the lake level was higher during storm events. This reduction in the extreme events provides major benefits to communities around Lake Taupo as well as those down river.



Appendix 4 – Flood management

The installation of the control gates in 1941 turned the Lake into a managed system. In addition to the benefits that this provides in terms of electricity generation, the control gates also allow for better management of flood events. The ability to hold water in Lake Taupo means that flooding further downstream in the Waikato can be reduced. This reduces the potential damage to property and loss of life from flood events providing significant benefits to the regional economy. In some instances the use of the control gates also limits the effect of flooding around Lake Taupo's Foreshore.

Environment Waikato's overall role is to monitor and manage

the whole river and flood event, whilst working with Mighty River Power to integrate their operation and requirements, and ultimately balance and manage flood impacts throughout the river system.

As part of their consents under the High Flow Plan, Mighty River Power are required to adopt a strict/sound risk management regime to ensure that the identified return period thresholds under their consents are not exceeded, and to work with Environment Waikato to manage flood events through the river system. Mighty River Power are also required to manage dam safety risks, to minimise the potential major impacts on both their structures and more

particularly on the wider community.

The Taupo Control Gates are owned and operated by Mighty River Power. However, the conditions of consent do provide Environment Waikato with the power to instruct Mighty River Power to operate the gates specifically for civil defence or flood management purposes. In practice however, flood management of the hydro system is usually achieved through consultation and agreement between Mighty River Power and Environment Waikato as provided for within the High Flow Management Plan (available from Environment Waikato).