6 Physical Description of the Tarawera River Catchment

6.1 Introduction

The Tarawera River catchment has an area of approximately 984 km^2 outlined in Map 1. Volcanic and tectonic activity associated with the Taupo Volcanic Zone has heavily influenced the topography of the Tarawera River catchment. The geology is dominated by an active complex system of interdependent features including faults, rhyolitic volcanoes and geothermal fields, all of which are geologically recent in origin.

The Tarawera River catchment rises in the south-west around a series of volcanically formed lakes. The catchment's high point is Mt Tarawera (1,111 metres). The Okataina Volcanic Centre to the northeast of Lake Tarawera represents a significant area of high ground, mostly above 600 metres. Below the Tarawera Falls, the Tarawera River enters a steep-sided valley known as the Tarawera Valley which quickly fans out into rough but undulating country of between 150 metres and 300 metres in height. The topography of catchment within this regional plan is shown in Map 2.

Putauaki (Mt Edgecumbe), a dormant volcano, rises to 821 metres in the east of the catchment. The Rangitaiki Plains, also geologically known as the Whakatane Graben, are the delta for the Tarawera, Rangitaiki and Whakatane Rivers. The Rangitaiki Plains which begin just south of Kawerau township, slope gently from approximately 30m above sea level in the Te Teko – Kawerau area down to just below seal level in parts of the catchment behind the coastal foredunes. The coastal foredunes rise to a height of approximately 6 metres on average. The Rangitaiki Plains are bordered in the west by the Manawahe Hills which rise to a height of approximately 300 metres above sea level.

The Tarawera River catchment has a temperate maritime climate. It is characterised by relatively high rainfall. Kawerau had an average annual rainfall of 1,676mm (1984-1992), while Waiotapu Forest had an average annual rainfall of 1,352mm for the same period[3]. The rain falls relatively evenly throughout the year with a small decrease in summer and increase in winter of the order of 5% to 10% either side of the mean monthly value. The mean daily temperature in winter (August) for the Tarawera Forest is 8.6°C, while the mean daily summer temperature (February) is 18.4°C. In Kawerau the mean daily temperature in winter is 9.0°C, while the summer daily average is 19.7°C. Whakatane, approximately 25kms to the east of Matata records an average of 2,329 hours of bright sunshine per year.

For the purposes of description, the area covered by this regional plan is divided into three distinct geographical areas:

- The Tarawera Lakes and their catchments
- The catchment of the Upper Reach of the Tarawera River
- The catchment of the Lower Reach of the Tarawera River

A brief overview is also given of the Tarawera River mouth, which although in the coastal marine area and therefore dealt with in the regional coastal environment plan, is often affected by natural and physical resource management decisions and actions made within the Tarawera River catchment.

[3] Quayle, A M, 1984.

6.2 The Tarawera Lakes and their Catchments

The Tarawera Lakes and their catchments, shown in Map 2, is characterised by seven small to medium sized lakes, and dominated by Mt Tarawera, (1,111 metres) an active rhyolite/basaltic volcano. Lake Tarawera, from which the Tarawera River originates, is the biggest of the lakes. Lake Tarawera is generally believed to be fed by five other lake catchments within the Lake Tarawera system. Lake Rotokakahi (Green Lake) drains into Lake Tarawera via the Te Wairoa Stream while Lake Okareka does so via the Waitangi Spring and over ground via a man-made overflow structure. Lakes Tikitapu (Blue Lake), Okataina and Rotomahana have no visible outlets, but are believed to drain by sub-surface flow to Lake Tarawera. Lake Okaro drains via a surface flow into Lake Rotomahana[4]. Part of the water draining from Lake Rerewhakaaitu is understood to flow through the crater basin to Kaue Springs and then into Lake Rotomahana. The ecology of the Upper Reach of the Tarawera River catchment is likely to be moving closer to that of its original state before the loss of indigenous forest following the eruption of Mount Tarawera in 1886.

All the lakes are of volcanic origin. The lakes have been formed by one of, or a combination of, the following three processes:

- Local explosive eruptions producing small circular craters. Many of these small craters have resulted from hydrothermal eruptions;
- Massive eruptions producing large collapse calderas. Calderas are usually associated with explosive rhyolite volcanoes which frequently subside with the withdrawal of magma following eruptions. This leaves behind large depressions in which lakes can form;
- Blocking of valleys by lava flows or other volcanic material.

The water quality of each lake is closely associated with the nature of its immediately catchment. The Tarawera Lakes catchments (Map 4) is a mixture of indigenous forest, pasture, and exotic forestry scrub, with some bare ground and scrub in and around Mt Tarawera. With the exception of the Lake Okataina catchment, there has been significant catchment modification in all the Tarawera Lakes catchments.

Before the 1960s much of this modification was the result of changing land use from indigenous forestry to pastoral agriculture, and in the past twenty to thirty years a marked move from scrub, pastoral, and bare land to exotic plantation forestry. There is some indication that changing land use to exotic production forestry may be resulting in fewer nutrients being discharged to water bodies in the catchment of the Tarawera River, affecting the ecology of the river and downstream environments.

Lake Okataina is the most oligotrophic of the lakes due to its catchment being composed almost entirely of native forest. The available storage in the Tarawera Lakes catchments and the permeable nature of the predominant pumice soils within the catchment combine to maintain relatively steady flow characteristics in the Tarawera River[5].

Significant geothermal activity occurs at Lakes Rotomahana, Tarawera and Okataina. The Tarawera Lakes catchments also includes the Waimangu/Rotomahana geothermal field, part of which is a significant tourist attraction.

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[4] Lake Rerewhakaaitu, which is outside the plan area, is also considered to drain, via a sub-surface flow, to Lake Rotomahana.

[5] More detailed information on the lakes in the catchment of the Upper Reach of the Tarawera River is contained in reports published by Environment Bay of Plenty and listed in the References to this plan.

The volcanic formed lakes in the catchment of the Tarawera River have unique heritage values, which include the natural character of the wetlands, lake and rivers and their margins, natural features and landscapes, indigenous ecosystems, intrinsic values, and resources of cultural importance. These components are all interrelated and their high degree of intactness contributes to the national significance of the Tarawera Lakes and their catchments. Objectives and policies have been included in this plan to ensure that the inherent attributes of the area do not become eroded, either in character or in degree.

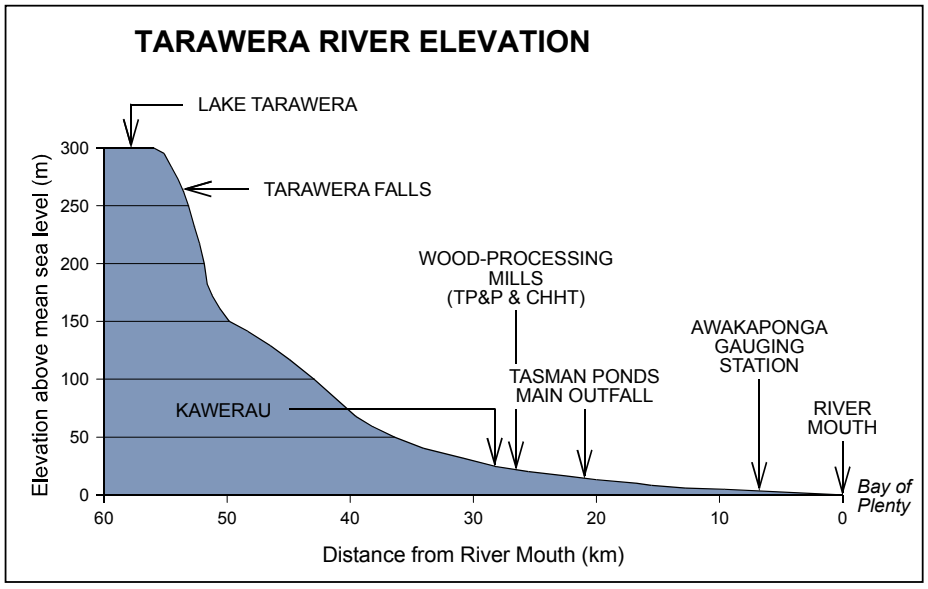
6.3 The Catchment of the Upper Reach of the Tarawera River

For the purposes of this regional plan the catchment of the Upper Reach of the Tarawera River is that area of the Tarawera River catchment from the outlet of Lake Tarawera to the Kawerau Road bridge over the Tarawera River, just north of Kawerau township at Grid Reference: Map Series 260, V15 – 357404.

The Tarawera Valley floor is covered with recent pumiceous alluvium and debris flow deposits produced by the Kaharoa Ash eruption approximately 700 years ago. The terrace on which Kawerau township is sited is composed of this material. Further up the valley, Kaharoa Ash material and Tarawera Lapilli produced by the 1886 eruption of Mt Tarawera are mixed together. This mixture is probably a consequence of a major flood in 1904 which resulted from the failure of a natural debris dam formed at the outlet of Lake Tarawera by the 1886 eruption. To the east of the Tarawera Valley, Matahina Ignimbrite occurs and extends to the Rangitaiki Valley. Rising above the ignimbrite sheet is Putauaki (Mt Edgecumbe), (821 metres), an andesitic volcano with a main cone and subsidiary centres around it. The volcano is traversed by a number of lineaments considered to be faults.

The Tarawera River begins at the Lake Tarawera Outlet. The majority of the catchment of the Upper Reach of the Tarawera River is in exotic production forestry, with some of the upper reaches of the tributaries and the eastern side of the Tarawera River in indigenous forest. The river is fed by a number of small tributaries as it flows north-eastwards towards Kawerau (Appendix 7, Figure 2). Three and a half kilometres from the Lake Tarawera outlet, the Tarawera River enters a subterranean chamber, exiting at the Tarawera Falls. The Falls sees the Tarawera River drop a total of 65 metres into the Tarawera Valley. From the Falls the river continues on a relatively steep grade to Kawerau township.

Figure 2



The Upper Reach of the Tarawera River and its tributaries contain organisms and plants indicative of a clean water environment. The water quality of the catchment of the Upper Reach of the Tarawera River, especially above the Tarawera Falls, can generally be described as being close to its natural state. This is supported by the high dissolved oxygen concentration, low water and sediment BOD and general high visual clarity of the water. The Upper Reach of the Tarawera River and its tributaries are spawning grounds for trout and habitats for a range of indigenous adult fish species.

The catchment of the Upper Reach of the Tarawera River is recognised as having important natural character and amenity values, such as trout fishing, canoeing and hiking. The quality of water from the Tarawera Falls to Kawerau and in the tributaries in the catchment of the Upper Reach of the Tarawera River is influenced to some extent by adjacent exotic plantation forestry operations, though it is still of high quality. There is some natural geothermal fluid discharge along the Tarawera River upstream of Kawerau, as well as geothermal inputs along the Managakotukutuku and Waiaute tributary streams.

The Tarawera River is characterised by relatively steady flows due to the effect of storage of Lake Tarawera and its tributary lakes and the "sponge" effect of the pumice soils in the catchment. The quantity of water in the Upper Reach of the Tarawera River has dropped over the past two decades. Changing vegetation cover from scrub, pasture and bare land to exotic plantation forestry, especially in the catchment of the Upper Reach of the Tarawera River, along with natural re-growth, and a regional rainfall decline, has resulted in reduced flows in the Tarawera River. This reduction has affected the ecology of the river and its tributaries and wetlands. Any reduction in water flow will place constraints on downstream users, especially iwi and also recreational and industrial users. Due to the wholistic view held by iwi with regards to the protection of the river, they feel constrained in their ability to abstract water upstream of the mills recognising that this would affect the assimilative capacity of the river downstream.

Although afforestation has had a negative impact in reducing water yield, it has at the same time had the positive effect of reducing the potential of flooding in the Lower Reach of the Tarawera River. Afforestation is thought to have reduced flood flows more than low flows. The Tarawera River now exhibits few peaks in its flows and smaller variations. In other words, the river flow has become steadier, but at lower levels[6]. Large scale exotic forestry planting has also had the beneficial effect of stabilising erosion on the light volcanic ash soils. In a number of areas significant tributary stream wash-outs have been extensively controlled as a result of exotic forestry plantation.

As well as diffuse geothermal discharges to the river and some of its tributaries, the catchment of the Upper Reach of the Tarawera River includes one significant geothermal field, the Rotoma/Tikorangi (Puhipuhi), which, by September 1996 had not been commercially exploited. Kawerau township which was built in the 1950s to house employees at the two pulp and paper mills is located at the northern edge of the catchment of the Upper Reach of the Tarawera River.

6.4 The Catchment of the Lower Reach of the Tarawera River

For the purposes of this regional plan the catchment of the Lower Reach of the Tarawera River is the catchment area downstream from the Kawerau Road Bridge across the Tarawera River to the Thornton Road Bridge across the Tarawera River, which is the Coastal Marine Area boundary with the Pacific Ocean, as shown in Map 2. The main stem of the Ruruanga Stream is included in the catchment of the Lower Reach of the Tarawera River, from its confluence with the Waikanapiti Stream to its confluence with the Tarawera River. The watershed of

[6] Pang, L, 1993, Report 93-2.

the Manawahe Hills marks the western extremity of the catchment of the Lower Reach of the Tarawera River, while the eastern side of the catchment of the Lower Reach of the Tarawera River abuts the western banks of the Rangitaiki River.

The Lower Reach of the Tarawera River flows past the farming communities of Otakiri and Awakaponga, before flowing into the Pacific Ocean just east of Matata township. Several tributaries and drains feed into the river near the mouth of the river, contributing agricultural point-source and diffuse discharges to the Tarawera River. Edgecumbe township has been included in the coverage of this regional plan as both town stormwater and treated sewage run into the Omeheu/Awaiti Canal system that drains into the Tarawera River. Although effluent whey from the Bay Milk Products Limited (Bay Milk) is spray irrigated onto land that drains towards the Tarawera River, all direct production effluent and stormwater drainage from that plant goes into the Rangitaiki River catchment.

The geology of the Rangitaiki Plains includes river transported pumice and silts interspersed with wetland materials (peats) and old beach and sand dune deposits. The plains are flanked on the east by the greywacke basement rocks of the Raungaehe Ranges and in the west by the volcanic/sedimentary sediments of the Kaharoa Plateau and Manawahe Hills. Geological investigation suggests that the Whakatane Graben that underlies the Rangitaiki Plains is subsiding at 2 to 3 mm a year, while the hills to both the east and the west are being forced upwards some indeterminate millimetres each year[7].

In addition to this subsidence and uplift, according to geodetic surveys, the land surface within the Rangitaiki Plains was extended horizontally at a steady rate of 7 millimetres a year over a forty-year period before 1987. Further evidence of the uplift and subsidence has been provided by the discovery of marine fossils both in the hills surrounding the Rangitaiki Plains and in bore holes drilled within the plains. The marine sand of the Rangitaiki Plains is overlain by volcanic ash deposits from the Taupo, Kaharoa and Tarawera eruptions[8].

The catchment of the Lower Reach of the Tarawera River is largely low-lying former wetlands, the Rangitaiki Plains, which are intensively farmed for dairying in particular. The Rangitaiki Plains are characterised by high groundwater levels and a large portion of the area is artificially drained for agricultural purposes. In this reach river gradient is low and the river moves relatively slowly. The current (1984-92) mean annual flow of the Tarawera River at Awakaponga is 26.2 cubic metres per second. The 7 day low flow (1984-92) is 20.9 cubic metres per second.

At Kawerau, approximately 10% of the mean annual flow of the Tarawera River is abstracted for use by Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue[9]. The water quality and biological conditions of the river are significantly different below the wastewater discharge points of the Tasman Pulp and Paper Company Limited[10] and Carter Holt Harvey Tissue[11] pulp and paper mills. The water below the discharge points is now significantly discoloured and gives off an odour typical of that associated with chemical pulp and paper mills. The Lower Reach of the Tarawera River and the remaining associated wetlands are characterised to varying degrees by low concentrations of dissolved oxygen,

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7 Gibbons, 1990.

8 Gibbons, 1990.

9 Kawerau township takes its water from local bores.

10 The Tasman Pulp and Paper Company Limited discharges its waste to the Tarawera River under conditions granted by the Water Resources Council in terms of the Tasman Pulp and Paper Company Limited Enabling Act 1954. The Enabling Act expired in 1995.

11 Carter Holt Harvey Tissue pulp and paper wastewater treatment facilities also process and discharge sewage from Kawerau township to the Tarawera River.

increased temperature, increased chemical and microbial contaminants, and a highly mobile bed.

The drainage of the Rangitaiki Plains in the early 1900s and the decision to locate major pulp and paper industries in Kawerau in the early 1950s have made significant changes to the Lower Reach of the Tarawera River in the last century. The effluent discharged from the pulp and paper mills has had a significant impact on traditional Maori food sources in the river. Mill effluent makes the river unavailable for traditional Maori food gathering. The effluent, combined with geothermal discharges and a highly mobile pumice riverbed, cause a restricted aquatic environment. There is little or no benthic vegetation in this section of the river and the fauna that is present consists principally of types indicative of reduced in-river aquatic habitat. This makes the river unattractive for recreation and traditional Maori food gathering. Extensive willow growth alongside and in the Lower Reach of the Tarawera River also acts as a barrier to public access and use. The water quality in the Lower Reach of the river is improving but there remains a belief that the health and safety of the local inhabitants and visitors who use the river is at risk.

The catchment of the Lower Reach of the Tarawera River includes a number of small lakes and wetlands areas associated with the Tarawera River (Appendix 6, Map 6). The biggest of these is the Matata Lagoon at the mouth of the Tarawera River. These wetlands are the last remaining (1-2%) wetland land areas of what was previously a continuous wetland on the Rangitaiki Plains. The wetlands are important for cultural, traditional, ecological, aesthetic, historical and recreation reasons. Some of these are also in danger of being perched, or left dry due to an inadequate water supply from the Tarawera River or canals on the Rangitaiki Plains. Point and diffuse discharges to the Tarawera River and canals on the Rangitaiki Plains result in significant pollution of the wetlands associated with the Tarawera River.

The Kawerau Geothermal Field, centred just north of Kawerau township, supplies steam to the Tasman Pulp and Paper Company Limited mill for process heat and power generation. Steam condensate provides a source of boiler feed water and is not discharged to the river under normal conditions. Heat energy is extracted from the waste geothermal water for power generation by a number of small power plants. The water is further cooled before discharge into the Tarawera River. Natural geothermal inflows occur in the Ruruanga Stream and the Tarawera River as it passed through Kawerau, contributing to the geothermal constituents already present in the river.

A 30 square kilometres mesotrophic peat deposit containing some 18 million cubic metres of mineralised deposits, Tarawera and Kaharoa ash with white pumiceous Taupo pumice at depth, is considered to exist in the lower reaches of the Tarawera River. Smaller outcrops occur to the east in the vicinity of Edgecumbe and Awakeri. There is ongoing debate over the impact of peat deposits on the river. Overall it is likely that peat would have some minor effect on the oxygen levels, colour and clarity of the river.

The soil patterns of the Rangitaiki Plains are based on the infill of pumiceous material, carried and deposited by a partially-locked river system. Infilling, wetland growth, subsidence and more infill behind the coastal sand dunes have been continuing for thousands of years. The mobile pumice bed of the Tarawera River results in significant siltation in the lower river, which has raised the bed so that it is higher than the surrounding land. Today the country surrounding the Tarawera and Rangitaiki Rivers is protected from flooding by a network of stopbanks. Drains and canals have been constructed to take surface runoff to outlets close to the Tarawera River mouth at Matata.

In the past fifteen years horticultural development has taken place with the introduction of kiwifruit, citrus orchards and vegetable crops, especially in the northern Rangitaiki Plains. Horticulture has led to demand for an increased depth

of drainage on some parts of the Rangitaiki Plains to a horticultural standard. In the Manawahe Hills (coastal hill country) production forestry and woodlot planting have been increasing, replacing sheep and beef farming[12]. It can be expected that, as in the past, fluctuations in international trading conditions will continue to cause medium term "fashion" changes in land use.

6.5 The Tarawera River Mouth

The Tarawera River mouth is that area downstream of the Thornton Road bridge across the Tarawera River east of Matata. This area falls within the coastal marine area and its management is covered by the *Bay of Plenty Regional Coastal Environment Plan*.

The present river channel to the Pacific Ocean was constructed in 1917 for drainage purposes. The Tarawera River previously flowed through the Matata Lagoon then out to sea at a portage situated opposite the old Matata Post Office. The channelling of the river directly to the Pacific to bypass the lagoon, the build-up of sediment from the steep surrounding catchments, the discharge of solids in the mill effluent and the lack of flushing due to the reduction of river flow volume has ultimately resulted in the Matata Lagoon becoming silted. The channelling has eroded and continues to erode an urupa on the eastern side of the current river channel near the river mouth that is of significant cultural importance to Tuwharetoa and related iwi. The pollution of the river water also contributes to the degradation of the urupa.

Tidal influence on water level is noticeable for approximately two kilometres upstream of the river mouth. The degree of saltwater penetration is expected to be variable, with the greatest penetration occurring on spring tides under conditions of low river flow.

The Tarawera River mouth shows very few estuarine characteristics. It is considered that the largely freshwater environment, with only temporary incursion of saline waters, is too unstable for the establishment of estuarine organisms. The rush *Juncus maritimus var australiensis* is the only 'estuarine' plant growing in the estuary.

[12] Groundwater Consultants, 1984, 1.