15 Surface Water Quality

15.1 Introduction

This chapter sets out the primary issues relating to water quality in the catchment. It includes a series of objectives and policies, and methods of implementation. The methods of implementation include water quality classifications and related rules.

The water bodies of the Tarawera River catchment exhibit a wide range of water quality, from what can be described as pristine, such as in the Upper Reach of the Tarawera River above Kawerau and in Lake Okataina, to the degraded, in the Lower Reach of the Tarawera River, downstream of Kawerau. Water quality is influenced by a number of factors, some naturally occurring. The main degradation of the quality of water in the Tarawera River below Kawerau results from industrial processing and discharges from geothermal sources.

In the *Tarawera River Management Plan* of 1985, the three main water quality issues in the Lower Reach of the Tarawera River were colour, dissolved oxygen and toxicity. There has been no change in the three main issues since that time. However, the high adverse impact that low dissolved oxygen has on river ecology is now better understood. As a result, this regional plan has specific policy to ensure that remedial action takes place to enhance dissolved oxygen content in the lower river.

The primary water quality issue in the Tarawera Lakes and their catchments is the impact of development on water quality and quantity. In both the lakes and upper river catchments a major cause for concern is the effect of removing vegetation cover, primarily from pasture, scrub and exotic plantation forestry areas. Increased water flow and changes in nutrient balance are possible outcomes. Potential adverse effects from forestry logging operations have generally been minimised due to the adoption of forestry codes of practice, the establishment of riparian margins and other related measures.

Water quality in the Lower Reach of the Tarawera River is adversely affected by the pulp and paper industry and geothermal discharges from both natural and industrial sources (Map 7). In addition there are diffuse and point-source discharges associated with agriculture which adversely affect water quality in the drains and canals on the Rangitaiki Plains. These discharges contribute to water discolouration, significant reductions in dissolved oxygen content, objectionable odour and increases in temperature in the drains and associated wetlands.

These concerns all have an adverse effect on the environment. They can cause adverse effects on ecosystems and their constituent parts, including people and communities; natural resources; amenity values; and related social, economic, aesthetic and cultural conditions.

15.2 Values Associated with Water Quality

It is not so long ago that large water bodies were considered as convenient sinks for the disposal of treated and untreated industrial, agricultural, and municipal effluent. This was an adopted practice and little concern was raised about small streams and rivers being used for the disposal of agricultural wastewaters, and the effects on aquatic ecosystems.

As the effects of contamination on the environment, particularly of water bodies, have become more apparent over the past thirty years, attitudes have changed significantly. As a result, the discharge of sewage (treated or untreated) and industrial and agricultural effluent, into rivers and coastal waters is now much less

acceptable. Changes in public attitude towards the environment have led to higher standards of wastewater treatment and the investigation of alternative disposal methods (e.g. land based spray irrigation). These changes have been reflected in the Resource Management Act which adopts a sustainable and holistic approach to environmental management and recognises traditional Maori attitudes and values towards resource management.

Tangata whenua values associated with water are intrinsically woven into their culture including passive, recreational, religious, food harvesting, clothing, transport, physical and spiritual activities. Water in the catchment is valued by agricultural, horticultural, industrial, and domestic consumers. Their uses of the water include drinking supplies for households and stock, irrigation supplies for pasture and crops, and a means of disposal of treated farm and industrial effluent. Stock owners require water to be of a suitable standard for farm animals to drink. Large amounts of water are essential for pulp and paper production. Recreational use of the lakes, rivers and wetlands in the Tarawera River catchment includes primary contact with water such as fishing, canoeing, boating, water skiing and swimming. For activities such as picnicking and sightseeing, water bodies form part of the landscape to be enjoyed.

It should be noted that the Health Department advises people not to use the water from the Rotorua Lakes, or their tributaries or outflow rivers, for consumption without first purifying it. The reason for this is that the catchment of the lakes and their streams is uncontrolled, with access by domestic and feral animals, waterbirds, and farm runoff. Some lake environments are also receiving waters for domestic effluent treatment systems. The lakes are known to contain the *Giardia* organism.

More specific information relating to community attitudes and perceptions is contained in Chapter 7 – *Community Attitudes and Perceptions*. Community attitudes and perceptions are particular to certain aspects of water quality in the Tarawera River catchment and are discussed under the relevant sub-headings below.

15.3 Water Quality Monitoring

Environment Bay of Plenty is the primary agency responsible for promoting the sustainable management of surface water quality within the catchment. Since its inception as a regional council, Environment Bay of Plenty has significantly increased its sampling and investigation of water quality related factors within the Tarawera River catchment. Sampling and investigation work have been concentrated in the Lower Reach of the Tarawera River.

As part of its Natural Environment Regional Monitoring Network, Environment Bay of Plenty maintains nine lake water quality monitoring sites. There are also six river sites; three gauged water quality monitoring sites in the Lower Reach of the Tarawera River, two water quality sites with flow recorders (one each in the Upper and Lower Reach of the Tarawera River) and one water quality monitoring site in the Matata Lagoon (Map 6). NIWA also maintains water quality monitoring sites in the Upper and Lower Reaches of the Tarawera River[75].

Information from the water quality monitoring sites is used to maintain a constant record of water quality, particularly of dissolved oxygen content in the Lower Reach of the Tarawera River. As well as undertaking extensive testing of water quality at its Whakatane headquarters, Environment Bay of Plenty also contracts specialist agencies such as NIWA, ESR[76] and university research centres to provide more specific information relating to toxicity and water chemistry. Environment Bay of Plenty maintains a compliance monitoring programme aimed at ensuring that the taking and discharging of water and contaminants are within the limits specified in

[75] Part of the National Monitoring Network.
[76] Institute for Environmental Health and Forensic Science Limited.

the respective consents, or as other permitted by Environment Bay of Plenty's various regional plans, or the Resource Management Act 1991.

Environment Bay of Plenty will seek to use accepted contemporary research standards and protocols to provide comparable high quality research results. To achieve quality and comparable results, Environment Bay of Plenty may adopt international or agency standards or protocols, including those developed and used by OPEC, USEPA, ANZEC or any other national standard. When considering the benefits of adopting any new standard or protocol, Environment Bay of Plenty will have regard to the need to relate results over time so that comparisons can be made and changes validly detected.

15.3.1 Effects on Water Quality

Water quality in the Tarawera River catchment can be adversely affected by natural or human-induced occurrences. Increased siltation due to increased river flows or flooding is an example of a natural occurrence (natural perturbation). In assessing the effect of human-induced discharges to water bodies, regard must be had to natural occurrences, such as natural changes in water temperature, and the occurrence of natural geothermal discharges. 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.

Adverse effects on water resulting from human-induced activities can occur through both point-source and diffuse discharges. There are a number of point-source discharges in the Tarawera River catchment which have an adverse effect on water quality. A list of current consents relating to the Tarawera River catchment is available from Environment Bay of Plenty on request.

Non-point source discharges primarily relate to runoff from agricultural and afforested areas and urban settlements and leachate from septic tanks and rubbish dumps. These sources of contaminants are more difficult to quantify. Discharges, either individually or cumulatively, point-source or diffuse, can adversely affect water quality, for a number of different water quality factors, as discussed in section 15.4 of this plan.

15.4 Water Quality Factors

15.4.1 Oxygen Content

The concentration of oxygen in water is a primary factor which determines the life-supporting capacity of a water body. Dissolved oxygen (DO) levels vary depending on temperature, the biochemical oxygen demand (BOD_5) load and the rate at which water re-aerates from the atmosphere.

The upper reaches of rivers commonly exhibit a high dissolved oxygen content of about 10 grams per cubic metre or more than 80% of the saturated concentration. The concentration can be reduced in the lower reaches of rivers, due to greater biochemical oxygen demand, a lower re-aeration rate and increased water temperature. Commonly, oxygen concentrations rise during the day as a result of the photosynthetic activity of aquatic plants and fall at night as a result of plant (including algal) respiration. This is termed diurnal dissolved oxygen fluctuation[77].

In the Upper Reach of the Tarawera River and its tributaries, the concentration of dissolved oxygen is usually greater than 9 grams per cubic metre, or above 80% saturation. At this level the existence of all indigenous and exotic fish species is considered to be sustainable. In particular, this level is considered important for

[77] The diurnal variation in the lower Tarawera River caused by aquatic plants averages 1 grams per cubic metre although at times it reaches 1.5 grams per cubic metre (Rutherford, J C 1993(a) and (b), April and September).

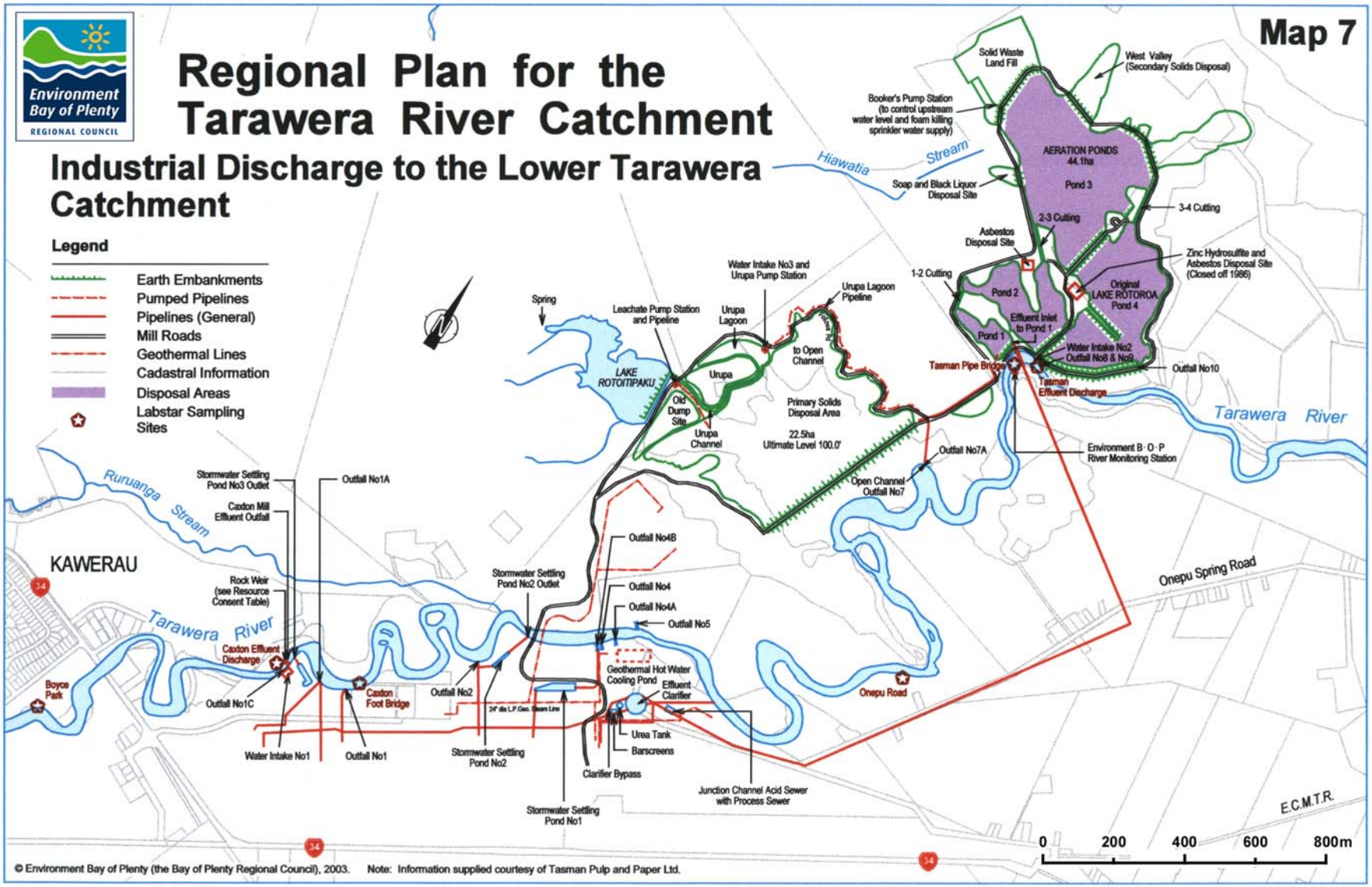
trout spawning, having regard to the lower levels of dissolved oxygen that occur in river gravels. Significant parts of the Upper Reach of the Tarawera River and its tributaries are trout spawning areas.

Dissolved oxygen reduces in a systematic pattern in the Lower Reach of the Tarawera River, as shown in Figure 8. The lowest dissolved oxygen level is always at Matata. In 1994, the lowest recorded level at Matata for a 15 minute interval recording was 2.5 grams per cubic metre, while the highest levels recorded at the same site were between 7 and 8 grams per cubic metre. The pattern of dissolved oxygen depletion was nevertheless always as shown in Figure 8. Trout are known to show a reduction in growth rate when dissolved oxygen concentrations average less than 6 grams per cubic metre. [78]

Awakaponga has been the long-term site for flow measurement in the lower reaches of the Tarawera River because it is above the influence of the tidal rise and fall in water level. Originally, because of security and to make use of already installed telemetry equipment, dissolved oxygen and temperature monitoring equipment was installed at the same site as the flow recorder. However, it was found that the dissolved oxygen continued to decrease beyond Awakaponga and the concentration at Matata was always the lowest in the river. To gather technical data for this regional plan, a dissolved oxygen and temperature monitoring site was established at Matata. The dissolved oxygen modelling of Dr J Rutherford and the revised BOD_5 limits are based on dissolved oxygen levels at Matata, where the situation was worst.

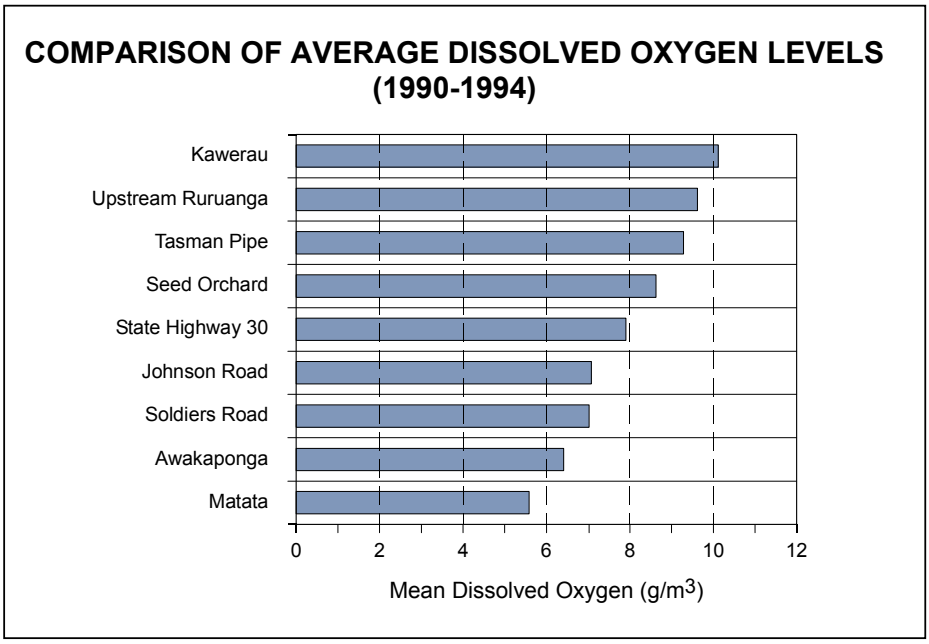
The low levels of oxygen in the Lower Reach of the Tarawera River are directly attributable to the discharge of effluents containing high BOD_5 loads. The notable discharges are from the Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue pulp and paper making facilities. The combined BOD_5 of the discharges is of the order of 5 to 7 tonne per day (Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue 1993 average). A list of current consents relating to the Tarawera River catchment is available from Environment Bay of Plenty on request. The breakdown of organic matter BOD_5 in these discharges by micro-organisms utilises the dissolved oxygen of the river at a rate faster than natural re-aeration replenishes dissolved oxygen.

[78] USEPA 1986.


Map 7
Regional Plan for the Tarawera River Catchment
Industrial Discharge to the Lower Tarawera Catchment
Environment Bay of Plenty
REGIONAL COUNCIL
Legend
Earth Embankments
Pumped Pipelines
Pipelines (General)
Mill Roads
Geothermal Lines
Cadastral Information
Disposal Areas
Labstar Sampling Sites
Solid Waste Land Fill
West Valley (Secondary Solids Disposal)
Booker's Pump Station (to control upstream water level and foam killing sprinkler water supply)
Hiawatia Stream
Soap and Black Liquor Disposal Site
AERATION PONDS 44.1ha
Pond 3
3-4 Cutting
2-3 Cutting
Asbestos Disposal Site
Zinc Hydrosulfite and Asbestos Disposal Site (Closed off 1986)
1-2 Cutting
Pond 2
Original LAKE ROTOROA Pond 4
Effluent Inlet to Pond 1
Pond 1
Water Intake No2 Outfall No8 & No9
Outfall No10
Tasman Pipe Bridge
Tasman Effluent Discharge
Water Intake No3 and Urupa Pump Station
Urupa Lagoon Pipeline
Spring
Leachate Pump Station and Pipeline
Urupa Lagoon
to Open Channel
LAKE ROTOITIPAKU
Urupa
Old Dump Site
Urupa Channel
Primary Solids Disposal Area
22.5ha Ultimate Level 100.0'
Outfall No7A
Open Channel Outfall No7
Environment B·O·P River Monitoring Station
Tarawera River
Ruruanga Stream
KAWERAU
Stormwater Settling Pond No3 Outlet
Outfall No1A
Caxton Mill Effluent Outfall
Rock Weir (see Resource Consent Table)
Caxton Effluent Discharge
Boyce Park
Outfall No1C
Caxton Foot Bridge
Water Intake No1
Outfall No1
Outfall No2
Stormwater Settling Pond No2
Stormwater Settling Pond No1
Stormwater Settling Pond No2 Outlet
Outfall No4B
Outfall No4
Outfall No4A
Outfall No5
Geothermal Hot Water Cooling Pond
Effluent Clarifier
Urea Tank
Barscreens
Clarifier Bypass
Junction Channel Acid Sewer with Process Sewer
Onepu Spring Road
Onepu Road
E.C.M.T.R.
0 200 400 600 800m
© Environment Bay of Plenty (the Bay of Plenty Regional Council), 2003. Note: Information supplied courtesy of Tasman Pulp and Paper Ltd.

C1623-7

Figure 8



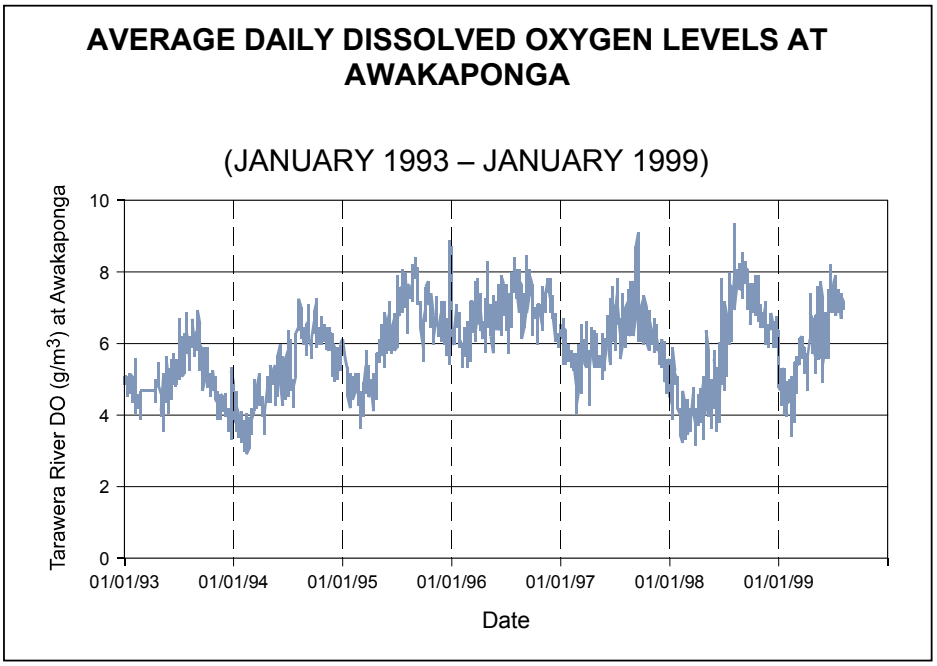
The adverse effect of the discharge of industrial effluent to the Lower Reach of the Tarawera River is exacerbated by the highly-mobile pumice bed which acts as a medium supporting a large active biological community. The rate of consumption of oxygen by this huge biomass has been found to greatly exceed that of previously studies rivers.

The industrial discharges lead to an increase in the temperature of the Lower Reach of the Tarawera River of about 2°C. This temperature increase on its own would have the effect of decreasing the dissolved oxygen content of the Lower Reach of the Tarawera River[79], by a factor of approximately 0.4 grams per cubic metre.

The averaged dissolved oxygen content of the Lower Reach of the Tarawera River has dropped since 1985, when the former *Tarawera River Management Plan* was introduced by the then Bay of Plenty Catchment Commission. In that plan the Bay of Plenty Catchment Commission established a dissolved oxygen standard of 5 grams per cubic metre. It recognised that this standard may be breached for short periods during a "two year surveillance period". The plan recommended that on each occasion that the dissolved oxygen level fell below 5 grams per cubic metre at the Awakaponga gauging site *"a comprehensive report shall be prepared by each company and be submitted to the Regional Water Board"* (now part of Environment Bay of Plenty). The 5 grams per cubic metre standard has generally been breached during summer months, as indicated by Figure 9.

[79] It is estimated that for every 1°C increase in temperature, the dissolved oxygen content in water reduces by approximately 0.2 g/m^3.

Figure 9



The annual mean dissolved oxygen content of the Lower Reach of the Tarawera River has been declining since 1991 and during the 1991, 1992 and 1993 summer periods, the dissolved oxygen concentration reached critical levels on several occasions. The annual mean dissolved oxygen content improved during 1995 and 1996. During the summer of 1998 and 1999 very low oxygen levels were measured in the lower river. Oxygen injection was not used continuously during the 1998 and 1999 summers. In previous years it had been used continuously. Effluent treatment strategies to reduce the summer BOD load on the river are planned by the pulp and paper companies.

Through evaluation and research into effects, Environment Bay of Plenty believes that the low dissolved oxygen levels in the Lower Reach of the Tarawera River are the most significant issue requiring remedial action.

Environment Bay of Plenty identified four primary alternatives for dealing with dissolved oxygen:

1 Retain the status quo within the catchment but maintain the absolute minimum dissolved oxygen level at 5.0 grams per cubic metre in the Lower Reach of the Tarawera River.

2 Have no specific classification.

3 Establish lower or higher dissolved oxygen content standards.

4 Establish dissolved oxygen classification standards specific for fish purposes in the Lower Reach of the Tarawera River.

15.4.1(a) Oxygen Content – Selected Management Alternative

Environment Bay of Plenty selects the fourth alternative, to establish dissolved oxygen classification standards specific for Fish Purposes in the Lower Reach of the Tarawera River.

Environment Bay of Plenty proposes that the dissolved oxygen in waters being managed in their natural state in the Tarawera Lakes catchments, excluding Lake Okaro, should be maintained at above eighty percent saturation. These standards

apply after allowing for reasonable mixing and natural perturbations (see Rule 15.8.4(b)). Environment Bay of Plenty does not consider it appropriate to establish a dissolved oxygen classification for Lake Okaro, which is being managed for contact recreation purposes, due to the significant naturally occurring fluctuation in dissolved oxygen.

Environment Bay of Plenty proposes that the waters of the Upper Reach of the Tarawera River, the tributaries of the Tarawera River (excluding the drains and canals on the Rangitaiki Plains, but including the tributaries of the Lower Reach of the Tarawera River) and the tributaries of the Tarawera Lakes catchments, be managed for fish spawning purposes, with dissolved oxygen concentrations maintained at above eighty percent saturation (see Rule 15.8.4(f)(i)).

Taking into account the aspirations of the community and the Tarawera River Liaison Group, Environment Bay of Plenty proposes that the oxygen content in the Lower Reach of the Tarawera River should be maintained at a level that ensures that stress on fish in the river is kept to a minimum (to meet the FPLT classification standard). In this context, fish purposes criteria are established in water quality classification standards for the Lower Reach of the Tarawera River. The classification standards promote limits required for the health and fertile wellbeing of those fish species that could be expected to freely inhabit the Tarawera River. Consequently, dissolved oxygen concentrations for the Lower Reach of the Tarawera River are to be introduced in three stages. These will require:

(a) That until 31 December 2002 the dissolved oxygen be maintained at or above 5.0 grams per cubic metre for the mean of any consecutive 30 days, 4.0 grams per cubic metre for the mean minimum of any consecutive seven days and 3.5 grams per cubic metre as an absolute minimum;

(b) That from 1 January 2003 the dissolved oxygen be maintained at or above 6.0 grams per cubic metre for the mean of any consecutive 30 days, 5.0 grams per cubic metre for the mean minimum of any consecutive seven days and 4.5 grams per cubic metre as an absolute minimum;

Introducing standards over two stages is considered to be necessary to allow current dischargers to implement alternatives and put in place new technology, procedures, agreements etc. (See Rule 15.8.4(h)(i)).

15.4.1(b) Oxygen Content – Supporting Technical Reports

The following technical reports, prepared as part of the preparation of this regional plan, contain more detailed information on oxygen content in the Tarawera River:

Dell, P M 1993, Tarawera River: Dissolved Oxygen Levels, A report to the Chairman and members of the Environmental Monitoring Committee meeting of 16 March 1993, Environment Bay of Plenty.

Environment Bay of Plenty 1994 (February), Oxygen Summary for Tarawera River Produced by Environment Bay of Plenty for the Tarawera River Liaison Group meeting – *Unpublished*.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

Rutherford, J C 1993 (September), Revised BOD Limits for the Tarawera River, Prepared for Environment Bay of Plenty by NIWA Ecosystems, Hamilton.

Rutherford, J C 1994 (July), Tarawera River Management Plan, Revised BOD loads based on USEPA dissolved oxygen criteria, NIWA.

15.4.2 Colour and Clarity

The principal water quality concerns of the local community are the colour and clarity of the water in the Lower Reach of the Tarawera River. Colour and clarity describe two main aspects of water appearance, and relate directly to the visual and aesthetic values of water. Colour is the effect on the human eye of reflected light energy. Visual clarity relates to the maximum distance at which objects can be viewed through the water. Variations in colour and clarity are caused by dissolved, colloidal and suspended material in the water.

The protection of the optical properties of aquatic ecosystem waters is required for three main reasons:

(i) A number of predatory fish, such as trout and smelt, rely upon the clarity of the water to be able to see their prey.

(ii) A reduction in the light penetration into a water body will have harmful effects on phytoplankton, macrophytes, and benthic plants, ultimately adversely affecting biodiversity. The colour of water may also affect aquatic ecosystems by influencing the spectral distribution of underwater light available for photosynthesis and illumination.

(iii) The discolouration of water bodies is often considered aesthetically displeasing, being associated with contamination, and inhibits people from bathing or enjoying other recreational pursuits. In the 1993 survey of *Attitudes and Perceptions Towards the Tarawera River and its Catchment*, the colour of the Lower Reach of the Tarawera River was raised as an issue of concern by 27% of respondents. When prompted, 72% of respondents said they were concerned about the colour of the river.

The dark colour of the Lower Reach of the Tarawera River is caused by the discharge of lignin and carbohydrate degradation products from pulp and paper production. Much of the colour produced in the pulping process is recycled and combusted during the kraft chemical recovery cycle. Most of the colour which appears in mill effluent comes from the bleaching process, which produces the white paper product demanded by consumers. Removal of colour from mill discharges is a worldwide problem. 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 1985 *Tarawera River Management Plan* introduced a timetable for the removal of colour from the Lower Reach of the Tarawera River, staged in five-year intervals. Platinum-cobalt units were adopted as the measure for assessing colour. The 1985 plan required a decrease from 80 platinum cobalt units in 1985 to less than 10 units by 2005. The colour reduction to date has been in line with this timetable.

The Tasman Pulp and Paper Company Limited, in particular, have made significant advances over the past ten years to reduce the colour content of their effluent. This has included the introduction of oxygen delignification, chlorine dioxide substitution and a bleaching sequence change that has substantially reduced the colour load. Unfortunately, by 1994, the major reductions in the discharge of colour made by Tasman Pulp and Paper Company Limited were not obvious or striking to the eye, due to the large percentage of colour which needs to be removed before a change becomes evident.

In order to produce a noticeable improvement in colour, more than 90% of the colour must be removed from the wastewater stream[80]. For a high volume dilute effluent such as that produced by Tasman Pulp and Paper Company Limited, 90% colour removal would require significant capital expenditure to achieve. In-mill modifications to bleaching processes may be the most cost-effective means of colour abatement, with "end-of-pipe" effluent treatments used as back-up.

Many parameters are involved in determining and describing the colour and clarity of natural waters. Following Ministry for the Environment guidelines[81], Environment Bay of Plenty has used black disc, Munsell Hue, and absorption measurements.

15.4.2(a) Black Disc (Visual Clarity)

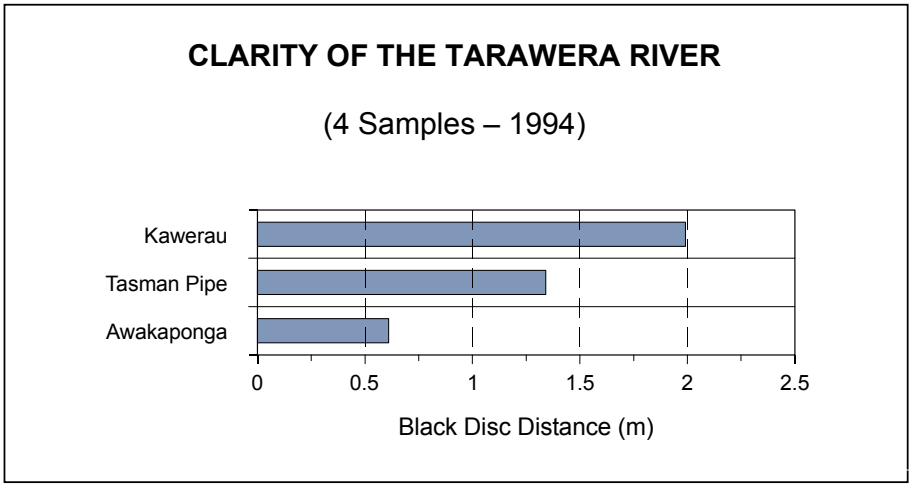
Visual clarity has been measured in the Tarawera River by means of the sighting distance of a black disc. The disc is viewed horizontally under water through an inverted periscope. The black disc distance in metres at which the disc just disappears from sight.

In the lakes of the upper catchment, black disc measurements are commonly in the range of 5 to 10 metres, dependent on the lake being surveyed.

Black disc readings from the Tarawera River indicate that clarity is much reduced with distance downstream. For example, at the Lake Tarawera outlet, black disk clarity averages 6.6 metres, more characteristic of lake water than of river water at this site. At the Kawerau Bridge site the range reduces to an average of 2.7 metres, which is more characteristic of river water (Figure 10). The change in clarity between these two locations is primarily attributed to natural occurrences, such as the cumulative effects of natural erosion and biological matter entering the waterway.

The Tasman Pulp and Paper Company Limited Pipe site shown on Figure 10 is below the effluent discharge point from Carter Holt Harvey Tissue and geothermal inputs, but upstream of the Tasman Pulp and Paper Company Limited effluent discharge.

Figure 10



At the State Highway 30 Bridge and at Awakaponga, below all the major discharges to the Tarawera River, the visual clarity of the water averages 0.7 metres when the black disc technique is used. While there may be some natural

[80] Davies-Colley *et al*, 1994.

[81] Resource Management Water Quality Guidelines No. 2: "Guidelines for the Management of Water Colour and Clarity, MfE, June 1994.

influences such as leaching from peat soils, changes to colour and visual clarity in most of the Lower Reach of the Tarawera River are primarily attributable to the discharge of pulp and paper mill effluent.

15.4.2(b) Munsell Hue (Colour Measurement)

Hue describes the colour of the water. Environment Bay of Plenty has chosen to use the Munsell Colour Units to describe hue. The Munsell technique compares water colour with an extensive chart of graded colour variants[82]. The hue of water depends on the wavelength of light back scattered within the water. The Munsell Hue scale is broadly defined in Table 11.[83]

Table 11

MUNSELL HUE SCALE AND SUITABILITY OF WATERS FOR BATHING

Munsell-Hue Units	Munsell-Hue Colour	Suitability for Bathing Purposes
50-60	Blue-Green	Eminently suitable for use
40-50	Green	Suitable for use
30-40	Green-Yellow	Marginally suitable for use
20-30	Yellow	Unsuitable for use
10-20	Orange	Totally unsuitable for use

Davies-Colley, R J et al., 1994 (August)

As another example pristine waters, such as some very clear lakes often appear blue-green. At the other end of the scale humic substances, which are contained in pulp and paper wastewaters, give a yellow/orange hue due to the absorption of blue light. In the Tarawera River so little light is reflected that the water appears black.

Munsell colour assessments were carried out on the Tarawera River in January 1990[84] and March 1994[85]. The findings of these surveys are recorded in Table 12. The same pattern of colour and clarity is apparent in the three surveys. The 1994 surveys were undertaken after Tasman Pulp and Paper Company Limited's bleaching processes had been altered to decrease chlorine bleaching and include oxygen-delignification. The increase in Munsell Hue at SH 30 between January 1990 and March 1994 may be an indication of colour improvement in the Tarawera River as a result of the Tasman Pulp and Paper Company Limited bleaching process changes.

82 Not unlike a colour charge one would use when buying paint.

83 Davies-Colley, R J et al, 1994 (August), Consultancy Report No. BRP 007.

84 Assessment detailed in Davies-Colley, 1990.

85 Assessment detailed in Davies-Colley *et al*, 1994.

Table 12

COLOUR (MUNSELL HUE) AND CLARITY (BLACK DISC)

(Comparative measurements made at three sites on the Tarawera River, on three different days)

Measurement Method	Kawerau Bridge (Boyce Park)	Tasman Pulp and Paper Company Limited Pipe Bridge	State Highway 30
10 January 1990 *			
Munsell Hue	50.0	42.5	20.0
Black Disc (m)	1.9	1.1	0.47
14 March 1994			
Munsell Hue	47.5	42.5	27.5
Black Disc (m)	3.25	2.2	0.67
16 March 1994			
Munsell Hue	45.0	41.3	26.3
Black Disc (m)	2.5	1.8	0.62

Davies-Colley (1990)

15.4.2(c) Absorption Coefficient (Light Absorption)

This is a calculation based on the amount of light absorbed when a beam of light is shone through a sample. Environment Bay of Plenty will utilise the absorption of coefficient of a filtered sample measured at a wavelength of 440 nanometres (nm) on a spectrophotometer as a suitable measure of colour in the Tarawera River[86].

The absorption coefficient is a more precise and convenient method to perform than other measurements, such as the platinum-cobalt method, and it relates more directly to the actual appearance of the water[87].

Figure 11 plots mean absorption coefficients at 440nm for filtered samples on six sites on the Tarawera River. The data are expressed in more detail in Table 13.

Two major discharges add substantial colour to the Tarawera River. Carter Holt Harvey Tissue discharges effluent into the river between the Kawerau Bridge and Upstream Ruruanga sites. Tasman Pulp and Paper Company Limited discharges effluent to the river downstream of the Tasman Pulp and Paper Company Limited Pipe site. The absorption response of river water can be clearly seen in Figure 11.

86 Davies-Colley *et al*, 1994.

87 Davies-Colley, 1990.

Figure 11

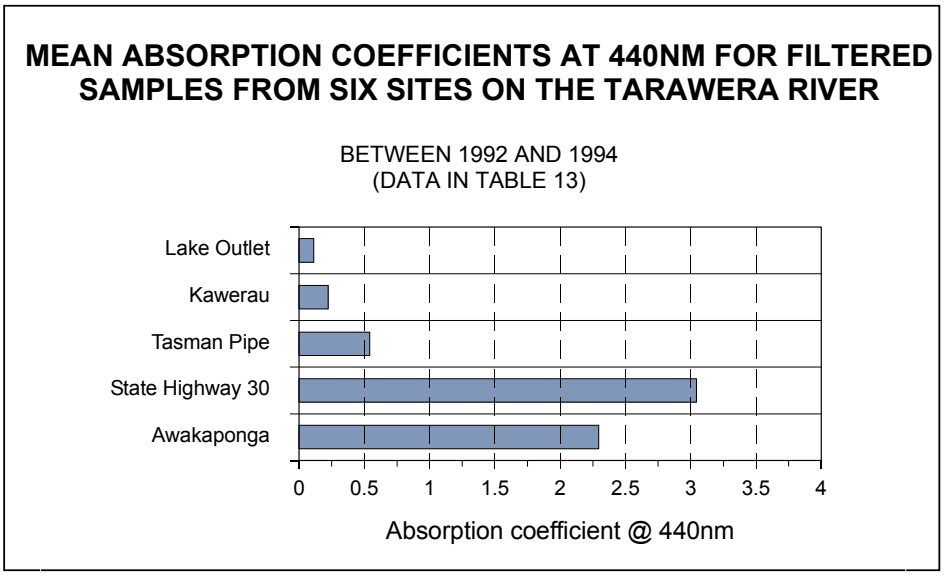


Table 13

ABSORPTION COEFFICIENT AT 440NM FOR TARAWERA RIVER SITES AND TWO EFFLUENT DISCHARGES BETWEEN 1992 AND 1994

(FOR FILTERED SAMPLES)

Site	Mean	Minimum	Maximum
Lake Outlet	0.11	0.00	0.23
Kawerau	0.22	0.00	0.50
Tasman Pulp and Paper Company Limited Pipe	0.54	0.00	2.13
SH 30	3.05	0.30	6.74
Awakaponga	2.30	0.30	6.05

15.4.2(d) Colour and Clarity – Selected Management Alternatives

Except in defined circumstances[88], sections 70(1)(d) and 107(1)(d) of the Resource Management Act 1991 restrict Environment Bay of Plenty from granting discharge permits which, after allowing for reasonable mixing, are likely to give rise to a conspicuous change in the colour or visual clarity of the receiving water (refer to section 15.7.1).

Environment Bay of Plenty proposes to develop quantitative standards for most of the water bodies in the catchment due to the subjectivity of purely visual assessments.

Environment Bay of Plenty has interpreted "conspicuous change in the colour or visual clarity of the receiving water" into those specific standards outlined in Rules

[88] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow for a conspicuous change in colour or visual clarity, if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

15.8.4(b), 15.8.4(d), 15.8.4(f), and 15.8.4(h). These standards apply after allowing for reasonable mixing of discharges and disregarding any natural perturbations, and have been set with regard to the purposes for which these water bodies are intended to be managed. These standards have been adopted in order to ensure the protection of the aesthetic quality of these water bodies and to protect aquatic life, including the food which trout feed upon.

In the Lower Reach of the Tarawera River, Environment Bay of Plenty has adopted quantitative standards in this regional plan which it considers will lead, in time, to discharges being visibly inconspicuous after allowing for reasonable mixing and natural perturbations.

Environment Bay of Plenty proposes that the discolouration of the Lower Reach of the Tarawera River caused by discharges from the Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue plants to be considered as an exceptional circumstance under section 107(2), of the Resource Management Act 1991, and be subject to compliance with staged standards designed to result in time in the reduction of colour, having regard to the colour standards of the former *Tarawera River Management Plan*, and supporting evidence from the companies.

15.4.2(e) Colour and Clarity – Supporting Technical Reports

The following technical reports were prepared and used to provide information for the development of this regional plan, and contain more detailed information on colour and clarity of water in the Tarawera River catchment:

Davies-Colley, R J	1990, Colour and Clarity Studies on the Tarawera River – New Methods applied to an Old Problem, Prepared for the Bay of Plenty Regional Council by the DSIR Water Quality Centre, Hamilton.
Davies-Colley, R J et al	1994 (August), Water Discolouration of the Tarawera River, Consultancy Report BPR 007 NIWA-Ecosystems Hamilton.
Donald, R	1993 (July), Bay of Plenty Regional Council, Natural Environment Regional Monitoring Network Freshwater Ecology Programme – Lakes Component 1991/92, Environment Bay of Plenty, Whakatane.
McIntosh, J J	1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.
Ministry for the Environment	1994(June), Resource Management Water Quality Guidelines No.2: "Guidelines for the Management of Water Colour and Clarity", Ministry for the Environment.

15.4.3 Toxicity

Concerns have been expressed about the toxic effects of industrial and natural discharges to the Tarawera River. In the previous Tarawera River Management Plan these concerns were not addressed. Over the last two years the technical investigations leading up to this regional plan have involved extensive scientific research into the toxicity of discharges to the river and the toxic effects in the river.

The findings were publicised and discussed over a two-day workshop held in Whakatane in May 1994[89].

In summary, the workshop showed that significant investigations had been performed in the last few years and were still being undertaken. It was made apparent that there was a natural change in water quality and ecology along the course of the river between the lake outlet and the river mouth at Matata.

Changes in mill processes at Tasman Pulp and Paper Company Limited were shown to have reduced the discharge of bioaccumulative chlorinated organic compounds markedly over the course of the two-year investigation. The levels of bioaccumulative compounds in sentinel mussels, caged eels and the eel populations of the Tarawera River were discussed in various presentations at the workshop. The effects of the river water at the coastal margin on marine shellfish and fish species were also presented. When Carter Holt Harvey Tissue commences sending its mill effluent to its spray irrigation disposal system, there is expected to be a measurable improvement in the dissolved oxygen levels in the Lower Reach of the Tarawera River.

The concerns of people in the Lower Reach of the Tarawera River who wish to irrigate pasture with river water were addressed in a presentation of the inorganic contaminants discharged to the river, mainly from geothermal sources. Elements of geothermal origin were not considered to be limiting with respect to pasture irrigation in the Lower Reach of the Tarawera River.

Constituents of the geothermal water can compromise aquatic ecosystems if present in sufficient concentration. Toxicity tests were carried out in a laboratory on three test species (an aquatic invertebrate, an alga and a bacterium), using geothermal wastewater diluted with river water[90]. The results showed that the concentration of geothermal wastewater necessary to produce a toxic effect in the three species is greater than would be found in river water. Arsenic and boron in the geothermal effluents were thought to be responsible for the observed toxicity[91].

Tarawera River water was also tested for toxic effects on the embryonic and larval stages of zebrafish in a laboratory situation. The water was aerated so that dissolved oxygen deficiency was not a factor in the test. Results showed no effects on the hatching success of newly fertilised eggs or on larval mortality in waters from effluent impacted sites. The experiments were repeated on 100% effluents and dilutions of the effluents. This study did not focus on the long-term sub-lethal effects of effluents. In Tasman Pulp and Paper Company Limited effluent the mortality of zebrafish eggs and larvae was unaffected at all concentrations. However in Carter Holt Harvey Tissue effluent, hatching and mortality were severely affected.

Recently developed scientific techniques were carried out by researchers into the sub-lethal effects of contaminants on the eel populations of the Tarawera River. The use of 'biomarkers' was explained to the Tarawera River Liaison Group during the Toxicity Workshop and the results of tests on Tarawera River eels was reported. Eels from the Tarawera River have not been found to exhibit external signs of stress relating to the industrial discharges to the river. Careful pathological examination showed that the internal organs of the eels from effluent-impacted sites did reveal adverse effects. Blood plasma enzyme levels suggested liver function abnormalities while urea and potassium levels indicated that kidney function was affected by effluent exposure. Red and white blood cell counts were marginally affected. The appearance of the liver of eels from effluent affected sites

89 Donald, R, 1994 (August), Proceedings of a Toxicity Workshop held in Whakatane 17-18 May 1994, Environmental Report 94/15.

90 Hickey, 1994.

91 Hickey, 1994.

differed in a way that suggested disturbed lipid metabolism. Despite these sub-lethal effects the eel population displays average growth rates but lower condition factors in the effluent affected waters of the Tarawera River[92].

Together with the study of pathology of the eels was the analysis of the 'biomarker' enzyme, ethoxyresorufin-o-deethylase (EROD). This enzyme has been widely used as a biomarker (indicator) of pulp and paper effluents. Increased EROD activity was detected in the livers of eels from impacted and unimpacted sites on the Tarawera River and from impacted and unimpacted sites throughout New Zealand. Significant increases in EROD activity were observed in both caged and feral eels at sites below the Tasman Pulp and Paper Company Limited effluent outfall. In the future this type of analysis could be used to assess the effect of reductions in toxic compounds being discharged to the river. In addition, the analysis could be performed in conjunction with blood chemistry analysis and liver examination.

With respect to the human health issues and the consumption of foodstuffs contaminated with dioxins, pentachlorophenol and 2,4,6-trichlorophenol, Dr Michael Bates, Epidemiologist of ESR Health, used a safety-factor approach and a risk assessment approach to determine the potential effects on human health due to the organochlorine contamination of eels in the Tarawera River.

The safety factor approach used a dioxin toxic equivalent factor (TEF) of 10 picograms (10^{-12} grams) per kilogram of human body weight per day (pg/kg/day) as the tolerable daily intake (TDI) or acceptable daily intake (ADI). Using the safety-factor approach, Dr Bates calculated that if a person ate eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity for fish consumption by New Zealanders, (which the NZ Department of Statistics[93] calculates is 31 grams of fish per person per day) then for a person of 'average' (60 kg) body weight, Lower Reach of the Tarawera River eel flesh would comprise 25% of their TDI (or ADI).

The risk assessment approach determines an estimated maximum possible excess numbers of cancers that might occur if a million people ate Lower Reach of the Tarawera River eel flesh for a lifetime at the specified levels of eel consumption every day. Dr Bates used two different 'risk-specific doses' that have been proposed by different US Government agencies for dioxin (USEPA, USFDA[94]). At a 'risk-specific dose' of 0.0064 pg/kg/day, he calculated there would be an estimated additional 402 cancers for every million people who were exposed to a lifetime of consuming eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity of 31 grams of eel flesh per person per day. At a 'risk-specific dose' of 0.12 pg/kg/day, there would be an estimated additional 21 cancers for every million people who were exposed to a lifetime of consuming eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity of 31 grams of eel flesh per person per day. It is stressed that these figures are upper-bound statistically derived estimates.

Dr Bates calculated that the direct consumption of water from the Lower Reach of the Tarawera River by humans was not restricted by current dioxin levels.

Overall, the discharges were considered to have impacted river ecology in a severe manner but that these effects were not due primarily to toxicity. Historically, the community had focused on dissolved oxygen, colour and toxicity as the major concerns regarding the Tarawera River. This was brought out in the first Tarawera River Management Plan. Studies over recent years demonstrate that these are still the priorities. The extensive research into toxicity of river water and discharges to

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92 Environment Bay of Plenty Report 98/19 Fish Health in the Lower Tarawera River and Rangitaiki River.

93 NZ Department of Statistics Food Balance Sheets for year ending June 1991.

94 USEPA – United States Environmental Protection Agency.
USFDA – United States Food and Drug Administration.

the river shows that the primary concerns with Tarawera River water are still dissolved oxygen and colour, with toxicity of lesser concern. Immediate attention needs to be focused on dissolved oxygen. However, colour and toxicity need also to be regulated tightly and the dischargers to the river encouraged to reduce over time their discharge of materials that contribute to colour and toxicity. The classification standards set in the plan will require reduction of discharge effects.

Ongoing monitoring should be conducted to assess reductions to toxic effects in the river. The concept of impairment has been explored with respect to dissolved oxygen levels in waterways by the USEPA. Different dissolved oxygen standards have been recommended by USEPA to achieve moderately-impaired waters, slightly-impaired waters and non-impaired waters. The bioassessment of the Tarawera River in 1993 demonstrated 'moderate impairment' below the Carter Holt Harvey Tissue discharge and 'severe impairment' downstream of the Tasman Pulp and Paper Company Limited discharge. This type of assessment allows future changes in effluent treatment and the effects on the Tarawera River to be compared to a fixed point in time.

The evidence of Dr Michael Bates, using USEPA standards, showed that there was a very small likelihood of human health being compromised by current levels of contaminants discharged into the Lower Reach of the Tarawera River. It should be noted, however, that USEPA has the guidelines for dioxins, in particular, under review. With this uncertainty in mind it is considered better to encourage industrial dischargers to the river to reduce their discharge of chlorinated compounds in the future from the present low levels rather than set some arbitrary bottom line. The Tarawera River Liaison Group came to the opinion that there should be reduction of all contaminants, including toxic substances, in the water resources of the Tarawera River catchment.

This philosophy was contrasted with the stance of Greenpeace who believe that the time has come for a zero discharge policy for dangerous chemicals (dioxins and organochlorines) entering the environment. Their paper to the Environment Bay of Plenty Toxicity Workshop concludes: "As a critical first step chlorinated chemical use must be investigated in this country and plans for its reduction and elimination rapidly progressed".

Environment Bay of Plenty does not consider it appropriate to specify discharge parameters for toxic compounds for which effects based evidence has not been established for the Tarawera River. However, a classification parameter designed to detect change in toxic effects from discharges is warranted. It is often appropriate to measure the overall toxicity of an effluent, in addition to testing for specific toxic substances. This is whole effluent toxicity (WET) testing, and can be usefully applied to a range of potentially toxic discharges, including those from industry, farms and urban stormwater systems. It is a useful test because it avoids the need to specify and quantify every potential toxic compound, a requirement that is currently unachievable. The interaction of chemicals (synergistic effects) also cannot be accounted for with single numerical standards. Protocols for acute and chronic testing have been specified in Rule 15.8.4(i).

15.4.3(a) Toxicity – Selected Management Alternative

Environment Bay of Plenty proposes that regardless of the purpose for which a water body is being managed, there should be no detectable increase in acute and chronic toxicity of any water body in the Tarawera River catchment. This applies to all water bodies in the catchment regulated by this regional plan, as well as the wetlands and drains and canals on the Rangitaiki Plains. Environment Bay of Plenty believes this precautionary approach to be necessary given that there is international uncertainty about the effects of toxic compounds. Regular monitoring of appropriate flora and fauna is required to identify toxicity in the Tarawera River catchment.

15.4.3(b) Toxicity – Supporting Technical Reports

The following technical reports, prepared or had regard to as part of the preparation of this regional plan, contain more detailed information on toxicity, especially related to the Lower Reach of the Tarawera River:

Bates, Dr M — 1994, Health Aspects of Tarawera River Contamination. A report prepared for Environment Bay of Plenty Tarawera River Regional Liaison Group Toxicity Workshop 17-18 May 1994, NIWA Ecosystems, Hamilton.

Beresford, D L — 1994, Investigation into the Effects of Geothermal and Pulp and Paper Mill Effluent on the Health of Fish Living in the Tarawera River (Bay of Plenty, New Zealand), in two volumes; Progress Report, December 1991 – June 1993 (22pp), and Final Report, November 1991 – April 1994 (44pp), School of Biological Sciences, University of Auckland.

Dell, P M — 1993, Pulp and Paper Industry Study Tour: July 1993. Environment Bay of Plenty Environmental Report 93-4. 73pp.

Donald, R C — 1994, Environment Bay of Plenty Tarawera River Regional Plan Technical Investigations Freshwater Ecology Component, Environment Bay of Plenty Environmental Report 94/1.

Hickey, C W — 1994, An Assessment of the Toxicity of Tarawera River: Effluent Discharges and Receiving Waters and Assessment of Geothermal Discharges. NIWA Ecosystems, Hamilton, Consultancy Report No. SCJ008/2461.

Hickey, C W — 1994, Mussel Biomonitoring in the Tarawera River 1991 and 1992. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, NIWA Ecosystems, Hamilton.

Jackman, G — 1994, Greenpeace: Toxic Chemicals – The Time for Zero Discharge Has Arrived. A report presented at the Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994.

McIntosh, J J — 1994, Inorganic Contaminants. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, Environment Bay of Plenty.

Park, S — 1991-92, Bay of Plenty Regional Council Monitoring Network – Coastal and Estuarine Ecology Monitoring Programme, Environment Bay of Plenty.

Park, S — 1994, Influence of the Tarawera River on the Naturally Occurring Marine Communities in the Vicinity of the River Mouth, Draft Discussion Paper, Environment Bay of Plenty.

Power, F A — 1994, Organic Contaminant Inputs/Dioxins and Organics in Foodstuffs. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, Environment Bay of Plenty.

Wilkins, A 1994, Chemical Investigations of some Tarawera River Water, Sediment and Mussel Samples. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994. Published by the Chemistry Dept, University of Waikato.

15.4.4 Water Temperature

Changes in receiving water temperature caused by a discharge that adds or removes heat is considered to be a contaminant under the Resource Management Act 1991. Changes in temperature can change the physical, chemical and biological condition of water. While there is a general lack of information on the effect of changes in water temperature on individual species, changes in water temperature can adversely affect the habitats and functioning of aquatic ecosystems and the physiology of river life. Changes in the ambient water temperature may adversely affect the growth, metabolism, timing and success of reproduction, mobility and migration patterns of river life. The effect of changes in the water temperature depends on the sensitivity of organisms.

Temperature changes also affect the ability of water to hold oxygen. In natural waters the decrease in temperature in winter is accompanied by an increase in dissolved oxygen. With warm summer temperatures dissolved oxygen levels tend to fall. These changes are generally within the range tolerated by fish and invertebrates.

In addition to the effect that temperature has on waters ability to hold oxygen, it also has several important effects on organisms. Increases in temperature within the ambient range for New Zealand waters tend to increase the metabolism and respiration of organisms. This has the effect of increasing the amount of oxygen an aquatic community will remove from the water. Within the Tarawera River, increases in temperature most likely result in increases in the total oxygen requirement of biological communities. Also, increases in water temperature and hence biological metabolism can result in an increased sensitivity of organisms to toxic contaminants and low dissolved oxygen levels.

In this regional plan, human-induced changes in water temperature are generally considered to be an issue only in the Lower Reach of the Tarawera River, to which heated waters are discharged. Increases in temperature resulting from discharges to the Lower Reach of the Tarawera River exacerbate the problem of low dissolved oxygen levels, and the adverse effects this has on the aquatic environment. The average summer temperature of the Lower Reach of the Tarawera River is 19.3°C (Awakaponga), while the winter average is 13.9°C (Awakaponga). In comparison, the summer temperature in the Upper Reach of the Tarawera River (Kawerau Bridge site) averages 16.6°C. In the Lower Reach of the Tarawera River the average increase in water temperature between Kawerau Bridge and Awakaponga sites is approximately 2.7°C. Of this increase, 1.2°C (45% of the overall increase) is attributed to the effect of natural temperature increases in the river. The remaining 1.5°C is attributed to wastewater discharges from the pulp and paper mills and human-induced geothermal discharges.

The primary adverse effect of these discharges is on the ability of the Lower Reach of the Tarawera River to carry oxygen. This is of critical importance in a water body where dissolved oxygen levels are often already low, due to the high biological demand created by the discharge of pulp and paper effluent. An increase in water temperature of 1°C will lower the dissolved oxygen content by approximately 0.2 grams per cubic metre.

Trout and invertebrates are generally considered to become stressed at temperatures above 25°C. Wastewater discharges to the Lower Reach of the Tarawera River do not generally result in temperatures of this level. However, trout, other fish species, and invertebrates, can still be indirectly affected by the lowering of the dissolved oxygen content (see sub-section 15.4.1 – *Oxygen Content*).

15.4.4(a) Surface Water Temperature – Selected Management Alternative

The Resource Management Act 1991 defines contaminants as including heat that, when discharged into water, changes or is likely to change the physical, chemical or biological condition of the receiving water. Increases in river water temperature can result directly from heat in discharges, and indirectly due to minor increases in solar absorption. Environment Bay of Plenty is of the opinion that a lack of control of temperature results, or is likely to result, in adverse effects on other water quality parameters, most notably in decreasing dissolved oxygen levels. Fluctuations in temperature are also likely to have an adverse effect on aquatic life.

Environment Bay of Plenty proposes that for the purposes of maintaining water in the Tarawera Lakes catchments, except Lake Okaro, in their natural state, water temperature should not be allowed to increase above its ambient (surrounding unaffected) level (see Rule 15.8.4(d)). Environment Bay of Plenty also proposes that for the purposes of maintaining Lake Okaro for contact recreation purposes, temperature should not be allowed to increase more than 3°C, with a maximum not to exceed 25°C (see Rule 15.8.4(d)(iii)).

For the purposes of protecting water for fish spawning purposes and allowing for maximum assimilative capacity for discharges to the Lower Reach of the Tarawera River, Environment Bay of Plenty proposes that the temperature in the Upper Reach of the Tarawera River, the tributaries of the Tarawera River, and tributaries of the lakes in the Tarawera Lakes catchments should not be allowed to increase, after allowing for reasonable mixing and disregarding any natural perturbations (see Rule 15.8.4(f)(iv)).

To manage water for fish purposes in the Lower Reach of the Tarawera River, and in order to minimise adverse effects of temperature increases on dissolved oxygen levels, and having regard to the need of industry to discharge reasonable amount of heat to surface water, Environment Bay of Plenty proposes that at no time should temperature be allowed to increase by more than 3°C, with a maximum not to exceed 25°C as a result of discharges after allowing for reasonable mixing and disregarding any natural perturbations (see Rule 15.8.4(h)(iv)).

Providing that it would not affect the requirement to achieve optimal reinjection of geothermal fluid back into the Kawerau Geothermal Field, the further recovery and use of heat for ancillary enterprises, such as prawn farming, are supported by Environment Bay of Plenty. This would be a way to further dissipate heat and lessen the movement of thermal energy into the river.

15.4.4(b) Surface Water Temperature – Supporting Technical Reports

The following technical reports, prepared as part of the preparation of this regional plan, contain more detailed information on water temperature and the effects of changes in water temperature in the Lower Reach of the Tarawera River in particular:

Vedder, I 1994 (May), Tarawera River Heat Balance (Revised May 1994), prepared for Tasman Pulp and Paper Company Limited, Caxton Paper Limited, and Geothermal Trading, by Works Consultancy, Wairakei.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.5 pH

pH is a measure of how acid or alkaline a solution is. The pH index has a scale of 1 to 14. An acidic solution ranges from pH1 to below pH7. Most natural fresh waters have a pH close to 7. In natural conditions the pH of water bodies is influenced by the soil type and vegetation cover of the land through which drainage water passes. Aquatic vegetation can also affect pH as gas exchange between plants and water takes place. Point-source or diffuse contaminant discharges into a drainage catchment and landuse practices, such as long-term fertiliser applications, can make a water body unnaturally acidic or alkaline.

It is generally accepted that a pH range of 5-9 will not adversely affect trout, invertebrates or other aquatic life. For example, adverse effects on eggs and the fry of sensitive fish species generally occur in waters with a pH of less than 5.0. However, the toxicity of several contaminants, such as ammonia and hydrogen sulphide, can be markedly affected at pH in the extremes of this range (i.e. pH5 to pH9)[95]. The pH in the lakes, wetlands, the Tarawera River and its tributaries, and in most of the canals on the Rangitaiki Plains, naturally falls between pH6.5 and pH8.5.

The discharge of geothermal sulphide and ammonia produces some potential for pH-related toxic effects. Undissociated (gaseous) hydrogen sulphide and ammonia are toxic to aquatic life. An acidic discharge into the river would push the river hydrogen sulphide equilibrium towards the production of toxic undissociated hydrogen sulphide. Conversely, an alkaline discharge would push the ammonium equilibrium towards the production of toxic ammonia.

15.4.5(a) pH – Selected Management Alternatives.

Environment Bay of Plenty has assessed that a sustainable pH range in the water bodies of the Tarawera River catchment is between 6.5 and 8.5. This is considered an appropriate range for sustaining aquatic ecosystems. It also takes into account potential toxic effects of ammonia discharges associated with natural and human-induced discharges of geothermal fluids. This range will be applied to all water bodies in the catchment, excluding the wetlands and drains and canals on the Rangitaiki Plains. Changes in the pH in wetlands, drains and canals as a result of discharges will be regulated through the resource consent process.

15.4.5(b) pH – Supporting Technical Report

The following technical report, prepared as part of the preparation of this regional plan, contains more detailed information on pH values in the Tarawera River.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.6 Sewage Discharges

The discharge of sewage to water bodies has traditionally been considered offensive by Maori, and is also considered offensive by many others in the community. The discharge of sewage is considered to degrade the mauri of the water and in turn adversely affect waahi tapu areas used for healing and cleansing, tohi and purification rites, as well as having an effect on taiapure and kaimoana.

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95 Australia & New Zealand Environment and Conservation Council, 1992, page 2024.

Ngati Awa, Tuwharetoa ki Kawerau, Ngati Rangitihi and Tuhourangi iwi have rohe within the Tarawera River catchment and have all at various times expressed deep concern at the continued discharge of sewage, treated and untreated, to water bodies, both within and outside the Tarawera River catchment. They do not accept that water bodies should continue to be used as waste disposal systems, to transport and treat effluents and wastes, particularly sewage. While some liquid wastes, including sewage, may be treated to a high degree before being discharged, this does not overcome the adverse effect of these discharges on the mauri life force of a water body, unless the waste has first been passed through the cleansing properties of earth. Maori cultural values with regard to the direct discharge of human sewage into water are discussed in greater detail in Chapter 8 – *Resource Management Issues of Significance to Iwi Authorities*.

The two biggest point-source discharges of human sewage into water bodies in the catchment of the Tarawera River are from the combined Kawerau town and Carter Holt Harvey Tissue outfall which discharges to the Lower Reach of the Tarawera River[96], and the outfall of the Edgecumbe sewage treatment ponds, which discharges to the Omeheu Canal on the Rangitaiki Plains. Treated sewage effluent from the Edgecumbe sewage treatment oxidation ponds discharges into the Omeheu canal which has a low flow. The effluent exacerbates the low dissolved oxygen levels in the canal and increases the nutrient load.

As well as being culturally offensive and a social and health concern for the wider community, the discharge of human sewage into water bodies also has the effect of lowering dissolved oxygen content and is the principal source of *Giardia* contamination in the Lower Reach of the Tarawera River. Since Carter Holt Harvey Tissue has treated both its mill effluent and Kawerau town sewage together in its anaerobic digesters, there has been a resulting small measurable net improvement recorded in the dissolved oxygen content of the Tarawera River downstream from the outfall, relative to the previous discharge of separate waste streams. However, the combined discharge of industrial and town effluent from the Carter Holt Harvey Tissue outfall still contributes to a drop in dissolved oxygen of approximately 0.5 grams per cubic metre between Kawerau Bridge site and upstream of the Ruruanga Stream confluence (Figure 8).

When considering the effects of sewage discharges, Environment Bay of Plenty needs to balance immediate and longer term costs and benefits within the constraints of statutory, community and cultural requirements. Any action goals designed to result in the reduction or eventual removal of sewage discharges will need to be structured into a realistic timeframe.

15.4.6(a) Sewage Discharge – Selected Management Alternatives

Environment Bay of Plenty has considered alternatives to manage domestic and municipal sewage within the catchment of the Tarawera River.

Policies and methods of implementation regarding the on-site treatment of human sewage, such as septic tank and soakage field systems, are contained within Environment Bay of Plenty's *Operative On-Site Effluent Treatment Regional Plan*. For effective on-site treatment of human sewage, the requirements and Rules of that regional plan will take precedence.

The following alternatives apply to the disposal of all municipal, industrial and domestic sewage that cannot be efficiently disposed onto or into land on-site.

(i) **Alternative 1**: Retain the status quo and permit existing discharge and disposal methods through resource consents issued under section 15 of the Resource Management Act 1991 .

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96 Carter Holt Harvey Tissue utilises sewage from Kawerau Township to assist the breakdown of pulp and paper mill effluent in its anaeraobic treatment process.

(ii) **Alternative 2**: Retain and permit existing discharge and disposal methods as discretionary activities, but require that effluent discharged into the Tarawera River or any catchment lake or tributary be treated to a defined tertiary level before discharge, using BPO (Best Practicable Option) criteria.

(iii) **Alternative 3**: Retain and permit existing discharge and disposal methods as discretionary activities, but require that effluent discharged into the Tarawera River or any catchment lake or tributary be treated to an environmentally acceptable level using BPO criteria that achieve a treatment efficiency equivalent to that of an efficient land based system acceptable to iwi.

(iv) **Alternative 4**:

(a) Until 31 December 2002 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment can continue as a Discretionary Activity, subject to compliance with classification standards.

(b) From 1 January 2003 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment will be limited to exceptional circumstances, provided that this limitation shall be suspended until 12 months past the date on which an application by Carter Holt Harvey Tissue to discharge AWWTP wastewater and sanitary wastewater from Kawerau township by spray irrigation to land has been decided and any appeals determined.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with defined effluent quality standards measured in the effluent stream prior to discharge.

(e) Subject to the provisions of the Operative On-Site Effluent Treatment Regional Plan, and the provisions set out in (a) to (d) above, and the provision for exceptional circumstances, all other new or existing unauthorised discharges of human sewage into the Tarawera River or any catchment lake or tributary will become a Prohibited Activity on the date on which this regional plan becomes operative.

Environment Bay of Plenty has selected **Alternative 4**:

(a) Existing sewage discharges into the Tarawera River aggravates the existing unacceptable adverse effects on water quality and river ecology caused by the low dissolved oxygen content in surface water and needs to be made to comply with classification standards.

(b) With respect to Maori cultural and traditional values, there should be no sewage effluent discharges into the surface water of the Tarawera River, except under exceptional circumstances, for a limited duration, where no other practicable options are available.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with defined effluent quality standards measured in the effluent stream prior to discharge.

(e) A reasonable time is set to enable the transition from existing sewage treatment and discharge quality to new classification or defined standards (see Rule 15.8.4(r)).

15.4.6(b) Sewage Discharges – Supporting Reports

The following reports and those indicated in subsection 15.4.1(b), *Oxygen Content – Supporting Technical Reports*, written as part of the preparation of this regional plan, contain more detailed information on concerns relating to the discharge of sewage to the Tarawera River and its tributaries:

Te Runanga o Tuwharetoa ki Kawerau:	1994, Tuwharetoa ki Kawerau – Background on the Tarawera River, Te Runanga o Tuwharetoa ki Kawerau, Kawerau – *Unpublished Paper*.
Te Runanga o Ngati Awa Trust Board:	1994 (March), Ngati Awa Policy Statement – Tarawera River, Te Runanga o Ngati Awa Trust Board, Whakatane – *Unpublished Paper*.

15.4.7 Dairy Shed Discharges

Environment Bay of Plenty is encouraging the disposal of dairyshed effluent to land. Guidelines that cover agricultural discharges are currently operating, and these are generally accepted by the dairy farming community and are having good results. The *Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments – September 1992* will be used to establish conditions on resource consents granted for the spray irrigation of dairyshed effluent onto land.

With respect to the cumulative impact of land based effluent treatment, there is no evidence that shallow groundwater is being unacceptably contaminated by dairyshed or other agricultural discharges[97]. There are specific high risks, however, for example where the on-farm management of a spray irrigation system is not adequate, where local water tables are high or where the irrigation of effluent is up-slope of springs used for community or household supply. For these reasons the spray irrigation of dairyshed effluent will remain an activity requiring a resource consent.

The surface drain water on the lower plains is usually slow moving and considered to be of generally low quality. Test results show that surface drain water over most of the plains is characterised by high nutrient concentrations, poor clarity, a wider range of pH values that can change rapidly (diurnal fluctuations), higher ambient water temperature and low dissolved oxygen. Setting unreasonable stringent controls is unlikely to result in any measurable increase in drain water quality over the short to medium term. However, the effective management of fertiliser use and effluent spray systems, together with the promotion of nutrient recovery, may, over time, improve dissolved oxygen levels and general water quality in the summer months.

Dairy shed effluent disposal will be managed in accordance with the *Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments - September 1992*, and controlled in accordance with the requirements of Rule 16.8.5(b) in Chapter 16 – *Groundwater Quality and Quantity*.

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97 Pang, L, Groundwater Resources of the Lower Tarawera Catchment, Environmental Report 94/3.

15.4.8 Odour

This regional plan is concerned with odour emission effects resulting from the discharge of effluent into water within the catchment of the Tarawera River. Odour emission effects resulting from the discharge of contaminants directly into air, or into or onto land, are dealt with by separate consents and may be dealt with in the *Operative Bay of Plenty Regional Air Plan* and *Operative Bay of Plenty Regional Land Management Plan.*

In its natural state, water in a water body gives off an odour consistent with the biological matter and chemical compounds found in it. For example, a stagnant stream, with a lot of decaying vegetation and micro-organisms will often have a 'rotten' odour associated with it. Human-induced discharges to water bodies can also result in the emission of odours, many of which are objectionable.

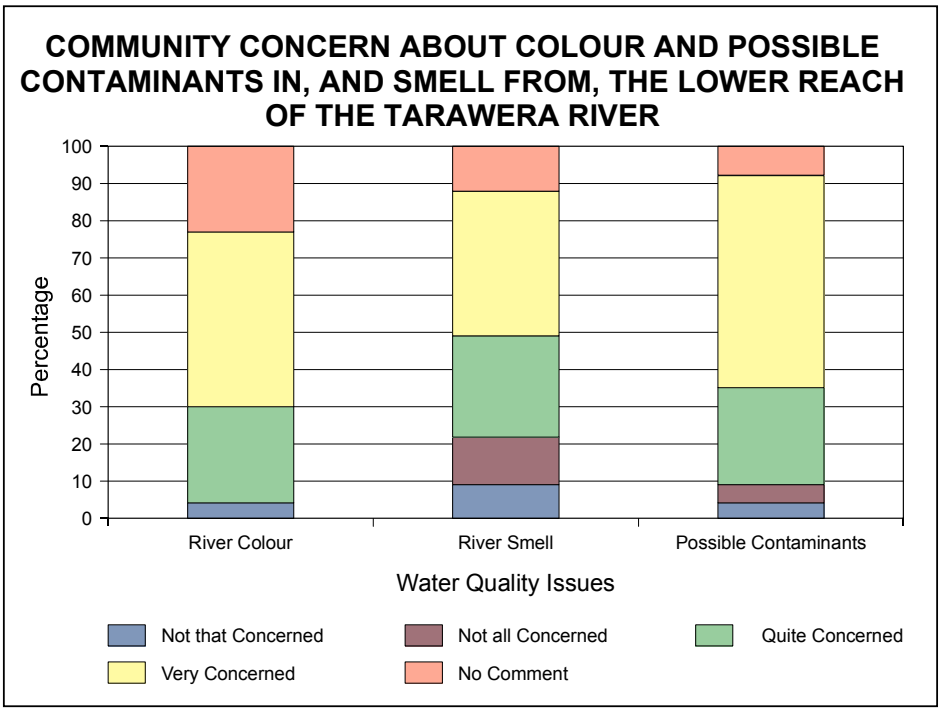
Within the catchment of the Tarawera River, the emission of objectionable odours is generally considered a problem only in the Lower Reach of the Tarawera River and to a lesser extent in the drains and canals on the Rangitaiki Plains. The main source of the odours is air discharges from the pulp and paper plants and their treatment ponds. Environment Bay of Plenty will continue to encourage industry to remove odour-causing compounds from their waste streams. This applies in particular to volatile organic compounds in the foul condensate generated at the Tasman Pulp and Paper Company Limited plan. Environment Bay of Plenty is requiring through air emission resource consents that by 31 December 1996 foul condensates are to be removed from the Tasman Pulp and Paper Company Limited discharge waste stream.

A study of the sources of odour in the Lower Reach of the Tarawera River carried out by the Water Quality Centre[98] in 1984 concluded that the presence of sulphureous compounds in the Lower Reach of the Tarawera River at the SH 30 bridge was the result of the discharge of sulphureous compounds with effluent from the wood pulping process. The study did not identify the particular substances responsible for the emission of the odour.

The measurement of the objectionable odour in the Lower Reach of the Tarawera River is complicated by natural geothermal discharges along the river which give off the characteristic "rotten egg" smell of hydrogen sulphide.

[98] A division of the former Ministry of Works and Development.

Figure 12



In the 1993 survey of *Attitudes and Perceptions Towards the Tarawera River and its Catchment*, smell from the Lower Reach of the Tarawera River was raised as an issue by 22% of respondents. Concern was lowest in Kawerau (19%). Matata ward residents indicated the highest level of concern about the smell of the river (52%). When prompted about the smell emanating from the Tarawera River, 68% of the respondents said they were concerned or very concerned (Figure 12).

The canals and drains on the Rangitaiki Plains typically emit a smell associated with rotting biological matter and a high concentration of biological organisms, especially during summer months. Environment Bay of Plenty attributes this in part, to the discharge of treated Edgecumbe sewage to the Omeheu Canal, and of dairy shed effluent to canals on the Rangitaiki Plains.

15.4.8(a) Odour – Selected Management Alternatives

The Resource Management Act 1991 (sections 70(1)(e) and 107(1)(e)) restricts Environment Bay of Plenty, except in special circumstances[99], from granting discharge permits, which after allowing for reasonable mixing, are likely to give rise to any emission of objectionable odour.

Environment Bay of Plenty does not consider that the narrative standard of 'no increase in the emission of objectionable odour' requires quantifying further. This narrative standard will be applied to all water bodies in the catchment. The standard will be regulated by a requirement that industry emissions will be remedied by the adoption of 'best practicable options' in terms of technical means to decrease the emission of objectionable odours.

Environment Bay of Plenty recognises that major industrial discharges to the Lower Reach of the Tarawera River and agriculture discharges into the drains and canals

[99] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may result in the emission of objectionable odour if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

of the Rangitaiki Plains currently can result in objectionable odours. Environment Bay of Plenty will continue to encourage all dischargers to remove or neutralise odour-causing compounds from discharge streams. With regard to statutory limits, Environment Bay of Plenty will require as a minimum that the emission of objectionable odour resulting from the discharge of effluent into water be remedied by the adoption of an ongoing programme to apply the best practicable options for odour removal from waste streams.

15.4.8(b) Odour – Supporting Technical Reports

Regard was had to the following technical reports:

Graham B W and Bingham A G	1991, Report on Odour Testing, Tarawera River, 31 July and 1 August 1991, NECAL Service Report S9/969.
Kevern R P H	1994, Evidence Report prepared for Discharge Application 03 0068, Tasman Pulp and Paper Company Limited, (June 1994).
Agricultural Engineering Institute	1993, Recommendations to the Ministry for the Environment: Odour Nuisance Control, AE1 2496/1, (September 1993).

15.4.9 Suspended Materials

Suspended materials are solids transported by moving water in the zone of turbulent flow. They are commonly fine soil or pumice particles, or living or dead biological material that can be supported by the river water.

Suspended material arises from both point and diffuse source discharges. The levels of suspended materials can vary dramatically at different times of the year and increase dramatically following heavy rainfall events which increases the amount of sediment washed into water bodies. The levels of suspended solids can also vary with turbulence as deposited sediment is resuspended. Resuspension of material in the Tarawera River is particularly marked, as a result of its highly mobile pumice bed.

Concentrations of suspended materials in the lakes in the upper lakes catchment are less than 2.0 grams per cubic metre (1992/93 data). In the Upper Reach of the Tarawera River concentrations of suspended solids under normal conditions average less than 5.0 grams per cubic metre (1992/93 data).

High suspended material levels can adversely affect aquatic ecosystems both when in suspension and when the material settles out. In suspension, the main impact of particulate matter is optical, as it can reduce light penetration and thus affect primary production. As discussed in sub-section 15.4.2 – *Colour and Clarity*, reduced light penetration caused by suspended material can adversely affect stream ecology. High levels of suspended solids can also interfere with the feeding mechanisms of filter-feeding organisms. Further, particulate matter may smother immobile organisms, change the nature of the substrate on settling, or do both.

In the Upper Reach of the Tarawera catchment, the bulk of suspended material in water bodies is considered to result from natural erosion from areas in native forest, exotic production forest and farm land. The suspended materials, along with bed-load, ultimately contribute to sedimentation in the lower reaches of the Tarawera River, associated wetlands, the Tarawera River estuary and the coast. Inappropriate land uses and land practices are discussed in Chapter 11 – *Land Use*. Effluent discharges from the pulp and paper mills, and from agricultural

activities on the Rangitaiki Plains, also contribute to increased suspended material levels.

15.4.9(a) Suspended Material – Selected Management Alternatives

The alternatives relating to suspended solids are limited by statue. Sections 70 and 107(1)(c) of the Resource Management Act 1991 restricts Environment Bay of Plenty, except as allowed by section 107(2)[100], from granting discharge permits, which after allowing for reasonable mixing, are likely to give rise to the production of conspicuous suspended materials in the receiving water body. The setting of defined standards for colour and visual clarity will provide an appropriate means of measuring and limiting unsustainable levels of suspended materials in the Tarawera River.

15.4.9(b) Suspended Material – Supporting Technical Reports

The following technical reports written as part of this regional plan, contain more detailed information on suspended materials in the catchment of the Tarawera:

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.10 Nutrients

Nutrients are substances which provide nourishment to plants and animals. Nutrient levels strongly influence the growth of organisms, and in large quantities can be undesirable. Nitrogen and phosphorus levels in water bodies depend on a number of factors including direct discharges to the water and the rate of removal of these nutrients from the water by absorption into sediment or uptake by aquatic biota.

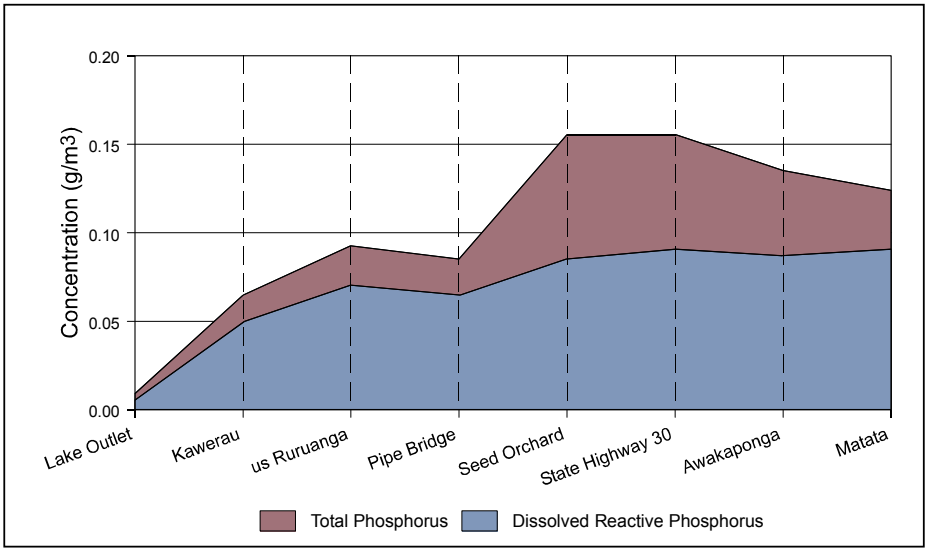
[100] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials if it is satisfied that:

(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

Figure 13

THE MEDIAN CONCENTRATION OF DISSOLVED REACTIVE PHOSPHORUS (DRP) AND TOTAL PHOSPHORUS (TP) AT EIGHT SITES ON THE TARAWERA RIVER

(mean number of samples per site = 14) (effluent from Carter Holt Harvey Tissue and Kawerau District Council, discharges to the Tarawera River between 'Kawerau' and 'us (upstream) Ruruanga'; effluent from Tasman Pulp and Paper Company Limited, discharges to the Tarawera River between 'Pipe Bridge' and 'Seed Orchard')



The addition of plant nutrients such as nitrogen and phosphorus from sewage and agricultural runoff can create an imbalance by stimulating the excessive growth of aquatic plants. These plants are normally a natural and important component of a stream. They provide habitat areas, food for other aquatic life, and contribute to re-aeration through photosynthetic production of oxygen. However, excessive summer growth due to nutrient enrichment can choke water bodies that have low flow rates. Seasonally, when plants die off, oxygen depletion occurs as they are decomposed by bacteria.

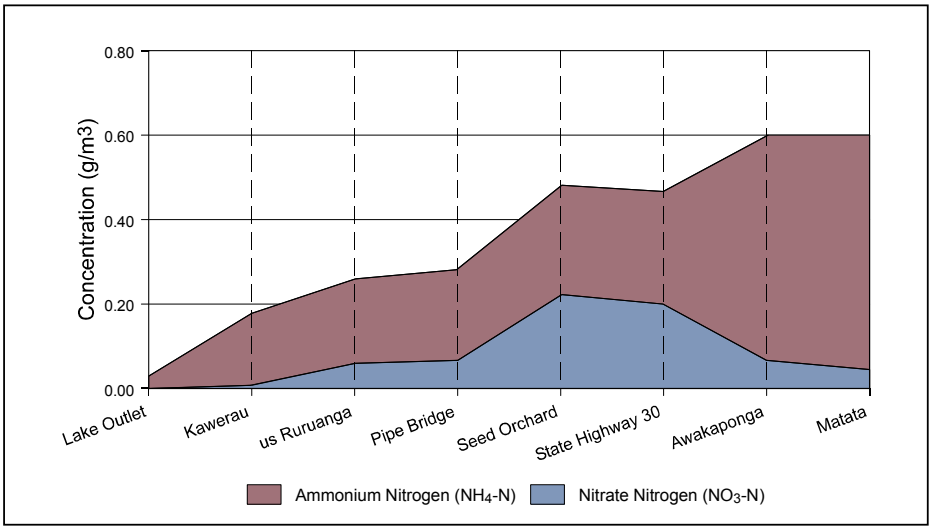
Figure 13 shows the median dissolved reactive phosphorus (DRP) and total phosphorous (TP) levels in the Tarawera River from 1992 to 1994. Figure 14 displays the medium ammonium nitrogen (NH_4-N) and nitrate nitrogen NO_3-N) concentrations in the Tarawera River between 1992 and 1994.

At the Lake Tarawera outlet very low nutrient levels are evident. This is consistent with lake nutrient chemistry for oligotrophic (very clean) waters. As the Tarawera River moves through the Tarawera Forest, spring-fed tributaries contribute geologically-derived nutrients to the phosphorus and nitrogen load. The median dissolved reactive phosphorus and nitrate nitrogen concentrations at Kawerau are much higher than at the Lake Tarawera outlet (Figures 13 and 14).

Figure 14

THE MEDIAN CONCENTRATION OF AMMONIUM NITROGEN (NH_4-N) AND NITRATE NITROGEN (NO_3-N) AT EIGHT SITES ON THE TARAWERA RIVER FOR 1992-1994 DATA

(mean number of samples per site = 14) (effluent from Carter Holt Harvey Tissue and Kawerau District Council, discharges to the Tarawera River between 'Kawerau' and 'us (upstream) Ruruanga'; effluent from Tasman Pulp and Paper Company Limited, discharges to the Tarawera River between 'Pipe Bridge' and 'Seed Orchard')



Downstream of the industrial discharges, nutrient levels increase in the Tarawera River (Figures 13 and 14). Between the Kawerau Bridge and Tasman Pulp and Paper Company Limited Pipe Bridge sites, Carter Holt Harvey Tissue effluent and geothermal discharges contribute to the nutrient levels.

Kawerau District Council sewage is a large contributor of nutrients to the Tarawera River. Since 1990 Kawerau's sewage has been diverted to the anaerobic treatment plant of Carter Holt Harvey Tissue, and is used as a nutrient source. This has altered the nutrient balance in the river. A greater proportion of phosphorus from sewage sources is now discharges in the dissolved form. The Carter Holt Harvey Tissue plant also utilises significant quantities of ammonium nitrogen from the sewage to break down its carbonaceous effluent. This has resulted in a reduction in the levels of ammonium nitrogen discharges to the Tarawera River from this source. However, over the same period, ammonium nitrogen levels have increased in the Tasman Pulp and Paper Company Limited discharge. This change has occurred at a time when the rate of dissolved oxygen consumption appears to have increased.

Figure 14 shows that the ammonium nitrogen component of the nutrient discharge is the most highly-utilised nutrient species in the Lower Reach of the Tarawera River. It also shows that the major source is the discharge from the Tasman Pulp and Paper Company Limited treatment ponds. The high rate of biological activity in the Lower Reach of the Tarawera River, with consequent severe oxygen depletion, is driven by the discharge of carbonaceous effluents. Ammonium nitrogen is consumed as a major nutrient source by this biological activity. It is apparent, therefore, than any effluent treatment measures that reduce the discharge of dissolved nutrients, particularly ammonium nitrogen to the Tarawera River, will benefit the oxygen supply of the Lower Reach of the Tarawera River.

15.4.10(a) Nutrients – Selected Management Alternatives

Increases in nutrients to the Lower Reach of the Tarawera River result from both point-source and diffuse discharges. Environment Bay of Plenty does not consider it necessary to establish water quality standards for nutrients. Nutrient discharges are likely to be significantly reduced by encouraging the land disposal of dairy shed, piggery and sewage effluent.

The control of nutrients and chemical inputs from diffuse agricultural sources is more difficult. This relies largely upon farmers and foresters minimising the spread of the main pollution sources, for example erosion, fertilisers and chemicals[101] to local water bodies. With diffuse discharges, the control of diffuse runoff will be most effectively controlled through buffering and education.

The provision of advice and a demonstration of alternatives to traditional application methods of fertiliser and nitrogen, are important means by which phosphate and nitrogen levels in water bodies can be reduced. Means of enhancing the containment of nutrients in soils can also benefit farmland.

15.4.10(b) Nutrients – Supporting Technical Report

The following technical report, written as part of the preparation of this regional plan, contains more detailed information on nutrients:

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.11 Tainting

Tainting refers to the contamination of water or aquatic life so as to make it unsuitable for a specified purpose, such as stock watering or human consumption. The Resource Management Act 1991 stipulates (sections 70(1)(f) and 107(1)(f)) that except as allowed by section 107(2) of the Act, discharges of contaminants or water into water cannot be granted, if after reasonable mixing, they are likely to render fresh water unsuitable for consumption by farm animals.

No surface water in the Lower Reach of the Tarawera River, outside the reasonable mixing zones of point-source discharges, and excluding the canals and drains on the Rangitaiki Plains, is considered to be unsuitable for stock watering purposes. In the 1993 survey *Community Attitudes Towards the Tarawera River and its Catchment*[102], inedibility of fish taken from the Lower Reach of the Tarawera River was raised as an issue by a small percentage of respondents. Furthermore, when prompted, 83% of respondents said they were concerned about the possible contamination of the river.

No surface water bodies in the catchment are considered to have water quality which renders their aquatic food resources unsuitable for human consumption although eels taken in the Lower Reach of the Tarawera River may need to be swum in clear water for a time to improve their taste. However, water in the Lower Reach of the Tarawera River and the drains and canals on the Rangitaiki Plains is generally considered unsuitable for human consumption, largely due to foul taste and smell, but also for health reasons.

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101 NWASCO, 1982, No. 29.

102 Research Solutions Limited, 1993 (March).

15.4.11(a) Tainting – Selected Management Alternatives

Alternatives for the management of tainting are limited by statute. Except as allowed by section 107(2), sections 70(1)(f) and 107(1)(f) of the Resource Management Act 1991 restrict Environment Bay of Plenty from granting discharge permits, which, after allowing for reasonable mixing, are likely to render fresh water unsuitable for consumption by farm animals. This standard will apply to all water bodies in the catchment. However, due to the tainting of water for human consumption in the Lower Reach of the Tarawera River and in the drains and canals on the Rangitaiki Plains, Environment Bay of Plenty will advise against taking water from these water bodies for human consumption purposes.

15.4.11(b) Tainting – Supporting Technical Reports

No specific technical reports were prepared on tainting as part of the preparation of this regional plan.

15.4.12 Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material

Foam is a mass of small bubbles of gas formed on the surface of a liquid. Foam can occur naturally due to natural carbohydrates washed from forested areas. Many substances in water will cause foaming when the water is agitated or air is entrained. It can also occur as the result of the discharge and mixing of contaminants. Scums are layers of matter that form on the surface of a liquid, such as the greenish film of algae and similar vegetation on the surface of a stagnant pond. Like foams, scums can and do occur naturally. They also arise from point-source contaminant discharges. Floatable materials are materials which have not dissolved in the water body concerned after allowing for reasonable mixing, and float on the surface. This is distinct from suspended solids as discussed in sub-section 15.4.9 – *Suspended Materials*.

While the production of conspicuous scums or foams has occurred in the Lower Reach of the Tarawera catchment in the past, the relocation of discharge points from above-surface to sub-surface discharge has largely overcome these problems.

15.4.12(a) Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material – Selected Management Alternatives

Alternatives for the management of the discharge of conspicuous oil or grease films, scums or foams, or floatable or suspended materials are limited by statute. Sections 70(1)(c) and 107(1)(c) of the Resource Management Act 1991 restrict Environment Bay of Plenty, except as all allowed by section 107(2)[103], from granting discharge permits, which after allowing for reasonable mixing, are likely to produce any conspicuous oil or grease films, scums or foams, or floatable or suspended materials.

Environment Bay of Plenty does not consider that the term 'conspicuous[104]', as used in sections 70(1)(c) and 107(1)(c) of the Act, requires quantifying.

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[103] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

[104] For the purposes of clarification, Environment Bay of Plenty considers the term "conspicuous" in relation to sections 70 and 107 of the RMA to mean:

15.4.12(b) Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material – Supporting Technical Reports

No specific technical reports were prepared on the production of conspicuous oil, grease films, scums or foams, or floatable material as part of the preparation of this regional plan.

15.4.13 Biological Growths

There are two main categories of biological growths which can proliferate in response to organic or nutrient-rich discharges to the water to such an extent that they become undesirable. These are heterotrophic slimes, commonly referred to as "sewage fungus", and phototropic organisms, including planktonic and benthic algae and large aquatic plants. They occur in most surface water bodies, including shallow areas of lakes.

Heterotrophic slimes (or sewage fungus) are proliferations of bacteria or fungi, or both that may form feathery, cotton-wool-like growths in streams with high concentrations of dissolved organic compounds from, for example, effluent discharges. Sewage fungus growths aesthetically degrade rivers, make the river bed unsuitable for fish spawning and many species of invertebrates and can cause severe oxygen depletion. The growth rate of bacteria or fungi that can form sewage fungus changes with the season and the flow of a river. Slower growth in winter is also caused by physical factors, such as lower temperatures, and scouring by floods.

Benthic algae, generally referred to as periphyton, grow on the river bed and other solid surfaces in rivers such as logs. They provide a food source for instream invertebrates, remove nutrients from the water and increase dissolved oxygen by photosynthesis during the day. The key nutrients promoting periphyton growth are dissolved inorganic nitrogen, ammonia and nitrate, and dissolved reactive phosphorous (see sub-chapter 15.4.10 – *Nutrients*). Excessive growth of periphyton due to nutrient enrichment of the water can have the following effects:

- severe night-time depletion of dissolved oxygen and high day-time pH;
- smothering of the river or beds, severely reducing invertebrate habitat; and
- visual degradation of the river.

In waters not polluted by nutrient enrichment the periphyton is almost invisible on stones and rocks but, with increasing pollution, it can form a thick mat covering the river bed. Its composition can be diatoms, which are brown or yellow algae which cover the stones with films or turfs, or filamentous green or blue-green algae, or a mixture of both.

From 1995 and up until July 2001, undesirable biological growths were not present in the lower Reach of the Tarawera River.

15.4.13(a) Biological Growths – Selected Management Alternatives

Environment Bay of Plenty has adopted quantifiable standards across three of the four water quality classes for the catchment of the Tarawera River (see Rules 15.8.4(b), 15.8.4(d), 15.8.4(f) and 15.8.4(h)). These standards are aimed at minimising increases in phytoplankton and benthic algae. For the Natural State (NS) water quality class, Environment Bay of Plenty proposes to adopt as its standard no change in the net volume of biological growths, after allowing for

"After allowing for reasonable mixing (a question of fact and degree in each particular case), the extent or magnitude that the issue in question is clearly visible, obvious or striking to the eye of a reasonable person observing the receiving water."

reasonable mixing and disregarding the effect of any natural perturbations (see Rule 15.8.4(b)(vii)).

15.4.13(b) Biological Growths – Supporting Technical Reports

The following technical report on biological growths was written as part of the preparation of this regional plan:

Donald, R 1994, Environment Bay of Plenty Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty Environmental Report – 94/1, July 1994.

Also referenced was:

Ministry for the Environment 1992 (June), Water Quality Guidelines No 1 – Guidelines for the Control of Undesirable Biological Growths in Water, Ministry for the Environment, Wellington.

15.5 Water Quality Standards

The Third Schedule of the Resource Management Act 1991 outlines a range of water quality classes which include standards for the management of surface water bodies for different purposes. These standards provide 'bottom lines' above which the water quality of the respective water bodies is to be managed. While specific water quality standards do not have to be established, they are useful in indicating to current and potential resource consent holders the use for which a water body is being managed.

Section 69(1) of the Act states that where water quality standards exist in a plan, any Rules relating to water quality must comply with the respective standards, unless, in the Council's opinion, those standards are not adequate or appropriate in respect of those waters in which case the Rules may state standards that are more stringent or specific.

Having regard to existing water quality standards in the Tarawera River catchment, and to discussions with the Tarawera River Liaison Group on desired water quality standards in the Tarawera catchment, Environment Bay of Plenty has decided to adopt the following water quality standards. As allowed by section 69(2) of the Act, in many cases these standards have been altered to make them more explicit in their intent, or to allow for the special character of the environment in which they are being applied.

15.5.1 Class NS Water (Natural State)

Class NS water is applied for the management of water bodies in their natural state. This water quality standard applies to all lakes in the Tarawera Lakes catchments, except Lake Okaro.

For the purposes of the Class NS classification, Environment Bay of Plenty defines natural state to mean that the water quality in the total water column of a lake should remain at 1994 water quality standards or better. The class NS water standards have been made more explicit than those contained in the Third Schedule of the Resource Management Act 1991. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect the lakes.

The specific water quality standards of class NS water are stated in Rule 15.8.4(b).

15.5.2 Class CR Water (Contact Recreation)

Class CR water is applied for the management of water bodies for contact recreation purposes. Within the Tarawera catchment the Class CR water is applied in respect of Lake Okaro only. Environment Bay of Plenty has interpreted the standards for class CR water to mean the application of standards which will not render the water quality in the total water column of Lake Okaro unsuitable for bathing. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect lake Okaro.

The specific water quality standards of class CR water are stated in Rule 15.8.4(d).

15.5.3 Class FSUT Water (Fish Spawning – Upper Tarawera)

The class FSUT water is applied for the purpose of managing water quality to a level suitable for trout spawning purposes. This is because the specific requirements of trout are well documented and it is assumed for the purposes of this regional plan that the classification criteria will also allow for the requirements of indigenous fish and other aquatic life. Class FSUT applies in respect of the Upper Reach of the Tarawera River, the tributaries of the Tarawera River (excluding the drains and canals on the Rangitaiki Plains, but including the tributaries of the Lower Reach of the Tarawera River), and the tributaries of the Tarawera Lakes. Class FSUT water applies regardless of whether streams or rivers are trout spawning grounds. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect the above mentioned water bodies.

The specific water quality standards of class FSUT water are stated in Rule 15.8.4(f).

15.5.4 Class FPLT Water (Fish Purposes – Lower Tarawera)

Class FPLT is applied for the purpose of managing water quality in the Lower Reach of the Tarawera River at a level equivalent to that required by trout, and thereby also allowing for the survival of a range of indigenous fish species that would normally be in the river in the absence of discharges. Class FPLT water relates to the main stem of the Lower Reach of the Tarawera River only, this being the reach from the Kawerau Road Bridge across the Tarawera River to the Thornton Road Bridge across the Tarawera River. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may effect the Lower Reach of the Tarawera River.

The specific water quality standards of class FPLT water are stated in Rule 15.8.4(h).

15.5.5 Drains and Canals and Wetlands on the Rangitaiki Plains

Environment Bay of Plenty does not consider that the water quality of the wetlands in the lower river catchment, or the drains and canals on the Rangitaiki Plains, require managing through the imposition of water quality standards. Environment Bay of Plenty favours the prohibition of all discharges to wetlands, other than those associated with controlling wetlands water levels, facilitating fish passage, and eradicating plant pests.

15.6 Overall Options to Achieve Water Quality Standards

During the preparation of this regional plan a number of alternatives were raised as to how industry might apply new techniques or technology to achieve the new water quality standards. An investigation commissioned by the pulp and paper companies[105], primarily focused on means to increase dissolved oxygen levels in the Lower Reach of the Tarawera River, though other important water quality factors, such as colour and clarity, and toxicity, were also considered.

It should be noted that the options do not form part of this regional plan but simply indicate the combination of approaches, which costs, time and technology permitting, may be available to industry to reduce some of the current adverse effects of discharges on the Lower Reach of the Tarawera River.

LOX (short for liquid oxygen) refers to the method of increasing the dissolved oxygen levels in the river water through the addition of water supersaturated with oxygen. In the following options the use of LOX forms either a main or ancillary means of boosting river oxygen levels. Environment Bay of Plenty particularly supports and encourages the use of LOX both as a short term option to achieve a direct remedial increase in river oxygen levels while other methods to reduce organic loads are put in place, and as a river oxygen buffering system in the longer term.

15.6.1 Options Proposed by Industry for Achieving Water Quality Standards

The options made available to the Tarawera Liaison Group and discussed as possibilities for achieving the new water quality standards for the Lower Reach of the Tarawera River were as follows:

(a) Separate Mill Treatment Systems plus LOX;

(b) Combined Mill Treatment Systems plus LOX;

(c) Changes to In-Plant Production Processes plus LOX;

(d) Extended Combined Mill Treatment Systems plus LOX;

(e) Land Application plus LOX;

(f) Reduction of Effluent Impact using LOX;

(g) Gravity Pipeline to Matata;

(h) Pumped Ocean Outfall;

(i) Reinjection of Geothermal Fluid or, if feasible, removal of contaminants in geothermal fluid before discharge.

It is noted that full investigation may result in variations or combinations of these options being adopted to achieve the best overall outcomes.

15.6.1(a) Separate Mill Treatment Systems

Each mill would improve its waste effluent separately of the other. At Tasman Pulp and Paper Company Limited it was assumed that these improvements would come from:

(a) A significant reduction of in-mill water usage;

[105] CH2M Hill, Confidential Report, 1994 (May).

(b) Revising the current foam control sprayers to use effluent water;

(c) Installing a screw press for primary solids handling to eliminate or significantly reduce water drainage and runoff BOD_5;

(d) Substantial dredging of secondary solids build-up in the effluent treatment ponds;

(e) Analysing adequacy of current effluent treatment ponds aeration system; and

(f) Providing additional nutrients and macronutrients to the waste effluent.

At Carter Holt Harvey Tissue's mill it was assumed that efficiencies could be gained from the current Anaerobic Wastewater Treatment Plant (AWTP), increasing the organic loading in the effluent by supplementing some sewage inputs with Tasman Pulp and Paper Company Limited low strength condensates. In addition it is considered that BOD_5 load to the Lower Reach of the Tarawera River would decrease if the use of the RIBs was expanded and direct discharges suspended.

It has been estimated that, in total, changes to the separate in-mill treatment systems would result in a reduction of 3.7 tonnes per day of BOD_5 discharged to the Lower Reach of the Tarawera River.

15.6.1(b) Combined Mill Treatment Systems

This option proposes taking advantage of the efficiencies and economies that could be gained in combining, in total or in part, Tasman Pulp and Paper Company Limited's and Carter Holt Harvey Tissue's treatment systems. This would involve combining Carter Holt Harvey Tissue's medium to high strength wastewaters with Tasman Pump and Paper Company Limited's low strength wastewaters.

It has been estimated that in total, the appropriate combination of Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue mill effluent would result in a reduction of 4.0 tonnes per day of BOD_5 discharged to the Lower Reach of the Tarawera River. This option would also have the significant beneficial effect of reducing the toxicity of Carter Holt Harvey Tissue's effluent. In January 1999 Tasman Pulp and Paper Limited began to take the Carter Holt Harvey Tissue mill clarifier effluent into their effluent treatment system. This has the ability to reduce the BOD_5 load on the river by approximately one tonne per day.

15.6.1(c) Changes to In-Plant Production Processes

This option was raised by the Tarawera River Liaison Group on a number of occasions. All the major dischargers to the river have been looking at new technology which would limit the amount or type of effluent discharged to the Tarawera River. In the case of the Tasman Pulp and Paper Company Limited, oxygen delignification has been introduced, reducing the need for chlorine compounds in the bleaching process. New colour reduction technology processes have also been introduced, which have enabled the company to reduce its colour loading to the Lower Reach of the Tarawera River quite substantially.

At this stage closed-cycle mills were seen as experimental and prone to major problems. However, the Liaison Group was concerned that the major industrial dischargers take steps to explore new pollution reduction technologies in their pulp and paper making processes. Environment Bay of Plenty will advocate, and encourage the adoption of, new technology aimed at reducing the adverse environmental effects of discharges to the Tarawera River.

15.6.1(d) Extended Combined Mill Treatment Systems

This option encapsulates four sub-options. The first sub-option is the extension of the retention time of wastewater through Tasman Pulp and Paper Company Limited's aerated sludge basins (ASBs) by a combination of raising the pond surface and deepening the ponds. The first sub-option also suggests the development of an ASB by Carter Holt Harvey Tissue. The second sub-option involves converting Tasman Pulp and Paper Company Limited's current Pond No. 2 to an activated sludge basin, while Carter Holt Harvey Tissue would develop a second activated sludge basin. It is proposed that these new ASBs would be unlined, fulfilling some of the functions of the current Carter Holt Harvey Tissue RIBs.

Sub-option three would involve combining and extending the Carter Holt Harvey Tissue and Tasman Pulp and Paper Company Limited pond systems resulting in additional retention time in the ponds. Sub-option four is effectively a combination of sub-options two and three. Of these sub-options the report favoured sub-option three as providing the most effective BOD_5 removal of the four sub-options. It is estimated in the report that this option could lead to the removal of approximately 0.8 tonnes per day more soluble BOD_5 than those options discussed in sub-sections 15.6.1(a) and 15.6.1(b). The additional BOD_5 removed would be a high marginal cost.

15.6.1(e) Land Application

The report divides this option into five sub-options. Each sub-option involves the combining of Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue effluent and pumping to the land application site. It was assumed that land application would be seasonal with 100 per cent application during summer months and 50 per cent of wastewater effluent applied to land during winter months.

The sub-options relate to the extension of rapid infiltration basins (RIBs), the development of artificial wetlands, and spray irrigation to pasture land, forest land, and hilly forest land. Of these sub-options the report favours the application of wastewater to hilly forest land as the most cost-effective and readily implementable of the five sub-options. This sub-option could lead to an estimated 85 per cent reduction in summer waste loads. It is estimated that BOD_5 would reduce by approximately 4.5 tonnes per day below the current discharge allowances. Carter Holt Harvey Tissue have undertaken to shift to a full land based effluent irrigation system. This will significantly reduce the impact of their mill effluent on the river. This initiative should result in the recovery of the river water over the (approximately) six kilometres above the Tasman Pulp and Paper Limited main effluent discharge outfall. Tasman Pulp and Paper limited are also considering a land based irrigation system for paper machine wastewater. If implemented this would further reduce the BOD_5 loading on the river.

15.6.1(f) Reduction of Effluent Impact on the Lower Reach of the Tarawera River

The report shows that the uptake of oxygen in the Lower Reach of the Tarawera River as a result of the BOD_5 load discharged by the pulp and paper mills, could be largely overcome by the implementation of one of three sub-options. Sub-option one involves the oxygenation of the Lower Reach of the Tarawera River with liquid oxygen via diffusers placed below the main discharge. Sub-option two would involve the planting of poplars along the river banks of the Lower Reach of the Tarawera River to provide shading and reduce diurnal temperature swings. The third sub-option, a radical option, would involve isolating the water in the Lower Reach of the Tarawera River from the pumice bed by using groat mats.

The report favours sub-options one and two, sub-option three being considered to require more development and having a high cost. It is estimated that sub-options one and two would result in reductions of BOD_5 below the current discharge allowance by 5.2 and 1.5 tonnes per day.

The discharge of liquid oxygen, either alone or in combination with other waste-stream alterations, would provide a rapid means to enhance the levels of dissolved oxygen in the river. The system for delivery of LOX could be automated to react to a dissolved oxygen meter, so providing an immediate and effective response system.

15.6.1(g) Gravity Pipeline to Matata

This option is intended to by-pass the problems associated with discharges to the Tarawera River by discharging the treatment effluent in the river mouth. As proposed, this option would involve the construction of a gravity pipeline to the mouth of the Tarawera River and then discharge to the river mouth[106] by a 1.8 metre multi-port diffuser across the river's width, or alternatively discharge into the canal alongside Sutherland Road (known as the 109 canal). This option would completely remove mill effluent BOD_5 and colour, and other constituents associated with the mill discharges, from the bulk of the Tarawera River.

During the preparation of this regional plan consultation with iwi authorities showed that they considered the direct discharge of effluent via a pipeline into the river mouth coastal marine area culturally offensive. In addition, the pulp and paper companies indicated that the cost of a pipeline to the river mouth may be prohibitive.

15.6.1(h) Pumped Ocean Outfall

This option is intended to by-pass the problems associated with discharges to the Tarawera River by discharging the treated effluent via an ocean outfall directly to the Pacific Ocean. Effluent would be moved by a gravity pipeline to the coast, from where it would be pumped through an ocean outfall into the Pacific Ocean. Many pulp and paper mills around the world discharge their effluent through ocean outfalls.

This option takes advantage of the large assimilative capacity of the Pacific Ocean and would completely remove mill effluent BOD_5 and colour, and other constituents associated with the mill discharges, from the Tarawera River. It is estimated that this option would result in a total reduction of BOD_5 into the river.

During the preparation of this regional plan consultation with iwi authorities showed that they considered the discharge of effluent to the coastal marine area also culturally offensive. In addition, the pulp and paper companies indicated that the cost of a pipeline and ocean outfall may be prohibitive.

15.6.1(i) Reinjection of Geothermal Fluid

In terms of the management of the field pressures and fluid levels in the Kawerau Geothermal Field, and the requirement to limit the impact of the discharge of geothermal fluid into the Tarawera River, the reinjection of geothermal fluid to a sustainable level will be encouraged. The mass, location and depth of reinjection will need to be carefully considered and the discharge monitored and controlled to limit the potential for any consequent adverse effect on the geothermal resource or on the potable groundwater resources of the catchment.

15.6.1(j) Options Proposed by Industry – Supporting Technical Reports

The following technical reports, written or referred to as part of the preparation of this regional plan, contain more detailed information on Options Proposed by Industry:

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106 It should be noted that the Tarawera River mouth falls within the coastal marine area. Discharges to the coastal marine area are subject to rules in the Bay of Plenty Coastal Marine Area and would require consent from both Environment Bay of Plenty and the Minister of Conservation.

Clark, T et al — 1993, Report for the Bay of Plenty Regional Council: The Pulp and Paper Industry and the Environment – An Overview, Contract Report No. 93/46, PAPPRO, Rotorua.

Dell, P — 1993 (November), Pulp and Paper Industry Study Tour: July 1993, Environment Bay of Plenty Environmental Report 93-94, Whakatane.

CH2M Hill International — 1994 (May), Effluent Reduction Study – Tarawera River, prepared for Caxton Paper Limited and Tasman Pulp and Paper Company Limited, CH2M Hill. Confidential Report (released to the Tarawera Liaison Group for their information and discussion).

15.6.2 Options Proposed by Other Parties

The following options are the view of Greenpeace NZ.

15.6.2(a) Totally Chlorine-Free Conversion of Mill

A totally chlorine-free bleaching process that would replace the use of chlorine and chlorine dioxide with hydrogen peroxide or “oxygen” bleaching, or thermophillic enzymes or “ozone” bleaching. None of these systems produce chlorine containing contaminants.

15.6.2(b) Totally Effluent-Free Conversion of Mill

A totally effluent-free or closed loop system that would release no discharges to water.

15.7 Reasonable Mixing Zones

The Resource Management Act 1991 (e.g. section 107(1)) requires that the effect of discharges on surface water bodies be measured only after allowing for reasonable mixing. The Act does not define the term “reasonable mixing”.

In order to be able to measure the effects of discharges to water bodies reasonable mixing zones need to be established for each discharge. Environment Bay of Plenty considers that this can be done in one of two ways:

(i) One approach is to establish, through rules in this regional plan, a formula by which specific reasonable mixing zones can be applied to each discharge. This approach enables the setting of quantitative mixing areas measured from the point of discharge, as a resource consent condition.

(ii) Alternatively reasonable mixing zones can be established on the basis of ratio of discharge to receiving waters. Environment Bay of Plenty suggests that this blanket method of calculating reasonable mixing discharges, while relatively simple is too coarse to apply across different types and sizes of discharges, which have different “effects”.

15.7.1 Reasonable Mixing Zones – Selected Management Alternatives

Environment Bay of Plenty’s selected approach is (i) above: to establish reasonable mixing zones, via a formula, case by case, based on a number of guiding criteria, as outlined in Policy 15.8.3(f) and Rule 15.8.4(s).

15.7.2 Reasonable Mixing Zones – Reference

In assessing the criteria related to reasonable mixing zones Environment Bay of Plenty had regard was had to the following document:

Ministry for the Environment	1994 (August), Resource Management Ideas No. 10 "A Discussion on Reasonable Mixing in Water Quality Management", MfE.

15.8 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

15.8.1 Issues

Issues relating to surface water quality are:

15.8.1(a) Degradation of water quality and its adverse effects on the life-supporting capacity, ecosystems, aesthetic, amenity and cultural values, other than those effects resulting from natural occurrences or perturbations, due to:

15.8.1(a)(i) Increased levels of nutrients from land runoff and effluent discharges.

15.8.1(a)(ii) The continued discharge of large quantities of industrial effluents containing a range of contaminants into the Lower Reach of the Tarawera River is a concern to the community.

15.8.1(a)(iii) Inappropriate farming and forestry practices and incompatible land uses.

15.8.1(a)(iv) The discharge of sewage into surface water in the Tarawera River catchment.

15.8.1(a)(v) Low dissolved oxygen levels in the Lower Reach of the Tarawera River and in the canals on the Rangitaiki Plains.

15.8.1(a)(vi) The discharge of toxic substances to the Lower Reach of the Tarawera River.

15.8.1(a)(vii) The discolouration of the Lower Reach of the Tarawera River.

15.8.1(a)(viii) Emission of objectionable odour from the Lower Reach of the Tarawera River.

15.8.1(a)(ix) The existence of undesirable biological growths in parts of the Lower Reach of the Tarawera River.

15.8.1(a)(x) The tainting of water in the Lower Reach of the Tarawera River.

15.8.1(a)(xi) The occasional production of conspicuous foams and scums in the Lower Reach of the Tarawera River.

15.8.1(a)(xii) The raising of the water temperature in the Lower Reach of the Tarawera River, and consequent effects on dissolved oxygen levels.

15.8.1(a)(xiii) The discharge of geothermal wastewaters into the Lower Reach of the Tarawera River.

15.8.1(b) A lack of appropriate water quality standards in the catchment to protect water bodies and the environment from the adverse effects of water degradation.

15.8.1(c) The strong community requirement that the degraded water quality in the Lower Reach of the Tarawera River be managed to avoid, remedy or mitigate unacceptable effects has not been achieved.

15.8.1(d) Degradation of the quality of water in the catchment of the Tarawera Lakes due to inappropriate subdivision, use and development.

15.8.2 Objective

Enhance surface water quality in the Tarawera catchment to a level which safeguards the life supporting capacity of the water and meets the reasonable needs of people and communities, especially:

(a) Reduction in the production of waste and discharge of contaminants throughout the catchment; and

(b) The maintenance of "Fish Spawning" water quality standards in the Upper Reach of the Tarawera River and its tributaries; and

(c) The establishment of "Fish Purposes" water quality standards in the Lower Reach of the Tarawera River; and

(d) The conservation of lakes and tributaries in their Natural State; and

(e) The enhancement of the water quality in Lake Okaro to that suitable for contact recreation; and

(f) To recognise that staged changes in industrial processes and waste treatment systems will be necessary to achieve the water quality goals of this regional plan.

(g) Unless there are exceptional circumstances there shall be not discharge of sewage into the surface water of the Tarawera River.

15.8.3 Policies

15.8.3(a) To establish a range of surface water quality classes that provide standards for the management of surface water bodies in the catchment. The purposes of these classifications are as follows:

(i) The quality of water in the lakes in the catchments of the Tarawera Lakes, excluding Lake Okaro, will be managed to retain its Natural State (NS) (see Rule 15.8.4(b)). For the purposes of the Class NS classification, Environment Bay of Plenty defines natural state to mean that the water quality in the total water column of a lake should remain at 1994 water quality standards or better.

(ii) The quality of water in Lake Okaro will be managed for Contact Recreation (CR) purposes (see Rule 15.8.4(d)).

(iii) The quality of water in the tributaries of the Tarawera Lakes, the tributaries of the Tarawera River, excluding the canals and drains and wetlands on the Rangitaiki Plains, and the Upper Reach of the Tarawera River will be managed for fish spawning purposes (FSUT) (see Rule 15.8.4(f).

(iv) The quality of water in the Lower Reach of the Tarawera River will be managed for fish purposes (FPLT) (see Rule 15.8.4(h)).

15.8.3(b) To promote reduction of contaminant discharges into the Tarawera River.

15.8.3(c) To reduce the discharge of contaminants into wetlands, canals and drains on the Rangitaiki Plains.

15.8.3(d) To advocate that the discharge of dairy shed effluent is in accordance with guidelines agreed between Environment Bay of Plenty and the agriculture industry.

15.8.3(e) To encourage dischargers to avoid, remedy or mitigate any actual or potential adverse effects arising from their direct or indirect discharge of contaminants into water by:

(a) Limiting and reducing quantities and concentrations of discharged contaminants, in particular, contaminants which can reduce the life supporting capacity of aquatic ecosystems.

(b) Promoting dischargers to land in preference to discharges into water in areas of the catchment of the Tarawera River where groundwater is not vulnerable to adverse effects from resulting contaminants and where runoff of contaminants into water can be controlled.

(c) Reducing adverse effects from non- point-source discharges of contaminants to water bodies by supporting and promoting appropriate land and riparian management practices, and discouraging the application of sprays and fertilisers adjacent to or over surface water bodies.

15.8.3(f) To establish reasonable mixing zones for all authorised discharges, excluding permitted activities, within the Tarawera River catchment, on a case by case basis, relative to but not limited to specified criteria (15.8.4(s)).

15.8.3(g) To promote the efficient use of water.

15.8.3(h) To enable public access to available water quality information.

15.8.3(i) To encourage discharge permit holders to conduct appropriate tests and monitoring of the toxic effect of their effluent.

15.8.3(j) To allow for the discharge of uncontaminated stormwater (15.8.4(q)).

15.8.3(k) To promote the guidelines and principles of the *Operative Bay of Plenty Regional Land Management Plan* with regard to the management of land use activities that aggravate soil erosion, and the subsequent sediment contamination of surface water sources.

15.8.3(l) To ensure the reduction in discharges with BOD loading into the Lower Reach of the Tarawera River to achieve dissolved oxygen standards required for Fish Purposes.

15.8.3(m) To encourage the reduction of colour to achieve Fish Purpose standards for the Lower Reach of the Tarawera River.

15.8.3(n) To encourage a reduction in human sewage discharges into the Tarawera River or its tributaries.

15.8.3(o) To discourage and eventually prevent the degrading of the purity of water caused by the discharge of human sewage by:

(a) encouraging the use of sewage treatment systems designed in consultation with tangata whenua to enhance or restore the mauri of receiving water;

(b) prohibiting any new sewage discharges to surface water;

(c) encouraging a shift to land based sewage treatment and disposal systems;

(d) requiring any discharge of human sewage from Kawerau township into the Tarawera River to comply with the Fish Purposes classification standards;

(e) requiring any discharge of human sewage from the Edgecumbe township sewage system into the Omeheu Canal to comply with defined effluent quality standards.

15.8.3(p) To encourage communities to develop land based treatment systems for sewage disposal.

15.8.3(q) To encourage the grant of consents for the discharge of treated sewage to land.

15.8.3(r) To allow the discharge of sewage to the Tarawera River and to its tributaries only in exceptional circumstances where no other practicable options are available, but limited in time to the duration of those circumstances.

15.8.3(s) To require a management plan to accompany consent applications; identifying the measures considered appropriate for avoiding the discharge of sewage to the river.

15.8.4 Methods of Implementation – Rules

15.8.4(a) All water within Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi in the Tarawera Lakes catchment, excluding Lake Okaro, is classified to be managed in its Natural State (NS), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standard in Rule 15.8.4(b) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(b) The standards for **Class NS**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by measurement on the Munsell Hue scale, and no decrease in visual clarity as assessed by black disc measurement[107].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature.

(v) No change in pH.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) No conspicuous increase in biological growths.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

(x) No increase in nitrogen and phosphorus levels relative to the total nitrogen and total phosphorus levels measured in the lake in 1994.

[107] Includes Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi. Does not include Lake Okaro.

Class NZ Tarawera River Catchment Lakes – 1994 Nutrient Quality			
Lake	**Total Phosphorus mg/m^3**	**Total Nitrogen mg/m^3**	**Trophic Lake Index**
Tarawera	6.6	119	2.6
Okataina	5.7	113	2.6
Tikitapu	3.1	185	2.7
Okareka	5.1	221	3.0
Rotokakahi	6.4	217	3.1
Rotomahana	41.1	247	3.9

15.8.4(c) All surface water within Lake Okaro is classified to be managed for Contact Recreation (CR), and any discharge permit granted for the discharge of contaminants into the water of Lake Okaro shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(d) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(d) The standards for **Class CR**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) No decrease in visual clarity below 1.6 metres as measured by the black disc technique.

(ii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iii) No increase in temperature of more than 3°C, and maximum no to exceed 25°C.

(iv) pH shall remain within the range of 6.0 to 9.0.

(v) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vi) No conspicuous increase in biological growths.

(vii) The median concentration of enterococci of at least 5 samples taken throughout the bathing season[108] shall not exceed 33 enterococci per 100 millilitre, nor shall any single sample exceed 107 enterococci per 100 millilitre.[109].

(viii) No increase in the emission of objectionable odour.

15.8.4(e) All surface water within the Upper Reach of the Tarawera River, including the reach from the Lake Tarawera River Outlet to the Kawerau Road Bridge across the Tarawera River, and also including all tributaries of the Tarawera River (other than the drains and canals on the Rangitaiki Plans) and tributaries of the Tarawera Lakes are classified to be managed for Fish Spawning Purposes Upper Tarawera River (Class FSUT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(f) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

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[108] The bathing season is defined as the period from 1 November to Easter inclusive.

[109] McIntosh, J J 1993, Bay of Plenty Regional Council Regional Monitoring Network Bathing Suitability Survey 1993, Environment Bay of Plenty Environmental Report 93/1, 76pp.

15.8.4(f) The standards for **Class FSUT**, that apply after reasonable mixing of any contaminant or water with the receiving water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by Munsell Hue colour units measurement, and no decrease in visual clarity as assessed by black disc measurement[110].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) pH shall remain within the range 6.5 to 8.5.

(vi) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vii) The seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (<ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption.

(ix) No increase in the emission of objectionable odour.

15.8.4(g) All water within the main stem of the Lower Reach of the Tarawera River, that being the reach from the Kawerau Road Bridge across the Tarawera River and the Thornton Road Bridge across the Tarawera River (excluding the tributaries of the Lower Reach of the Tarawera River and the drains and canals on the Rangitaiki Plains), is classified to be managed for Fish Purposes Lower Tarawera (FPLT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(h) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(h) The standards for **Class FPLT**, which apply after allowing for the reasonable mixing of any discharge of contaminants or water to surface water, and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall not at any time fall below:

Until 31 December 2002:

5.0 grams per cubic metre for the mean of any consecutive 30 days;
4.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
3.5 grams per cubic metre as an absolute minimum.

[110] Utilising protocol laid down in Smith, D G et al, 1989.

From 1 January 2003:

6.0 grams per cubic metre for the mean of any consecutive 30 days;
5.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
4.5 grams per cubic metre as an absolute minimum.

(ii) Above the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, no decrease in visual clarity of more than 20% of the ambient black disc measurement measured at the Kawerau Bridge site.

Below the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, colour, as measured by the absorption coefficient of a 0.45 micron filtered sample at 440nm on a spectrophotometer, shall not exceed:

(a) To 31 December 2000:

The 6 month mean shall not exceed 3.8 (equivalent to 50 platinum-cobalt units).

(b) From 1 January 2001:

The 6 month mean shall not exceed 2.3 (equivalent to 30 platinum-cobalt units).

(c) From 30 December 2005:

The 6 month mean shall not exceed 0.8 (equivalent to 10 platinum-cobalt units).

(iii) No detectable increase in acute and chronic toxicity between a reference river water sample taken from the Kawerau Bridge site and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) The pH shall remain within a range of 6.5 to 8.5.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) From 1 July 2000, the seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (>ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

15.8.4(i) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the toxicity of effluent shall be tested over a standard geometric dilution series factor of 0.5 which encompasses the mixing ratio. Four different species of freshwater organisms will be tested as per the following protocols:

(i) For Acute Testing:

Environment Canada (1990). Biological test method. Reference method for determining acute lethality of effluents to rainbow trout. Conservation and Protection, Ottawa, Ontario. EPS 1/RM/13.

(ii) For Chronic Testing:
OECD (1981). Chronic reproduction test using a cladoceran (*Daphnia magna*). Test Method 211 (adopted 21 September 1998), or the most up to date equivalent of Test Method 211, In: "OECD Guidelines for the testing of chemicals", Organisation for Economic Cooperation and Development, Paris.

Environment Canada (1992). Biological test method. Toxicity test using luminescent bacteria (*Photobacterium phosphoreum*). Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/24.

Environment Canada (1992). Biological test method. Growth inhibition test using the freshwater alga *Selenastrum capricornutum*. Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/25.

To comply with the classification standards, chronic tests shall show no detectable toxicity at the specified mixing ratio.

15.8.4(j) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the specified mixing ratio shall be determined for each discharge permit on a case by case basis by dividing(÷) the maximum permitted effluent flow by the mean annual 7 day low flow statistic recorded nearest to the discharge point.

e.g. A permitted discharge with a maximum flow of 2 cubic metre per second occurs at Pipe Bridge.

The mean annual 7 day low flow at Pipe Bridge is 16.6 cubic metre per second.

$\therefore$ The mixing ratio = 2 : 16.6 = 0.12

15.8.4(k) Relative to the acute and chronic toxicity standards for NS, CR and FSUT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii) and 15.8.4(f)(iii), the site of reference water collection shall be determined on a case by case basis. Reference (or diluent) water will be collected directly upstream of the discharge or, in the case of a lake, from a site not influenced by the discharge.

15.8.4(l) Any discharge to water that contravenes or causes contravention of any Rule, standard or term of this regional plan, in particular any classification standard of Rules 15.8.4(b), 15.8.4(f) or 15.8.4(h), shall be a Non-Complying Activity.

15.8.4(m) Any discharge to water that:

(a) is within a water classification area defined in this regional plan, and does not contravene or cause contravention of any classification standard for that water classification area, and any other Rule, standard or term in this regional plan; or

(b) is outside a water classification area defined in this regional plan, and does not contravene or cause contravention of any Rule, standard or term in this regional plan;

shall be a Discretionary Activity unless otherwise specifically provided for in a Rule in this regional plan.

15.8.4(n) Subject to the provisions of Rule 15.8.4(t), the classification standards set in Rules 15.8.4(b), 15.8.4(d), 15.8.4(f), and 15.8.4(h), shall apply to all existing and new consents.

15.8.4(o) The discharge of aerated and/or oxygenated water or oxygen into the Tarawera River for the purpose of increasing the dissolved oxygen content of the river water shall be a Discretionary Activity.

In considering an application for a discharge consent pursuant to this Rule, Environment Bay of Plenty shall have particular regard to:

(a) Whether the applicant is taking action to reduce the total mass of biochemical oxygen demand (BOD_5) in the discharge that is causing the need for oxygen injection into the river water.

(b) Whether the applicant is installing capital works to achieve compliance with the FPLT classification standard.

(c) Whether the oxygen injection proposed is a means to remedy the effect of inadequate effluent management or an inadequate primary effluent treatment system.

(d) Whether the location, design, construction and installation of the structure for the oxygen discharge is adequate to ensure optimal oxygenation with minimum adverse effect on river ecology.

(e) Whether the proposal to inject oxygen is the more effective method to increase the dissolved oxygen levels in the river water relative to other methods.

(f) Whether the discharge will have a net adverse effect on the environment.

(g) Whether the discharge will adversely affect other users of the Tarawera River.

(h) Whether the time periods during which discharges are to occur are adequately managed and effective.

15.8.4(p) The discharge of contaminated stormwater is a Discretionary Activity, and shall be considered with particular regard to:

(i) The installation and maintenance of effective traps or other spillage retention devices.

(ii) The effective sealing and bunding of contaminant storage and transit areas.

(iii) The production and implementation of chemical spillage prevention, retention and disposal protocols (contingency plans).

15.8.4(q) The discharge of uncontaminated stormwater into water within the Tarawera River catchment is a Permitted Activity, subject to the following requirements:

(i) The maximum discharge shall not exceed the flow from a 300 millimetre pipe on a flat grade or equivalent of 80 litres per second.

(ii) The suspended solids concentration of the water discharged does not exceed 150 grams per cubic metre.

(iii) The water discharged is substantially free of grease and oil;

(iv) The works shall be designed, constructed and maintained in such a manner so as not to cause erosion or flooding or to adversely affect any land or property owned or occupied by another person.

For the purposes of this Rule, uncontaminated stormwater includes stormwater runoff from roofs, sealed and unsealed roads and streets, hard stand areas, yards and grassed areas and the like.

15.8.4(r) Except for the provisions of the Operative On-Site Effluent Treatment Regional Plan, and for the provisions for Kawerau township and Edgecumbe township set out in (a) to (d) of this rule, and the provisions of rule 15.8.4(x), all new or existing discharges of human sewage or contaminants derived from human sewage into surface water within the Tarawera River catchment will become a Prohibited Activity on the date on which this regional plan becomes operative.

(a) Until 31 December 2002 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment shall be a Discretionary Activity, subject to the discharge complying with all rules, standards and terms in this regional plan and meeting or bettering the receiving water classification.

(b) From 1 January 2003, the discharges of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment will be limited to the provisions of rule 15.8.4(x), provided that this limitation shall be suspended until 12 months past the date on which an application by Carter Holt Harvey Tissue to discharge AWWTP wastewater and sanitary wastewater from Kawerau township by spray irrigation to land has been decided and any appeals determined.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment shall be a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005, the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township shall be a Discretionary Activity limited to discharge that complies with all rules, standards and terms in this regional plan and meets or betters effluent quality standards of:

(i) BOD<10 milligrams per litre,
(ii) Suspended Solids<15 milligrams per litre,
(iii) Total N<25 milligrams per litre,
(iv) Faecal Coliform<10^4/100 millilitre,

measured in the effluent stream prior to discharge, and produced by a treatment and disposal system that has been designed in consultation with affected iwi.

15.8.4(s) Except for the discharge of uncontaminated stormwater in compliance with Rule 15.8.4(q), every discharge permit granted to discharge contaminants from a point-source outfall into any water body within the Tarawera River catchment shall have a condition defining a reasonable mixing zone, stated as a classification non-compliance zone defined as a distance or radium measured from the outfall point. Each non-compliance zone shall be the minimum practicable relative to the relevant classification standards and assessment criteria. In establishing a non-compliance zone for a discharge, Environment Bay of Plenty will consider the following assessment criteria.

(i) Relevant classification standards;

(ii) The flow regime of the receiving water;

(iii) The ambient concentrations of contaminants in the receiving water;

(iv) Effluent discharge flow rate and contaminant concentrations;

(v) Cumulative and other effects;

(vi) Existing discharge and abstraction consents;

(vii) Fish migration and instream ecosystems requirements;

(viii) Maori cultural values;

(ix) The location of the discharge and position of the outfall;

(x) Outfall diffuser design criteria;

(xi) Information provided by the applicant;

(xii) Any other relevant information.

15.8.4(t) The discharge of a dye or gas into water for scientific or investigation purposes is a Permitted Activity subject to the following conditions:

(i) Environment Bay of Plenty is given at least ten working days notice prior to the discharge.

(ii) Details of the proposed discharge are publicly notified at least one week prior to the discharge.

(iii) Any person or persons likely to be affected by the presence of dye or gas in water used for recreational, consumption or other uses is notified of the proposed discharge at least one week prior to the discharge.

(iv) The dye or gas used shall not exceed a concentration that is proven to be inert and non-toxic in effect.

15.8.4(u) Environment Bay of Plenty will support education programmes as a means of encouraging the development of buffer zones and other methods to prevent land discharge of contaminants from reaching surface water.

15.8.4(v) The discharge of dairy shed effluent into unclassified water shall be a Discretionary Activity managed in accordance with guidelines including "Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments, September 1992".

15.8.4(w) Environment Bay of Plenty will provide available water quality test information on request.

15.8.4(x) Notwithstanding all other rules in this plan, the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment in exceptional circumstances and when no other practicable options are available, shall be a non-complying activity. Any application made shall be accompanied by a management plan that identifies the measures considered appropriate for avoiding the discharge of sewage to the river.

15.8.5 Principal Reasons

The aim of this regional plan, as set out in clause 1.2, is sustainable management of the Tarawera River catchment by ensuring that:

(a) There is integrated management of the natural and physical resources of the Tarawera River catchment;

(b) The high quality water in the catchment of the Upper Reach of the Tarawera River is maintained and improved where appropriate;

(c) The water quality in the Lower Reach of the Tarawera River is managed to ensure that the effects of industrial discharges are substantially reduced;

(d) The community remains involved in the management process;

(e) There is reduction in the discharge of contaminants into the Tarawera River;

(f) The Mauri of the Tarawera River is restored and the balance maintained.

This chapter makes operative a major part of the means to achieve these requirements. There will be ongoing debate on exactly how and when remedial activities should take place. However, in general, the consultation process to develop the chapter have resulted in:

(a) Clear goals being set;

(b) A staged agenda developed to provide achievable goals within a reasonable and realistic time-frame;

(c) The determination of all those involved towards achieving those goals;

(d) A qualified willingness between many of those involved to work together rather than as adversaries in order to make clear progress towards realising the goals set.

The Tarawera Lakes and the catchment of the Upper Reach of the Tarawera River are in a reasonably clean state and the classifications proposed should protect and maintain if not improve their existing high water quality.

The Lower Reach of the Tarawera River still has degradation due primarily to the discharges of the pulp and paper industries in Kawerau. The three main contamination effects – low dissolved oxygen, colouration and toxicity – are the same three identified 10 years ago during the development of the 1985 *Tarawera Management Plan*. Of the three, low dissolved oxygen is found to have the major effect on river ecology. The classification proposed in Rule 15.8.4(h)(i) stages an increase in the 30 day average dissolved oxygen concentration to 6.0 grams per cubic metre from 1 January 2003, the minimum amount necessary for Fish Purposes.

The problem of colour reduction is acknowledged to be a significant one for the pulp and paper industry to solve. However, the community desires that the visual appearance (colour and clarity) of the Tarawera River be improved. Rule 15.8.4(h)(ii) sets out a staged requirement which will ensure that from 1 January 2005 the visual colour and clarity of the river water will be considerably improved.

The amounts of toxic compounds, including organochlorine compounds, discharged from the Tasman Pulp and Paper Company Limited outfall have diminished over time. This regional plan will encourage further reduction in the discharge of toxic contaminants by establishing a classification standard for all water bodies in the Tarawera River catchment stating: “No detectable increase in acute and chronic toxicity”. The progress of industry in achieving further reductions

in toxic compounds will be measured using the toxicity, water quality and ecological monitoring programmes described in section 19.2.5 of this regional plan.

15.8.6 Anticipated Environmental Results

15.8.6(a) Retention and protection of the high quality water in the Tarawera Lakes and the catchment of the Upper Reach of the Tarawera River.

15.8.6(b) Continued improvement in the quality of water in the Lower Reach of the Tarawera River so that it will reach a quality sufficient for fish purposes by 1 January 2003 for dissolved oxygen and 1 January 2005 for colour.

15.8.6(c) Reduction in the effects caused by the discharge of contaminants into the Tarawera River and its catchment tributaries and lakes.

15.8.6(d) The enhancement of habitat and the return of more indigenous species into the waters of the Lower Reach of the Tarawera River.

15.8.6(e) The Lower Reach of the Tarawera River becoming an asset to the people of the region and a testament to the determination of industry to resolve difficult contaminant disposal issues.

15.8.6(f) The mauri of the Lower Reach of the Tarawera River is enhanced.