WHANGANUI CATCHMENT STRATEGY

Operative 1997
Updated Action Plan September 2003

Acknowledgements to:
Action Plan (1997) review and Updated Action Plan staff working group, Natasha Sitarz, Ian Moore, Allan Kirk, Clare Ridler, Sharn Hainsworth, Eric Dodd, Malcolm Todd, Andrea Harris and David Scott.

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Cover: Upper reaches of the Ohura River.
Photo by Rachel Williams.

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FOREWORD

The Whanganui River has great intrinsic, cultural and recreational values for the people in the Manawatu-Wanganui Region. The Manawatu-Wanganui Regional Council has prepared this Strategy to protect the values of the Whanganui River and enhance its water quality.

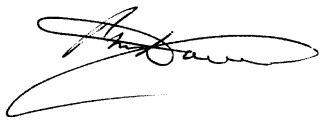
The Strategy establishes a partnership with the community based on co-operation, not regulatory provisions. The Council believes environmental outcomes can best be achieved by working with the community towards an agreed common goal.

The relationship with agencies and interests groups in the Whanganui Catchment is strong and this is increasingly the case with Tangata Whenua. The Whanganui iwi have Mana Whenua over the Whanganui River. Council respects that role and looks forward to a number of partnerships evolving in the next few years.

The key to improved water quality is sustainable land management throughout the Whanganui Catchment. This strategy outlines steps the Council has committed itself to undertake. For the Strategy to succeed, widespread support for the necessary actions by the community is needed. Accordingly, the Council invites organisations, landowners in the catchment and other individuals who share a concern for the river, to participate in a wide reaching and long term effort to improve the water clarity of the Whanganui.

The issues of accelerated erosion and its effects upon water quality occur in many parts of the Region. There are three reasons why a strategy should be prepared for the Whanganui Catchment only. The first is that the erodible soils, steep hills and relatively heavy rainfall make land in the catchment especially prone to accelerated erosion, which creates a need for soil conservation. The second that water clarity problems occur in the Whanganui River as a result of accelerated erosion, and the community has an expectation that these will be remedied. The third is that the area has had no base of subsidised soil conservation projects in the 1960's and 1970's as other areas had, and still has a lower uptake of soil conservation work than other parts of the Region. By providing impetus to soil conservation the strategy should help the catchment "catch up" with other parts of the region.

In taking a non-regulatory approach to land management in the Whanganui Catchment Council seeks a "win-win" outcome with the community, especially the farming community. Better water quality **and** better long term economic returns can be obtained from the catchment. The means to do this are appropriate land use, and better management techniques. The Council offers advice, education and assistance through its regional grants. The land management decisions are for the landowners in the catchment to make.



C J Lester
CHAIRMAN

P M Davies
CHIEF EXECUTIVE

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PART ONE
BACKGROUND INFORMATION

1. Introduction

1.1 Reasons for preparing a strategy

The Whanganui[1] River is an important natural resource in the Manawatu-Wanganui Region. The objective of the strategy is to enhance the water quality and protect the values of the Whanganui River, and the prime means of achieving this is to promote sustainable land management in the Whanganui Catchment.

Accelerated soil erosion is widespread in the Whanganui Catchment. The adverse effects of erosion include firstly, degradation of the water quality in the Whanganui River, and secondly, continual loss of part of the soil resource, which reduces the productive capability of the land.

The strategy is one way the Council is implementing its responsibilities under the Resource Management Act, particularly its responsibilities for soil conservation and water quality. The strategy is a planning document with an action focus, providing policy guidance to landowners and all whose decisions affect the soil and water of the Whanganui Catchment. The strategy commits the Council to stated courses of action, to achieve specific environmental outcomes.

Land resource management requires the integration of complex natural systems, to maintain productivity while avoiding adverse effects. The adverse effects of accelerated erosion visible in the Whanganui Catchment are the result of a vast number of day-to-day decisions of each landowner. Regulation of all these decisions would require a large bureaucracy and impose substantial costs on the community. It is impractical for the decisions to be made other than by the land owner, but by providing information and advice, and limited financial incentives, the quality of the decision making can be improved. For these reasons the Council believes that non-regulatory methods are more appropriate, and can be effective in achieving improved water quality in the Whanganui Catchment.

[1] The correct maori spelling "Whanganui" is preferred for the river and the catchment. The spelling "Wanganui" is used as part of the formal names of the City, the District Council, and the Manawatu-Wanganui Regional Council.

There has been wide support expressed to the Council in preparing this strategy. Individuals and groups within the community acknowledge a problem with water quality in the Whanganui River, and look for better land management practices to be adopted within the catchment. The size and complexity of the problem and the lack of a clear solution have meant that in the past little has been done. The strategy presents the issues simply and clearly, and concentrates on the actions the Council considers are necessary to achieve improved environmental outcomes.

The strategy addresses the significant issues of water quality and land management. It complements other actions affecting resource use in the Whanganui, including:

- sewage discharges from Taumarunui and Wanganui, which have been managed under individual resource consents;
- the upper Whanganui minimum flows issue, as determined by the Planning Tribunal in October 1990;
- possible protection of the main stem of the river, and major tributaries, from inappropriate development (i.e. damming), which will be addressed in the Regional Plan for the Beds of Rivers and Lakes and Associated Activities, which is soon to be notified;
- control of soil disturbance and vegetation clearance, which is regulated in the Transitional Regional Plan and will be further addressed in the Regional Land Management Plan when renotified;
- the claim by Whanganui iwi to the bed of the river, which has been heard before the Waitangi Tribunal; and
- the application for a water conservation order for the river, which is yet to be heard.

It is not desirable that these be duplicated or relitigated. Accordingly, the scope of the strategy does <u>not</u> include these other actions.

1.2 Consultation

The Council has approached tangata whenua and other organisations it considers stakeholders, with an interest in the Whanganui Catchment. The Council is grateful for the contribution these organisations have made in the development of the strategy through providing information, comment and interim support. Stakeholders include: Whanganui River Maori Trust Board; Ngati Apa; Department of Conservation; Federated Farmers in both Wanganui and Taumarunui; Maruia Society; Royal Forest & Bird Protection Society; Taranaki, and Auckland/Waikato Fish & Game Councils; and Ruapehu, Wanganui and Stratford District Councils.

The draft strategy was discussed at five public meetings and 24 written submissions were received. Some suggestions for improvement have been incorporated into the final strategy, and others will be incorporated into the first review of the Strategy.

The Strategy was adopted by the Manawatu-Wanganui Regional Council at its meeting on 16 December 1997.

2. Resource Description

The catchment comprises approximately 7,100 square kilometres of predominantly steep hill country, with areas of mountainland, indigenous forest, scrub, farmland and exotic forestry. The Whanganui is New Zealand's third longest river, at approximately 320 kilometres. Its average rate of discharge at its mouth is 211[2] cubic metres per second, which is the second largest in the North Island. Its source is in the mountains Tongariro and Ruapehu on the central volcanic plateau, and it then flows initially to the north, before turning west and south to enter the Tasman Sea at Wanganui.

The Department of Conservation is the largest land manager in the catchment. It manages the Whanganui and Tongariro National Parks, and other conservation areas. Both the Department and the Council recognise that they share common interest and responsibility for natural resources and undertake to work together for the benefit of the Whanganui Catchment.

[2] This is a median flow recorded by the NIWA recording site at Paetawa since 1971, after diversions to the Tongariro Power Development.

2.1 Values of the Whanganui River

The Whanganui River has intrinsic value to many New Zealanders, both Maori and Pakeha. Cultural and spiritual values are especially significant for Maori. The river was used as a transport route by European settlers, and so has many historical associations from early colonial times. The river now is a popular tourist destination. Major amenity values are boating, particularly canoeing, and fishing.

All rivers are taonga (treasures) to the Maori people who live near them. To Whanganui iwi, the Whanganui River is an essential part of their identity. They use it to distinguish themselves from other iwi. The river has a spiritual significance to them which is difficult to convey in words. It includes the concept of kaitiakitanga (guardianship) whereby the people of the iwi, including their ancestors and descendants, are the spiritual guardians of the river in perpetuity. In turn, the river is a source of strength to them, and to some it has healing properties. The river and its tributaries also have obvious material value to Maori, including as a means of access for transport, a food source, and supply of water.

The Whanganui River and its intrinsic values have many associations with the arts. The river has stimulated artists, painters and photographers, writers and historians. One notable artist is the poet James K Baxter, who lived for many years beside the river in the small settlement of Jerusalem. Sister Suzanne Aubert founded her Order, the Sisters of Compassion, on the Whanganui.

The Whanganui River is closely linked with the identity of Wanganui city and district. It is the reason why Wanganui city is located where it is, initially as a port and transport centre based on the river. The reliance on the river for transport has lessened during this century, but the dominance of the river in the local landscape has remained. Wanganui has been known as the “river city”. The river is used for many water based sports, and Wanganui is particularly strong nationally in the sport of rowing.

The river is also important to other communities in the catchment, most of which are sited upon its banks or those of significant tributaries (for example Taumarunui, Ohura, and Waimiha).

The river supports a thriving tourism industry, based on the district’s history, scenic and amenity values. It has a unique place in New Zealand as a canoeing river, because it offers a range of waters able to be managed by inexperienced canoeists, in surroundings of natural beauty. Over six thousand people take canoe trips each year, and for many it is the place of their first such trip.

The Whanganui Catchment contains significant conservation values. It supports a range of native fish, a number of which migrate between the river and the sea during their life cycles. Safeguarding the migratory pathway for these fish is important. The juveniles of some of these fish contribute to the whitebait fishery. Small streams are important habitat. For example short jawed kokopu, a category A threatened species, has been recorded in some upper catchment streams[3]. Blue duck (Whio) populations reside in the headwaters of the Whakapapa and at the confluence of the Whanganui, Mangatepopo and Okupata streams[4] as well as the Manganui o te Ao. Blue duck are a category B threatened species and serve as an indicator of riverine system health and the completeness of ecological relationships within that ecosystem.[5]

Some parts of the river are valuable trout fisheries. These include the headwater rivers, the Whanganui, Whakapapa and Ongarue; also the Retaruke; and especially the Manganuioteao.

The Manganuioteao is nationally significant in other respects too. It has a water conservation order in recognition of its outstanding wild and scenic characteristics, its outstanding habitat for the blue duck, and its outstanding recreational fishery.

The river can have direct economic value to industry, but these uses generally result in conflicts with other values. Examples are as a source of hydroelectric power, and as a means of assimilating wastes from sewage treatment and freezing works. The strategy accepts as given the current resolution of those conflicts, and does not consider alternatives.

No attempt has been made to quantify the values of the river in dollar terms. This would be very difficult to do, and would entail the risk of argument focusing on the validity of methods of valuation rather than on the values the Council seeks to protect. The Council considers the cultural, intrinsic and amenity values outlined above are significant for the Region.

[3] Molloy J, Davis A (1992) Setting priorities for the conservation of New Zealand's threatened plants and animals. 2nd edition. Published by the Department of Conservation.

[4] Keys, H; S. Bell; C. Speedy (1996) Blue Duck Monitoring in the Tongariro/Taupo conservancy to summer 1995/1996. Internal DoC report.

[5] J. Adams; D. Cunningham; J. Molloy; S. Phillipson (1997) Blue Duck (Whio) Hymenolaimus malacorhynchos Recovery Plan 1997-2007. Threatened Species Recovery Plan No. 22. Department of Conservation, Wellington.

2.2 Geology

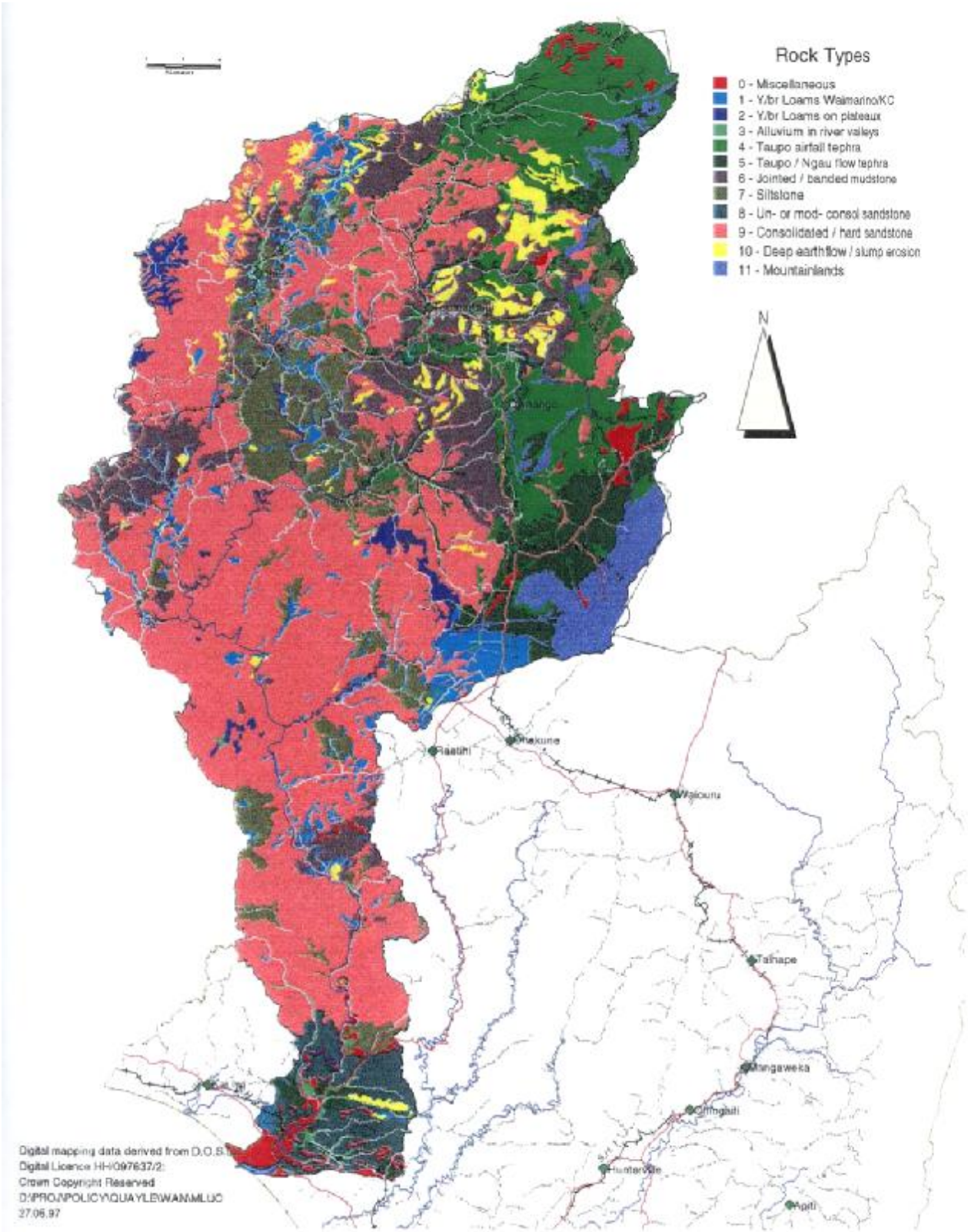
The land is young in geological terms, younger than most of the North Island. The predominant rock types are tertiary sediments, which vary in their degrees of consolidation and therefore in their stability; and soils of volcanic origin which are easily transported by flowing water. The coastal fringe of the catchment has different soils, including soft sandstone and loess, and sandy soils.

The land is being uplifted by geological forces within the earth. This, combined with soft rock types and regular rainfall, has resulted in a high rate of natural erosion that has formed the Whanganui River. Its present landscape is characterised by steep, V-sided valleys and an irregular, meandering pattern in the rivers.

The map of Major Rock Types (on page 7) shows a classification of rock and soil types into 11 basic categories. See Annex 1 for a description of these classifications.

Major differences in geology exist between tributary catchments of the Whanganui. For example, volcanic soils predominate in the Whanganui headwaters, the Whakapapa and Ongarue. The Ohura is predominantly siltstone and types of mudstone; the Retaruke is both sandstone and banded mudstone; and the Whangamomona is sandstone with an area of jointed mudstone. The map presents a generalised view of the geology of the catchment. It does not attempt to show all the combinations that occur. For example, in some areas such as Tahora in the Tangarakau catchment, there is airfall tephra overlaying hard sedimentary rocks beneath.

The upper parts of the catchment contain a significant amount of land prone to slumping, (category 10 on the map).


Rock Types
0 - Miscellaneous
1 - Y/br Loams Waimarino/KC
2 - Y/br Loams on plateaux
3 - Alluvium in river valleys
4 - Taupo airfall tephra
5 - Taupo / Ngauruhoe flow tephra
6 - Jointed / banded mudstone
7 - Siltstone
8 - Un- or mod- consol sandstone
9 - Consolidated / hard sandstone
10 - Deep earthflow / slump erosion
11 - Mountainlands
N
Raetihi
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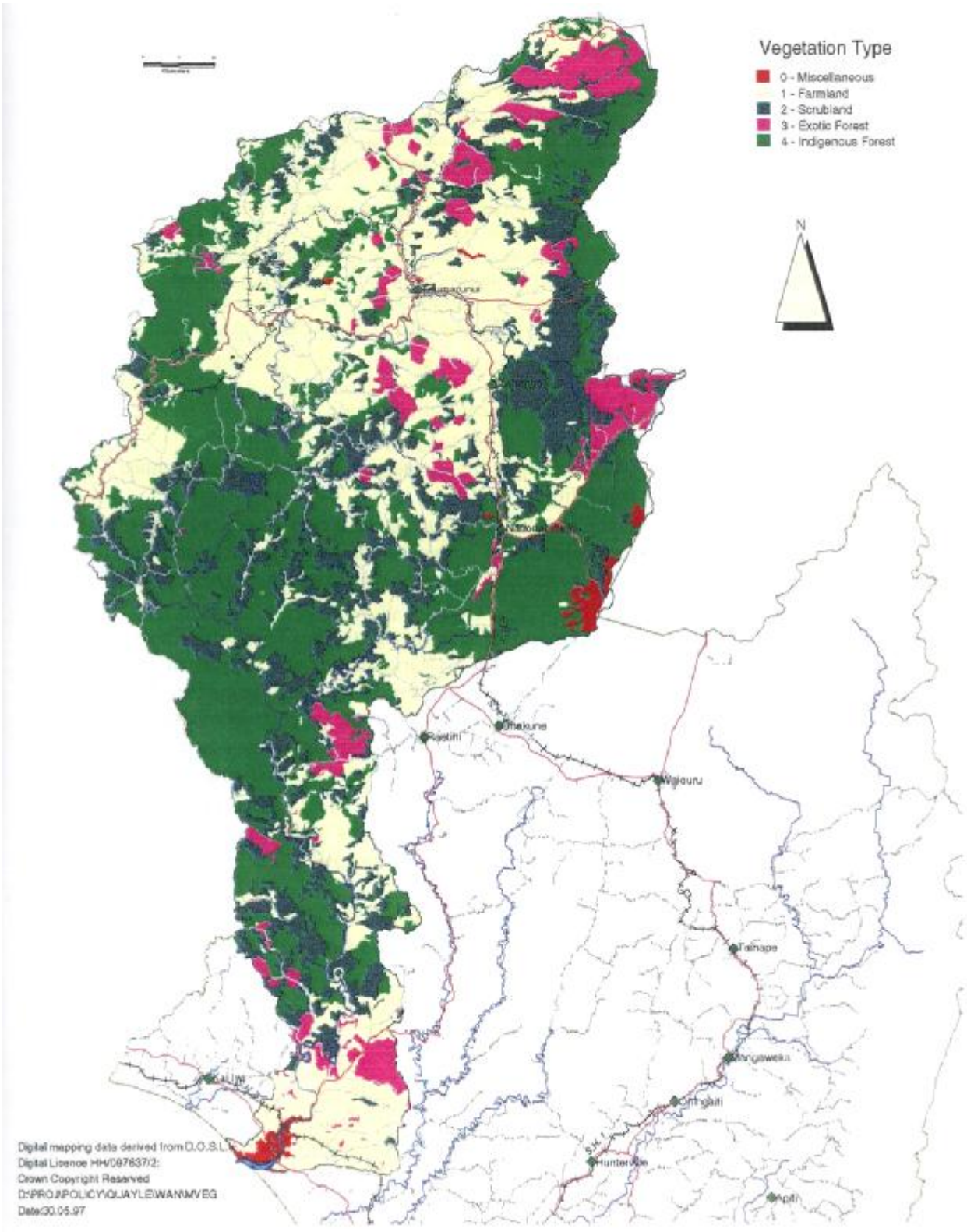
2.3 Vegetation

The entire Whanganui Catchment was once heavily forested. Substantial areas are still in forest, while others that have been cleared have regenerated rapidly to scrub and, given sufficient time, will regain full forest cover.

On page 9 is a map of Dominant Vegetation Types. The categories are: pasture/farmland; scrubland; exotic forest; indigenous vegetation (forest, swamp or tussock) and miscellaneous (which includes mountain vegetation, water, bare rock, and urban areas). The base data is from the New Zealand Land Resource Inventory, updated to include known areas of exotic forestry planted since the inventory was mapped in the late 1970s or early 1980s.

Land used for farming correlates with certain soil types. This shows clearly in a comparison between the soil and the vegetation maps. Sedimentary rocks which are soft and erodible also tend to be more fertile. In the Retaruke, the sandstone areas correspond with indigenous bush, and the more fertile banded mudstone corresponds with pastoral farming. The area of the Whangamomona and Tangarakau where farming still continues is jointed mudstone, more fertile than the surrounding sandstone. The Ohura catchment, which is used largely for pastoral farming, is predominantly siltstone, again more fertile than sandstone.

The largest area of rock type represented is the hard sandstone. This breaks down only slowly and does not form a fertile soil. Most of the large areas of indigenous forest remaining in the catchment are on hard sandstone.


Vegetation Type
0 - Miscellaneous
1 - Farmland
2 - Scrubland
3 - Exotic Forest
4 - Indigenous Forest
N
Ohakune
Raetihi
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Taihape
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2.4 Land Use Capability in the Whanganui Catchment

In preparing the strategy the Council has conducted a desk top analysis of the capability of land in the Whanganui Catchment. The study takes available knowledge about capability of land in the catchment, and present land uses, and records whether land use is within land use capability or not.

This study is based on the best available existing information, which is known to have limitations. No fieldwork has been undertaken to verify it. Therefore its purpose is not to identify any actual sites where different land management is recommended. Rather, it is a calculation of the areas of land expected to be found within the descriptions given, in order to provide a basis for a policy approach. Actual changes to land management should be based on site-specific advice, rather than on this study.

Land uses assigned as within land use capability include:

- indigenous vegetation; which is the naturally occurring use assumed to be within capability.
- scrub; which may be naturally occurring, or may be undesired species such as gorse and blackberry, or may be a mixed vegetation including some grazing. For simplicity scrubland is assumed to be within capability.
- exotic forestry is assumed to be within capability. This is certainly so for the growing of trees. Harvesting can, if carried out inappropriately, cause substantial erosion, so being within land capability depends upon the assumption that appropriate methods of harvesting the trees will be adopted. (Controlling this is part of the role of the Regional Land Plan, which is under preparation).
- land suitable for cropping; this land is also suitable for grazing without conservation management techniques being required.
- land suitable for grazing; without conservation management techniques being required.
- other land (mountain, water and urban) is assumed to be within capability, and it is impractical to change these land uses.

Land uses assigned as outside capability include land presently used for grazing, but which requires one of three alternative management regimes to be considered within the capability of the land:

- land suitable for grazing provided sufficient trees are planted to reduce erosion
- land suitable for afforestation
- land that should be retired from grazing (and is not suitable for afforestation).

The basic results are summarised in Figure 1. The 74% of the land in the catchment that is used within its capability is shown in the main body of the "pie". The slices of the pie which are separated make up the 26% of land in the catchment found to be used outside its capability. These slices represent areas presently used for farming but which are recommended to be used for grazing with space planted trees; afforestation; and retirement, respectively.

The five categories of farmland are described further in sections 2.4.1 to 2.4.5, and further details of the results and how the study was done are in Annex 3.

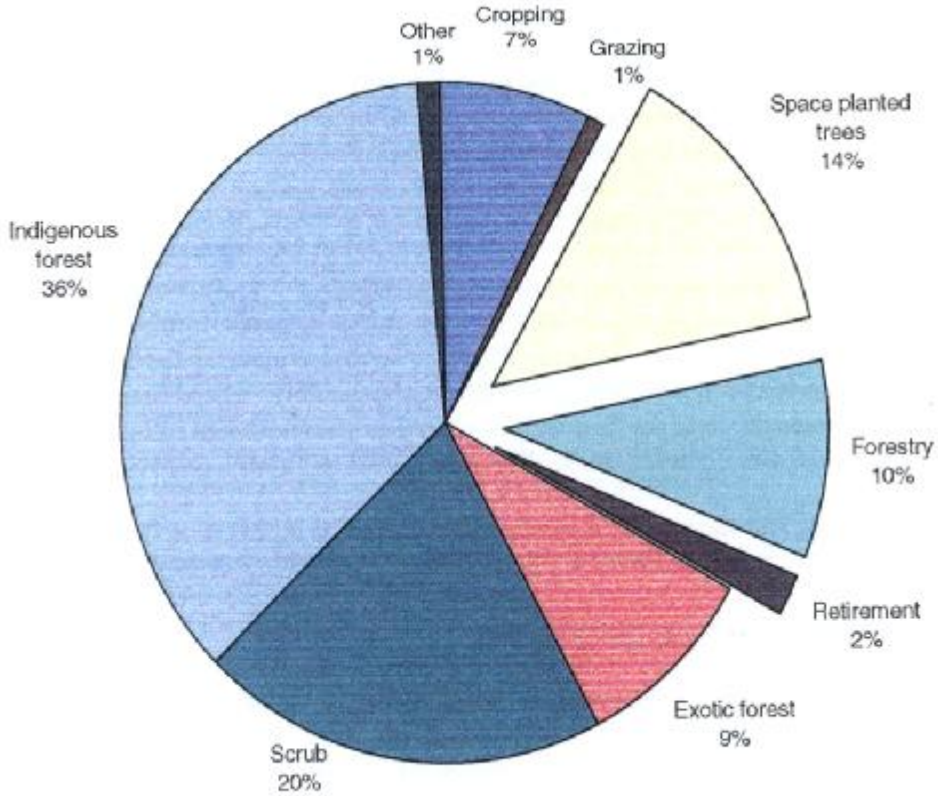
2.4.1 Land suitable for cropping

The 52,000 hectares of land identified as suitable for cropping is not a significant part of the land use problem in the catchment. Most is being used for grazing which is within its capability. If it is used for cropping then contour cultivation should be a standard technique to minimise the loss of soil and consequent effects on water quality. There is no significantly greater cost in using contour cultivation, and it confers benefits which are both on-site (soil retention) and off-site (water quality). Education and advice are therefore the appropriate methods for the Council to use to achieve general use of contour cultivation.

Recommended uses:

- selected cropping, with contour cultivation
- grazing

Figure 1 : Land Use Capability Study of the Whanganui Catchment



	Hectares	% of Catchment
Land uses within land capability		
Indigenous vegetation and forest	254,573	36
Scrubland	139,018	20
Exotic forest	65,000	9
Cropping & gazing on cropping land	52,347	7
Grazing on good grazing land	6,284	1
Other (mountain, urban, water)	9,943	1
Subtotal	**527,165**	**74**
Land uses outside land capability		
Grazing on land requiring spaced trees	95,808	14
Grazing on land best suited to forestry	71,059	10
Grazing on land best suited to retirement	13,313	2
Subtotal	**180,180**	**26**
Total	**707,345**	**100**

2.4.2 Land suitable for grazing

About 6,500 hectares of land is suitable for grazing and this is also not a significant part of the land use problem in the catchment. It can be used for grazing without special management being required. This figure is only 2% of all the land being used for farming, reflecting the fact that land in the catchment is "hard" hill country, not as suited to pastoral farming as many other areas of the country.

Recommended uses:

- grazing

2.4.3 Grazing land requiring conservation planting

The study shows there are over 96,000 hectares of pastoral land which should have some trees planted in order to reduce slipping, slumping and other mass movement erosion, if they are still to be grazed. (Total afforestation is an alternative land use which would give superior protection against accelerated erosion, but this may not be the choice of most farmers). This land needs trees in the right places in order to be used within its capability. Wise decisions on its future management are a priority under the strategy.

The trees required are space planted trees of any species, but poplars are most often used. Native trees are suitable and individual trees remain in some cases. The desk top study estimates the total number of trees required at over 2 million, and the cost of these in the ground with a protective sleeve to prevent damage from grazing animals is approximately $8 each, or a total of over $16 million. This nominal figure is an indication of the scale of the issues facing the catchment. A large financial investment for protection of the environment and future productive capability is required, and will not easily be found.

The Council actively encourages soil conservation measures, including the spaced planting of poplar poles, and provides regional grant assistance for this. So far the planting rate achieved is insignificant compared to the total requirement. In the northern part, which contains much of the farmland in the catchment, over 4,000 poplar poles have been planted in each of the last two years. In the southern part, about 3000 poles have been planted per year. At this rate it will take about 300 years to plant sufficient trees.

The uptake of soil conservation work in the catchment is less than for the rest of the region. The proportion of the regional grant allocated by the Taumarunui office in the 1995-96 year is 7% of the regional total, whereas it has approximately 14% of the Region's farmland.

Mass movement erosion is not the only erosion problem on this land. Surface erosion is also important. The grazing management objectives adopted should include the keeping of a full vegetation cover as much as possible to reduce surface erosion.

Recommended uses:

- grazing with conservation planting and grazing management
- afforestation

2.4.4 Land suitable for afforestation

Nearly 65,000 hectares are identified in the study as suitable for afforestation. (This is acknowledged as somewhat misleading because most of the land in the catchment is suitable for afforestation, although it is not the preferred land use.) This land needs lots of trees in order to be used within its capability, and full afforestation is a more economic alternative than total space planting. Seedlings are much cheaper than poles. For afforestation, stock has to be excluded, and this saves the substantial cost of protective sleeves for each tree.

Decisions on the future management of this land are a priority for the strategy, but there are positive indications that changes are happening without any further special action being necessary. A significant amount of forest planting has been undertaken in recent years within the Whanganui Catchment. The area shown on Map 2 is nearly 53,000 hectares, but this is known to be an underestimate because many small woodlots are not included. The total is estimated at 65,000 hectares. Forestry has expanded rapidly in recent years. In its present stage it is developing a large base of plantations with an increasing sustainable harvest. The forest development has three main contributing sources. These are: large companies, particularly Carter Holt Harvey which has holdings around Taumarunui, and Rayonier which owns Lismore forest near Wanganui; private investors are providing capital for forestry investments either in syndicates (which buy and develop land) or joint ventures (which develop forest on private land, in partnership or profit-sharing with the landowner); and private landowners diversifying their own land use.

The growth of forestry is an encouraging development for land management and water quality in the catchment. Providing the effects of harvesting are well managed, forestry is a land use that provides considerable protection against accelerated erosion compared to pastoral farming, and over the long term almost certainly provides higher returns to the landowner as well. There is evidence that market signals existing at the moment are succeeding in producing a significant amount of new planting. The Council notes these developments and supports the continuation of the trend.

Recommended uses:

- afforestation
- retirement

2.4.5 Land which should be retired

The study shows about 14,000 hectares of land should be retired from grazing. This land was once economic to farm, but has low production capability. When the full costs of fertiliser, fencing, and pest control, and the external cost to the community resulting from erosion and poor water quality are included, the Council believes it is uneconomic to farm it now. It is part of the history of the catchment for some land to be cleared in hope of good returns, only to revert rapidly to gorse or manuka scrub, and later to be cleared again. It is in the interest of the landowner to decide once and for all what the appropriate use of each area of land is. The cycle of clear and revert is bad for the land and its ability to grow even indigenous forest, it is bad for water quality because of the constant erosion, and it is wasteful of the owner's time, effort and capital.

There are clear economic signals to owners that unproductive land should be retired, and these are often heeded. The Council supports a considered, long term view of the capability of each area of land, leading to a decision to retire unproductive land permanently. Similarly, a reliable assessment of the capability of marginal land should be made before clearing scrub or forest from it.

There may be a cost in fencing involved in retirement of land. The Council actively encourages retirement of land unsuitable for grazing, and provides regional grant assistance for fencing costs.

Recommended uses:

- retirement

PART TWO
ISSUES

3. Issues

3.1 Issue One: Water Quality in the Whanganui River

The reduction of cultural and amenity values and life supporting capacity of the Whanganui River, as a result of low water clarity and the presence of bacterial contamination.

The major water quality issues in the Whanganui River are poor clarity and bacterial contamination. With the upgrading of major sewage discharges in the catchment, the remaining water quality issues are associated with diffuse sources such as land use. The strategy does not deal with any problems identified with point source discharges.

Any adverse effects from dissolved nutrients, such as nuisance algal growths, are unlikely to arise from diffuse sources for a number of reasons:

- nutrient contribution from land use in the Whanganui Catchment is more likely to be in an insoluble form, i.e. adsorbed to soil particles in runoff;
- flows in rivers are too high to be suitable for algal growth at the time that overland runoff discharges nutrients to those rivers;
- river substrates in much of the catchment, being erodible sedimentary rock or deposited silt, are unsuitable for algal growth; and
- light penetration into the water is low.

A range of contaminants are present from time to time, but their quantities are too small to have any significant adverse effect on the river.

A study has also shown that high water temperatures in subcatchment streams may also be a significant issue (Davies-Colley *et al*, 1995)[6]. However, water temperature in the Whanganui Catchment is a function of stream habitat conditions rather than contamination of waterways. Nevertheless, some of the methods considered in this strategy, such as riparian management, can also address issues of habitat improvement.

[6] Davies-Colley, R J; Stroud, M J: and Smith, B J (1995). Water quality degradation by pastoral agriculture in the Whanganui River Catchment. NIWA Consultancy Report DoC050/1, prepared for Department of Conservation, Wanganui. May 1995.

Water quality in the main stem of the Whanganui River is illustrated in Figures 2, 3 and 4. This is the most recent information on water quality in the Whanganui River. Some reliance has also been placed on older data, from extensive monitoring done by the former Catchment Board, generally during the period 1977-1982.

3.1.1 Clarity

Clarity is a key aspect of water quality associated with values of the Whanganui River. Poor clarity degrades the river's amenity value and appeal for contact recreation. Poor clarity can also affect the ability of sight-dependent organisms such as fish to see their food sources.

Concern about the effects of catchment erosion on clarity in the Whanganui River is a major reason for undertaking this strategy. However, the information needed to form a basis for action in the strategy is lacking in two respects:

- information is lacking on river clarity *before* land clearing for pastoral development occurred, i.e. we don't know what exactly to aim for; and

- cause-effect relationships between the degree and types of land erosion and river clarity are extremely complex and poorly understood, i.e. we're not sure what will be most effective in achieving better clarity.

Information to show the extent of clarity *reduction* is lacking, because there is no water quality data on the period before catchment development for pastoral agriculture. The understanding that clarity has deteriorated since land was cleared for pastoral development is based on anecdotal evidence from people who remember the Whanganui River being much clearer in the past.

Some of the best pieces of evidence are these quotes collected for a forthcoming book by David Young[7]:

Salmon and trout:

In 1880 H.M. Brewer took 3,500 fingerlings up the river to a spot near Mangaporau, presumably Mangapurau, near Jerusalem, where he liberated them. Trout and perch had already been released. In those days, the river flowed 'for miles over gravelly reaches interspersed with rapids and deep, dark pools, looking a very paradise for salmon and trout'. (H.M. Brewer, paper read before Otago Institute, 18 Feb., 1881.)

[7] Young, David. Honoa: Histories from the Whanganui River. Huia Publishers, Wellington (in preparation).

Five years later a number had returned to their natal streams, evidence of the clarity and quality of the Whanganui. (Wanganui Chronicle, 6 January, 1886).

Kuia from the Whanganui, born 1912 at Putiki, interviewed in 1997:

" The river in those days tasted like kowhai. The trees used to grow over the river and drop into the water, and the water tasted like that. I would have been about nine, and although I didn't grow up there I had relatives at Parikino and would spend six weeks over the summer there. That's where the water had the kowhai taste.....

At Putiki, in those days, the silt hadn't silted up in the river like now. You couldn't possibly go down to the river and be up to your knees in silt. The river bottom was stoney and they were big stones, not gravel. We didn't hurt our feet walking on them – you walked out to them.....

For someone to paint the river blue, it wasn't. It was always green – if it wasn't green, it was muddy .....

My mother regularly whitebaited – she was never there once my sister and I were old enough to help around the house. She was either whitebaiting on the river or going to Castlecliff for tunagi, which is a special pipi. We also ate piharau, the blind eel, from Pipiriki, the Anglican minister, Henare Keremenate used to send them down to us. My mother also had an eel basket, a hinaki she used to use. We also used to pick up kakahi, freshwater mussels, down at Corlis Island....."

On river life as a bioindicator:

One of the most sensitive animals to the ecology of the river is the lamprey or piharau. These once ran in such numbers on the river that Richard Taylor tells us that death from a surfeit of lampreys was "far from uncommon" (Elsdon Best, Fishing Methods and Devices of the Maori p189). Up to 600 lampreys may be caught on a good night, with a total season's catch amounting to several thousand. (T. W. Downes, Notes on eels and eel weirs (tuna and pa-tuna, Transactions and Proceedings of the New Zealand Institute 50; 296-316). 'Blind eel' were still being caught in considerable numbers as far up the river as Maraekowhai in 1922. (Arthur Anderson oral conversation, Taumarunui, June 1988.)

Today, however, there is occasionally but one piharau weir in use on the entire river, at Pipiriki. Because the fish is still prized, such a decline in the practice is far more a measure of ecological than cultural decline.

Clarity is affected by suspended sediment in the water. There are three separate ways this can be measured:

- the quantity of suspended sediment, measured in grams per litre;
- visibility of a black disc, measured in centimetres;
- turbidity, measured by a machine in turbidity units. (Turbidity is a measure of the scattering of a beam of light from particles in the water.)

Each measure may be useful in particular circumstances. Within the strategy the Council has chosen to express most measurements and targets in turbidity units, taking the median of a number of readings. Annex 4 contains more details about these measures and the reasons for this preference.

Davies-Colley *et al*, 1995 compared water quality in streams draining forested and cleared subcatchments within the Whanganui Catchment. The study concluded that pastoral agriculture caused a degradation in clarity, but the study acknowledged that this may be obscured by other factors such as geological variability and steepness of slopes.

A major limitation of such a study is that pastoral land in the Whanganui hill country is generally on more fertile soil types such as siltstone and mudstone, while remaining indigenous forest is on less fertile sandstones. Thus it is difficult to find cleared and forested catchments of similar geology to compare water quality.

The extrapolation of findings on small catchments to larger rivers such as the main stem of the Whanganui is also uncertain. Other factors such as bank erosion may be different in larger rivers which have greater erosive power.

Thus, while there may be a general acceptance that clarity in the Whanganui River has deteriorated because of pastoral development, scientific data to support this is lacking, particularly with regard to the *extent* of deterioration. The NIWA study showed that streams in the forested subcatchments in steep hill country, while generally clearer than those in pastoral subcatchments, were still not particularly clear when compared to stony, gravel-bed streams draining volcanic or greywacke areas.

This makes the task of setting targets for clarity in the strategy very difficult. Any target values will be somewhat arbitrary without information on the original clarity in the Whanganui River, and until there is a better understanding of the cause-effect relationships between land use and water clarity. The strategy attempts to address this in part, by allowing a timeframe for further monitoring and investigation into water clarity issues in the Whanganui Catchment.

The methods to improve clarity in the Whanganui River include the standard range of soil conservation methods (see Annex 2, Types of Erosion), and riparian management.[8] Priorities for certain methods may develop as our understanding of cause-effect relationships between land use and water clarity improves.

Riparian management may play an important role for clarity improvement where streambank erosion is a significant cause. However, use of riparian management for filtering of sediment from overland runoff may have limited application in the Whanganui hill country because of the fine clay-like nature of the erodible soils. Once mobilised, this fine material may not readily settle out in riparian margins. Emphasis on control-at-source is likely to be more effective.

Figure 2: Black Disc Visibility in the Whanganui River (1992-1997)
(Note: a high reading is good visibility).

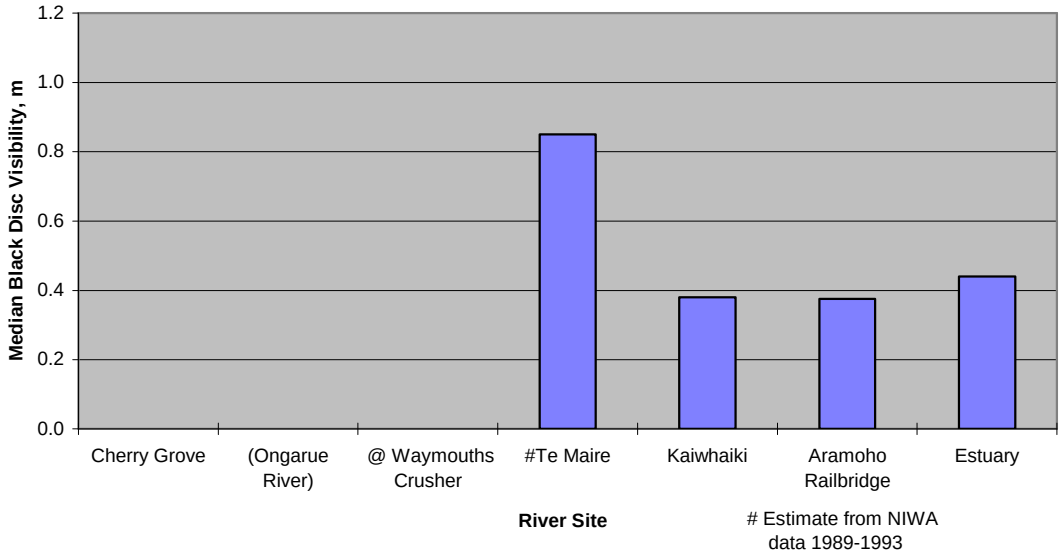


Figure 2 shows current visibility levels in the Whanganui River. (The higher the reading, the clearer the water).

[8] Managing Riparian Zones, Collier K J et al. DoC/NIWA 1995

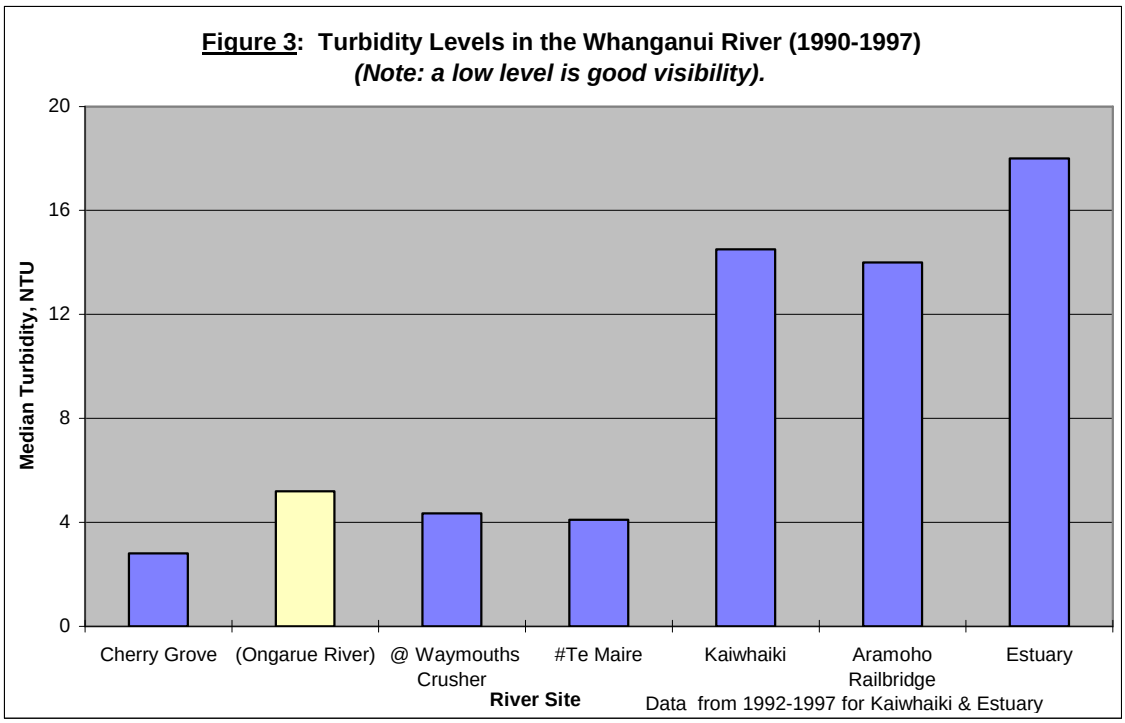


Figure 3 shows clarity in terms of turbidity levels. (Note that now the *lower* the reading, the clearer the water). The overall deterioration in clarity downstream is apparent.

Median turbidity levels are less than 3 NTU above the Ongarue River confluence because of the excellent clarity in headwater streams draining the central volcanic plateau. The volcanic origins of the geology in these headwater catchments give rise to coarse soils which, while vulnerable to erosion when vegetation is removed, do not degrade water clarity significantly.

Some deterioration in clarity below the inflow of the Ongarue River is apparent in Figures 2 and 3. Data is lacking below Te Maire, but historical data held by the Council suggests that some tributaries downstream contribute significantly to poor clarity in the Whanganui River. However, there is also the possibility that erosion of bank material along the main river stem contributes to poor clarity below Te Maire. This will be further investigated.

Figures 2 and 3 show that clarity is particularly poor in the lower reaches of the main river. Council data indicates that some minor streams draining into the lower reach of the Whanganui River have extremely poor water quality, some of the worst in the whole Whanganui Catchment. However, the overall contribution of these streams to the poor clarity in the lower Whanganui is uncertain.

Some further specific comment on clarity throughout subcatchments of the Whanganui Catchment is given in Section 6.

3.1.2 Bacterial Contamination

Bacterial contamination is also a key aspect of water quality that affects values of the Whanganui River, particularly cultural and recreational values. Bacterial contamination can arise from point sources and diffuse sources. Point sources include sewage and industrial discharges. Diffuse sources include overland runoff from farmland that contains faecal waste from farm livestock.

Point sources of bacteria within the Whanganui Catchment are addressed through the resource consents process rather than through this strategy. The two significant sources have been the sewage discharges from Wanganui and Taumarunui. A consent can require improvements in the treatment of the discharge, or an alternative discharge method such as irrigation to land.

Taumarunui sewage treatment has been upgraded progressively since 1993 and this upgrade has resulted in major improvement in bacteria levels in the upper Whanganui River. Pre-1990 data is not directly comparable with the more recent data in Figure 4, because it measures faecal coliforms, but it shows high bacteria counts in both tributaries and the main river around Taumarunui. Wanganui sewage is in the process of being diverted from the lower river to the ocean, and will be discharged to land in the future, which will improve the situation in the lower reaches of the river.

Overland runoff from farmland is a more common problem. Bacteria from animal faecal waste is readily adsorbed to soil particles, grass and leaf litter. Contamination of waterways is relatively minimal, unless sufficient rain falls for overland runoff to occur. The runoff can mobilise bacteria directly, or indirectly by mobilising surface soil and organic matter which has bacteria adsorbed to it. Thus bacteria levels in waterways tend to increase with river flow.

Direct deposition of faecal matter by livestock in waterways is also a potential source of bacterial contamination.

Faecal contamination in overland runoff results from the presence of both domestic and wild animals. It is not practical to remove the source completely, so the best alternative is to adopt management techniques that limit the transfer of bacteria from pastoral land to waterways via overland runoff. This can be done by maintaining a healthy sward of grass in the pasture to trap bacteria, and by managing the riparian margins of waterways.

Riparian management involves the fencing off margins of waterways to exclude stock and allow growth of vegetation, and may include active planting of more permanent, deep-rooted vegetation or trees. This controls faecal contamination of waterways, not just by filtering overland runoff, but by limiting stock access to prevent direct defecation in waterways and their margins.

Figure 4: Enterococci Levels in the Whanganui River (1993-1997)

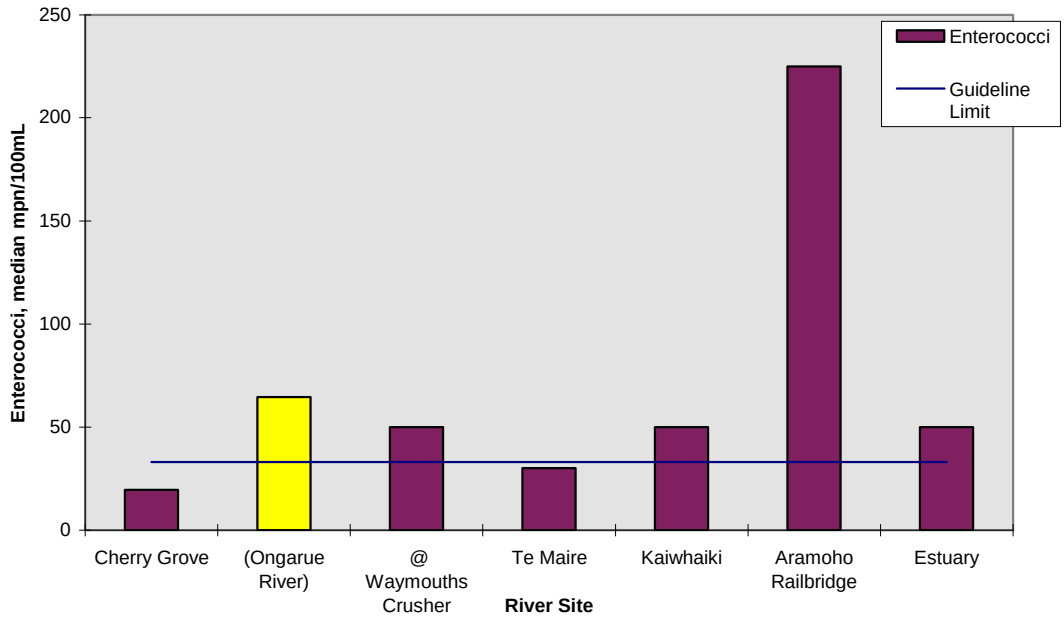


Figure 4 shows that bacterial contamination follows a pattern of deterioration similar to that for clarity, progressing from pristine headwaters down to higher levels of contamination, where the river flows through cleared areas of the upper and lower catchment. Elevated levels at the Aramoho Railbridge reflect the discharge of sewage into the river at Wanganui, which has ceased since mid-1996. Nevertheless bacteria levels elsewhere, other than headwater streams, often still exceed guidelines for safe contact recreation if the guidelines are applied to all flows.

3.2 Issue Two: Accelerated Erosion

The continuing loss of soil from accelerated erosion as a result of past and present land management practices; particularly scrub and forest clearance, and grazing management.

The Whanganui Catchment has a naturally high rate of erosion. This results from the combination of unstable soils, the uplift of the land, and the regular heavy rainfall.[9]

Large wash-outs or landslides sometimes occur that result in vast amounts of soil being deposited into the river. This can kill fish, smother aquatic habitat, and produce extremely dirty water downstream right to the mouth of the river. These may be natural events, but it is also probable that land use practices trigger such events more frequently than would occur naturally.

Indigenous vegetation has evolved to suit the conditions found in the Whanganui Catchment. The natural vegetation is a dense cover of forest, which grows quickly and that moderates the rate of erosion by a number of mechanisms. Roots bind the soil and prevent it washing away. The forest canopy absorbs a proportion of the rainfall, which never reaches the ground. The mass of vegetation takes up water through root systems and returns it to the air via transpiration through the leaves. In heavy rain the raindrops fall on leaves, not on bare ground, and consequently their energy and erosive force is lessened.

The natural forest cover does not completely prevent erosion from occurring. There is a recurring pattern, typically over a period of several hundred years, for each steep hill slope to erode and revegetate.[10] The replacement of forest by pasture speeds up this cycle, and erosion is likely to occur on every such area of pasture every few years or decades. In order to return the rate of erosion to something like the natural rate, trees are vital. The productive capability and the nature of the land, and therefore the minimum number and type of trees required, will vary from case to case. In the most extreme erosion-prone areas, indigenous forest should be left undisturbed. Other areas can support production forestry with an acceptable level of adverse effects. Pasture can be appropriate on the easier hill country, but space-planted trees will be required in some areas in order to avoid unacceptably high rates of erosion.

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9 There are many different types of erosion. Some land types are more susceptible than others to various kinds of erosion. All types of erosion release sediment which will find its way into surface water, and therefore all must be addressed in order to achieve the best practical level of water quality for the Whanganui. Annex 2 contains a description of the common types found within the Whanganui catchment, and a brief discussion of the appropriate remedies.

10 Douglas L Hicks, "Thresholds of physical sustainability in the Taranaki Hill Country". Paper presented to NZARM Conference, 1996.

Exotic forest plantations provide good protection from accelerated erosion for most of their growth cycle. In the harvesting stage some ground disturbance and erosion is inevitable, but the mass of roots in the ground binds the soil together and protects it through the first three years after replanting. It then takes a number of years for the young trees to grow sufficiently for canopy closure to occur, during which time there is greater risk of erosion. After canopy closure of pine forest the rate of erosion is close to the natural rate.[11]

Space planted mature trees also provide substantial protection from erosion. Various species of poplars are often used. At optimum spacing, which is a maximum of 12 metres apart,[12] the roots from adjacent trees will intertwine and help to bind the soil. Removal of additional water by transpiration is especially helpful on areas prone to earth slumping.

Animal pests make a contribution to accelerated erosion. The principal animal pests in the catchment are goats and possums. The Council has in place an Animal Pest Management Strategy, which classifies goats and possums as pests and sets out measures to deal with them. However the Whanganui Catchment Strategy considers the whole catchment on a long time scale, and it is appropriate to note that goats and possums are a definite threat to soil and water values. These animals, if unchecked, can have significant impact on the forest understory and therefore on forest regeneration. If the indigenous vegetation is damaged then additional erosion is to be expected as a consequence. Animal pests also pose a threat to the growth of conservation plantings of poplars, willows, pines or other tree species.

[11] Philips, C J et al. Effectiveness of reforestation in prevention and control of landsliding during large cyclonic storms. Proc. 19th IUFRO Congress, Montreal.

[12] Control of Erosion on Farmland, MAF Policy Technical Paper 95/4, August 1995.

PART THREE
ACTION PLAN

4. Goals of the Strategy

To maintain the water quality of the Whanganui River at a standard that protects its cultural and amenity values and life supporting capacity.

To achieve land management that minimises the extent of accelerated soil erosion.

These goals provide broad policy direction for the Council and the community over the long term.

5. Objectives and Actions

Objectives are shorter term, measurable milestones for the Council and the community in achieving the goals. Three objectives have been identified, and are described in sections 5.1 to 5.3 with the key actions required to achieve them.

5.1 To measure water quality in the Whanganui River and its tributaries and understand the processes involved.

The Regional Council will:

a. Undertake further monitoring and information gathering in the Whanganui Catchment. Three levels of monitoring are proposed:

   i. First level: Continue the expanded programme of baseline monitoring of water quality over a range of sites in the catchment including significant tributaries, principally measuring water clarity. This will enable more definite identification of the contributions that different parts of the river make to the water clarity issue, and will allow for the progress and success of the strategy's focus on water clarity to be measured. A water quality monitoring report will be prepared by June 2007.

   ii. Second level: carry out individual studies to provide answers to key water quality questions. In particular conduct study on turbidity in the Ongarue catchment.[13]

[13] This study would build on the study by Louise Watt as reported in the "Ongarue Turbidity Investigation" by S, Hodges 2003.

iii. Third level: Encourage local initiatives, where concerned individuals or groups monitor their local streams to determine either the effect of actions taken or the need for action to be taken. The Council will provide the necessary equipment and training for such local monitoring. Council will develop a water sampling program for local farmers and community groups by December 2004.

b. Continue turbidity monitoring at the Te Maire and Te Rewa recording sites in the catchment. A turbidity monitoring report will be prepared by June 2006.

c. Scope a study on instream sediment process modelling in the Whanganui River and priority catchments by November 2004. This study would aim to establish how long it would take for the results of erosion control to be visibly reflected in the Whanganui River.

5.2 To increase the amount of land in the Whanganui Catchment that is managed within its land use capability.

Landowners should:

a. Accept responsibility for control of erosion, and take action appropriate to their individual circumstances.

b. Consider the inherent productive capability of each separate part of their land, and manage within that capability. The Council recommends an environmental plan, or farm plan, be prepared.

c. Manage land prone to mass movement erosion (principally soil slips and slumps), by planting trees to reduce accelerated erosion. The trees may be:

- scrub or indigenous forest on retired land;
- plantation trees for future harvest; or
- space planted trees to enable continued grazing.

d. Aim to maintain areas under pasture with a full groundcover and a healthy sward of grass, in order to avoid or mitigate surface erosion.

e. Retain indigenous vegetation in riparian areas where it exists. In riparian areas where indigenous vegetation does not exist, appropriate riparian management should be adopted considering the individual characteristics of the site. This may include planting and/or fencing of riparian margins.

f. Consider local monitoring of water quality, to determine the effect of their own land management decisions on water quality.

The Regional Council will:

a. Provide information and advice to individuals and groups on sustainable use of the land, including emphasis on soil conservation and erosion control, and riparian management; and will prepare an environmental plan for a property on request and at no charge (subject to the availability of soil conservation staff).

b. Provide Environmental Grant Assistance to approved soil conservation projects within the catchment, as part of its existing soil conservation programme throughout the Region. The strategy has not introduced any change to the type of incentives offered by the Council under the environmental grant. Community input will be valuable to determine what types of assistance would be most effective in individual cases.

c. Seek to reduce the area of land in the catchment which is managed outside its inherent productive capability by 3,000 hectares, as a direct result of the implementation of environmental plans and environmental grant assistance. The progress and success of this target will be reported every 5 years.

d. Deliver environmental education programmes, and develop new programmes where required, to the community, and particular interest groups within the community. Prepare brochures advising on best management practice for common land types in the Whanganui Catchment.

e. Promote public awareness of the strategy, and the availability of services and information from the Council and from other sources in the community; through:

- published articles about the work undertaken as a direct result of implementing this strategy;
- the Council website, leaflets and brochures; and
- farm field days.

f. Produce a report every 5 years showing the total change in land use activities, especially looking at the change in land managed within its land use capability.

g. Encourage the prioritisation of erosion control and riparian management in catchment areas shown in Table 1[14]. The Council will, where appropriate, direct use of its own resources to these priority areas[15].

Prioritised catchments	Priority	Stabilisation of slip and gully erosion	Stabilisation of slumps and earth flows	Riparian management
Retaruke - focusing on the Oio and Kawautahi streams	High	√		√
Hikumutu and Te Maire.	High	√		
Ohura	High	√	√	√
Main river reach Pipiriki – Kaiwhaiki	High	√		√
Matarawa	Moderate		√	√
Tangarakau	Moderate	√		√
Whanga-momona	Moderate	√		√
Ongarue	Moderate			√

Table 1 Priority Subcatchments and Recommended Actions within the Whanganui Catchment

The community should:

a. Consider starting or joining landcare or catchment groups. The Council offers support to landcare groups or any other community initiatives consistent with this strategy. This support will take the form of:

- information and advice, including initial facilitation;
- equipment and training for local monitoring of water quality;
- group projects may qualify for regional grant assistance at a preferential rate.

[14] See Annex Two for descriptions on the Whanganui Catchment and subcatchments.
[15] See Section 6 for more information on the setting of priorities for action.

5.3 Water quality targets

The Council has set initial indicative targets for water quality for different parts of the catchment. "Indicative" means that the targets are thought to be achievable but this is subjectively based. Review of the strategy will include review of the targets in future, as information from studies undertaken as part of the strategy becomes available.

a. At all points in the catchment: the 95-percentile concentration of *E. coli* shall not exceed 550 per 100 ml.

b. At Te Maire recording site: reduce median turbidity from **4.2 NTU** to **2.5 NTU** [16] within 15 years.

   [Explanatory note: this reduction in turbidity corresponds to an increase in visibility from 0.85m to 1.2m. This visibility allows an average person standing waist deep to see their toes.]

c. At Te Rewa recording site: reduce median turbidity from **14.5NTU** to **8 NTU** within 25 years.

   Note: Information on progress towards these turbidity target will form part of future reviews of the Strategy.

6. Priority Catchments

The Council has taken the following factors into account in setting priorities for action:

- tributaries in the upper parts of the whole catchment have a cumulative effect on all waters downstream, for the better or the worse, and this increases their significance compared to tributaries downstream;

- tributaries that are dirtier than the main river at their point of confluence are significant in that they visibly reduce clarity downstream;

- individual tributaries that offer potential for a project to achieve a large visible improvement, (rather than slow incremental improvement), are preferred;

[16] This reduction in turbidity corresponds to an increase in visibility from 0.85m to 1.2m. This visibility allows an average person standing waist deep to see their toes.

- tributaries with a high proportion of land being used beyond its inherent capabilities, as determined by the LUC study of the catchment.

- the findings of scientific reports from water quality studies carried out under the Strategy.

- information from studies carried out in subcatchments as well as the wider catchment on land types and erosion, and water quality. (reports listed under references at the back of the Strategy.)

- that priorities will change over time and that consideration is given to new information, and that the prioritised catchment list, Table 1, be updated regularly as part of the Strategy review.

7. Implementation and Review

7.1 Management of the Strategy

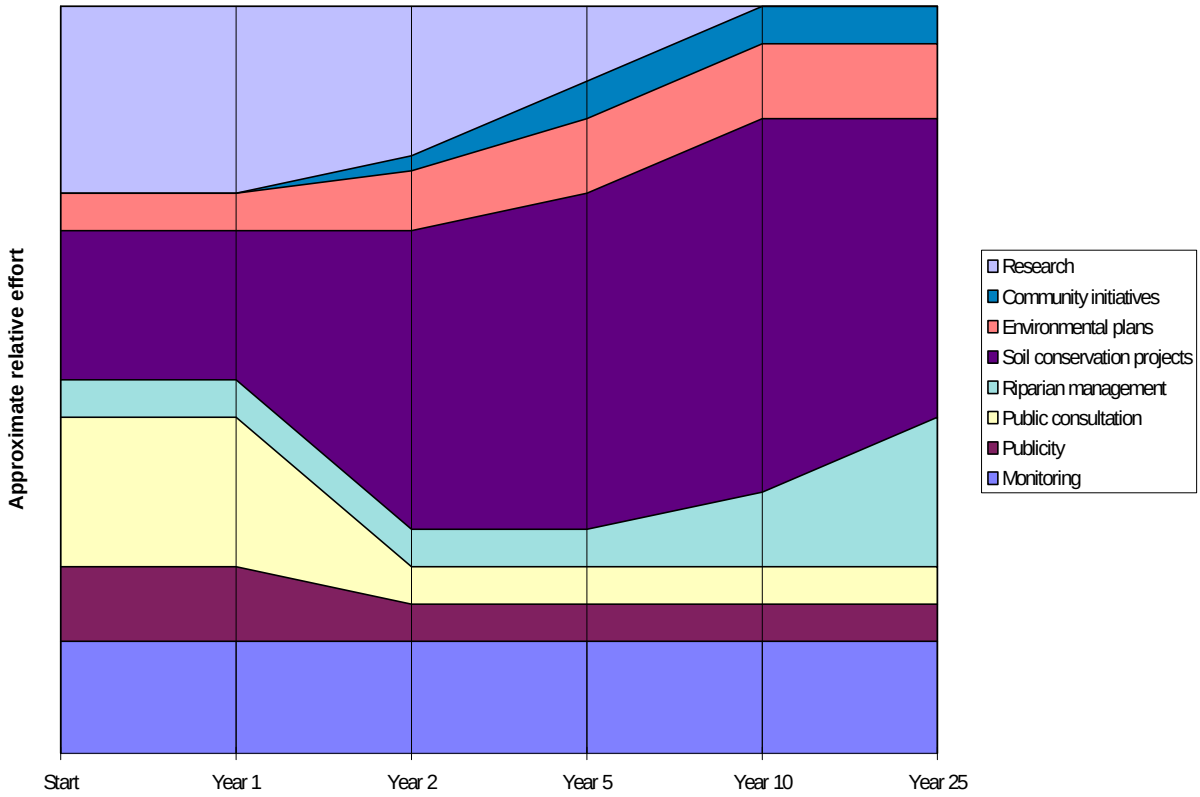
One staff member shall be designated the Champion of the strategy. This position involves ensuring Council resources are directed at the areas identified in the strategy, and reporting on progress to management and the Council as required. Otherwise the Council will undertake its commitments under the strategy using existing service centres at Taumarunui and Wanganui, and existing staff and management structures.

7.2 Implementation of the Strategy

The initial stages of implementation of the strategy are the actions that the Regional Council has committed itself to undertake. These are stated in Part Two, Action Plan and will generally be addressed within the first three years of the strategy. After this the plan becomes increasingly less definite, because the strategy will be shaped by feedback from public consultation, the results of specific studies conducted, the experience of advisory staff in dealing with landowners, and the review after three years.

The implementation plan is outlined in Figure 5. This chart contains eight different activities that are part of the strategy. It shows the approximate relative effort that the Regional Council plans to make over the next 25 years. The chart is indicative only. Note that the timescale shown on the chart is not linear.

Figure 5: Whanganui Catchment Strategy Implementation Plan



The eight categories of activity are:

- Research - specific studies will have a significant early role and will be completed within 10 years.
- Community initiatives will take some time to develop but are expected to be established in 5 to 10 years.
- Environmental plans will be introduced at a rate limited by staff resources.
- Soil conservation projects will steadily increase in significance for many years.
- Riparian management is part of the solution long term and will be given additional emphasis following successful soil stabilisation measures.
- Public consultation will be ongoing with most emphasis at the beginning.
- Publicity will be ongoing with most emphasis at the beginning.
- Monitoring is an ongoing responsibility of the Council with constant effort over time.

7.3 Review of the Strategy

The Council has a long term commitment to the strategy. Implementation will require active involvement and commitment from many individuals and groups. Some consultation has been undertaken with stakeholder groups but this is only a start to obtaining the support of the community. The Council will undertake the actions contained in the strategy and welcomes comment and feedback.

The Council will review the Strategy every five years.

Reviews will:

- consider the effectiveness of methods based on measurement of results and feedback;
- set new targets as appropriate;
- assess public awareness and response to the strategy; and
- review the overall effectiveness of the strategy.

ANNEXES

Annex 1: Rock/soil classification of land use classification units in the Whanganui Catchment[17]

Category 0: Miscellaneous, including coastal sand, loess and urban areas.

Category 1: Yellow-brown loams in the Waimarino/King Country
Yellow-brown loams in the Waimarino include flat and undulating slopes on the southern Ruapehu ring plain. 45% is flat or gently undulating. The land is fertile although is has a high phosphorus requirement. Land use includes cropping, pasture, scrub and forest. Erosion is not widespread but there is potential for sheet and rill erosion on cultivated slopes. This is especially adverse to water quality when it occurs adjacent to rivers and streams.

Yellow-brown loams in the King Country are rolling to moderately steep, and only 6% is flat or gently undulating. Land use is intensive sheep and cattle farming. This soil type is not particularly prone to erosion.

Category 2: Yellow-brown loams on inland plateaux.
These soils are flat and poorly drained. Higher altitude means cool winters and high rainfall. Access is also difficult. If cleared then the moderate erosion risk can be overcome by space planted trees. Most is still in native forest with negligible erosion.

Category 3: Alluvium in narrow river valleys
These are typically gleyed soils (i.e. containing a sticky blue clay) composed of alluvium and colluvium. Land use is generally pastoral farming. Meandering, incised rivers and streams can have significant streambank erosion.

Category 4: Taupo airfall tephra
90% of this is deep (> 44 cm) tephra. Deep tephra has more limitations on use and greater potential for erosion than shallow tephra. Main types of erosion are sheet, and soil slip on the steeper slopes. Rolling slopes when cultivated have potential for severe sheet, rill and gully erosion. The major trigger for erosion is channelling of runoff, and the best way of avoiding this is to preserve a full vegetation cover at all times.

Category 5: Taupo flow tephra and water-sorted tephra
Soils of this type are similar to airfall tephra but are more limited because of less developed and weaker soil structure, low fertility, and susceptibility to drought because of coarse texture. There is a high potential for gully erosion, and also streambank erosion.

[17] This is based on that developed by J R Fletcher, in "Land Use Capability Classification of the Taranaki-Manawatu Region" 1987.

Category 6: Jointed and banded mudstone
There is 60% of jointed mudstone and 40% banded mudstone. A large proportion is in native scrub and forest. This land is very fertile for pasture growth but is prone to erosion unless carefully managed. Soil slip, sheet and shallow earthflows are the dominant types. (Active slumps and deep-seated earthflows are described elsewhere). Erosion scars tend to revegetate quickly.

Category 7: Siltstone
This is steep to very steep hill country that is intermediate between the mudstone and sandstone types. The landscape is strongly dissected. Soil slip is the dominant erosion, with also sheet erosion in low rainfall areas and earthflow on colluvial footslopes. This can be controlled with open planting of conservation trees. On the steeper slopes debris avalanches can occur, most likely in forested areas, and these will revegetate provided feral goats can be controlled.

Category 8: Un- or moderately- consolidated sandstone
This rock type is found in the coastal region around Wanganui. It comprises weak, loose and friable sands interspersed with weak mudstones and sandstones. This land is susceptible to gully, sheet and soil slip erosion. Erosive action by water often results in characteristic rills on exposed slip surfaces, and gully erosion can start in drainage channels.

Category 9: Consolidated or hard sandstone
This is the most widespread rock type in the catchment. It is weak, massive sandstone of low fertility. Revegetation of erosion scars is slow because of low fertility and slow rates of weathering. The landscape is strongly dissected with steep slopes and narrow, sharply defined ridge crests. Types of erosion include soil slip, debris avalanche, sheet, tunnel gully and earthflow. Land use is mainly scrub and forest with some pasture. Much of the “hard hill country” has been developed for pasture in the past but has now reverted to scrub and forest. The hardest sandstone is not favoured for forestry because of low fertility and shallow soils.

Category 10: Deep-seated earthflow and slump erosion
This type is mainly on mudstone or fine siltstone, and is characterised by large, presently active slumps and deep-seated earthflow erosion complexes. It is fertile but one of the types most prone to erosion.

Category 11: Mountainlands
Mountainlands should be left in their natural state for catchment protection.

Annex 2 : Types of Erosion

Slumps

A slump is a piece of land that has insufficient strength to hold itself in place, and which tends to move downhill in a mass. The rate of movement may be quite slow. At risk are specific areas where the underlying geology consists of soft or shattered rock, often also affected by ingress of water which both adds weight and lubricates the rock along a zone of movement. Potentially, large slump areas can keep moving for years; eventually they are likely to reach a watercourse. Once the toe of the slump is removed by running water, the remainder will accelerate and enter the watercourse. The areas at risk are often gently sloping (the rock is not strong enough to support a steeper slope), and are fertile (the rock breaks down rapidly making nutrients available).

Areas prone to slumping are identified on the map (see page 5), and will be further individually identified in an environment plan prepared for a property. There are approximately 25,000 hectares of land at risk, chiefly in the upper catchment around Taumarunui.

The principal remedy is to plant sufficient trees to stabilise the slump. Trees assist both through root development binding the soil, and uptake of water that would otherwise weaken the slump. It is possible to stabilise slumps with space planting and continue to obtain good grazing, although this requires proper management. In some cases full afforestation is more appropriate.

Soil slips

These are a common form of erosion found throughout the Whanganui Catchment. A typical example is when a mass of soil detaches from the upper part of a slope, and is deposited on the lower slope. The upper slope that remains is steeper than it was originally. It is this form of erosion which has created the razor-back ridges found on the hard sandstone country. The bare rock exposed and the soil that is detached are both vulnerable to the elements and will undergo further erosion until revegetation occurs. The area at risk includes all the hill county in the catchment to varying degrees.

Trees are necessary to return the rate of erosion to the natural rate. Total prevention of soil slips is very difficult on pasture land. The most at-risk areas can be identified and space planted.

Sheet erosion

Sheet erosion can be caused by either water or wind. Sheetwash erosion occurs when soil is washed in separate particles from a surface exposed to water, as opposed to mass movement of a large amount of soil as in a slip or a slump. Surface erosion associated with land under cultivation is of minor significance in the Whanganui Catchment.

This is because cropping is a relatively uncommon land use, and so far at least has been carried out on suitable land without major problems arising. The surface erosion that is most significant is runoff from bare land, which for this purpose can include pasture which is not thick enough to protect the soil from rain.

Poor grazing management contributes significantly to surface erosion. The rate of stocking in many parts of the catchment at present results in pasture too short to protect the soil from rain and flowing surface water, producing sheet erosion of the soil and discoloured runoff to rivers and streams. The adverse effects include gradual loss of productivity from those pastures, and loss of water quality through discoloration of rivers. This type of erosion is not as noticeable as other types, it will be noticed only during rain which is heavy enough to generate surface runoff, and the runoff will be dirty in colour.

The remedy is to maintain a full vegetation cover to the greatest extent possible.

Gully erosion

Gully erosion occurs when surface runoff concentrates into a rivulet which cuts its own channel deeper and deeper into the soil. In its initial stages the very shallow channels are known as “rills”. It is an active form of erosion as any fall of rain will take more material from the gully. Runoff will invariably be discoloured until the gully is stabilised. Gully erosion occurs wherever flowing water has sufficient energy to carry away particles of rock or soil, and can occur throughout the Whanganui Catchment even on relatively flat land. Gullies can move up slopes, becoming larger as they do so. If a gully is not managed properly it may continue to grow almost indefinitely.

Remedies are the construction of debris dams and sediment traps to stabilise the gully floor and absorb energy from the water; combined with urgent revegetation of the gully sides and the immediately surrounding area.

Tunnel gullies

Tunnel gullies can occur when water is flowing underground. Naturally occurring tunnel gullies are reasonably common in pumice formations and are sometimes known as ‘tomos’. The situation is not always apparent from the surface - the first sign may be the collapse of the previously solid ground into a new gully. If tunnel gullies are known to exist specialist advice should be obtained.

Streambank erosion

Streambank erosion occurs naturally and has played a part in creating the landscape as it is. A good example is the gorges and high bluffs carved out by the main stem of the river. As with other forms of erosion the natural rate is by definition sustainable, but clearance of indigenous vegetation in riparian areas, and the trampling of grazing animals, are responsible for instances of accelerated streambank erosion.

The adverse effects upon water quality of this type of erosion are immediate, because the material displaced enters the water directly. The material eroded is often fine alluvial and colluvial material that has previously been deposited on the floodplain, and which can form a milky suspension in water and significantly reduce water clarity. Accelerated erosion from hillsides puts additional sediment into rivers and streams, which through the natural process of being deposited and eroded then also adds to the total amount of streambank erosion.

Streambank erosion occurs throughout the catchment and tributaries, though there are local differences in the extent. In some areas the banks are solid, stable mudstone or sandstone; but unconsolidated banks of either sandstone, mudstone, pumice, or alluvial material are more common.

The only practical remedy for streambank erosion is appropriate riparian management and re-vegetation. The removal of access for stock is generally beneficial. The presence of riparian vegetation moderates the extent of erosion by binding the soil and protecting the surface from rain and floods, and also has many other beneficial effects on water quality. Indigenous vegetation is usually best, as it is adapted to the conditions. However in some circumstances it is difficult to re-establish indigenous vegetation and there is a case for using species such as willow. Willows favour wet areas, are fast growing, and form a thick root mat that provides protection to the banks. However, willows can be a problem when they grow too large, through toppling and impeding water passage in floods, and they require active management.

There are also cases where riparian planting can perform a valuable environmental protection function, and can be of a productive species. Examples include pines, where harvesting considerations permit, and there are minor species which can be considered, for example hazelnuts.

Annex 3 : Land Use Capability Assessment

The LUC Method

Control of accelerated erosion in the Whanganui Catchment depends upon sustainable land use. In turn this requires achieving consistency between the actual use and the inherent capability of every individual area of land. Each piece of land is unique and the number of relevant variables is enormous, so that assessment from first principles is not practical in individual cases. A systematic approach is needed.

Land use capability for any piece of land can be assessed by considering a number of factors including the soil type, the slope, the climate, etc. A proven methodology of Land Use Capability (LUC) exists to do this, based upon both scientific knowledge and practical experience. This method of assessment is well established internationally and is a regular tool for scientists and soil conservators.

LUC assessment is based on a primary classification into eight classes, (usually written in Roman numerals) where I is the best, most versatile land, with few if any limitations to its use, and VIII has the most limitations.

Land Class	Sustainable uses
I and II	few limitations to any use, and sought after for high value uses such as cropping and horticulture
III and IV	good soils which are potentially arable, although with some limitations
V	not arable but generally suitable for pastoral farming
VI and VII	not arable but are generally suitable for either pastoral farming or forestry, although with increasing limitations on their use
VIII	generally unsuited to any productive use and needs to be protected, or managed in its natural state as far as practicable

New Zealand Land Resource Inventory

New Zealand has a Land Resource Inventory (NZLRI) which is ideal for regional planning purposes. The detail within the NZLRI can provide an overall assessment of the catchment with high reliability.

The NZLRI was prepared by the National Water and Soil Conservation Organisation in the late 1970s and early 1980s, and incorporates an expert assessment of land use capability. It records five physical parameters about each area mapped. These are: rock type, soil type, slope, erosion and vegetative cover. It translates these five factors into an assessment of the land use capability of that area. The inventory consists of a large database and maps at a scale of 1:63,360.

The most detailed grouping in the inventory is the capability unit. This groups together mapped areas which respond similarly to the same management, require the same conservation measures, and will produce the same crops for about the same potential yield. Some units are a combination of land use capability descriptions, where there are mixtures of soils or topography on a small scale. There are about 120 different units in the Wanganui Catchment. Each mapped area is considered to be homogeneous within the boundaries shown. As an indication of the useful scale the smallest separate units mapped are about 40 hectares in size.

At the scale of an individual farm property the inventory is not detailed enough. For an individual landowner, an expert assessment at the scale of individual paddocks is required to determine appropriate land management practices.

Land Use Capability Study of Land in the Whanganui Catchment

The base data is from the New Zealand Land Resource Inventory. It has been updated to include areas known to have been planted in exotic forest since the inventory was prepared. This amended inventory has then been used to assess the present uses of land in the catchment and to contrast that with the inherent capability of the land. The study concentrated on areas used for agriculture, because other uses of land in the catchment such as indigenous forest, scrub, or exotic forestry are almost certainly within the capabilities of the land. The total area involved is over 252,000 hectares, or about 36% of the total catchment.

The following assumptions were made in the analysis:

- LUC units with less than 100 hectares farmed in the catchment were deleted as being insignificant. (The total area affected by this was 22 units totalling 1,115 hectares).

- Land units which have indigenous forest or scrub as the dominant land use have been assessed as managed within the capability of the land.

- Land in exotic forestry has been assessed as managed within the capability of the land, on the assumption that appropriate harvesting methods are used.

- Land units which have cropping or pastoral farming as the dominant land use, (which are the main types of active use for production and income in the catchment), have been assigned to five categories. The five categories are shown in the table, and represent increasing limitations on land use:

Most intensive sustainable land use	**Range of sustainable uses**
cropping	cropping, grazing, forestry, protection
grazing	grazing, forestry, protection
grazing with conservation management	grazing with space planted trees, forestry, protection
forestry	forestry, protection
protection (i.e. retirement to scrub or indigenous forest)	protection

- Where the recommended soil conservation measures required include an option, e.g. grazing with space planted trees or afforestation, the area has been divided equally between the options recommended.

- Where the recommended soil conservation measures include grazing with space planted trees, the number of trees per hectare is determined as per the table:

Land Class	**Trees per ha**	**Area of planting**
IV	6	Pair planting of gullies
VI or VII	25	Gully and slope planting
Mixed classes	various - determined individually	Gullies and steep slopes

- No allowance has been made for space planted trees that have already been planted and have survived. This number is estimated at about 18,000, which at 25 per hectare equates to 720 hectares treated.

Wanganui Catchment Land Use Capability Study

MVEG	LUC	Total ha	Soil Conservation measures recommended	ha cropping	ha grazing	ha trees	trees/ha	Total trees	ha forestry	ha retirement
1	1c 2	356	nil	356						
	1c 3	510	nil	510						
	2c 1	386	shelterbelts	386						
	2s 2	1862	cropping - protect soil structure	1862						
	2s 4	592	nil	592						
	2s 5	788	riparian mgmt	788						
	2w 2	2554	nil	2554						
	3c 1	2109	shelterbelts	2109						
	3c 1+6e 6	252	selected cons planting			252	6	1512		
	3c 4	639	nil	639						
	3c 4+6e 6	262	selected cons planting			262	6	1574		
	3e 1	1095	contour cultivate	1095						
	3e 1+6e 3	284	selected cons planting			284	6	1704		
	3e 3	139	contour cultivate	139						
	3e 4	905	contour cultivate	905						
	3e 5	1508	contour cultivate	1508						
	3e 6	146	contour cultivate	146						
	3e 7	2635	contour cultivate	2635						
	3e 7+6w 1	302	contour cultivate; surface water control	302						
	3e 8	1063	contour cultivate except ephemeral watercourses	1063						
	3e 8+8e 2	143	fence off gullies and conservation planting			143	6	856		
	3s 4	1534	contour cultivate/shelterbelts	1534						
	3s 6	5023	surface water control- drainage management	5023						
	3s 6+4w 1	490	surface water control- drainage management	490						
	3s 6+6e26	1066	surface water control- drainage management	1066						
	3s 6+7e19	686	surface water control, no drainage, fence off gullies	686						
	3s 6+8e 2	934	surface water control, no drainage, fence off gullies	934						
	3w 2	4131	streambank protection	4131						
	3w 4	361	shelterbelts; maintain vegetation cover in gullies		361					
	4c 1	772	contour cultivate	772						
	4c 4	1509	nil	1509						
	4c 4+6w 1	169	surface water control	169						
	4e 1	2879	contour cultivate	2879						
	4e 3	112	contour cultivate	112						
	4e 4	401	contour cultivate	401						
	4e 5	2206	contour cultivate	2206						
	4e 5+6e17	384	selected cons planting			384	10	3840		
	4e 5+6s 2	477	nil (for grazing)		477					
	4e 6	2887	contour cultivate, soakholes	2887						
	4e 6+6e23	184	selected cons planting			184	6	1104		
	4e 7	683	contour cultivate	683						
	4e 8	810	conservation planting; afforestation			405	10	4051	405	
	4e 9	6174	contour cultivate/cons planting of gullies			6174	10	61741		
	4e 9+6s 5	847	selected cons planting			847	6	5084		
	4e11	3094	contour cultivate; plant gullies	3094						
	4e13	3142	surface water control- drainage management	3142						
	4e14	204	surface water control- drainage management	204						
	4w 1	2069	streambank protection	2069						
	4w 1+3e 1	310	streambank protection	310						
	4w 2	459	streambank protection	459						
	4w 3	1032	afforestation/drainage						1032	
	5s 2	1838	nil		1838					
	6c 1	1670	cons planting			1670	25	41761		
	6c 4	425	conservation planting/afforestation			212	25	5309	212	
	6c 4+6e26	1149	conservation planting/afforestation			575	25	14363	575	
	6c 4+6w 1	159	conservation planting/afforestation			79	25	1986	79	
	6e 3	26811	conservation planting & grazing mgmt; afforestation			13405	25	335136	13405	
	6e 5	17873	conservation planting & grazing mgmt; afforestation			8936	25	223411	8936	
	6e 6+3c 4	420	selected cons planting			420	25	10501		
	6e 7	846	conservation planting & grazing mgmt; afforestation			423	25	10578	423	
	6e 8	1470	conservation planting & grazing mgmt; afforestation			735	25	18378	735	
	6e10	14658	conservation planting & grazing mgmt; afforestation			7329	25	183224	7329	
	6e11	2319	surface water control- drainage management		2319					
	6e14	10389	conservation planting & grazing mgmt; afforestation			5194	25	129857	5194	
	6e17	15745	"farm" mgmt & conservation mgmt; afforestation			7873	25	196818	7873	
	6e18	2023	afforestation						2023	
	6e18+4e 9	446	afforestation						446	
	6e19	790	conservation planting; afforestation			395	25	9869	395	
	6e20	15287	conservation planting; afforestation			7644	25	191093	7644	
	6e20+4e 1	290	conservation planting; afforestation			145	25	3629	145	
	6e22	1725	cons planting			1725	25	43128		
	6e23	5300	"farm" mgmt & conservation mgmt; afforestation			2650	25	66253	2650	
	6e24	124	"farm" mgmt & conservation planting			124	25	3106		
	6e26	618	surface water control- drainage management		618					
	6s 1	4532	afforestation/cons planting			2266	25	56654	2266	
	6s 2	3510	cons planting			3510	25	87755		
	6s 5	3075	afforestation/ grazing mgmt plus cons planting			1538	25	38441	1538	
	6s 8	1307	afforestation/ grazing mgmt plus cons planting			654	25	16338	654	
	6w 1	431	surface water control- drainage management		431					
	7e 1	9755	conservation planting & grazing mgmt; afforestation			4878	25	121943	4878	
	7e 3	309	cons planting & grazing mgmt; afforestation; retirement			103	25	2575	103	103
	7e 5	2750	cons planting & grazing mgmt; afforestation; retirement			917	25	22914	917	917
	7e 7	3854	conservation planting & grazing mgmt; afforestation			1927	25	48176	1927	
	7e 9	10357	cons planting & grazing mgmt; afforestation; retirement			3452	25	86306	3452	3452
	7e11	19117	"farm" mgmt & cons mgmt; afforestation; retirement			6372	25	159310	6372	6372
	7e14	900	conservation planting; afforestation			450	25	11256	450	
	7e15	195	erosion control forestry						195	
	7e16	733	cons planting & grazing mgmt; afforestation; retirement			244	25	6107	244	244
	7e17	3077	"farm" mgmt & cons mgmt; afforestation; retirement			1026	25	25638	1026	1026
	7e19	486	retire/ or **extensive** mgmt							486
	7s 1	240	grazing mgmt		240					
	8e 3	203	retire							203
	8e 3+2c 1	311	retire							311
	8e 3+4e13	199	retire							199
Total		251276		52347	6284	95808		2253276	83523	13313

Annex 4 : Measurement of water quality

There are three different measures that could be used for water quality in the strategy. These are suspended sediment, visibility and turbidity. They are briefly discussed in this appendix and reasons given for the choice of turbidity as a target indicator.

Suspended sediment

There is a direct relationship between erosion and the amount of sediment in the water of the Whanganui River. The management methods advocated in the strategy will, if adopted, result in reduced erosion and therefore less total volume of sediment. This indicates that suspended sediment is a relevant measure to use for the strategy; however, there are several practical difficulties with it.

Suspended sediment is measured by filtration of a sample of river water. The filtered material is dried and weighed, to give a result in grams per cubic metre. Sampling technique is very important in measuring sediment. In a flooded river, the heavier sediment travels near the bottom of the river. A technique to representatively sample all depths is required. Also, definition is required to distinguish between sediment suspended in the water, and rocks and gravel being moved along the bed by the force of the water. The size of the largest particles in the sample will have a large effect on the result. The measurement requires laboratory facilities and is time consuming, and therefore relatively expensive.

These practical difficulties could be overcome. However, there is further major reason why suspended sediment is not chosen as the most useful measure. This is that perception of water clarity is based on its appearance, which is different to the amount of sediment.

Clarity is affected by fine particles to a much greater extent than by large particles. Therefore the relationship between sediment volumes and clarity is not linear. A small mass of fine particles has a significant effect on clarity, whereas a large mass of large particles may have little effect. Fine material is readily generated from either pumice or mudstone common in the Whanganui Catchment and has a significant effect on the clarity of the whole river downstream. These particles are so fine that many are not caught by normal filtration. After a sample of Whanganui River water has had suspended sediment measured, the filtrate can still be cloudy.

Recreational users will form their perception of water quality at the times when use occurs. This is unlikely to be during a flood. Recreational use is greatest in the summer months, when river levels are generally below mean flow. The perception of water quality will be made on its visual appearance, principally clarity and colour, and not on the total amount of sediment that may be carried.

The cultural and recreational values of the Whanganui River are strongly affected by the perception of water quality, and so suspended sediment by itself is an inadequate measure to choose.

Clarity

Black Disc Visibility and Turbidity are the most widely used indicators for clarity.

Black disc visibility is measured in metres. It is the furthest distance away that a black disc can be seen when viewed under the water in a horizontal direction. Higher values for black disc visibility correspond to higher water clarity. The Ministry for the Environment have recommended 1.6 metres as a minimum guideline for contact recreation (MfE, 1994). This value is not often achieved in rivers in hill country of the Whanganui Catchment, even in fully forested catchments.

Black disc visibility is widely favoured as a clarity indicator because visibility is a parameter that directly relates to the values to be protected: amenity, and aquatic life dependent on sighting their food. However, current methods for measuring black disc visibility are cumbersome, requiring two people, and it is not amenable to continuous monitoring.

Turbidity is a measure of the light-scattering properties of water. Light scattering is caused by suspended material within the water column. Historically, turbidity is a more common measure of water 'clarity'. It is measured in Nephelometric Turbidity Units, or simply NTU.

In contrast to black disc visibility, turbidity *increases* as water clarity decreases. As a parameter, turbidity does not relate easily to the values to be protected; NTU units are not very meaningful unless they are related to particular levels of 'clarity' that people understand. For example, water with turbidity less than about 2 NTU is reasonably clear. This level of turbidity occurs on very few occasions in the mid-to-lower Whanganui River. On the other hand, during floods turbidity readings in the order of 100's of NTU units are not uncommon.

The median of a number of readings is preferred because it ensures that the extreme readings that occur during a flood are eliminated. If included in an average reading flood values would dominate all others.

Unlike black disc visibility, turbidity can be continuously monitored because it is not a manual method. Submerged electronic turbidity sensors can be linked to a data logger to enable continuous monitoring over a period of time. This has particular advantages when done in conjunction with continuous monitoring of river flow rate.

The black disc parameter has only been used in Whanganui River monitoring since 1992, and has only been done in the lower reaches. Better historical records exist for suspended solids and, to a lesser extent, turbidity.

Annex Five: Description of the water ways down the Whanganui Catchment

The Whanganui River has many sizeable tributaries. Differences between these tributaries can be substantial, as indicated by study of the maps on page 5 and page 7.

The catchment area has been divided into 15 parts. These are shown in a map on page 32. Also shown on the map are the areas of farmland on Class VII and VIII land, which is the poorest and most erosion prone land and which is a priority for retirement, afforestation or conservation planting.

SUBCATCHMENT AREAS OF THE WHANGANUI CATCHMENT

Whanganui above Taumarunui, and Whakapapa

These rivers start as the mountain headwaters of the whole river, on Mt. Tongariro and Ruapehu respectively. The rivers and landscape have significant scenic value. Much of the flow in the mountain headwaters (9 cubic metres per second in most circumstances) is diverted to the Tongariro power scheme. The rivers then flow through land developed for farming. The predominant soils are light pumice, of volcanic origin, that are easily eroded. The two flows combine about 10 kilometres north of Taumarunui.

The mountain waters are of exceptionally good quality, and tributaries from farmland are of poorer quality. The Piopiotea Stream has recorded high counts of bacteria, the source of which is uncertain, but possible sources could be the small sewage discharges at either National Park or Raurimu.

Pungapunga and Taringamotu

The Pungapunga enters the Whanganui, and the Taringamotu enters the Ongarue, in both cases just upstream of Taumarunui. Both are medium-sized tributaries, the Taringamotu somewhat larger. They flow west from the Hauhungaroa range. The headwaters are forested but the large part of both rivers flows through farmland. The soil types are mixed, including pumice soils, mudstones and areas prone to deepseated earthflows and slumps. There is considerable scope for soil conservation measures to control accelerated erosion.

Water quality in these rivers is moderate at best, and both clarity and bacterial counts are of concern.

Ongarue

The Ongarue is a large tributary with its confluence south of Taumarunui. Its headwaters are largely pumice soils in the Hauhungaroa range, but these are well forested both with indigenous forest and large exotic forest plantations. In the middle reaches the soils change to predominantly sandstone, with many striking plateau formations that provide good farmland on the flats, plus inaccessible steep cliffs. The major impact on water clarity may be streambank erosion in the lower reaches, where the river meanders through a floodplain of soft alluvial material. A limited study determining the impact on water clarity of different parts of the Ongarue catchment was carried out under this Strategy. The Ongarue Turbidity Investigation report showed that turbidity increases significantly from the confluence of the Mangakahu Stream. Other tributaries, such as the Paraketu stream and the Taringamotu river, also showed a significant increase in turbidity during rainfall. A further study is to be carried out under this Strategy on turbidity in the Ongarue catchment.

Bacterial counts vary above and below target levels, and are somewhat better in the upper catchment. Clarity is below target levels but still better than some tributaries further downstream.

The Hikumutu, Te Maire and Otunui

These streams all enter the Whanganui between Taumarunui and the Ohura confluence. The Hikumutu and Te Maire enter the Whanganui from the south while the Otunui flows in from the North. This area of the catchment is largely pastoral land with mudstone geology. The Water Quality Monitoring Report 2001 carried out under this Strategy found that these streams contribute high turbidity to the Whanganui River and recommended that erosion conservation be a priority in these subcatchments.

Ohura

The Ohura is another large tributary catchment, flowing south and draining land west of Taumarunui. The land is predominantly in pastoral farming. A significant area is Class VII land. The soils are siltstone and prone to soil slip and sheet erosion. The hillsides are steep, generally with very few trees. The valley floors are flat, fertile land comprising soft alluvium and colluvium. There is very little riparian vegetation other than grass in many places. The Ohura catchment is therefore a priority area for soil conservation work to be undertaken. Close to its confluence with the Whanganui the Ohura River has a scenic waterfall, which is one of the attractions of the Whanganui National Park.

The Ohura River is very dirty and it will take great effort to reach target levels for clarity. Bacterial contamination is, somewhat surprisingly, around target levels and therefore is not as significant an issue as clarity. If clarity can be improved, bacterial counts should also improve to better than target levels.

Retaruke

The Retaruke is a large catchment south of Taumarunui and west of National Park. Its predominant soils are a mixture of siltstone, mudstone and sandstone. The headwaters are in indigenous bush and have generally clear waters, and a significant trout fishery. Substantial areas are in pastoral farming, and good management is required to prevent excessive erosion. Many streams are in steep-sided valleys where indigenous vegetation has been left in riparian areas, and this is of benefit to erosion control and water quality. The Retaruke has been the scene of very large slumps, the most recent example was in 1985.

Water quality from the main headwaters is generally good for clarity. It has had high bacteria counts, and the average exceeds target levels, but the specific reason is unknown. The Oio and Kawautahi Streams are significantly dirtier, and while it is apparent that these catchments have more farming they also have more easily erodible soils. Soil conservation work in these areas could improve the clarity of the Retaruke.

Tangarakau River & Heao stream; and Whangamomona River

These rivers flow generally south, and drain land in the west of the catchment. The Tangarakau is larger than the Whangamomona. Most of their area is in indigenous forest, but two separate areas are in pastoral farming. A large proportion of this is Class VII land. One is in the headwaters of the Heao stream, (a tributary of the Tangarakau). The pastoral areas are predominantly jointed mudstone soils, and the indigenous forest hard sandstone. Erosion is prevalent in the farmed areas, and this could be much reduced by greater use of soil conservation techniques.

Farmland is a small proportion of the Whangamomona, and a very small proportion of the Tangarakau, (predominantly in the Heao), but erosion from the farmed areas seems to have a significant effect on the clarity of both rivers.

Manganuioteao River

The Manganuioteao has a water conservation order in recognition of its outstanding wild and scenic characteristics, its outstanding habitat for the blue duck, and an outstanding recreational fishery. It flows west from Mt. Ruapehu to join the Whanganui north of Pipiriki. It has headwaters which are in indigenous forest, and deeply entrenched streams, while in the lower reaches it becomes more meandering in nature and some pastoral farming occurs. Erosion is not as widespread as in other parts of the Whanganui, but the normal range of soil conservation methods are advisable. There are sizeable areas of Class VII land which are a priority for more trees. Riparian management is important to protect the outstanding values identified in the water conservation order.

Water quality is good. Clarity is generally higher than most tributaries. Bacterial counts in the lower river sometimes exceed desirable levels.

The Whanganui (Taumarunui to Whakahoro)

This part of the catchment has high scenic value, and recreational use for boating. A number of small streams flow into the main river from farming catchments. While the contribution of total flow from each is relatively small, they are all important as they are visible to many users, and even a small but very dirty stream can reduce the clarity of the whole river downstream.

There is very little data available on the small streams in this section of the river, but the geology and land use are similar to other streams where both turbidity and bacterial counts are high. There is a significant amount of Class VII land. A study to determine the contribution these streams make to the quality of the main river is part of the strategy.

Whanganui (Whakahoro to Pipiriki)

This part of the catchment has very high scenic value, and recreational use. It is the most popular stretch for canoeing and covers most of the area of the Whanganui National Park. The Mangapurua Stream (where the Bridge to Nowhere is located) has very poor turbidity. The other small streams flowing into the river come from areas covered in indigenous forest, and therefore the water clarity of these streams is likely to be higher. A study to determine the contribution these streams make to the clarity of the main river is part of the strategy, together with an assessment of the contribution bank erosion may make.

Whanganui (Pipiriki to Hipango)

This stretch of the river has moderately high scenic value, and recreational use. It is less used for canoeing, but this is compensated by sightseeing from the river road and easier access for the population of Wanganui. The small streams flowing into the river come from a mixture of areas covered in farmland, exotic forest and indigenous forest. The relative contribution of these flows on the river is small, and they enter below the areas of greatest recreational use. Soil conservation measures are very important as the soft sandstone areas are especially erodible.

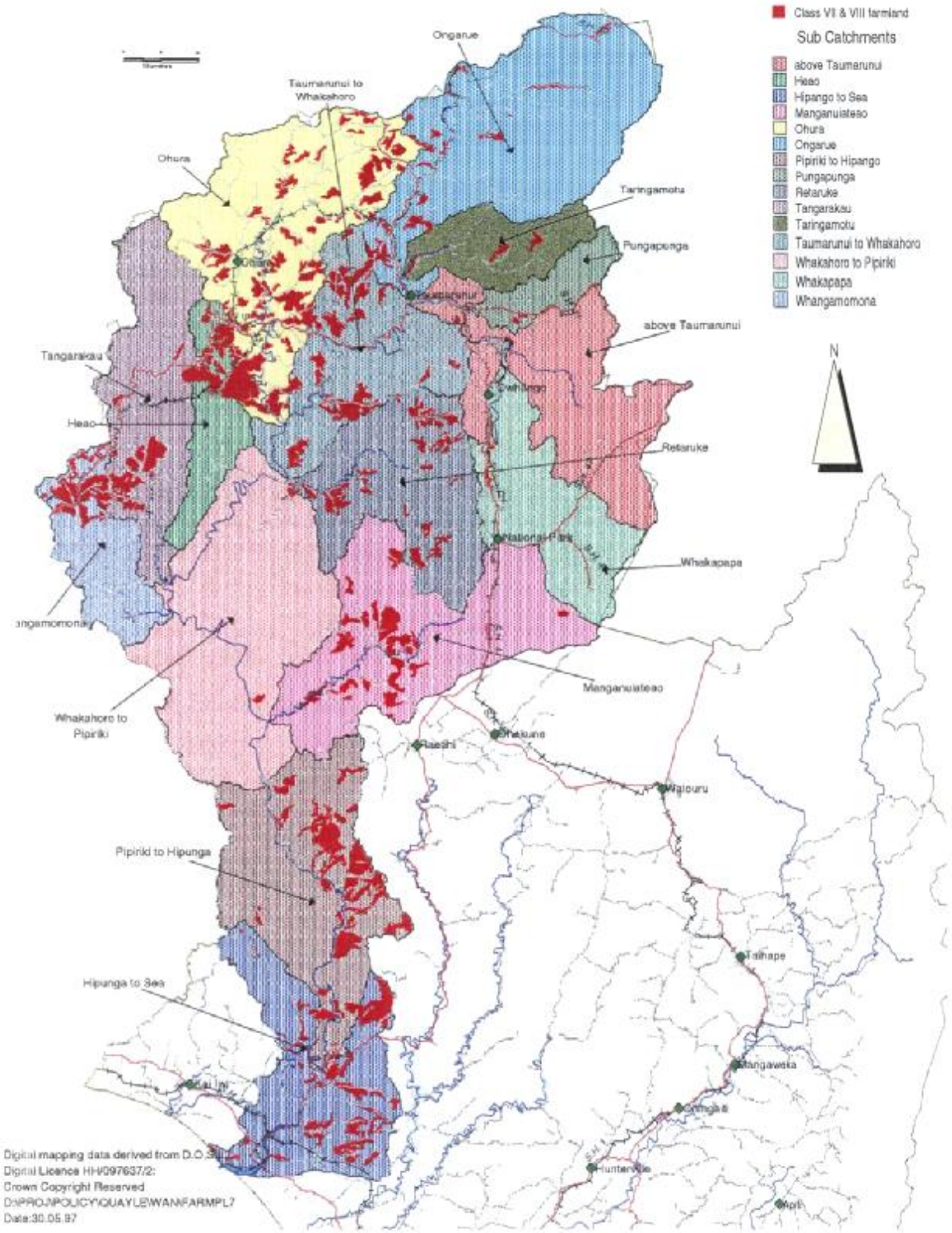
There are many poor quality streams entering the river in the lower reaches. A relatively high proportion of farming land is Class VII. Both turbidity and bacterial counts are as bad as any tributaries in the whole catchment. The water in the main river is very turbid, but this shows the cumulative effect of all the tributaries upstream. It will take a very long time to significantly improve clarity in this stretch of the river.

Whanganui (Hipango to the sea)

Hipango is about 22 kilometres upstream of the river mouth, and marks the normal limit of tidal influence. This estuary stretch of the river has moderately high scenic value, and recreational use, primarily by the population of Wanganui. The streams flowing into the river in this section are very small. The soil is especially prone to erosion, being predominantly soft sandstone, loess and sandy soils. Soil conservation measures are appropriate.

The Regional Council has in its work programme for 1997/98 to conduct an investigation into flood mitigation, drainage and erosion control for this section of the river. The investigation will be in conjunction with the Wanganui District Council and is consistent with the direction of the strategy.

The water in the main river is very turbid. It has also had high bacteria counts, although this has improved with the diversion of Wanganui city sewage.


Class VII & VIII farmland
Sub Catchments
above Taumarunui
Heao
Hipango to Sea
Manganuiateao
Ohura
Ongarue
Pipiriki to Hipango
Pungapunga
Retaruke
Tangarakau
Taringamotu
Taumarunui to Whakahoro
Whakahoro to Pipiriki
Whakapapa
Whangamomona
Ongarue
Taumarunui to Whakahoro
Ohura
Taringamotu
Pungapunga
above Taumarunui
Tangarakau
Heao
Retaruke
Whakapapa
Manganuiateao
Whakahoro to Pipiriki
Pipiriki to Hipunga
Hipunga to Sea
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GLOSSARY

This glossary is included to explain Maori and technical words and to provide the meaning of various terms used in the strategy. It is not a complete list and should be used as a guide only. Definitions in italics are taken from the Resource Management Act 1991.

Maori Terms

Iwi — Tribe, people.

Kaitiaki — Guardian, steward.

Kaitiakitanga — *The exercise of guardianship; and in relation to a resource, includes the ethic of stewardship based on the nature of the resource itself.*

Taonga — Treasure, property - prized and protected sacred possessions of the tribe.

Waahi Tapu — Sacred site - typically includes burial grounds and sites of historical importance to the iwi.

Other Terms

Accelerated Erosion — Soil erosion occurring at a rate exceeding the rate at which a soil layer can be formed from the underlying material; and commonly due to human activity.

Adsorbed — Held to the surface of a solid substance.

Aesthetic Value — A value associated with the beauty or the inherent visual quality of an element in the built or natural environment.

Amenity Values — *Those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.*

Catchment — That area of land defined by the ridges of the terrain and where surface water flows towards a river or stream.

Clarity — Clearness.

Community	Individuals and groups concerned for the Whanganui River.
Consolidation	(Of rock types) is the degree of strength.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a function unit.
Environment	*Includes -* *(a) Ecosystems and their constituent parts, including people and communities; and* *(b) All natural and physical resources; and* *(c) Amenity values; and* *(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.*
Erosion	The wearing away of the earth's surface by physical processes, for example by the action of water and wind.
Gleyed soil	A soil formed anaerobically (i.e. containing bacteria which live in the absence of oxygen) and typically containing a sticky blue clay.
Habitat	The preferred place for an animal or plant to live.
Indigenous	Native to New Zealand.
Issue	A matter of concern to the Region's community regarding activities affecting some aspect of natural and physical resources and the environment of the Region.
Lithology	The physical characteristics of a rock, including colour, composition and texture.
Land Use Capability	Land Use Capability (LUC) is a way of classifying land based on its capacity for permanent sustained production. This capacity depends largely on the physical qualities of the soil and the environment. Such factors include altitude, slope, geology, soil type, vegetation and erosion.

Loess — A soil composed of accumulated wind blown particles and characterised by a very fine texture.

Monitoring — Means regularly checking.

New Zealand Land Resource Inventory — An expert assessment of land use capability prepared by the National Water and Soil Organisation, in the late 1970s and early 1980s, across all of New Zealand.

Nutrients — Minerals which can stimulate plant growth in rivers and lakes.

Riparian Management — Means the collection of activities and practices that can be applied to the riparian margin, in order to improve the natural characteristics and functioning of the waterway itself as well as the riparian margin.

Riparian margin — Means a strip of land adjacent to a waterway which is frequently moist, and which generally extends from the perceived change in contour of the flood plain to the waterway itself.

Sedimentary rock — Rock composed of (originally) water-borne particles

Soil Conservation — The management of land to maintain soil and water resources.

The Council considers that soil conservation includes:

i. maintaining the productive potential of the region's soil resources;
ii. maintaining a high quality water in catchments to provide a resource for downstream users;
iii. land management practices that enhance the protection of waterways from suspended sediments, nutrients, harmful micro-organisms and other pollution;
iv. the mitigation of the impacts of land related hazards including flooding, subsidence and erosion; and
v. the maintenance of aesthetic, scientific and cultural values related to land and water.

Suspended sediment	Particles of rock or soil contained within the water of a river or stream and moving along with the water.
Tephra	Rock fragments ejected by a volcanic eruption.
Tertiary	Refers to a geological time period during which sedimentary material was deposited. Rock were formed when this material was subsequently covered and subject to heat and pressure. The rocks were later uplifted and exposed.
Turbidity	The light-scattering properties of water, measured by a machine calibrated in Nephelometric Turbidity Units, or NTU for short.