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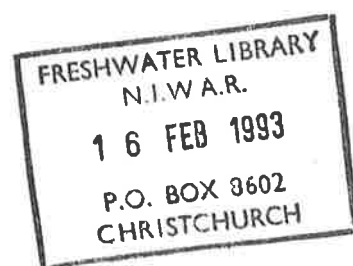
PERCEIVED RIVERINE PROBLEMS IN NEW ZEALAND

***Impediments to
Environmentally sound
Riparian Zone
Management,
and the Information needs
of Managers.***

**PERCEIVED RIVERINE PROBLEMS IN NEW ZEALAND,
IMPEDIMENTS TO ENVIRONMENTALLY SOUND RIPARIAN ZONE
MANAGEMENT, AND THE INFORMATION NEEDS OF MANAGERS**

C. M. Smith

Water Quality Centre, Ecosystems, NIWAR, Hamilton



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SYNOPSIS

The Resource Management Act 1991 explicitly addresses land-water ecotones. Their intrinsic values are a matter of national importance (section 6). Also, the Act recognises that land-water ecotones affect and may protect aquatic ecosystems from adverse effects of land activities (section 229), but requires that riparian management controls be directed toward meeting specified objectives, be justified and defensible (section 32). Given this legal framework, ready access to technical information on land-water ecotones is important for resource managers. Where information gaps exist, research is necessary.

In June 1992, the opinions of staff within Local Authorities, the Department of Conservation, and Fish and Game Councils were sought on the

- extent and severity of riverine problems within New Zealand,
- the effect of present land use activities on our rivers,
- the performance of regulatory authorities, and their information needs to better manage riverine riparian zones for the protection of our rivers.

Qualitative information sought by the questionnaire will assist in focusing and prioritising future research initiatives, and is seen by Ecosystems Division, NIWAR, and DoC as a prerequisite to the development of riparian management guidelines. Responses will influence the scope and contents of riparian management documents that the Division and/or the DoC prepare (possibly in collaboration with other organisations). One hundred and ten questionnaires were sent out. The replies from 46 respondents are summarised in this report. An additional questionnaire soliciting information from each Local Authority and Department of Conservation Conservancy Office on existing riparian retirement and management schemes elicited replies from 3 Regional Councils. A summary of this information is also presented.

In the opinion of respondents, there are diverse and extensive riverine problems. Present rural land uses have caused or contributed to many of these problems. Pastoral farming has the most damaging effects on our waterways. Our estuarine, lake and wetland margins have also been extensively modified by human activities. It is recognised that land-water ecotones fulfil a vital function within the landscape and that, if protected or managed correctly, they can moderate the effects of intensive land use on our freshwaters. Whilst acknowledging that riparian ecotones have intrinsic values, many respondents did not demonstrate a thorough understanding of riparian attributes essential for native flora and fauna. Such an appreciation is necessary among resource managers if habitats for valued species are to be preserved or enhanced.

Technical, legal, political, and social impediments to the adoption of ecologically sound riparian management practices exist. There is a perceived inability to scientifically substantiate the need for and benefits that will accrue from specific riparian land use controls. To some measure, this impediment can be dealt with by the provision of management documents. The majority of respondents requested that information of an applied nature be made more available (e.g., design criteria for riparian schemes to meet specific purposes). A sizeable group also expressed a need for information of a fundamental nature on the structure of ecotones, and of the underlying linkages and dependencies between riverine ecotones and their terrestrial and aquatic ecosystems. This would ensure that management decisions and schemes are well founded. There is a need to develop, and advocate for the adoption of a holistic management approach for New Zealand's riverine riparian zones.

Non-technical impediments to the adoption of best riparian management options need to be addressed by the regulatory authorities. The resolution of many of these issues requires a change in public attitudes.

ACKNOWLEDGMENTS

The success of this study depended on the willingness of those individuals listed in Appendix 1 within the Department of Conservation, Local Authorities, and Fish and Game Councils to participate in a survey. I was pleased to receive so many responses to a lengthy questionnaire. The quality of the replies indicates that numerous individuals put considerable effort and thought into preparing their answers.

My thanks to Kevin Collier, Theo Stephens and others within the Department of Conservation, Dr Michael O'Driscoll of Waikato University, Bryce Cooper and Bruce Williamson for variously, commenting on drafts of the questionnaire, a draft of this report or for advice on 'riparian dependent species'.

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INTRODUCTION

The Resource Management Act 1991 (RMA) emphasises land-water ecotones including riverine riparian ecotones¹. Their intrinsic values are a matter of national importance and persons exercising authority under the Act are to provide for

"The preservation of the natural character ofwetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development" (section 6)

whilst there is provision under the Act (section 230) to set aside Esplanade Reserves² (a strip of land along the bank of any river, lake e.t.c.) upon subdivision for the purpose of

"Protecting the natural values associated with the esplanade reserve" (section 229).

Esplanade Reserves may also be set aside for the purposes of (section 229)

- "i) Maintaining or enhancing the natural functioning of the adjacent sea, river, or lake; or
- ii) Maintaining or enhancing water quality; or
- iii) Maintaining or enhancing aquatic habitats"

thereby recognising in law that land-water ecotones affect and may protect aquatic ecosystems from adverse effects of land activities. The duty to avoid, remedy, or mitigate any adverse effects of activities on the environment (sections 5, and 17) also has relevance to activities within land-water ecotones. However, Section 32 places the onus

¹ An ecotone is a zone of transition between adjacent ecological systems, having a set of characteristics uniquely defined by space and time scales and by the strength of interactions between adjacent ecological systems (Holland 1988).

In the questionnaire, the term riparian zone was used instead. The following working definition was given - the marginal zone between aquatic and terrestrial ecosystems. It may be distinctive in character or indistinguishable at a cursory glance from the adjacent terrestrial ecosystem except with respect to location. The boundaries are indistinct.

² Proposed amendments to the esplanade reserves provisions of the RMA will not alter the purposes for which a esplanade reserve may be set aside.

on Local Authorities to demonstrate that benefits are likely to occur, and to consider alternatives and costs before adopting any objective, policy or rule (such as the provision of Esplanade Reserves) that would restrict human activities within riparian ecotones. In addition, they must document a method to be used to monitor how effective the imposed restrictions are in achieving their objective.

Ready access to technical information on land-water ecotones is thus necessary to those involved in regulating land uses and to those advocating for environmental protection. In June 1992, representatives from these two professional groups were surveyed to evaluate what information they require to better manage riparian ecotones for the protection of our freshwaters. The opinions of Local Authority, Fish and Game Council, and Department of Conservation officers were sought by way of a questionnaire. This questionnaire is presented as Appendix 2. It includes questions specifically designed to promote discussion, and assess individual opinions on

- the extent of specific riverine problems within New Zealand;
- the extent to which these problems have or are being caused by current productive rural land activities;
- to assess how well informed professionals are about essential riparian ecotone attributes for the survival and success of New Zealand flora and fauna;
- to survey present regulations/conditions placed upon activities within riparian ecotones;
- to assess whether (in the opinion) of professionals, the regulatory authorities are managing riparian ecotones in a manner that protects our stream and rivers; and
- to assess whether the officers are hindered in carrying out their duties by a lack of information, and if so, with regard to which issues.

A second questionnaire was also sent out to one individual in each Local Authority and Department of Conservation Conservancy office requesting detailed information about existing riparian retirement and management schemes.

In the main body of this report, I summarise the replies to questionnaire 1. The questions are interspersed through the text (in a different format to that used in the survey, and in *italics*) with a summary of the responses immediately following. Information supplied in response to Questionnaire 2 is presented in Appendix 3.

The views and opinions presented in this summary report will help decide future research initiatives, and influence the scope and contents of riparian management documents that

Ecosystems Division, NIWAR, and/or DoC prepare (possibly in collaboration with other institutions).

SURVEY METHODOLOGY AND RESPONSE

One hundred and ten questionnaires were sent out to 14 Local Authorities (12 Regional Councils, 2 District Councils), the 12 Fish and Game Councils, and the 14 Department of Conservation Conservancy offices. All officers regulating activities within or managing riparian ecotones were invited to participate in the survey. Forty seven questionnaires were returned. One of these was discarded as two respondents in the same office gave, to all intents and purposes, identical replies. I assumed that they dealt with the questionnaire together and considered that a joint response was more appropriate. Altogether, 21 questionnaires were completed by staff within Regional Councils, 16 by Department of Conservation staff, and 9 by Fish and Game Council staff (Table 1). Unfortunately only 8 of the respondents come from the South Island. Thus the opinions of those managing freshwaters within the South Island is poorly represented in this report. Manawatu-Wanganui and regions further north are by contrast, well represented. Only 2 of the respondents are engineers; the remainder are environmental protection advocates, environmental planners, administrators, soil conservators, environmental and wildlife managers, and scientific officers.

Most questions were phrased such that respondents had to make a value judgement. Not all respondents expressed an opinion on all the issues that were raised. On these occasions, they generally indicated that they felt unqualified to respond.

Respondents were asked to describe conditions and give their view on matters within their own region. However, the responses were not dealt with in any detail on a regional basis for several reasons. Firstly, Regional Council, Department of Conservation Conservancy, and Fish and Game Council district boundaries do not coincide. Areas of jurisdiction differ substantially throughout central and southern parts of the North Island. Secondly, there were too few replies from most regions to draw reliable conclusions about specific issues or problems within the region. Instead, all the responses were collated and categorised. An overview is presented which reflects the spread in opinions and describes commonly held views. Where a few respondents held an opinion distinctly variant from the majority, possible reasons for this deviation from the norm were examined. In several instances, it emerged that regional factors, such as differences in land uses, may be important.

Table 1. Number of respondents from each region within each organisation.

Northland Regional Council	2
Auckland Regional Council	4
Waikato Regional Council	5
Bay of Plenty Regional Council	4
Gisborne District Council	1
Taranaki Regional Council	2
Manawatu-Wanganui Regional Council	2
Southland Regional Council	1
Northland Fish and Game Council	1
Hawkes Bay Fish and Game Council	1
Taranaki Fish and Game Council	1
Wellington Fish and Game Council	2
West Coast Fish and Game Council	1
North Canterbury Fish and Game Council	2
Southland Fish and Game Council	1
Northland Conservancy - Warkworth	1
Auckland Conservancy - Auckland	2
Waikato Conservancy - Hamilton	2
Te Kuiti	1
Bay of Plenty Conservancy - Rotorua	1
Tongariro/Taupo Conservancy - Turangi	1
Bay of Plenty Conservancy - Rotorua	1
Hawkes Bay Conservancy - Napier	2
Wellington Conservancy - Masterton	1
Waikanae	1
Nelson/Marlborough Conservancy - Nelson	1
Canterbury Conservancy - Christchurch	1
Otago Conservancy - Queenstown	1

The survey was not intended nor designed to examine differences between the attitudes and views of individuals from the 3 organisations. Answers to most questions are not reported on an organisational basis because of the imbalance in the geographical distribution of the sample groups. The exceptions were responses to questions seeking individuals opinions on their organisation's performance; and the contribution made by different primary industries to the development of riverine problems.

**RIPARIAN ECOTONE AND RIVERINE 'PROBLEMS'
AND CAUSATIVE/CONTRIBUTING FACTORS**

Participants were initially queried about the extent and severity of specified riverine 'problems' within their area.

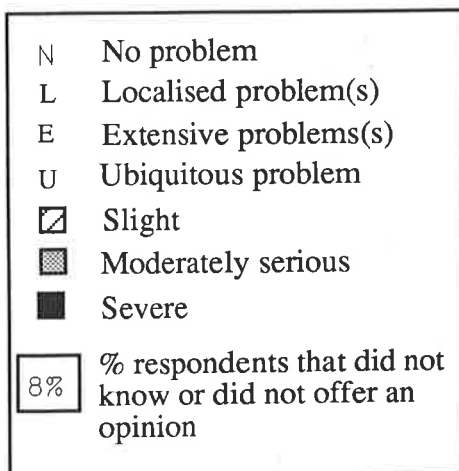
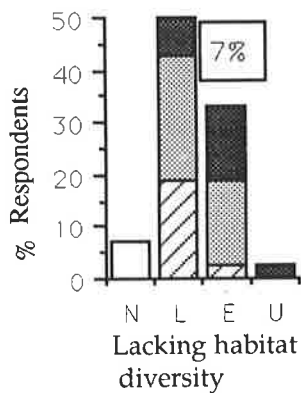
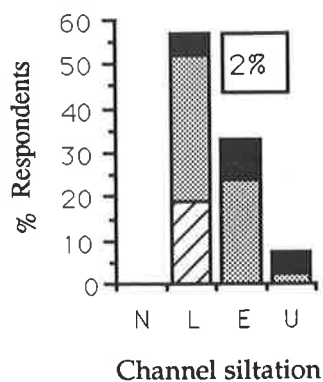
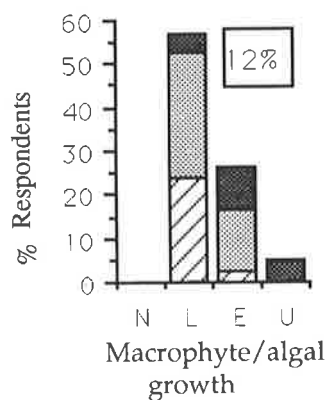
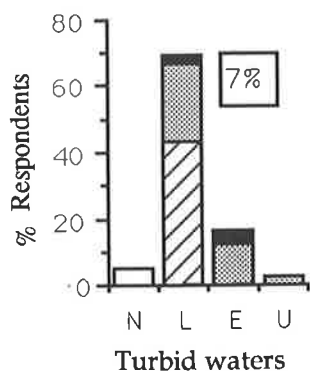
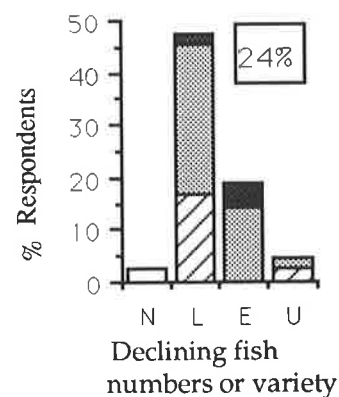
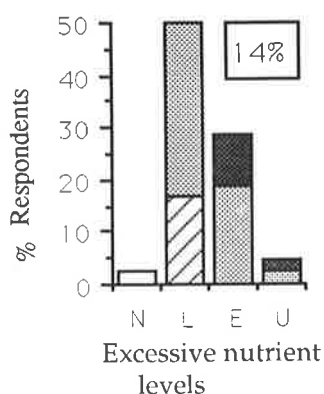
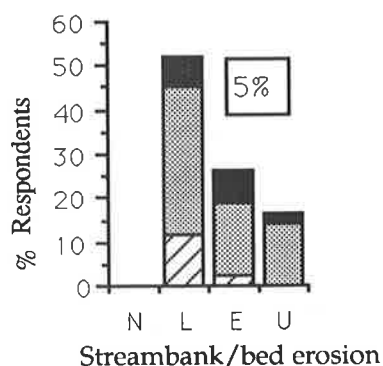
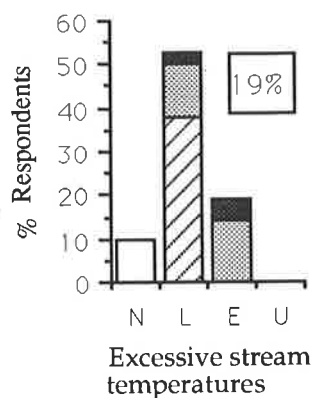
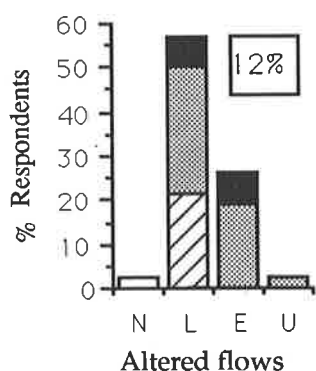
Question 1

How much of a problem are stream/river bank and channel erosion, siltation, excessive in-stream/river nutrient levels, macrophyte/algal growths, excessive stream temperatures, lack of stream habitat diversity, altered flow patterns, declining fish population or variety, and turbid waters within your region/conservancy? Please rate based on the severity of the problem in affected stream/river reaches (slight to severe) and on the extent of the problem (no problem to ubiquitous, or unknown).

Each of these problems was selected because catchment development to intensive agriculture or production forestry may either have caused or contributed to the problem. Changes in catchment hydrology, upland erosion rates, diffuse source nutrient runoff or riparian zone development are obvious, possible contributing factors.

Numbers of respondents classifying a problem into each of 10 possible categories are shown in Fig. 1. To summarise, fifty percent or more believe that each of the specified problems are either localised ($\geq 47\%$) or do not exist within their region. Conversely, sizeable minorities (i.e., 19-43%) believe that specific problems occur over extensive areas or throughout their region. The foremost of these problems is streambank/bed erosion; considered by 43% to be a moderately serious or severe problem. Channel siltation is considered a moderately serious or severe problem by 41% of respondents. Likewise, extensive or ubiquitous problems of a moderate or severe nature exist because of a lack of diverse instream habitats (36% of respondents), excessive nutrient levels (33% respondents), macrophyte/algae growths (31%), declining fish numbers or variety (29%), altered flow regimes (29%), excessive turbidity and temperatures (19% respondents). Only 43% of those respondents concerned by a lack of instream habitat diversity also believe that fish numbers or variety have declined. Sizeable minorities did not know whether fish numbers or variety have declined or whether excessive stream temperatures pose problems. Possibly, there is a lack of qualitative or/and quantitative data on present conditions or reference data for un-impacted systems on which to base an opinion. Responses to a later question suggest that there may also be a general

Figure 1. Riverine problems.



lack of expertise on New Zealand's freshwater fish.

Respondents were then requested to identify other riverine problems within their area.

Question 2

What other problems exist in streams/ivers within your region/conservancy?

Base ratings on both the severity and extent of the problem.

Some respondents misunderstood the question and described processes that may lead to instream/river problems or the source of the problem (e.g., leachate from rubbish tips) rather than actual problems. Some respondents listed reduced river flows, regulated flows, increased flood peaks, abstraction, damming, or loss of floodplain storage. Because these respondents all identified altered flows as a problem in response to the earlier question (and gave similar ratings), this issue was not considered further. Some problems were only identified as such by one respondent; that is, are confined to one region, or are not perceived by others within the area to constitute a problem. Those stream/riverine problems identified by >1 respondent are listed in Table 2.

Table 2. Additional stream and riverine problems. L indicates localised problems, while E refers to an extensive problem in the region.

	Extent	Range in severity of the problem	Number
Physical barriers (to fish)	L-E	moderately serious - serious	7
Physically modified watercourse §	L-E	Slight-moderately serious	5
Toxic substances (e.g., pesticide residues, hydrocarbons, high ammonia)	L	Slight-severe	5
Dissolved oxygen sags	L	moderately serious - serious	4
Loss of riparian wetland habitat	E	Moderately serious- severe	3

§ i.e., channelised, straightened, confined by stopbanks, gravel extraction; also relates to altered flow patterns in earlier question.

The loss of riparian wetlands occurred with drainage to increase agricultural production. All 5 registering concern about toxic substances commented that urban and industrial sources were more important than pesticides applied to rural and riparian areas.

Question 3

To what extent are present agricultural, horticultural, or production forestry practices responsible (directly or indirectly) for the problems noted in response to the preceding 2 questions.

Most of the group believe that problems in their region are in large measure, a consequence of present productive land uses (Fig. 2).

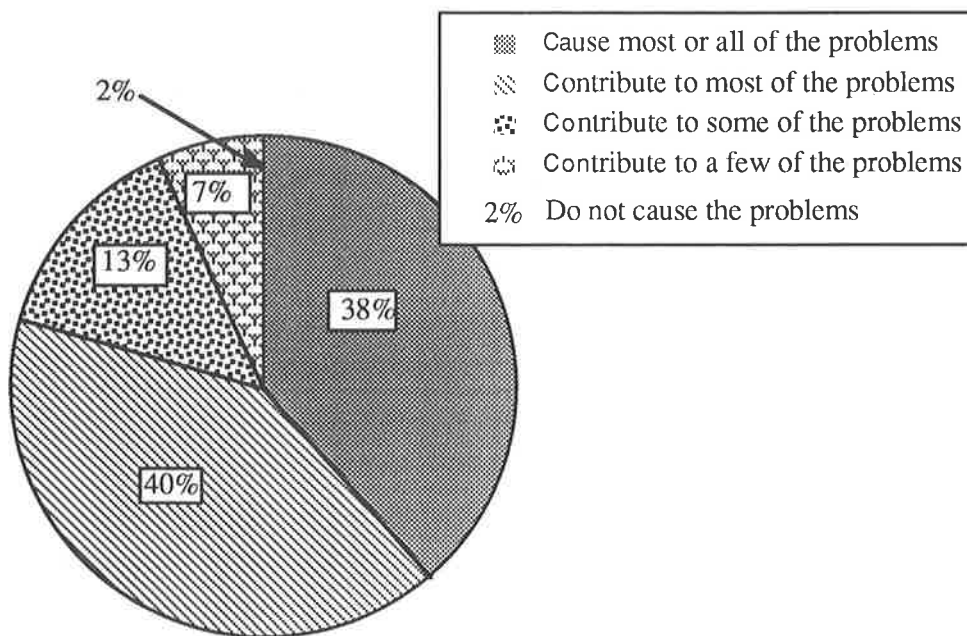


Figure 2. The extent to which productive rural land uses have contributed to the development of riverine problems within the regions.

Question 4

Rank pastoral farming, cropping, production forestry, and horticulture (if they occur within your region) in order of their importance as factors contributing to the problems identified in questions. 1 and 2 Base rankings on how widespread the effects are, and on the severity of the effect in affected stream/river reaches.

Average rankings³ (based on a scoring system of 4 for the industry most extensively or severely affecting waterways, 3 for the second most damaging e.t.c.) presented in Table 3 illustrate that pastoral farming is thought to have the most widespread and severe effects on our waterways. The former to be expected as it is our major rural land use. Forestry is ranked second with regard to both the extent and severity of effects. Closer inspection showed that the extent of problems related to production forestry, horticulture, and cropping varied regionally. For instance, respondents in Gisborne and Christchurch districts considered cropping of importance only secondary to pastoral farming, while in Nelson horticulture is similarly ranked. In the Bay of Plenty, forestry is ranked of secondary importance.

Table 3. Average ranking for the primary industries.

	Pastoral farming	Forestry	Cropping	Horticulture
Extent of effects	4	2.4	1.9	1.7
Severity of effects	3.9	2.4	1.7	1.6

Question 5

List and rank the 5 to 6 farming/forestry activities that in your experience most severely damage streams and rivers ecosystems.

A few respondents listed general management systems (e.g., cropping) as most damaging but most described specific activities. These were put into general categories (Table 4). A score in the range 1 to 6 was then given for the activity when it was included in an individual's list. The maximum score of 6 was given for the activity considered most damaging in an individual list, 5 for the second most damaging activity, and so on. Scores for each activity were then added to give an overall ranking of the different activities. The 5 activities considered most damaging by the group using this method are listed in Table 5. Three of these are pastoral farming activities, one involves production forestry, while earthworks, roading e.t.c. are usually associated with either pastoral farming or forestry. Three are activities within the riparian zone.

³ Many respondents rated rather than ranked the 4 land uses. The summary of responses on the extent and severity of effects are thus based on the opinions of only 27 and 16 respondents respectively.

Table 4. Farming and forestry activities that respondents consider most severely damage stream and river ecosystems.

Category	Description	No. respondents
Water use	Water abstraction & damming; Afforestation (as induces reductions in water yield).	7
Channel modifications	Channel straightening & maintenance (e.g, weed removal); Presence of culverts.	6
Drainage	Drainage of extensive agricultural areas - during construction (e.g., open drains), maintenance, & because of effects on runoff (e.g., of mole & tile drains); Draining of land-water ecotones (i.e., wetlands, seeps).	10
Fertiliser/ Pesticide use	Any use of fertilisers or excessively high fertiliser application rates; Fertiliser application to riparian areas; Aerial topdressing (presumably specified because riparian areas are not avoided during topdressing); Spraying of herbicides (including aerial and blanket herbicide application in riparian areas of production forests.)	12
Waste Discharge	Discharge of dairy shed &/or piggery wastes directly into streams; Spray irrigation of wastes onto land in the vicinity of streams; Discharge of treated agricultural wastes (e.g., oxidation pond effluents) into streams; Disposal of other agricultural wastes (e.g., sheep dips & animal remedies; silage pit leachates) near or into watercourses ; Dumping of refuse, including animal carcasses into watercourses.	8
Grazing practices	Stocking practices that promote erosion & runoff (e.g., continued grazing or overgrazing of (in particular, steep) erodible land, strip grazing, wintering-over dry stock); Failure to protect conservation plantings from grazing stock; Stock access (watering, stock crossings) to watercourses - in particular, cattle and deer; Grazing of wetlands, seeps, dry streambanks, partial areas (surface runoff source areas).	44
Earthworks/ Tracks	All operations within vicinity of watercourses such as construction and maintenance of forestry roads, farm tracks, vehicle crossings, and gravel extraction.	14
Cultivation	Cultivation to the edge of streams & ditches.	4
Production forestry	Clear felling (native forests specified by some respondents); Harvesting of timber within riparian areas; Burning slash after logging; Careless use, or any use of watercourses for access (e.g., by skidders) during tree recovery (e.g, log hauling through watercourse, debris left in stream); Uncontrolled small-scale milling on private property.	18
Land clearance	Land clearance (qualified by some respondents by inclusion of statement, "without retention of (native) riparian vegetation"); Removal of native cover or regenerating scrub from steep slopes; Clearance of native riparian/streambank vegetation; Tussock burning in high country.	22

Table 5. Farming and production forestry activities that most severely damage stream and river ecosystems in the opinion of the sample group.

Activity	Score
Stock permitted access to watercourses and/or riparian wetlands, seeps, dry streambanks and partial areas (runoff source areas) for whatever purpose.	164
Earthworks in, or within the vicinity of watercourses, (e.g., river metal extraction), presence of farm tracks near watercourses, & vehicle crossings.	64
Poor grazing practices within the catchment (e.g., overgrazing, strip grazing).	56
Common production forestry activities within riparian zones (e.g., clear felling, mechanical damage to streambed during log recovery).	56
Discharge of untreated or treated farm wastes (e.g., dairy shed, piggery, wintering barn, animal carcasses) directly into streams.	53

Question 6

Is there serious stream or riverbank erosion that can clearly be attributed to stock grazing in your region/conservancy? If yes, please note whether goats, sheep, cattle, or other animal(s) cause (most of) the problem(s).

Given the responses to Question 5, it is not surprising that most respondents (69%) believe stock cause serious streambank erosion within their district. The majority of those responding in the affirmative (66% or 21) think that cattle cause most of the serious erosion. Four respondents listed both sheep and cattle. Others choose to describe the situation in greater detail. According to 3 respondents from districts with a sizeable deer farming sector, deer wallowing in streams cause the most severe localised damage. Pigs cause severe localised damage (1 respondent). The erosion caused by sheep is extensive or ubiquitous and as such, it is not noticed (2 respondents). Goats cause most damage in steep country (1 respondent), or cause 'widespread diffuse' damage (1 respondent).

Question 7

If there is a forestry industry in your region/conservancy, indicate whichever of the following applies - Milling of trees within riparian zones of the forests is common or normal practice, quite common, uncommon, not done, don't know.

In Northland, milling of riparian trees is quite common or common (4 respondents). In other areas there was little consensus between respondents within the same organisation (thus, within the same region), and therefore little merit in presently the results in full. For instance of the 4 respondents from one Regional Council, 2 reported that milling of riparian trees is uncommon and the other 2 that it is common. Staff of another Regional Council reported that riparian milling in their area was uncommon (2 respondents), quite common (1), or normal practice (2). Possibly, some respondents are uninformed about this issue because quantitative data has not been gathered or documented, or they do not participate in managing/regulating milling practices.

RIPARIAN ECOTONE DEPENDENT SPECIES
Questions 8 & 9

To your knowledge, are there rare, commercially important, culturally valued or recreationally important species that are dependent for their survival on riverine riparian zones within your conservancy/region? If yes, please specify the species.

If known, please list critical (riparian zone or stream/river) factors for the survival and success of these species or communities.

Questions on riparian dependent species were included to determine how well informed the group are about the intimate association between some New Zealand flora and fauna and riverine riparian ecotones. If habitats for valued species are to be preserved or enhanced, critical riparian attributes must be known to both those that regulate land use and the users themselves.

Respondents differed in their interpretation of the terms 'dependent for their survival' and 'critical'. I had intended that a rigorous approach be used but many respondents applied a rather casual translation of the terms. Some species were incorrectly listed (e.g., Cran's bully). Lists of species given by the respondents under each category are presented in Table 6.

Nine respondents did not, or were unable to list any species that critically depend on riparian ecotones. Of the remaining 37, sixteen only identified whitebait or a specific species of whitebait. Nineteen were able to describe critical riparian attributes for one or more of the species that they listed.

Fish

Fourteen respondents were unable to identify any rare species of fish that are dependent on riparian ecotones, although some of these individuals listed threatened/rare species (i.e., Lamprey, Shortjawed or Giant kokopu) under other categories. Another three respondents listed species that are not threatened or rare within this category.

Eleven respondents listed specific attributes of the riparian zone or instream environment that are critical for at least one of the rare species. This included for one or more of the species, overhanging vegetation, undercut banks, fallen logs or other woody debris within the watercourse, shade (and lower temperatures), suitable spawning sites, or the riparian habitat (e.g, declining Canterbury mudfish numbers have paralleled swamp drainage and a lowering of groundwater levels, McDowall 1990).

Table 6. Respondents' list of rare, commercially important, culturally valued or recreationally important species that are dependent for their survival on riverine riparian zones. † indicates species are rare or threatened (Information sources: Williams and Given 1981, McDowall 1990; DoC 1992).

	No. respondents
Rare species	
<i>Fish</i>	
Giant kokopu (<i>Galaxias argenteus</i>)†	10
Shortjawed kokopu (<i>Galaxias postvectis</i>)†	7
Banded kokopu (<i>Galaxias fasciatus</i>)†	7
Black mudfish (<i>Neochanna diversus</i>)†	2
Brown mudfish (<i>Neochanna apoda</i>)†	2
Canterbury mudfish (<i>Neochanna burrowsius</i>)†	1
Koaro (<i>Galaxias Brevipinnis</i>)†	1
Giant bully (<i>Gobiomorphus gobioides</i>)	1
Redfinned bully (<i>Gobiomorphus huttoni</i>)	1
Cran's bully (<i>Gobiomorphus basalis</i>)	1
<i>Birds</i>	
Blue duck (<i>Hymenolaimus malacorhynchus</i>)†	5
Brown teal (<i>Anas aucklandica chlorotis</i>)†	3
Australasian bittern (<i>Botaurus poiciloptilus</i>)	3
Fernbird spp.†	1
Banded rail (<i>Rallus philippensis</i>)	1
<i>Frogs</i>	
Hochstetter's frog (<i>Leiopelma hochstetteri</i>)†	2
<i>Plants</i>	
<i>Amphibromus fluitans</i>	1
<i>Baumea rubinogosa</i>	1
<i>Cyperus</i> sp.	1
Tall sedge (<i>Schoenoelectus validus</i>)	1
Commercially important species	
Whitebait spp. (or inanga specifically)	17
Eels (either short and/or long finned eel)	14
(<i>Anguilla dieffenbachii</i> , <i>Anguilla australis</i>)	
Trout spp.	3
Grey Mullet (<i>Mugil cephalus</i>)	2

Common smelt (<i>Retropinna retropinna</i>)	1
Salmon spp.	1
Glowworms	1
Culturally valued species	
Eel spp.	17
Whitebait spp. (or shortjawed† or giant kokopu† specifically)	17
Lamprey (<i>Geotria australis</i>)†	1
Koura (<i>Paranephrops</i> spp.)	3
Flax (<i>Phormium tenax</i>)	2
Trout spp.	1
Tall sedge (<i>Schoenoslectus validus</i>)	1
Kowhai (<i>Sophora microphylla</i>)	1
Pheasant	1
Recreationally important species	
Whitebait spp. (or Inanga or Banded kokopu† specifically)	26
Trout spp.	16
Waterfowl/Wildfowl (or Mallard duck, Grey duck, Pheasant or Quail specifically)	11
Eels	7
Salmon spp.	2
Rabbit	1

Whitebait, eels and trout spp. were the species commonly listed as of recreational, cultural, or commercial value.

Birds

The Blue duck, Brown teal, Australasian bittern, Fernbird, and Banded rail were listed as rare. The bittern and fernbird inhabit swamps rather than riverine riparian zones. The Banded rail is not listed as threatened or rare by Williams and Given (1981), or DoC (1992).

Other species

One respondent listed glowworms (inhabits an riparian ecotone) as a commercially valued species. Two listed the rare native New Zealand frog, *Leiopelma hochstetteri*. Only 3

respondents listed flora. This included at least 2 species listed as rare by respondents that are quite widespread. Two listed flax as culturally valued.

The replies suggest that many professional resource managers lack knowledge of New Zealand's flora and fauna. Experts need to educate resource managers. Possibly, a handbook listing riparian dependent species (perhaps in categories ranging from critical- a moderate dependency), species distribution and population, and critical/beneficial riparian attributes for the species could be compiled. A handbook that is informative whilst not being overly technical is recommended. Any publication would need to be made widely available.

In addition, the distribution to resource managers of a bibliography of authoritative text giving more comprehensive information on the various riparian dependent species would be helpful.

RIPARIAN ECOTONE MANAGEMENT ISSUES
Question 10

Do you think restrictions should be imposed on riparian land use? If yes, list appropriate restrictions and briefly give your reasons.

The group was unanimous in advocating some form of regulation on activities within riverine riparian zones. Under the RMA, provision is made for prohibiting specific activities, regulating or placing conditions on certain activities, and for promoting voluntary control of activities by the use of inducements (e.g. levies) and education. Any one or a mixture of these approaches can be used to achieve specific objectives. Of the sample group, 4 advocated using education of the public and users as the means of achieving control. A sizeable group favoured a total prohibition on all, or specific activities within the zone, whilst the majority opted for restrictions or the imposition of conditions on certain activities.

Table 7 lists the restrictions and prohibitions that were recommended. Where respondents gave details these are included. However, some respondents were not specific; for example, they advocated fencing and restricted grazing of riparian areas but did not indicate whether this recommendation applied to all or only certain riparian areas, and if so when. In this situation, I erred on the side of conservatism and assumed that only selected areas were intended.

The RMA requires that resource management controls be clearly directed toward meeting specified objectives, which are justified and defensible. The recommendations of respondents were directed toward

- reducing stream channel and bank erosion (16 respondents),
- reducing sediment, nutrient and pesticide inputs to freshwaters and improving instream water quality (23 respondents),
- reducing temperatures and providing shade (3), and to
- protecting or enhancing instream and riparian habitats for native or introduced valued species (14).

However, as becomes evident from replies to later questions, one of many hindrances to the imposition of riparian controls is a perceived inability to scientifically substantiate the need for and benefits that will accrue from riparian land use controls. Improved access to existing scientific information on riparian ecotones and their natural value for mitigating adverse effects from land based activities would benefit environmental advocates and those with regulatory functions under RMA.

Table 7. Conditions and prohibitions that respondents consider should be imposed on land use within riparian zones.

	No. respondents
Prohibited Activities	
Removal of our remnant native riparian vegetation.	3
Fertiliser, pesticide, or herbicide applications within riparian areas.	3
Cattle grazing.	3
Productive land uses within all riparian zones, or along streams <3 m wide.	2
Logging of riparian zones.	2
Deer grazing.	1
Cultivation within 10 m of streams and rivers.	1
Land irrigation of agricultural wastes within 20 m of streams or rivers.	1
Excavation or earth works within riparian zones.	1
Restricted activities	
Restricted grazing - by all stock.	15
- with priority placed on restricting grazing in 'sensitive' catchments or those with critical habitats for native fish.	3
- by cattle/or with priority placed on preventing cattle grazing	2
- where appropriate/or practical.	1
- Grazing prohibited except for light sheep grazing in special (not described) circumstances.	1
Riparian vegetation clearance controls	
- Clearing to be subject to consent/control (no further details given).	5
- Clearance prohibited unless for special, permitted management purposes (e.g., flood control, removal of noxious weeds).	1
- Unrestricted removal of riparian vegetation for flood control not permitted (i.e., requires justification).	1
Restrictions on (no details of when and where were given)	
- earthworks in riparian areas.	5
- quarrying in riparian areas.	1
- waste discharge.	1
- production forestry in riparian areas.	1
Use of riparian areas restricted to environmentally sound, low impact production systems.	2
Production forestry controls	
- Restrictions on type of vegetation grown in riparian areas (e.g., where production forestry, use long rotation species).	1
- Prohibit dropping of trees within/into riparian zone.	1
Mining activities to include riparian buffers (no details given of type of mining operation).	1

Vehicle crossings are to be bridged.	1
Only conditional public access to many riparian areas.	1
No silage pits to be established in riparian zones.	1
Storm water runoff from tracks to be diverted away from watercourses.	1

Questions 11 & 12

If your organisation has the right to regulate riparian management under certain situations/in certain areas, does it have any in-house 'rules' or general guidelines to regulate management. If yes, please describe these rules or guidelines (e.g., no milling within 20 m of streambank where slopes are >30°).

Activities that are regulated to some extent include forest milling, land disposal of wastes and earthworks. Few respondents provided details of the controls imposed (Table 8). At least 2 Regional Councils have documented management policies for certain activities that occur within riparian zones (Table 8). Another Regional Council is in the process of developing a management strategy for riparian zones. DoC has committed funds toward the development of guidelines. Thus, there is a move toward the development of formal policies/recommendations; albeit on a regional or institutional basis. The adoption of a co-ordinated nationwide approach for dealing with many issues could be advantageous (e.g., the earlier recommended, Riverine Riparian Dependent Species Handbook).

Table 8. General guidelines and controls placed on riparian management by Local Authorities and the Department of Conservation.

Northland Regional Council

Commonly, land use consents for forestry and land clearance, and consents for land disposal of wastes impose prohibitions on activity within a 20 m buffer zone of waterways.

Waikato Regional Council

Logging and land clearance guidelines are outlined in an internal document based on the Logging Industry Research Association's (1990) "New Zealand Forest Code of Practice".

Bay of Plenty Regional Council

Riparian land use policies/recommended controls are described in the "Forestry Operations Guidelines" (Bay of Plenty Regional Council 1988) and "Erosion and Sediment Control Guidelines for Earthworks" (Bay of Plenty Regional Council 1992). The forestry operations guidelines are presently under review. The Council are currently compiling Guidelines for Quarry Management and Sand and Shingle Removal. Consents for felling of exotics adjacent to streams generally restrict replanting of the riparian zone. The actual width of this zone is decided on a case by case basis depending on the topography and geology.

Manawatu-Wanganui Regional Council

Production forestry restrictions include,

- No milling within 20 m of streambank where slopes are >30°.
- No crossing of waterways during milling.
- Restricted helicopter logging over certain waterways in case of log drops.

Gisborne District Council

Conditions are decided on a case by case basis. Buffer zones are <40 m wide.

Taranaki Regional Council

No specific guidelines or controls were described, but Council policy and operating procedures are presently being prepared (Taranaki Regional Council 1992).

Department of Conservation

The following summary was compiled from details provided by 3 respondents.

The Department of Conservation's role is generally that of advocacy. DoC have a general policy of excluding stock from riparian zones as grazing leases come up for renewal. However, in many areas the owner of land adjoining DoC administered 20 m Crown land is the effective manager because the land is unsurveyed and unfenced.

Where control is possible, the conditions imposed vary with site and proposed activity. Often, the following guidelines are adhered to,

- No milling or replanting within 20 m on flat land, and usually within 30 m on sloping land.
 - No spraying over watercourses (with exception of broom spraying around braided rivers).
 - Maintain public access.
 - Re-vegetate using natives.
-

Questions 13 & 14

Do you think that your organisation manages riparian zones/regulates riparian land use in a manner that protects stream/river ecosystems; generally protect (to the extent that this is possible) streams and rivers; are often inadequate to protect streams and rivers; do not protect streams and rivers; or are you uncertain? If the organisation's management practices are often inadequate or do not protect our streams and rivers, please give reasons.

Local Authority staff are in the best position of all respondents to influence riparian land use but are often dissatisfied with the performance of their organisation (Table 9). Their reasons are given in Table 10.

Table 9. Respondents' opinions on the value of restrictions presently placed on activities within riparian zones.

	Do not protect	Are often inadequate	Generally protect	Protect
DoC	0	3	7	5
Regional Council	1	11	5	1

Table 10. Reasons given by Regional Council respondents for their organisation's perceived failure to adequately manage riverine riparian zones for the protection of our rivers and streams.

	No. respondents
<i>Legislative failings</i>	
• Past legislation provided inadequate protection for freshwater ecosystems.	1
<i>Internal priorities/policy decisions</i>	
• Inadequate monitoring/enforcement of regulations and restrictions.	5
• Uncertain and conflicting objectives compromise decisions and the activities of council (e.g., the costs for landowners of implementing protection measures serves to deter the Regional Council from imposing and enforcing restrictions).	3
• Inadequate controls have been placed on farming activities.	3
• The Regional Council has failed to protect native fish habitats.	1
• Flood control schemes fail to consider ecological issues/implications.	1
• Riparian protection is not recognised as an important management issue <u>throughout</u> the region.	1
<i>Technical impediments</i>	
• The council lacks detailed management guidelines.	1
• The council lacks a simple, clear guide on riparian management to promote.	1
• How do you monitor benefits (to justify previous and future council decisions).	1
<i>Practical impediments</i>	
• Protection is impractical in many circumstances.	1
• Lack the staff and funds to encourage appropriate riparian management.	1
<i>External impediments</i>	
• Poor appreciation among the farming community of the need for restricted riparian land use.	1

The majority of respondents from within DoC think that their organisation manages riparian zones in a manner that protects the stream/river ecosystem (Table 9). Where management is inadequate, this reflects a lack of funding for fencing stock out of riparian zones in DoC administered estates (3 respondents).

Although Fish and Game Councils have no power to regulate land use, they have a duty under law to protect fish and game habitats. The difficulties that they experience in carrying out these obligations include a lack of regulatory power (1 respondent), and a lack of resources to facilitate improved riparian zone management (1 respondent). One respondent commented that they are consulted after rather than before river reaches are modified.

The responses of, in particular, Regional Council staff illustrate that the implementation of adequate management controls is hindered for social, economic, and technical reasons. A lack of technical information on best riparian management options to meet specific objectives can be dealt with to some extent by improving access to existing scientific information. Where scientific understanding is incomplete, future research can focus on the issue. All the other issues that were raised are internal matters for the regulatory authorities to decide upon after consultation with relevant parties, and/or the solution lies in changing public attitudes.

Question 15

Will the Resource Management Act alter the way in which riverine riparian zones in your region/conservancy are usually managed? If yes, please briefly describe how, and why.

The majority of respondents (73%) are of the opinion that the Resource Management Act will alter riverine riparian management. The wide ranging legal requirements and obligations placed upon Local Authorities will induce changes (Table 11). The Act also serves as a valuable educational tool (Table 11). Most of those not expecting management changes, identified social factors as a powerful deterrent to change (Table 11).

Table 11. Reasons given for likely changes or alternatively, no change in riverine riparian management as a consequence of the enactment of the Resource Management Act.

	No. respondents
Catalysts provided by the RMA for a change in riverine riparian management	
•Legal framework exists so that effective riparian land use controls can be set in place (i.e., the requirement for regional plans e.t.c., provision for Esplanade Reserves, emphasis on sustainable use of resources and the maintenance of the natural character of land-water ecotones, the requirement for Environmental Impact Assessments, and that deleterious effects be mitigated e.t.c.).	22
•RMA has served to increase awareness of the importance of riparian zones, and has educated developers and Local Authorities.	6
•Legal framework exists such that <u>inevitably</u> (i.e., ultimately, will force) effective riparian land use controls will be set in place.	1
Factors preventing a change in riverine riparian management	
•RMA is administered at a local level where loyalties are divided or there is little political commitment.	6
•Regional plans may impose controls but Local Authorities may not monitor or enforce the restrictions.	2
•Funding for fencing and remedial work is not available.	2
•Lack detailed management guidelines.	1

INFORMATION AND RESEARCH NEEDS FOR THE PROTECTION OF
RIPARIAN ECOTONES AND RIVERINE ECOSYSTEMS

Question 16

How difficult is it generally to get the information required to control or limit stream/river ecosystem problems by riparian management? Please indicate whichever one of the following best describes the situation. It is very difficult to get information of practical value; information of practical value is not readily accessible; information is readily available; or I am uncertain about the accessibility of information.

The results are presented in Table 12. Obviously, insufficient effort has been invested translating scientific findings into practical guidelines, and in disseminating this technical information. However, in my opinion there is another complicating factor; that is, the scientific community do not thoroughly understand land-water ecotones, processes occurring within these zones, and the implications that changes in the former have on riverine ecosystems. Direct effects of management changes may be understood or deduced, but there are complex interactions and feed-back loops within ecotones, and between ecotones and aquatic ecosystems. Side-effects and indirect consequences of management changes may be difficult to predict. Thus, the scientific community is hesitant to provide 'widely-applicable guidelines'. The present legal framework necessitates that guidance be provided to resource managers, and ongoing research to answer technical questions.

Table 12. Accessibility of technical information of a practical nature on riparian management options for controlling stream/river ecosystem problems.

Affirmative responses	
Very inaccessible	12
Not readily accessible	19
Readily accessible	8
Uncertain	6

Another relevant issue was raised by three respondents. Each consider that, when necessary, resource managers have a professional responsibility to delve through the scientific literature for solutions to resource management problems. In New Zealand, we do not have a well developed infrastructure for the dissemination of scientific information to environmental resource managers, as exists for the agricultural sector with the Farm Advisory Service. Certain organisations have addressed this problem by funding the

preparation of guidelines (e.g., Ministry for the Environment Water Quality Guidelines for the Control of Undesirable Biological Growths in Water (1991)). Present government policy emphasises the end-users (information and resource users) responsibility in this regard.

Questions 17 & 18

Riparian zones can be managed to limit 'undesirable' stream/river ecosystem changes brought about by land development/forest harvesting. Which issues or problems do you think require (in-depth) consideration in a guideline document on riparian zone management for the protection/enhancement of New Zealand's rivers and streams?

What other matters or issues do you think need to be included in any management document on riverine riparian zones?

Respondents require not only technical information to better manage riverine riparian ecotones. All those matters that are perceived to impede or prevent the imposition or voluntary adoption of ecologically sound riparian, catchment, and riverine management practices (in response to earlier questions) were identified as matters that need to be addressed; be they technical, legal, political or social issues (see, Table 10). Overall, 23 respondents included non-technical matters; the remainder confined their requests to matters of a technical nature as implicitly requested.

I categorise and list all the issues in Table 13. Although many of those surveyed perceive a need for information of an applied nature (e.g., design of a riparian scheme to meet a specific purpose) a sizeable group also expressed a need for information of a fundamental nature on the intrinsic value of ecotones, their structure, and on the underlying linkages and dependencies between riverine ecotones and their terrestrial and aquatic ecosystems. This would ensure that management decisions and schemes are well founded. There is a need for recommendations to regulate specific riverine riparian characteristics but also a need for the development and advocacy of a holistic management approach for New Zealand's riverine riparian zones.

Other technical issues raised by a sizeable minority require a process based analysis of the impacts of present rural land uses on riverine ecosystems.

Most of the non-technical issues relate to matters that entail value judgements. As opinions and values differ between individuals it is not surprising that these issues were raised. One respondent, possibly in an endeavour to avoid the problem of making a

subjectively based decision, asked how risk analyses could be used to describe acceptable instream damage for a specific management activity. However, this raises the question of what is acceptable, and whether this is to be decided on a social or ecological basis. Furthermore, what is perceived to be 'acceptable damage' in social terms will change as public attitudes change. Such value judgements are required under the RMA.

In the opinion of a sizeable group of respondents, we need to change resource user and general community attitudes. Respondents expressed a specific need for educational material, effective publicity of instream and riparian values, regret and frustration with the 'slash and burn' culture and also with the notion that waterways are acceptable waste disposal sites. They requested that guidelines be compiled for users (specifically, farmers). In my opinion, the preparation of any educational material and user guidelines would benefit from a co-ordinated nationwide campaign. Most of the other non-technical issues were also raised by respondents in different regions and could be dealt with on a national basis.

Table 13. Information requirements of resource managers and environmental protection advocates, and impediments to ecologically sound management practices.

	No. respondents
TECHNICAL ISSUES	
<i>Riverine and terrestrial ecosystems, and the riparian ecotone</i>	
• Riparian processes, and interactions with terrestrial and riverine ecosystems; the dynamic nature of riparian ecotones and the protective role that unmodified ecotones fulfil (downstream benefits).	10
• Intrinsic riparian values, riparian and (riparian dependent) freshwater flora and fauna and their habitat requirements.	5
• Definition and classification of riparian ecotones.	2
• Riparian resource mapping/documentation techniques (to identify problems and aid in determining priorities).	2
• A stream classification system.	1
<i>The impacts of man's activities on riverine ecosystems and riparian ecotones</i>	
• Impacts of present productive rural land uses on our riverine ecosystems	
* Identify 'damaging' productive rural activities, and environmentally sound land use practices.	18
* Description of the processes by which damaging rural land use activities alter riparian ecotones and riverine ecosystems, including direct effects and the indirect consequences of land uses.	13

- * Comparative analysis with other water and land based activities/uses, such as channel flood control works, waste disposal, and recreation. 5
- * Documentation of evidence (within New Zealand) of the impacts of riparian ecotone development/loss. 2

Protection/mitigation of adverse rural land use effects on riverine ecosystems and riparian ecotones

- Riparian measures to mitigate land use effects on stream and river ecosystems, with an emphasis on long-term solutions
 - * Problems that can be mitigated by restoration; 13
 - * Critical analysis of riparian management options for protecting/enhancing on-site values and/or downstream values, including 28
 - Broad-scale planning issues (e.g., the value of targeted protection measures ('hot spots') versus catchment wide riparian restrictions, and headwater protection for lowland benefits);
 - Design principles to alter/protect specific instream/riparian attributes;
 - Multi-purpose protection strategies;
 - Enhancing modified watercourses (i.e., following stream diversion, confined waterways). Address the issue of apparently conflicting objectives; that is, flood protection and river/riparian zone protection;
 - Design criteria (i.e., dimensions of a filter strip, plant species selection);
 - On-going management issues in protected ecotones (e.g., control of nuisance or noxious weeds).
- Collation of scientific information demonstrating benefits (to justify the implementation of protection measures). 7
- Riparian protection performance indicators, and techniques for monitoring the effects of protection (necessary under RMA). 5
- Catchment management measures to alleviate freshwater 'problems' including protection measures that can be incorporated into farming routines, and guidelines for farmers. 4

NON-TECHNICAL ISSUES

Economic Issues

- Cost-benefit analysis of present land use activities and riparian protection measures. 9
- Procedure for undertaking a protection scheme cost/benefit analysis. 1

Legal Issues

- Clarification of property rights & responsibilities under the RMA (1991). 6

- Statutory mechanisms whereby riparian protection measures can be implemented. 3

Political and Social Issues

- Educational material required to alter user attitudes, and organisational initiatives required to begin the process. Effective publicity of existing regulations. 12
- Apportioning protection scheme implementation and on-going maintenance costs (within the context of protection cost-benefit analysis). 7
- Address the issue of public access to riparian ecotones. 6
- Address the issue of conflicting objectives and prioritising management objectives. 2
- Maori perceptions and the cultural significance of rivers and riparian ecotones. 2
- Risk analysis, describing 'acceptable' instream damage for a specific management activity. 1

Question 19

Is it very important, important, of low priority, or unnecessary to develop riparian management guidelines specifically for confined river reaches.

The replies (Table 14) indicate a preference for the development of specific guidelines for confined river reaches.

Table 14. Necessity for specific guidelines for confined river reaches.

	Affirmative response
Very important	16
Important	18
Low priority	6
Unnecessary	1
No opinion	4

WETLAND, LAKE MARGIN AND ESTUARINE PROBLEMS, & INFORMATION NEEDS FOR THEIR MANAGEMENT/PROTECTION

Question 20

How have wetland, lake, and estuarine riparian environments in your region been modified by human activities. Please rate on the basis of how widespread the changes have been (entirely altered, extensively altered, localised changes, little or no alteration), and on their magnitude (minor - large effects).

According to the majority of respondents (Fig. 3) wetland, lake, and estuarine margins in their region have been entirely or extensively altered by human activities within the ecotone, by modifications to the adjacent aquatic ecosystem, and/or by activities within their catchments. Of this group, more than half believe that large changes have occurred.

Question 21

What issues do you require information on to fulfil your advocacy/regulatory role in protecting or enhancing wetland, lake, and estuarine margins and their associated aquatic ecosystems?

Respondents believe that to better manage these land-water ecotones, they require technical information on ecotone structure and processes, the relationships between these land-water ecotones and their adjacent terrestrial and aquatic ecosystems, and the management of these relationships. Many of the issues are complex. Also, issues of a social, legal, and economic nature need to be clarified or addressed. The issues that were raised for wetland, lake, and estuarine margins are described in Tables 15-17 respectively.

Figure 3. Extent and magnitude of changes to land-water ecotones induced by human activities

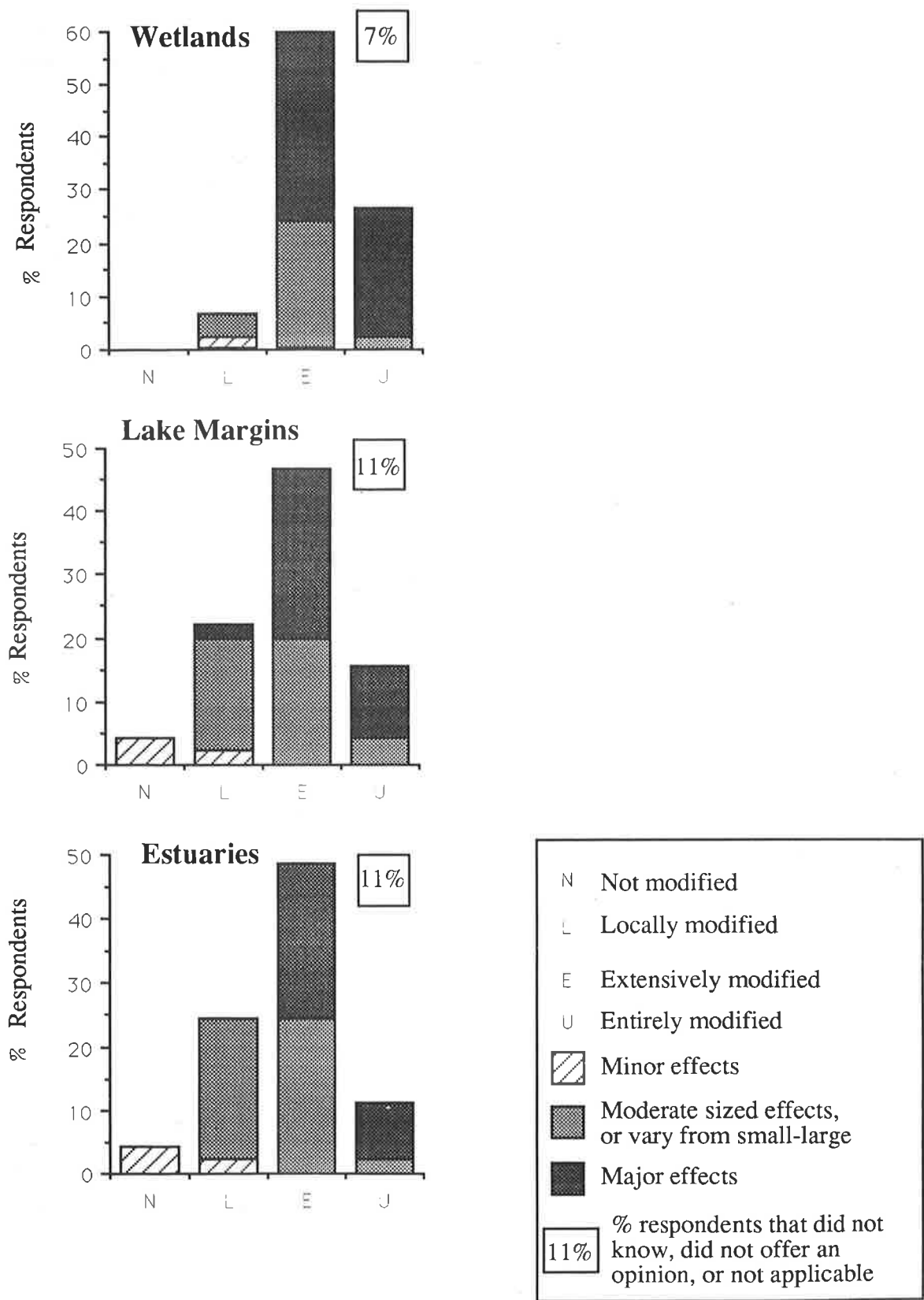


Table 15. Wetland ecotone information requirements and impediments to ecologically sound management practices.

	No. respondents
• Functional value of wetlands as a land-water ecotone (e.g., nutrient filtering, moderating open channel drainage).	9
• The impacts of land use on wetlands (damaging activities, direct effects, and indirect consequences)	6
Specifically,	
* Effects of stock grazing;	9
* Effect of altered flows on ecology (in particular sensitivity of flora and fauna to changing water table levels;	6
* Effects of eutrophication on wetland ecology;	3
* Effects of siltation and increasing turbidity.	2
• Wetland processes (e.g., nutrient transformations); susceptibility to change and damage/the dynamic nature of the wetland ecotone.	6
• Intrinsic wetland values e.g., as specialised habitat for flora and fauna (specify species tolerances), and as corridor for a wide range of species.	4
• Inventory of specific wetlands having significant values for rare or other valued species, and species population information.	3
• The critical size for a sustainable wetland community.	2
• Restoration techniques for degraded wetlands.	2
• Indicators of wetland health/survey techniques to monitor effects of protection.	2
• Clarification of responsibilities under the RMA act.	2
• The issue of raising public awareness of wetland values.	2
• Wetland use for waste treatment, and constructed wetlands	
* Wetland use to polish wastes including detailed design specifications;	2
* Design criteria for constructing wetlands as wildlife habitats and for diffuse runoff treatment.	1
• Farm practices that minimise adverse effects.	1
• Cost/benefit analysis for wetland restoration or protection.	1
• Apportioning protection costs.	1

Table 16. Lake ecotone information requirements and impediments to ecologically sound management.

	No. respondents
• Ecotonal processes and interactions with lake ecosystems e.g., (nutrient transformation, sedimentation zone).	7
• Damaging land based activities (urban and rural); the processes whereby they impact margins and the consequences e.g.,	7
* changing nutrient levels (e.g., effects of fertilisers and horticultural sprays);	4
* changing water levels;	4
* stock grazing effects on ecotone ecology;	4
* elevated sedimentation or erosion rates.	3
• Restoration/protection measures	
* General protection scheme components and design criteria;	6
* On-site and lake ecosystem benefits;	5
* Area required to ensure habitat diversity, sustainable populations;	1
* Water table management;	1
* Controlling exotic macrophyte growths.	1
• Intrinsic values.	4
• Indicators of ecotone health and survey techniques for monitoring long-term changes in extent, and ecology of lake margins (c.g., remote sensing).	3
• Raising public awareness and understanding of the values of lake margins.	3
• Clarification of responsibilities under RMA.	2
• Water sources for dune lakes.	1
• Susceptibility to change and damage.	1
• Farm practices that provide a measure of protection.	1
• Cost/benefit analysis of protection measures.	1

Table 17. Estuarine ecotone information requirements and impediments to ecologically sound management.

	No. respondents
• Ecotone processes, interactions with estuaries, and the natural protective role that the ecotone fulfils.	8
• Description of potentially damaging catchment and estuarine activities/modifications; the processes whereby they impact the margin, and direct and indirect effects	8
* grazing stock;	4
* hydrological changes associated with estuary modifications;	2
* changing nutrient inflows, pesticides;	2
* increased sedimentation.	1
• Restoration techniques	6
* Criteria for designing, and components of a protection/enhancement programme;	6
* On-site and downstream benefits of ecotone protection;	2
* Practical farming practices that will reduce adverse effects of development;	1
* Cost/benefit analysis of protection/restoration schemes.	1
• Indicators of health, methods for monitoring changes, procedure for assessing ecotone resource.	4
• Intrinsic values	
* in particular, their importance for valued fish species.	3
• Susceptibility of the ecotone to change and damage.	2
• Public awareness of estuarine values, changing attitudes of users.	2
• Methods of assessing rates and areas of siltation.	1
• Climate warming/sea level change effects on estuarine ecotones.	1
• Legal requirements and responsibilities under the RMA.	1

SUMMARY, CONCLUSIONS, & RECOMMENDATIONS

Qualitative information was sought from water resource managers to help Ecosystems, NIWAR decide upon future research initiatives, and to highlight management issues that need to be addressed in documents that Ecosystems and/or DoC prepare (possibly in collaboration with other institutions). General findings, and implications of the survey are that,

- Extensive, diverse riverine problems exist within New Zealand;
- Present land uses have caused or contributed substantially to the development of these problems;
- Pastoral farming has the most widespread and damaging effects on our waterways. Stock access to watercourses, riparian zones, dry streambanks, and partial source runoff areas is considered the most severely damaging activity. The majority of those surveyed believe that cattle cause most of the problems. Other severely damaging activities are earthworks, roading near watercourses and metal extraction, the discharge of treated and untreated farm wastes into or near watercourses, present catchment grazing practices and common milling practices within riparian zones;
- New Zealand's wetland, lake, and estuarine margins have also been extensively modified by human activities;
- Many resource managers lack expertise on New Zealand's freshwater and riparian zone fauna and flora;
- Resource managers believe that activities within riparian zones need to be restricted;
- A few organisations have/are developing and documenting riparian management policies and guidelines;
- Local Authority staff are often dissatisfied with the way that their organisation manages and regulates riparian land use;
- The RMA is likely to alter riparian management practices because of wide ranging requirements placed upon Local Authorities and because the Act has/is serving as an educational tool;

- The implementation of ecologically sound riparian management practices is hindered for social, economic and technical reasons;
- There is a perceived inability to scientifically substantiate the need for and benefits that will accrue from riparian land use controls;
- Technical information of a practical nature on riparian zones is not readily available. Scientific information needs to be translated into practical guidelines and these widely distributed to resource managers;
- There is a need to develop (and advocate for the adoption of) a holistic management approach for New Zealand's riparian ecotones;
- Regulatory authorities and environmental protection advocates need to address social impediments to the adoption of ecologically sound riparian zone management. We need to change resource user and general public attitudes.

In view of the results, I recommend that

- Additional resources be committed to the development of regionally and/or nationally based riparian management guidelines or handbooks.
 Technical information on the intrinsic values of land-water ecotones, their structure, processes, and linkages between ecotones and their terrestrial and aquatic ecosystems also needs to be widely distributed for resource managers.
 Certain issues would most effectively and efficiently be dealt with by experts in the specific field and on a national basis (e.g., the compilation of information on riparian zone dependent species). Other issues could be dealt with on a regional basis, but there are benefits from combining resources. DoC have committed funds toward the development of guidelines (by Ecosystems, NIWAR). Other organisations could contribute to this programme; and thus broaden the scope of the management document.
- A document be compiled that lists species dependent on riverine riparian zones, their distribution and population, and critical riparian attributes for the species. An informative but not overly technical publication is recommended. It must be made readily available to resource managers. *(Recently, DoC have indicated interest in compiling such a document).*

- A bibliography of authoritative reference text giving detailed information on riparian dependent species be compiled and widely distributed to resource managers.
- Educational material be prepared and distributed to resource users (e.g., farmers), and instream and riparian values widely publicised. These 2 issues would in particular, benefit from a co-ordinated nationwide approach.

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Appendix 1. Respondents to Questionnaire 1, Survey of Information Needs.

Regional Councils/District Council

Tony Phipps	Senior Planning Officer	Northland Regional Council
Dwane Kokich	Senior Monitoring Officer	Northland Regional Council
Peter Thomas	Engineer	Auckland Regional Council
Chris Hatton	Manager - Resource Quality	Auckland Regional Council
Lee Whiley	Senior Soil Conservator	Auckland Regional Council
Edie Grogan	Water Quality Scientist	Auckland Regional Council
Adrian Meredith	Scientist - Environmental Quality	Waikato Regional Council
Judy van Rossen	Scientist - Environmental Quality	Waikato Regional Council
Beat Huser	Senior Scientist - Environmental Quality Section	Waikato Regional Council
David Cameron	Scientific officer - Biologist	Waikato Regional Council
Alan Campbell	Soil Conservator	Waikato Regional Council
Ross Titchmarsh	Design Engineer	Bay of Plenty Regional Council
G.J. Sutton	Environmental Consents Officer	Bay of Plenty Regional Council
Mike Vine	Senior Resource Planner	Bay of Plenty Regional Council
Norm Ngapo/	Senior Soil Conservator	Bay of Plenty Regional Council
Tony Hall	Manager, Land Resources	Bay of Plenty Regional Council
Ian Moore	Land Resource Officer	Manawatu-Wanganui Regional Council
Barry Gilliland	Manager, Resource Monitoring	Manawatu-Wanganui Regional Council
Ian Petty	Water Conservation Officer	Gisborne District Council
Chris Fowles/	Scientific Officers	Taranaki Regional Council
Stephen Moore		
Claire Robertson	Soil Conservator	Taranaki Regional Council
Graeme Arthur/	Soil Conservator/	Southland Regional Council
Ian Welsh	Water Quality Officer	

Fish & Game Councils

Mark Poynter	Manager	Northland
L.W. Spooner	Game Farm & Hatchery Manager	Hawkes Bay
	Field Officer	
Allen Stancliff	Field Officer	Taranaki
S.C. Smith	Manager	Wellington
P.H. Taylor	Field Officer	Wellington
Maurice Rodway	Manager	Southland
P.W. Lambert	Field Officer	West Coast
James Low	Field Officer	North Canterbury
Walter C. Clark	Chairman, Water Resources Committee, Vice Chairman of Council	North Canterbury

Department of Conservation

Thelma Wilson	Conservation Officer	Warkworth
D.E. Woodcock	Field Centre Manager	Great Barrier Island
Chris Green	Conservation Officer, Habitat Protection	Auckland
P.F. Hardy	Resource Planner	Hamilton
Theo Stephens	Conservancy Advisory Scientist	Hamilton
Chris Richmond	Protection Manager	Rotorua

	(Bay of Plenty)	
Ray Scrimgeour	Field and Water Manager	Te Kuiti
John Gibbs	Fishery & Water Manager	Turangi
John Adams	Senior Conservation Officer (Protected species/Habitat)	Napier
Neil Grant	Senior Conservation Officer	Napier
Hans Rook	Conservation Officer	Napier
Ian Cooksley	Field Centre Manager	Waikanae
Tim Harrington	Conservation Officer	Masterton
Neil Deans	Conservation Officer (Freshwater & Ecological Survey)	Nelson
Martin Rutledge	Conservation Officer (Marine Resources)	Christchurch
Rudi Hoetjes	Conservation Officer	Queenstown

Appendix 2.

SURVEY - INFORMATION NEEDS FOR RIPARIAN ZONE MANAGEMENT, RESTORATION, AND PRESERVATION

The DSIR Water Quality Centre wish to determine what information is required to better manage riverine riparian zones for the protection and enhancement of stream/river ecosystems. This will help us to decide what research needs to be undertaken in future. It will also help determine the scope and content of any future guideline documents.

To this end, we are sending this questionnaire to DoC conservancy staff, Regional Councils, and Fish and Game Council staff. It elicits **your views** on

- the extent, and severity of riparian/riverine problems within your region/conservancy,
- the effects that agriculture and production forestry have on stream/rivers in your region/conservancy,
- the technical information that you require on riparian zones to manage streams and rivers, and so fulfil your advocacy/regulatory role,
- your experiences when seeking the technical information required,
- existing management schemes, and on why they are/are not successful, and
- barriers/inducements to the implementation of riparian schemes.

We seek your personal, professional opinion on various issues rather than responses which reflect the organisation's policy. Your participation will substantially contribute to our understanding of the information needs of resource managers and other interested parties. A self addressed envelope is attached. Please answer as many questions as possible, and return the questionnaire to me by **31 July, 1992.**

Another questionnaire requesting factual information (such as design and implementation costs) on riparian retirement schemes within your region/conservancy has been sent to one representative in each region. The information provided by both questionnaires will be summarised and a report made available to staff in the contributing organisations.

QUESTIONNAIRE 1

SURVEY OF INFORMATION NEEDS

Name:

Location:

Position:

Organisation:

In this questionnaire, the riparian zone is loosely defined as being the marginal zone between aquatic and terrestrial ecosystems. It may be distinctive in character or indistinguishable at a cursory glance from the adjacent terrestrial ecosystem except with respect to location. It's boundaries are indistinct.

- 1) How much of a problem are each of the following in your region/conservancy?
Please base ratings (write number in box) on the severity of the problem in affected stream/river reaches, and on the extent of the problem, where

Extent

- 1=not a problem
- 2=localised problem(s)
- 3=extensive problem
- 4=ubiquitous problem
- 5=unknown

Severity

- 1=slight problem
- 2=moderately serious problem
- 3=severe problem

	<u>Extent</u>	<u>Severity</u>
stream/river bank and channel erosion.	<input type="checkbox"/>	<input type="checkbox"/>
siltation of stream/river beds.	<input type="checkbox"/>	<input type="checkbox"/>
excessive in-stream/river nutrient levels.	<input type="checkbox"/>	<input type="checkbox"/>
macrophyte/algal growths.	<input type="checkbox"/>	<input type="checkbox"/>
excessive stream temperatures.	<input type="checkbox"/>	<input type="checkbox"/>
lack of stream habitat diversity.	<input type="checkbox"/>	<input type="checkbox"/>
altered flow patterns (e.g., following land development).	<input type="checkbox"/>	<input type="checkbox"/>
declining fish population or variety.	<input type="checkbox"/>	<input type="checkbox"/>
turbid waters.	<input type="checkbox"/>	<input type="checkbox"/>

- 2) What other problems exist in streams/ivers within your region/conservancy?
Please base ratings on the severity and extent of the problem using the same scales as used for Question 1.

<u>Problem</u>	<u>Extent</u>	<u>Severity</u>
.....	<input type="checkbox"/>	<input type="checkbox"/>
.....	<input type="checkbox"/>	<input type="checkbox"/>
.....	<input type="checkbox"/>	<input type="checkbox"/>
.....	<input type="checkbox"/>	<input type="checkbox"/>

- 3) To what extent are present agricultural, horticultural, or production forestry practices responsible (directly or indirectly) for the problems noted in response to Questions 1 and 2? Please tick the box that best describes the situation.

- ☐ Cause most or all of the problems. Please go to Question 4.
- ☐ Contribute to most of the problems. Please go to Question 4.
- ☐ Contribute to some of the problems. Please go to Question 4.
- ☐ Contribute to a few of the problems. Please go to Question 4.
- ☐ Do not cause the problems. Please go to Question 7.
- ☐ Uncertain. Please go to Question 7.

- 4) Rank the following landuses (if they occur within your region) in order of their importance (1, 2, 3, 4, where 1 = most important) as factors contributing to the problems identified in Questions 1 and 2. Please base rankings on how widespread the effects are, and on the severity of the effect in affected stream/river reaches.

	<u>Extent</u>	<u>Severity</u>
Pastoral farming	<input type="checkbox"/>	<input type="checkbox"/>
Cropping	<input type="checkbox"/>	<input type="checkbox"/>
Production forestry	<input type="checkbox"/>	<input type="checkbox"/>
Horticulture	<input type="checkbox"/>	<input type="checkbox"/>

- 5) Please list and rank the 5 to 6 farming/forestry activities that in your experience most severely damage streams and rivers ecosystems (i.e., 1, 2, 3, e.t.c. , where 1 is most important). Please be as specific as possible (e.g., strip grazing of the riparian zone by cattle).

1.....
2.....
3.....
4.....
5.....
6.....

- 6) Is there serious stream or riverbank erosion that can clearly be attributed to stock grazing in your region/conservancy? Please tick one box. If yes, please note whether goats, sheep, cattle, or other animal(s) cause (most of) the problem(s).

☐ No.

☐ Yes.....

- 7) Is there a forestry industry in your region/conservancy? If yes, please tick whichever one of the following applies.

Milling of trees within riparian zones of the forests is

☐ common, or normal practice.

☐ quite common.

☐ uncommon.

☐ not done.

☐ don't know.

- 8) To your knowledge, are there rare, commercially important, culturally valued or recreationally important species that are dependent for their survival on riverine riparian zones within your conservancy/region? If yes, please specify the species. If a species falls into more than one category please list it twice.

Rare species.....

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Commercially important.....

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.....

Culturally valued.....

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Recreationally important.....

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- 9) If known, please list critical (riparian zone or stream/river) factors for the survival and success of those species or communities identified in response to Question 8.

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- 10) Do you think restrictions should be imposed on riparian land use? Please tick one box. If yes, list appropriate restrictions and briefly give your reasons.

☐ No.

☐ Yes.

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- 11) Does your organisation have the right to regulate riparian management under certain situations/in certain areas. Please tick one box.

☐ No. Please go to Question 15.

☐ Yes. Please go to Question 13.

☐ Uncertain. Please go to Question 15.

- 12) Does your organisation have any in-house 'rules' or general guidelines to regulate riparian management (e.g., you impose riparian management conditions when issuing consents for forest milling)? Tick one box. If yes, please describe these rules or guidelines (e.g., no milling within 20 m of streambank where slopes are >30°).

☐ No.

☐ Yes.

☐ Uncertain.

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13) Do you think that your organisation manages riparian zones/regulates riparian land use in a manner that protects stream/river ecosystems? Please tick one box.

☐ Yes. Please go to Question 15.

☐ Our management practices generally protect (to the extent that this is possible) streams and rivers. Please go to Question 15.

☐ Our management practices are often inadequate to protect (to the extent that this is possible) streams and rivers. Please go to Question 14.

☐ No. Please go to Question 14.

☐ Uncertain. Please go to Question 15.

14) Please give reasons for your response to Question 13 (i.e., how do they fail).

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15) In your opinion, will the Resource Management Act alter the way in which riverine riparian zones in your region/conservancy are usually managed? Tick one box. If yes, please briefly describe how, and why.

☐ No.

☐ Yes.

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- ☐ Very difficult to get information of practical value.
 - ☐ Information of practical value is not readily accessible.
 - ☐ Information is readily available.
 - ☐ Uncertain about the accessibility of information.
- 17) Riparian zones can be managed to limit 'undesirable' stream/river ecosystem changes brought about by land development/forest harvesting. Which issues or problems do you think require (in-depth) consideration in a guideline document on riparian zone management for the protection/enhancement of New Zealand's rivers and streams?

This image shows a full page of primary-ruled paper. It features ten sets of horizontal lines. Each set consists of three lines: a solid top line, a dashed middle line, and a dotted bottom line. The lines are evenly spaced across the entire page, providing a guide for letter height and placement for young learners. There is no handwriting or other markings on the page.

18) What other matters or issues do you think need to be included in any management document on riverine riparian zones?

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19) How important is it to develop riparian management guidelines specifically for confined river reaches. A confined river reach is one modified by channel works and/or stopbanks. Please tick one box.

- ☐ very important.
- ☐ important.
- ☐ low priority.
- ☐ unnecessary.

- 20) How have other riparian environments in your region been modified by human activities. Please rate on the basis of how widespread the changes have been, and on their magnitude.

Extent

- 1=entirely altered
- 2=extensively altered
- 3=localised changes
- 4=little or no alteration
- 5= unknown

Magnitude

- 1=large effects
- 2=effects vary from small to large between localities or, are generally moderate
- 3=minor effects

	<u>Extent</u>	<u>Magnitude</u>
wetland margins	<input type="checkbox"/>	<input type="checkbox"/>
lake margins	<input type="checkbox"/>	<input type="checkbox"/>
estuarine margins	<input type="checkbox"/>	<input type="checkbox"/>

- 21) What issues do you require information on to fulfil your advocacy/regulatory role in protecting or enhancing wetland, lake and estuarine margins and their associated aquatic ecosystems?

Wetland margins

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Lake margins

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Estuarine margins

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Appendix 3.

Bay of Plenty Regional Council riparian retirement and protection schemes

The Kaituna Catchment control (KCC) scheme was implemented in the Lake Rotorua/Rotoiti catchment in conjunction with other works to address lake water quality problems. Retirement works began in 1980 and concluded in 1992.

Lake Okareka Catchment Control Scheme (LOCC) was implemented to address erosion problems in the catchment and control siltation within the lake. Retirement began in 1978 and concluded in 1981.

Both the KCC and LOCC schemes entailed

- Fencing, the exclusion of stock, and planting of riverine riparian areas and other sensitive zones within the catchments,
- Provision of alternative stock water supply, and stock crossings,
- Erosion control structures.

Species commonly planted in the retired areas were

Natives: Flax, *Pittosporum* spp., *Coprosma*, hebes along streams margins because they require little maintenance.

Exotics: Generally, high value long-rotation species to encourage careful management of the stands. Common species were *Acacia melamoxylon*, *Cupressus* spp., and *Eucalyptus* spp.

Both schemes involved 'semi-compulsory' arrangements with landowners. Farmers in the KCC scheme were compensated for loss of use of the land, but not those in the LOCC scheme. Central government provided 87.5% of the ~\$6.9 million funds required for the KCC scheme by way of NWASCA and Ministry for the Environment grants. Landowners contributed the remaining 12.5% . The LOCC scheme cost ~\$75,000 with central government (i.e., via NWASCA grants) providing 75% of the funds and the Rotorua District Council providing 25%.

The major problem encountered with these schemes has been on-going maintenance of the retired/planted areas. Legal covenant on the title does not guarantee appropriate long-term management.

Soil conservation works have also been underway since 1970 on a priority catchment basis. This involves voluntary agreements with landowners. Initially, farm plans are prepared. Works include fencing, planting and construction of erosion control

structures. Central and Regional government grants assisted in the past, but now only Regional government provides grants (55% of cost) for works. Landowners are not compensated for loss of use of the land.

Waikato Regional Council riparian retirement and protection schemes

Schemes have been implemented in the Taupo and Rotorua districts by the Waikato Valley Authority and the Waikato Regional Council for the purpose of erosion control, soil conservation and water quality enhancement. These include the Lake Taupo Catchment Control Scheme (1976-1987), Torepahutahi Catchment Control Scheme, Whirinaki Catchment Control Scheme, and Paeroa Range Catchment Control Scheme (1987-1993).

The following approach was used to implement the schemes:

- Identify problem sites; that is, sources of sediment and nutrients, and sites of stock intrusion to waterways, with a focus on 'significant' (terminology used in reply by Waikato Regional Council) waterways systems,
- Formalise arrangement on mutually agreed funding basis,
- Regional Council oversees works programme which involves; fencing, stock exclusion from waterways, and conservation planting, provision of alternative stock water supply and stock crossings, and erosion control structures .
- Long-term agreements entered into regarding maintenance (Land Improvements Agreements).

In areas unsuitable for production forestry, natives species preferred by the landowner are planted. In other areas, production forest species are planted. The common species are *Pinus radiata*, Douglas fir (*Pseudotsuga menziesii*), *Eucalyptus* spp. and Larch (*Larix* spp.).

Voluntary agreements were entered into with landowners for all the schemes underway or completed. The Lake Taupo Scheme cost \$10.8 million with Central government providing 87% of the funds. Landowners met 13% of the costs. For other schemes, regional government meet some of the costs (e.g., Rotorua District Council provided 15% of the funds for the Paeroa Range Catchment Control Scheme).

Impediments and inducements/support encountered when implementing the riparian retirement/protection schemes are tabulated below.

Impediments

- Legal - Ownership/tenure problems (e.g., un-allocated Crown land, Maori tribal ownership).
- Social - Implementation dependent on owners agreement, and there is a reluctance to forfeit land for conservation purposes.
- Economic - Owners' 'inability' (terminology used in reply by Waikato Regional Council) to meet their share of costs.
- Political - No government support by way of funding is anticipated with future schemes.

Inducements/Support

- Social - High level of community support for the schemes and their objectives
- Economic - Previously, there was substantial 'external' funding.
- Political - A high level of support at Local Authority level in the past, but this reflected attractive funding arrangements.
-

Taranaki Regional Council

Refer discussion document (Taranaki Regional Council 1992).