Contingent Valuation of Improved Water Quality in the Lower Waimakariri River

Ron Sheppard *
Geoff Kerr **
Ross Cullen +
Tessa Ferguson *

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* Agribusiness and Economics Research Unit
** Centre for Resource Management
\+ Department of Economics and Marketing

Agribusiness and Economics Research Unit
PO Box 84
Lincoln University
Canterbury
New Zealand

Telephone (64) (3) 325-2811
Fax (64) (3) 325-3847

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AGRIBUSINESS & ECONOMICS RESEARCH UNIT

LINCOLN UNIVERSITY CANTERBURY, NEW ZEALAND

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The AERU operates as a research co-ordinating body for the Economics and Marketing Department and the Department of Farm Management and Accounting and Valuation. This means that a total staff of approximately 50 professional people is potentially available to work on research projects. A wide diversity of expertise is therefore available for the AERU.

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PREFACE

Lincoln University has been at the forefront of New Zealand research which employs methods involving non-market valuation techniques. Of particular interest has been the use of contingent valuation methods involving the derivation of willingness to pay for some change in a public good. Both the Centre for Resource Management (CRM) and the Agribusiness and Economics Research Unit (AERU) have undertaken research in these areas, as have staff from the Department of Economics and Marketing (DEM).

This Research Report provides a further example of this type of research which has involved all three of the above University Departments in a collaborative project co-ordinated through the AERU. The research provides evidence of the practical use of the contingent valuation method to establish the perceived value of the benefit of a change in the nature of a public resource - the improvement of the water quality of the Lower Waimakariri River. The value of the benefit can then be assessed against the cost of the actions necessary to achieve the benefit, and the quality of the decisions with respect to any water quality changes can be enhanced by the provision of this further information for the decision process.

It is anticipated that this research will serve as an example of the type of analysis which can be undertaken when assessing resource management issues and the potential costs and benefits associated with resource management decisions. Lincoln University will continue to adopt a role of contributing research expertise to these resource management issues with the continued development of research technique skills being a significant priority.

A C Zwart
DIRECTOR

SUMMARY

The Agribusiness and Economics Research Unit (AERU), in association with the Agricultural Engineering Institute (AEI) and the Centre for Resource Management (CRM), all at Lincoln University, carried out, on behalf of the Canterbury Regional Council, an analysis of the costs and benefits associated with improving the water quality in the Lower Waimakariri River. The costs of achieving a specified water standard were assessed by the AEI through consultation with various dischargers to the river and design and estimation of the processes and associated costs needed to reach the discharge standard set. The present value of these costs was estimated as between $10.1 million and $17.2 million (10 year period) depending upon the final interpretation of the water quality standard requirements.

The benefits associated with a water quality improvement were assessed through a Contingent Valuation Method using a Willingness to Pay process. A sample of 2,628 Canterbury residents were sent a mail questionnaire which sought information on their present use of the Lower Waimakariri River, use of alternatives and Willingness to Pay (via rates) for a specified improvement of the water quality. A response rate of 44.2 per cent (1161 responses) was achieved. In addition a sample of 512 respondents from a predefined "User" group was sent questionnaires from which a response rate of 63.7 per cent (326 respondents) was achieved. A non respondent telephone survey of 400 from the original sample was also undertaken. Responses were received from 320 people, a response rate of 80 per cent.

The results indicate that a high proportion of Canterbury residents (nearly 40 per cent) had visited the Lower Waimakariri River over the preceding two years. Of those who hadn't visited, most were not inclined to visit for a variety of reasons, while approximately 10 per cent cited pollution as their reason for not visiting. The major activities undertaken were walking, picnicking and fishing.

Respondents cited "Increased Health Risk", "Murkiness" and "Smell" as the main effects of pollution and up to 30 per cent of respondents indicted that these factors influenced their decision with respect to visiting the Lower Waimakariri River.

Depending on the activity, up to 40 per cent of respondents indicated they would increase their level of use if the water quality was improved.

Respondents were asked to indicate their Willingness to Pay (WTP) for an improvement in Lower Waimakariri River water quality to the point where the water was safe for swimming. The results indicate a mean WTP of about $102 per respondent household with a range of $72 to $153 representing the 95 per cent confidence interval. Given the number of households in the survey area, this represents a potential present value of benefits of $94.4 million (eight per cent discount rate over 10 years). This clearly exceeds the present value of water quality improvement costs of up to $17.2 million. Analysis of the "User" survey results and the "Non Respondent" survey results confirm the robustness of the general population survey results with any adjustments to the mean Willingness to Pay being within the standard error of the original estimate.

It is concluded that the research indicates that the benefits associated with an improvement in Lower Waimakariri River water quality exceed the cost of achieving such an improvement and therefore the improvement should be sought by policy makers and resource managers. No assessment of an equitable method of distribution of the cost of achieving the improvement has been attempted.

CHAPTER ONE
INTRODUCTION

The Canterbury Regional Council, as part of its responsibility for the allocation of water rights and the maintenance of water quality, reviewed the status of the Lower Waimakariri River during 1991. As a result of the review, new water quality requirements were established. These requirements are for an upgrading of the water quality to provide for the water to be safe to swim in. At present, the water is only safe for boating and fishing.

During March 1992, the Agribusiness and Economics Research Unit (AERU), in association with the Centre for Resource Management (CRM) and the Agricultural Engineering Institute (AEI), at Lincoln University was requested to undertake research on the costs associated with upgrading the water quality and the valuation of the benefits that would be achieved. The costs were those that would be incurred by the companies and organisations discharging effluent into the river given the need to improve the quality of those discharges to meet the new standards. These costs were to be supplied by the companies affected by the change in the standards and by staff from the AEI. As a range of options for improving the water quality of the effluent discharge was available, assessment of the costs associated with each option was undertaken. The minimum cost options which provided for the achievement of the required standard were adopted and the present values of those costs calculated based on a ten year project life at a discount rate of eight percent. The minimum costs on this basis ranged between $10.1 million and $17.2 million, depending upon the interpretation of the water quality standard requirements.

The detail of the costing procedure is contained in the confidential report to the Canterbury Regional Council (July, 1992). As the costs are presented for individual companies and organisations, the derivations cannot be publicly reported (Tipler, 1992).

This analysis provided the cost estimates associated with upgrading the water quality. It should be noted that these costs represent "first round effects" only in that the assumption was made that the organisations involved would choose to upgrade their effluent disposal systems, and so incur the estimated costs, rather than close their processing operations. In other words, the analysis has been undertaken on a marginal cost basis, i.e. the incremental cost associated with a change in processing practices (effluent disposal). It is possible that companies might choose to make more radical changes to their operations in response to the potential imposition of the significant effluent disposal costs. Such changes could include plant closure, either completely or through relocation. If this were to occur then a range of other costs should also be considered, e.g. redundancy costs, social costs (e.g. associated with increased unemployment) in the area, regional costs associated with potential relocation of the processing activity to another region outside Canterbury, etc. A variety of arguments can be advanced for including/excluding such costs and in the event of a major change in processing activity being implied by the required change in the effluent quality, then these arguments would require consideration and the cost analysis modified as appropriate.

However, given the uncertainty associated with the interpretation of the water quality standard and the estimations required to assess the costs of the various effluent treatment and

disposal options, the assessment of the present value of the costs as between $10.1 million and $17.2 million on a marginal cost basis represents a fair indication of the cost of improving the water quality.

It should be noted that the cost of an improvement in the water quality has been measured in terms of a limitation on the faecal coliform bacteria content of the waters. The C classification, which has been adopted by the Canterbury Regional Council, requires "based on not fewer than five samples taken over not more than a thirty day period, the median value of the faecal coliform bacteria content of the waters shall not exceed 200/100 ml". This technical specification may have only limited "appeal" to the general public. It is accepted that a C classification provides for water which is safe for water contact recreation, i.e. swimming. The detail of the description of "Class C Waters" under the Water and Soil Conservation Act 1967, Third Schedule, is as follows:

Water and Soil Conservation Act 1967, Third Schedule

Class C Waters

The quality of Class C waters shall conform to the following requirements:

(a) the natural water temperature shall not be changed by more than 3 degrees Celsius;

(b) the acidity or alkalinity of the waters as measured by the pH shall be within the range of 6.5 to 8.3 except when due to natural causes;

(c) the waters shall not be tainted so as to make them unpalatable nor contain toxic substances to the extent that they are unsafe for consumption by humans or farm animals, nor shall they emit objectionable odours;

(d) there shall be no destruction of natural aquatic life by reason of a concentration of toxic substances;

(e) the natural colour and clarity of the waters shall not be changed to a conspicuous extent;

(f) the oxygen content in solution in the waters shall not be reduced below 6 milligrams per litre;

(g) based on not fewer than 5 samples taken over not more than a 30-day period, the median value of the faecal coliform bacteria content of the waters shall not exceed 200 per 100 millilitres.

In addition to the Class C classification, the Canterbury Regional Council adopted the SB classification. This reads as follows:

Water and Soil Conservation Act 1967, Sixth Schedule

Class SB Waters

The quality of Class SB waters shall conform to the following requirements:

(a) the natural water temperature shall not be changed by more than 3 degrees Celsius;

(b) the natural pH of the waters shall not be changed by more than 0.1 unit and at no time shall be less than 6.7 or greater than 8.5;

(c) there shall be no fouling of fishing grounds;

(d) the coliform bacteria content of the waters shall not consistently exceed 1,000 per 100 millilitres;

(e) the waters shall not have their natural colour effected to a conspicuous extent nor give off an offensive smell.

All discharges into Class SB waters shall be substantially free from suspended solids, grease and oil.

It is on the basis of achievement of the above water standards that an analysis of the benefits was carried out. This implies that other improvements in the water quality (over a reduction in faecal coliform bacteria) may be required by the public before the requirements of Class C (and SB) are met. While water which has a low level of faecal coliform bacteria may be "safe" for swimming, discolouration and odours may still preclude public swimming in the river. The retention of "natural colour and clarity" and the non-emission of "objectionable odours" are provided for in the Class C classification and these aspects could require

additional correction costs in order for the river to meet the Class C classification and the public perception of water "safe" for swimming.

Therefore, the costs described may represent only a part of the total costs associated with bringing the Lower Waimakariri River to a Class C standard.

In order to asses the benefits associated with upgrading the Lower Waimakariri River to a Class C standard, an analysis was undertaken which would express the benefit in terms of the Willingness to Pay (WTP) of Canterbury residents for an upgrade of the water quality. The remaining Chapters of this report describe the research which was undertaken to produce the WTP estimate and the results which were achieved. These chapters are preceded by a brief review of the literature on WTP analyses which place the work within its theoretical concepts. Finally, some conclusions are presented and some implications derived for further consideration.

CHAPTER TWO
WILLINGNESS TO PAY (WTP)

Economics can be divided into two sections, positive and normative. Positive economics attempts to describe and explain how social and economic activity occurs. Normative economics, often called welfare economics, attempts to provide guidance on the desirability of various social and economic policies. Cost Benefit analysis is the modern applied arm of normative economics.

A key notion employed in normative economics is pareto optimality - the idea that a welfare improvement is attained if a policy will result in at least one person being better off and nobody being any worse off. Cost benefit analysis employs a variant on this criteria which requires estimation of the magnitudes of the gains and the losses expected from a policy. A policy where the magnitudes of the expected gains exceeds the magnitudes of the expected losses results in a net gain, and is called a potential pareto improvement.

Determination whether a policy will indeed result in a net gain or not requires formalisation of what is meant by gains and losses, and use of some technique to help quantify the expected gains and losses. The traditional measures in economics of gains and losses, is consumer surplus. However consumer surplus can be shown to be an inappropriate measure in circumstances where utility levels change. Alternative Hicksian measure have been developed to provide more appropriate measures of gains and losses. Depending on the property rights for the item being studied, Hicksian measures can involve either payments, or compensation, to maintain individuals at certain utility levels. Hicksian variation measures are used when individuals are free to vary the quantity of the good being considered, and surplus measures are used when individuals are constrained to buy only fixed quantities of the good. In total there are eight Hicksian welfare measures, and the following table illustrates their relation to each other.

Hicksian Welfare Measures for Contingent Valuation Surveys

	WTP	WTA
Quantity increase	CS	ES
Price decrease	CS, CV	ES, EV
Quantity decrease	ES	CS
Price increase	ES, EV	CS, CV

Definitions:

WTP - Willingness To Pay
WTA - Willingness to Accept
CS - Compensating Surplus
CV - Compensating Variation
ES - Equivalent surplus
EV - Equivalent Variation

These measures - compensating and equivalent variation, and compensating and equivalent surplus - can be measured directly via the Contingent Valuation Method (CVM). In many real world situations interest is focused on the potential benefits to be obtained from proposed policies. In these cases individual's initial levels of utility are the benchmark and researchers will wish to use compensating surplus measures to establish the magnitude of changes from those initial utility levels. CVM researchers can ask survey respondents "Willingness To Pay", and "Willingness To Accept" questions. Choice between these two questions can in theory be determined by noting who holds the property rights to the item under consideration. Where for example, respondents do not have a right to improvements in water quality in a river, they could be surveyed on their Willingness To Pay for improvements in water quality. In this situation compensating surplus can be interpreted as the individual's maximum willingness to pay for the water quality improvement and still be on the initial utility level. Where respondents do hold rights to water quality, they could be surveyed on their Willingness To Accept reductions in water quality. Here compensating surplus can be viewed as the minimum compensation required in the face of a water quality decline to keep the individual on their initial utility level.

While early economic theory suggested there should be little difference in the magnitudes of Willingness To Pay and Willingness To Accept, empirical research has repeatedly demonstrated there are major divergences between WTP and WTA (Mitchell and Carson 1989). Hence the choice of WTP or WTA measure can be very important in determining the magnitude of the expected benefits from a policy change. Recent thinking on this topic has focused attention on the question of property rights for public goods.

Air quality and water quality are argued to be items whose quality is maintained through annual payments by business and government. Without these annual expenditures, air and water quality would steadily decline. Air quality and water quality are excellent examples of public goods - there is no rivalry in use, and users cannot readily be excluded from use. Individuals cannot sell rights to these goods, and entrepreneurs find it hard to supply these goods at a profit.

As we noted earlier our benchmark in policy proposals is on initial utility levels, and we wish to estimate likely changes from those levels if proposed policies are adopted. If the collective owners and users of air and waterways wish to obtain increases in air or water quality, this is likely to involve costs which will be borne by all individuals through some combination of price increases, taxes and other charges. To attain water quality increases, which are collectively held, payments are likely to be required from all individuals. In these situations a compensating surplus WTP measure is argued to be the appropriate Hicksian measure to employ, to gauge the expected welfare change.

In practice in New Zealand there is much national, regional and local expenditure to supply collectively held goods, and individuals are familiar with the tax requirement to maintain or enhance the quantity and quality of many of these goods. Hence CVM studies which use taxes as the payment vehicle, and ask WTP questions, appear appropriate means to gauge the likely changes in welfare resulting from policy changes.

CHAPTER THREE
WTP FOR
LOWER WAIMAKARIRI RIVER UPGRADE

3.1 Introduction

As described in Chapters 1 and 2 of this report the assessment of the benefits associated with upgrading the water quality in the Lower Waimakariri River was to be carried out by measuring the Willingness to Pay (WTP) of people in the Canterbury region for such an upgrade.

3.1.1 Population

The selection of the population scope was influenced by two considerations. The work was being undertaken for the Canterbury Regional Council and therefore the Council was mainly interested in the views of the people living within the region, especially the adult population. This provided one constraint to the population to be considered. The second aspect was the concept of population familiarity with the area that would be the subject of the inquiry. Although some people outside the Canterbury Region could be expected to have views on the desirability or otherwise of upgrading the water quality of the Lower Waimakariri River, the views of those living closer to the river could be expected to be "more significant" than those from further away. While the issue of water quality in this particular river could be seen as a national issue, the change in water use characteristics, i.e. a rise in the water quality to allow for swimming, would be expected to have a significant local impact while from further away, the impact would be much less. However, as there is a proportion of the general population which would no doubt ascribe some value to improving water quality wherever that improvement might be located, the benefit measurement presented in this report may tend to under-estimation through geographically limiting the population which was included in the study.

3.1.2 Research Method

A number of survey methods are available by which the information required can be obtained. These include the personal interview, mail questionnaires and telephone surveys. Personal interviews provide the best opportunity for the collection of in-depth information. However, this type of survey is characterised by high costs, especially where a large sample is required and where the sample is distributed over a wide geographic area. For these reasons, the personal interview survey technique is best suited to smaller samples within a compact area where in-depth interviews are required in order to meet the survey requirements.

Telephone surveys are a common means of gathering information where the survey involves less depth and there is no requirement for a transfer of detailed information to the respondent before the questions can be answered. Where a quick response is required and a guaranteed sample size needed, then a telephone survey can be the most appropriate. However, in this

case, the use of the Contingent Valuation method requires the transfer of a significant amount of information to enable the respondent to adequately answer the survey questions. This meant that a telephone survey would not be appropriate.

It was therefore decided that a mail survey would be used.

(i) Mail Survey

In order to achieve the target sample size of 1000 respondents an initial sample of at least 2700 potential respondents was considered to be required. This provided for a 40 per cent response rate from the total sample. Such a response rate was considered feasible given past experience with similar surveys. For example, a national postal survey of adults carried out by Greer and Sheppard (1990) on non market valuation using a contingent valuation of willingness to pay with a dichotomous choice approach achieved a response from 1294 respondents from a usable sample of 2805; a response rate of 47.1 per cent.

The research method involved the construction of a questionnaire which provided "user friendly" lead-in material and a high quality presentation designed to induce the recipient to complete the questions and return the form. A copy of the questionnaire is included in this report as Appendix 1.

The population from which the sample was drawn was defined as the adult population listed on the electoral roll and residing within the part of the Canterbury Region between Kaikoura, the Southern Alps and Ashburton. The sample was randomly drawn from the relevant electoral rolls given the above limitations on the location. A total of 2812 names and addresses were extracted.

The questionnaire, including a reply paid envelope, was sent to the sample on 22, 23 and 24 April 1992 and a reminder letter was sent on 7 May 1992. Responses were received up to and including 8 June 1992.

(ii) Minor Survey

In addition to the survey of the general population, a survey of a sample of "river users" was also undertaken. This survey was intended to provide information on a "biased" group of respondents, i.e. those with an expressed interest in the river, in order that a comparison could be made between the views of "users" and the views of the general population. It was anticipated that the "users" would have a higher WTP than the general population. Comparison of the results would help to determine if bias had occurred in the responses to the general population survey.

During the process of reviewing the river water classification, the Canterbury Regional Council had called for public submissions on the issue. As a result, 714 submissions were received from people "supporting reclassification of the Lower Waimakariri generally" (CRC, 1991). Of those, 525 were signatories to a petition and 189 were in the form of individual letters. From the total (714) a sample of 512 "users" was drawn. This sample was randomly drawn but only those who could be

identified as recreational water users were included. The same questionnaire and reminder were sent to this sample (at the same time). It was anticipated that a high response rate from the "users" would be achieved as these people had expressed an interest in upgrading the river and therefore could be expected to have a greater interest in contributing to the discussion and valuation of the options.

(iii) Non-Respondent Survey

Given the type of information required, i.e. information on respondents' "willingness to pay", there is the potential for bias in the results. This could occur in at least two possible ways.

1. Non-Response Bias

Those sample members with a considerable interest in the outcome of the research, i.e. those who either are strongly in favour of an improvement in the water quality (e.g. recreational water users) or who are strongly opposed to water quality improvements (e.g. present dischargers into the river), could be expected to have a greater interest in returning the questionnaire than those people without any direct interest. Such action has the potential to bias the results of the survey given that it is likely people who are closely involved with the river could be expected to have views which are different to those held by the general population. Such potential bias can be dealt with. Regression analysis with respect to the demographic characteristics of respondents and the relationship between this and the level of the WTP can be carried out. In other studies (Kerr & Cullen (1992), Greer & Sheppard (1990), Willis & Garrod (1993)), a strong relationship between socio-economic factors and WTP has been established. If this is not the case with the study result, then further investigation of the data would be required. Where WTP clearly exceeded the capacity to pay, then adjustments would be needed.

Another method of investigating for non-response bias is to undertake a non respondent survey. This involves taking a sample of those who did not respond to the survey and conducting a further investigation with respect to key variables identified in the main survey results.

In this case, a non-respondent survey of 400 people, randomly selected from the non respondents, was carried out. The questionnaire was designed to gather information on variables which were found to be significantly related to the WTP after initial analysis of the main survey results. The non respondent survey was conducted by telephone by trained interviewers during the week commencing 19 June 1992.

This survey did not attempt to gather information on non respondent WTP. The emphasis was on the variables associated with WTP so as to enable a comparison between the non respondent group and those who did respond. Where a significant difference was found, then adjustment of the main survey results could be carried out to correct for the representation error.

2. Strategic Bias

There is the potential for people to overstate their WTP in order to influence the overall level of WTP (benefit) upwards in the knowledge that a higher WTP will be interpreted as a greater benefit and therefore place more pressure on those responsible for administering water quality improvement policies. However, past research on the subject of strategic bias (Mitchell & Carson (1989)) has concluded that such bias is not a significant problem.

At least two methods can be employed to restrict the level of strategic bias which may occur. The first involves aspects of questionnaire design. It is of critical importance that the phrasing of the payment vehicle is designed to ensure that a realistic option is being offered. This helps to ensure that respondents can objectively assess their WTP in the expectation that an actual charge of this amount may result from the research. It is also important that adequate information about the problem being studied is supplied to respondents. An "objective" scale should be supplied which indicates the type of water quality improvement being considered. However, it is important to ensure that the sample responding to the questionnaire do not become "over educated" as the response would then reflect the views of a well informed sector of the population, rather than those held by the population in general.

The second method of controlling for strategic bias involves checking the results for evidence of a distribution which is unusual. In work of this kind, some concentration of the distribution of WTP would be expected. The results can be inspected to identify "flyers", i.e. responses which are completely different from the median response. In analysing the data, a method of checking for strategic bias involves excluding the extreme results, i.e. those in the highest and lowest 5 per cent of the range, and comparing the resulting mean and median WTP with that obtained from including all responses.

3.1.3 Samples Achieved

As described in Section 3.1.2 (i), a total sample of 2812 potential respondents was selected for the main survey and questionnaires were posted to these people on 22, 23 and 24 April. As was expected, some survey forms were returned as "undeliverable" due to incorrect and changed addresses. These returns reduced the potential sample to 2628, i.e. 184 forms were returned as undeliverable, 6.5 per cent of the original sample. A reminder letter was sent to those who hadn't responded by 7 May 1992.

By the return cut-off date of 8 June 1992, a total of 1161 responses had been received, representing 44.2 per cent of the potential sample.

A potential sample of 512 "user" respondents was also selected (Section 3.1.2 (ii)). From this total sample, responses were received from 326 respondents, or 63.7 per cent of the sample.

Responses to the telephone survey of non respondents were received from 320 people of the 400 who were contacted, a response rate of 80 per cent.

3.2 General Results

The following tables provide information on the responses as drawn from the questionnaire. A copy of the questionnaire is included in this report as Appendix 1.

3.2.1 People Who Had Visited the Lower Waimakariri River

Question 1 asked respondents to indicate whether they had visited the Lower Waimakariri River within the last two years. Table 1 provides the response. The first column indicates that nearly half the respondents to the mail questionnaire had visited the Lower Waimakariri River during the last two years. This proportion was checked through the non respondent survey. As a result of this, it was determined that only 30.3 per cent of non-respondents had visited the Lower Waimakariri River during the last two years indicating that the mail questionnaire responses were biased in favour of those with a greater interest in the river. The results from the mail questionnaire were therefore adjusted to eliminate the bias and the third column of Table 1 provides the "corrected" response for the total sample as a representation of the Canterbury Region population.

Table 1
Proportion Who Had Visited the Lower Waimakariri River During the Last Two Years
(% of "respondents")

	Mail Respondents	Non-respondents	Adjusted Responses
Yes	47.5	30.3	37.9
No	52.5	69.7	62.1
Total	100.0	100.0	100.0
Valid Responses	1157	320	2628

The adjustment of the results has been carried out using the following method. The non-respondent population was 1471. The proportions yielded by the non-respondent sample survey were applied to the non-respondent population to determine the number of non-respondents in each category. This number was added to the number who responded (to the mail survey) in each category and the sum expressed as a percentage of the total sample. For example, the number of non-respondents who had visited the Lower Waimakariri River during the last two years was calculated as follows:

$$1471 * 30.3\% = 446.$$

The number of mail questionnaire respondents who had visited the Lower Waimakariri River during the last two years was 550. Therefore the total number in the sample who had visited was:

446 + 550 = 996.

This was expressed as a proportion of the total sample, i.e.

996 / 2628 = 37.9%.

This represents the estimate of the proportion of the population who had visited the Lower Waimakariri River in the last two years.

3.2.2 Reasons for Not Visiting

Those people who had not visited the Lower Waimakariri River in the last two years were asked why they hadn't used the area. The responses are given in Table 2.

Table 2
Reasons Why Mail Questionnaire Respondents Had Not Visited the Lower Waimakariri River
(% of respondents)

	Proportion of Respondents Giving Each Reason (% of respondents)
No Need / No Interest	42.8
Too Far From Where Live	13.6
Prefer Alternatives	11.8
Polluted	10.2
Ill Health / Old Age	6.6
Hadn't Thought Of It	6.1
No Transport	4.5
Lack Time	4.5
Recent Christchurch Arrival	2.2
Other	1.6
TOTAL	103.9
Valid Responses	558

3.2.3 Activities When Visiting

Those mail questionnaire respondents who had visited the Lower Waimakariri River during the past two years were asked "how many days have you spent on the following recreation activities during that time?". A list of possible recreation activities was provided. Table 3 provides the analysis of the responses. Walking, picnicking and fishing were clearly the most popular activities with fishing being a more intensive use as many fishing respondents spent a large number of days doing this activity. Comparison of these results with the survey of non-respondents indicated that a lower proportion of non-respondent visitors had been involved in fishing (23.7 per cent cf 30.5 per cent) and more non-respondents had been walking (58.8 per cent cf 49.8 per cent). Adjusting the results to eliminate non-respondent bias indicates that 27.5 per cent of the visiting sample/population fished in the Lower Waimakariri River and 53.8 per cent went there for walking. As a proportion of the total sample/population, the results indicate that 10.4 per cent of the sampled population have visited the Lower Waimakariri River for fishing during the last two years and 20.4 per cent had been there for walking.

Table 3
Activities on the Lower Waimakariri River
(% of those who had visited)
(% of those doing each activity)

Activity	% Participating	Number of Days (%)			
		1-5	6-10	11-20	> 20
Fishing	30.5	56.0	15.5	11.3	17.3
Picnicking	40.5	83.0	9.9	3.1	5.4
Walking	49.8	79.2	9.9	4.4	6.6
Windsurfing	0.5	33.3	-	33.3	33.3
Canoeing	3.1	88.2	5.9	5.9	-
Yachting	1.6	66.7	11.1	-	22.2
Jetskiing	1.1	83.3	16.7	-	-
Powerboating	11.6	73.4	15.6	6.3	4.7
Birdwatching	4.4	83.3	8.3	4.2	4.2
Other	23.3	78.9	13.3	4.7	3.1
Valid Responses	550				

3.2.4 Effect of Pollution

All respondents, including those who had not visited the Lower Waimakariri River (in the last two years), were told that the Lower Waimakariri River is polluted and were asked to indicate "what effects you believe pollution has on Lower Waimakariri water quality". The following possible effects were listed:

> "Pollution makes the water - murkier, smelly, greasy, taste different, an increased health risk."

The responses were as provided in Table 4.

Table 4
Effect of Pollution on the Water Quality
(% of respondents)

Pollution Effect	Valid Responses	Yes (%)	No (%)	Don't Know (%)
Murkier	1037	78.8	3.4	17.8
Smelly	973	65.8	6.3	28.0
Greasy	895	49.4	7.6	43.0
Taste Different	920	56.6	1.7	41.6
An Increased Health Risk	1103	85.8	1.1	13.1

The aspects of "increased health risk" and "murkier" were identified as the most common effects of pollution on the Lower Waimakariri water quality. These two aspects also had the highest response rates from respondents. It is clear from the pattern of responses that a proportion of respondents only answered the "yes" option for this question and did not tick "no" or "don't know" when these would have been the appropriate answer. Given this probability (from observation of Table 4), standardisation of the results to a fixed "Valid Response" level of 1100 respondents would result in the proportions giving "yes" as their answer as follows:

	Yes (%)
Murkier	74.3
Smelly	58.2
Greasy	40.2
Taste Different	47.4
An Increased Health Risk	86.0

The above analysis indicates that "murkier" and "an increased health risk" remain as the most significant pollution effects, "smelly" is at a second level, while "greasy" and "taste different" are less significant.

3.2.5 Pollution Influence on Visits and Sites

All respondents were asked whether any of the factors influenced whether they visited the Lower Waimakariri River. The results are given in Table 5. These indicate that up to 30 per cent of respondents are influenced by the pollution as to whether they visit the Lower Waimakariri River or not.

Table 5
Factors Influencing Whether Visit the Lower Waimakariri River
(% of respondents)

Factor	% Influenced by Factor
Murkiness	22.7
Smell	22.1
Greasiness	12.7
Taste	8.4
Health Risk	31.0
Valid Responses	1161

The factors of "murkiness" and "health risk" were assessed in the non-respondent survey. With respect to murkiness 28.7 per cent of non-respondents indicated that this influenced whether they visited or not (cf. 22.7 per cent of mail questionnaire respondents). With respect to health risk, 50.5 per cent of non-respondents indicated this affects their decision (cf. 31.0 per cent of mail questionnaire respondents). The combined/adjusted per centages are 26.1 per cent for murkiness and 41.9 per cent for health risk. Fewer non-respondents had visited the Lower Waimakariri River (than respondents) and a higher level of aversity to pollution effects could therefore be expected from this group.

Those who are influenced by the pollution on the Lower Waimakariri River were asked if they go to alternative sites. Of those, 81.6 per cent of the mail questionnaire respondents indicated that they do go to alternative sites. These people were asked which alternative sites they went to. The most commonly cited alternatives for each type of activity are given in Table 6.

Table 6
Alternative Sites Used by Respondents Influenced by Lower Waimakariri Pollution
(% of respondents for each activity)

Activity / Alternative Site	% Using Alternative Site
A. Fishing (180 respondents)	
Sea / Beach	35.0
Rakaia River	23.3
Ashley River	16.1
Middle and Upper Waimakariri	12.8
Lakes	13.9
Hurunui	7.8
Rivers - general	6.1
Rangitata	4.4
Other	11.1

Activity / Alternative Site	% Using Alternative Site
B. Picnicking (251 respondents)	
Sea / Beach	38.2
Parks / Tracks / Gardens	22.3
Ashley River	23.1
Middle and Upper Waimakariri	10.8
Groynes	14.3
Rakaia	4.4
Other	19.5

Table 6 Continued

Activity / Alternative Site	% Using Alternative Site
C. Walking (211 respondents)	
Sea / Beach	41.2
Parks / Tracks / Gardens	38.9
Ashley River	12.8
Middle and Upper Waimakariri	9.0
Groynes	4.3
Rakaia	3.3
Other	11.4

Activity / Alternative Site	% Using Alternative Site
D. Powerboating (48 respondents)	
Sea / Beach	52.1
Lakes	12.5
Middle and Upper Waimakariri	29.2
Other	18.8

Activity / Alternative Site	% Using Alternative Site
E. Birdwatching (44 respondents)	
Sea / Beach	54.5
Ashley River	18.2
Parks / Tracks / Gardens	15.9
Other	45.5

Table 6 Continued

Activity / Alternative Site	% Using Alternative Site
F. Swimming (156 respondents)	
Sea / Beach	46.8
Ashley River	24.4
Public Swimming Pool	26.9
Middle and Upper Waimakariri	14.1
Other	22.4

Other activities which were included in the list were Windsurfing (21 respondents who mainly used the sea/beach), Canoeing (35 respondents who mainly used the sea/beach, other parts of the Waimakariri and the Avon River), Yachting (29 respondents who mainly used the sea/beach) and Jetskiing (16 respondents who mainly used the sea/beach). The only "Other" activity recorded was Camping with seven respondents.

3.2.6 Effect of Change in Water Quality

Following the definition by respondents of their impressions of the water quality and the effect of pollution on those activities, the respondents were provided with a "Water Quality Ladder". This indicated that the state of the river at present was step D which is OK for boating and fishing. The new standards are intended to raise the water quality from step D to step C which would make the water safe for swimming as well. All respondents were asked to indicate what effect this change in the water quality would have on the range of activities that were listed. Respondents were asked to indicate whether they would do "more" of the activity, "no change" or "less". The results are given in Table 7.

Table 7
Effect on Respondent Activities
Following Improvement in Water Quality
(% of respondents)

Activity	Valid Responses	% Doing More	% No Change	% Doing Less
Fishing	864	31.7	67.8	0.5
Picnicking	903	40.0	59.7	0.3
Walking	865	29.5	70.4	0.1
Windsurfing	661	5.9	93.2	0.9
Canoeing	674	9.9	89.9	0.1
Yachting	665	6.5	93.1	0.4
Jetskiing	655	6.6	94.0	1.4
Powerboating	683	8.9	89.8	1.3
Birdwatching	678	10.8	89.1	0.1
Swimming	821	35.9	63.3	0.7
Other	656	10.2	88.6	1.2

Given the variability in the level of valid responses recorded for each activity, it may be appropriate to record the results on the assumption that those who did not respond to each category were not involved in the activity and therefore there would be no change to their behaviour as a result of an improvement in the water quality. If this assumption is applied to the results and the response rate is set at 1100 respondents, then the following Table is generated (Table 8). It may also be expected that some of those not involved in a particular activity may become involved in the future and, as a result of lower water pollution, choose to use the Lower Waimakariri River. To this extent, Table 8 may understate the proportion who would "do more".

The responses indicate that swimming, picnicking, fishing and walking would be the main activities that would be encouraged with between 20 and 30 per cent of respondents indicating that more of these activities would be done if the water quality was improved.

The non respondents were asked what effect improving the water quality would have on their fishing activity there. Of the non respondents, 30.5 per cent indicated they would do more fishing there compared to 31.7 per cent (unadjusted to constant response rate) of the respondents. There is no significant difference between these results. The "adjusted to constant response rate" (Table 8) respondent results indicated that 24.9 per cent would do more fishing.

With respect to the effect of improved water quality on walking near the Lower Waimakariri River, 45.2 per cent of non respondents indicated that they would do more walking compared to 29.5 per cent (unadjusted to constant response rate) of respondents. The "adjusted to constant response rate" (Table 8) results indicated that 23.2 per cent of respondents would do more walking.

For both activities, the non respondents have a higher willingness to undertake more of the activity than did the respondents. This is a consistent result given that fewer non respondents had visited than had respondents. The results indicate that the pollution has had a more significant effect on the Lower Waimakariri River activities than was indicated by the respondents to the main survey. On a combined basis, 28.0 per cent of the sample/ population indicated they would do more fishing and 35.5 per cent of the sample/population would do more walking.

Table 8
Effect on Respondent Activities Following Improvement in Water Quality Adjusted to Constant Response Rate
(% of respondents)

Activity	Adjusted Valid Responses	% Doing More	% No Change	% Doing Less
Fishing	1100	24.9	74.7	0.4
Picnicking	1100	32.8	66.9	0.3
Walking	1100	23.2	76.7	0.1
Windsurfing	1100	3.5	96.0	0.5
Canoeing	1100	6.1	93.8	0.1
Yachting	1100	3.9	95.8	0.3
Jetskiing	1100	2.8	96.4	0.8
Powerboating	1100	5.5	93.7	0.8
Birdwatching	1100	6.6	93.3	0.1
Swimming	1100	26.8	72.7	0.5
Other	1100	6.1	93.2	0.7

3.3 Willingness to Pay (WTP) Results

Responses to the contingent valuation survey were analyzed using maximum likelihood logit regression procedures. The dependent variable is the response to the dichotomous referendum question (Question 8) which posed a stated dollar increment in rates and asked

households whether they would be willing to pay that amount to achieve the improved water quality standard.

3.3.1 Sample Validation

Household willingness to pay one dollar per year for improved water quality in the lower Waimakariri River, and reasons for being unwilling to pay (Question 7) were used to select the final sample for analysis. Of the total respondents, 66.4 per cent were prepared to pay an extra dollar. Those who were not prepared to pay an extra dollar were asked to provide a reason. Those reasons are given in Table 9.

Table 9
Reasons Why Respondents Were Not Prepared to Pay an Extra Dollar for Improved Water Quality
(% of respondents not prepared to pay)

Reason for Not Paying Extra Dollar	% of Respondents
Factories/polluters should pay	42.2
Don't use area	16.7
Already pay enough rates	13.4
Can't afford it	9.9
Too far from where I go	6.0
Our local rivers just as important	3.0
Use other water facilities	2.7
Other	10.1
Valid Responses	365

The intention of this process was to identify those who were willing to accept the contingent valuation scenario. Those households not willing to pay one dollar who suggested that they were not willing to pay because (for example) they were unconcerned about lower Waimakariri River water quality, or because they never intended to use the lower Waimakariri River were judged to have made valid responses and were included in the sample for further analysis. Households who made responses such as "polluters should pay" or "rates are already too high" or "the council would not spend the rates on cleaning up the river" were judged to be invalid and were excluded from further analysis.

An important consideration in surveys of this nature is whether the response rate is uniform across nominated dollar amounts. One hypothesis is that those survey participants who receive questionnaires with very high nominated dollar amounts are less likely to respond. Response rates (after deletion of invalid responses) for each dollar amount nominated were compared to the overall response rate. Results are reported in Table 10.

Table 10
Test of Differences in Response Rate by Dollar Amounts

Dollars	Response Rate	Z-score	Significance
2	.3600	0.54	
7	.3467	0.31	
12	.3333	-	
17	.3333	-	
22	.3467	0.31	
27	.2800	0.91	
32	.3733	0.79	
37	.3867	1.03	
42	.2933	0.55	
47	.3333	-	
57	.3733	1.01	
67	.2933	0.92	
77	.4067	2.02	95%
87	.3733	1.01	
97	.3600	0.76	
117	.3000	0.63	
137	.2400	1.88	90%
157	.3000	0.63	
177	.3500	0.42	
197	.2400	1.88	90%
217	.3900	1.25	
237	.3200	0.21	
257	.3200	0.21	
277	.2500	1.67	90%
297	.2800	1.05	

The overall valid response rate was 0.3296

The issue of varying response rates does not appear to be a major concern for this survey. There is only one value for which there is a difference significant at the 95% confidence level. For that case the response rate is greater than expected with the nominated dollar amount being near the middle of the range ($77). Three other dollar amounts ($137, $197, $277) showed differences significant at the 90% confidence level, all with lower than expected response rates. The dollar amounts for these three cases were all at the middle to high end of the scale, but were not clustered around the very high end as would be expected from the hypothesis. Consequently, differences in response rate by dollar amount are expected to have little impact on willingness to pay. In order to confirm this suspicion, two data sets are retained for further analysis. These are:

DATASET 1: The original set of valid responses.
DATASET 2: The set of valid responses with cases removed for which the response rate was different from the overall response rate at the 90% and higher confidence level.

3.3.2 Tests on Independent Variables

The primary aim of the analysis is to identify the relationship between (probability of) willingness to pay and dollars. Initial analysis used linear and logged forms of the independent variable (dollars). Both were found to be highly significant, with the logged independent variable form providing a better fit to the data than the linear independent variable form.

The socio-economic data collected in Questions 9 through 13 added little in explanatory power. The only variable to be significant (at the 90% or better confidence level) is number of people under 18 years in the household. This relationship is negative, possibly reflecting the effect of additional children on ability to pay.

There are insignificant effects from number of adults in the household and distance from the Lower Waimakariri River. Christchurch City households are willing to pay (insignificantly) more than others. Ethnicity has no identifiable effect, while income is insignificantly positively correlated with willingness to pay.

The next stage of analysis investigated the effects of past use, perceptions of the impacts of pollution, and changes in use with cleaner water on willingness to pay.

Past Use

Willingness to pay is strongly positively correlated with use in the last two years (Question 1). Investigation of the amount of use by activity showed that willingness to pay is positively correlated with number of days spent fishing (95% confidence) and with number of days spent canoeing (90% confidence). Days spent on other activities and total number of days summed over all activities are not significant. The number of days spent walking is not significant, however participation in the activity of walking is (95% confidence).

Effects of Pollution

Responses to Question 3 were recoded to create a dummy variable for each of the characteristics. Those dummies took the value 1 if respondents answered yes, and 0 if they answered no or don't know. Beliefs that pollution in the lower Waimakariri River makes the water murkier and smelly both increased willingness to pay. However, a strong correlation between these two variables meant that both could not enter the same model. Belief that pollution makes the river murkier is the better predictor of willingness to pay.

In a similar vein, responses to Question 4 (features influencing whether the respondent visits the lower Waimakariri River) are all individually significant, but are highly correlated. Murkiness provides the best indicator of willingness to pay.

Changes in use with improved water quality

Dummy variables were constructed for each use category in Question 6. The respective dummies were coded as 1 if the respondent indicated that they would use the lower Waimakariri River more for that particular use and were coded as 0 if they indicated less use or no change in use with a cleaner river. Increases in walking and fishing are strong indicators of willingness to pay. Increases in swimming are also significant alone, but a strong correlation between increases in swimming and increases in walking precludes inclusion of the increase in swimming variable.

3.3.3 Final Modelling

To this point, analysis has indicated which variables are worthy of further investigation and which may safely be ignored. Final models were estimated using the following variables:

VISIT	0,1 dummy - 1 if has visited the Lower Waimakariri River in the last 2 years
FISHDAYS	Days spent fishing on the Lower Waimakariri River in the last 2 years
WALK	0,1 dummy - 1 if has walked beside the Lower Waimakariri River in the last 2 years
MURK	0,1 dummy - 1 if believe that pollution makes the water murkier
USE	0,1 dummy - 1 if murkiness influences use of the Lower Waimakariri River
WALKMORE	0,1 dummy - 1 if would walk more beside the Lower Waimakariri River if it were cleaner
FISHMORE	0,1 dummy - 1 if would fish more in the Lower Waimakariri River if it were cleaner

The socioeconomic data were revisited at this point to ensure that interaction effects were not precluding their inclusion. The following two variables are significant in some cases:

CHCH	0,1 dummy - 1 if household is located in Christchurch City
KIDS	Number of people under 18 years of age in the household

Results for the two datasets are presented in Tables 11 and 12. There are two important points to note about the welfare change estimates included in these tables. First, the estimates of mean willingness to pay for the linear-form models are actually bounds within which the actual 95 per cent confidence intervals lie. The 95 per cent confidence interval is somewhat narrower than the stated interval.

Table 11
Results for DATASET 1

	A	B	C	D	E	F	G	H
Constant	2.9137	2.7919	2.9914	2.6504	0.59082	0.28441	0.40475	0.14372
(t-score)	(8.45)	(7.81)	(8.08)	(7.27)	(4.93)	(2.20)	(2.91)	(0.93)
LN($)	-0.7708	-0.8343	-.8541	-.8386				
(t-score)	(-9.73)	(-9.98)	(-9.98)	(-10.0)				
$					-.009279	-.010185	-.010197	-.010213
(t-score)					(-9.04)	(-9.45)	(-9.40)	(-9.46)
FISHMORE		.49188	.49849	.52574		.51098	.50969	.53943
(t-score)		(2.50)	(2.48)	(2.65)		(2.60)	(2.55)	(2.73)
WALKMORE		.75380	.80729	.73007		.75962	.81801	.73813
(t-score)		(3.96)	(4.14)	(3.82)		(3.97)	(4.19)	(3.85)
USE		.42341	.38644	.43702		.42934	.39585	.44434
(t-score)		(2.11)	(1.88)	(2.18)		(2.15)	(1.94)	(2.22)
KIDS			-.13770				-.14259	
(t-score)			(-1.84)				(-1.95)	
CHCH				.29071				.26226
(t-score)				(1.83)				(1.68)
MEDIAN WTP	$43.27	$44.91	$46.32	$44.79	$62.61	$66.00	$67.93	$71.74
95% ci	$34.02 $52.90	-	-	-	$43.84 $78.62	-	-	-
MEAN WTP	$124	$120	$120	$120	$111.17	$106.47	$107.70	$110.16
95% ci bounds	-	-	-	-	$93 $133	-	-	-
n	824	824	806	824	824	824	806	824
-2 LLR (dof)	121.7(1)	164.7(1)	167.2(5)	168.1(5)	99.8(1)	144.3(4)	144.3(5)	147.1(5)
Log Likelihood	-498.7	-477.2	-464.6	-475.5	-509.6	-487.4	-476.0	-486.0

Unrestricted log-likelihood = -559.5

Table 12
Results for DATASET 2

	J	K	L	M	N	P	Q	R
Constant	3.0210	2.9207	2.8744	3.1099	.65885	.40707	.36887	.52350
(t-score)	(8.36)	(7.87)	(7.71)	(8.07)	(5.18)	(3.00)	(2.67)	(3.55)
LN($)	-.81102	-.86365	-.86066	-.88378				
(t-score)	(-9.52)	(-9.71)	(-9.66)	(-9.69)				
$					-.010500	-.011305	-.011242	-.011327
(t-score)					(-8.83)	(-9.15)	(-9.10)	(-9.11)
FISHMORE		.53868	.45574	.53015		.57882	.49663	.56147
(t-score)		(2.57)	(2.09)	(2.49)		(2.75)	(2.28)	(2.63)
WALKMORE		.80544	.75382	.83553		.81004	.75108	.84560
(t-score)		(3.93)	(3.61)	(3.99)		(3.95)	(3.58)	(4.04)
USE			.32953				.32975	
(t-score)			(1.45)				(1.45)	
KIDS				-.11203				-.12441
(t-score)				(-1.39)				(-1.56)
MEDIAN WTP	$41.02	$42.28	$42.50	$43.99	$61.89	$64.58	$64.96	$66.92
95% ci	$32.16 $50.48	-	-	-	$44.42 $77.38	-	-	-
MEAN WTP	$118	$114	$115	$115	$102.47	$99.37	$99.94	$100.85
95% ci bounds	-	-	-	-	$72 $153	-	-	-
n	690	690	690	675	690	690	690	675
-2 LLR (dof)	119.2(1)	146.9(3)	149.0(4)	148.5(4)	100.5(1)	129.5(3)	131.6(4)	129.2(4)
Log Likelihood	-410.8	-397.0	-395.9	-386.9	-420.1	-405.7	-404.6	-396.6

Unrestricted log-likelihood = -470.4

3.3.4 Discussion

Effects of independent variables

In all models the dollar variable is extremely significant, and is much more important than any other independent variable. The coefficients on the dollar variables are stable when new independent variables are introduced. Further, welfare measure estimates are robust, being little affected by the introduction of alternative independent variable sets.

Dataset differences

In all comparable cases median willingness to pay is greater for Dataset1 than for Dataset2. However, none of the differences is significant for those cases in which confidence intervals are available. Differences for the four pairs of comparable cases range from 78 cents to $2.25, representing changes of between 1% and 5%. The four pairs of cases for which mean willingness to pay are comparable indicate absolute decreases in willingness to pay of $6 to $9 (5.9%).

Effect of functional form

Two functional forms are used, one using unadjusted dollars (linear-form) while the other used the natural log of dollars (log-form). In both cases the dependent variable is the logit of probability.

The log-form appears to fit the data better, resulting in lower log-likelihoods than the comparable linear-form models, and higher t-scores on the individual parameters. Functional form has a marked effect on estimates of median willingness to pay. For comparable cases median willingness to pay is 45-60% greater for the linear form, although comparison of the confidence intervals on cases A and E and cases J and N indicate that these differences are not significant. Median willingness to pay between $43 and $53 satisfies both functional forms for Dataset1, while a range from $44 to $51 satisfies Dataset2.

Measures of welfare change

Mean willingness to pay is significantly greater than median willingness to pay in all cases. These differences arise because of the skewed nature of the distribution, caused by the asymptotic nature of the tail. Both functional forms imply that there exist people willing to pay infinite amounts for improved water quality in the lower Waimakariri River, an assumption which is clearly untenable. Two potential solutions present themselves: set upper limits of integration or accept the median as a more robust measure of consumer preferences. The problem with the first approach lies in identifying a reasonable upper limit, which must be done arbitrarily. The second approach is useful if political acceptability is the key decision criterion, but does not help to identify true mean willingness to pay.

Role of use of the lower Waimakariri River

While use of the lower Waimakariri River over the past two years is not a central variable in predicting willingness to pay for improvements in water quality after controlling for other variables, it does have an independent effect. This effect is important to understand where

the response rate to the survey is different for user and non-user groups. Differentiating by user status allows weighting of estimated welfare change measures to obtain a better estimate of society's willingness to pay for the proposed water quality change. The effects of use are identified in Table 13.

Table 13
Effect of Respondent Use of the Lower Waimakariri River

	S Dataset 1	T Dataset 1	U Dataset 2	V Dataset 2
Constant	2.69715	0.36030	2.86391	0.49399
(t-score)	(7.65)	(2.58)	(7.74)	(3.29)
LN($)	-.77260		-.80992	
(t-score)	(-9.68)		(-9.48)	
$		-.0092925		-.010473
(t-score)		(-9.03)		(-8.80)
VISIT	.46188	.47785	.31583	.33561
(t-score)	(3.01)	(3.16)	(1.87)	(2.02)
MEDIAN WTP	$43.68	$63.35	$41.37	$62.48
MEDIAN VISITORS	$59.68	$90.20	$50.70	$79.21
MEDIAN NON-VISITORS	$32.82	$38.77	$34.33	$47.17
MEAN WTP	$124	$110.86	$117	$102.45
MEAN VISITORS	$143	$122.88	$130	$113.78
MEAN NON-VISITORS	$109	$95.72	$108	$92.65
n	824	824	690	690
-2 LLR (dof)	130.8	109.9	122.7	104.6
Log Likelihood	-494.2	-504.6	-409.0	-418.1

Unrestricted log-likelihood for Dataset 1 = -559.5
Unrestricted log-likelihood for Dataset 2 = -470.4

Mean willingness to pay in log-form models

There is no simple method available for integrating the probability function to provide mean willingness to pay estimates for log-form models. Consequently, this task was done

numerically. The upper limit of integration for mean willingness to pay for log-form models in Tables 11, 12 and 13 was arbitrarily set at $500. This particular functional form has "thick, asymptotic" tails (see Table 14) so mean willingness to pay increases significantly with the upper limit of integration. On the other hand, the thin tails of the linear-form models result in mean willingness to pay quickly converging to a limit. An infinite upper limit was therefore used in mean willingness to pay calculations with these models. The impact of the upper limit of integration for the two functional forms is illustrated in Table 15, using the comparable models M (log-form) and R (linear-form).

Table 14
Dollars Needed to Result in Given Probabilities of Willingness to Pay

Probability	Dollars	
	Model M (log-form)	Model R (linear-form)
.10	$396	$261
.01	$4,355	$473
.001	$43,946	$677
.0001	$440,000	$880
.00001	$4.4 million	$1,083

Table 15
Mean Willingness to Pay by Upper Limit of Integration

Upper limit of integration	Mean willingness to pay	
	Model M	Model R
$350	$97	$97
$500	$115	$100
$700	$134	$101
$1000	$154	$101
Infinity	-	$101

At lower limits of integration the two models produce similar results. Which model is to be preferred is a matter of personal preference. Log-form models predict better within the range of observed dollars. However, there is no information available on which to base a preference for behaviour outside the observed range. If it is judged that one household in 100,000 obtaining increased annual benefits of around $1000 or more from improved lower

Waimakariri River water quality is more plausible than one household in 100,000 obtaining $4.4 million or more of annual benefits from the same change then the linear form model is preferred.

3.3.5 Conclusion

The robustness of results across independent variable sets and the overlap of median willingness to pay across functional forms indicate that it is likely that median annual willingness to pay lies in the range of $40-$50 per household. Mean willingness to pay for the respondents to the mail questionnaire is probably in the region of $100 per household per annum. The survey area contains approximately 130,500 households (Department of Statistics, 1986). Discounting the annual stream of benefits at 8 per cent over ten years results in a present value of the benefit of water quality improvement in the survey area (assuming a static population) of $96.4 million.

Further testing of the results with respect to the impact of non-respondent bias and the valuation of benefits by a selected group of Lower Waimakariri River "users" has been undertaken and is reported in Sections 3.5 and 3.6 of this Report.

3.4 Sample Statistics

The respondents were asked a number of questions with respect to their particular circumstances. The following provides the results.

Respondents were asked how many people aged 18 years and over and how many aged under 18 years were living in the household. Table 16 provides the responses. There was no significant difference between the mail questionnaire respondents and the sample of "non-respondents".

Table 16
Age of People Living in Household
(% of respondents)

Number of Members in Each Category	Mail Questionnaire: % with members 18 and over	Mail Questionnaire: % with members under 18	Non-Respondent Sample: % With Members Under 18
Nil	0.6	62.0	60.0
1	12.9	12.0	17.5
2	60.9	17.6	14.4
3	16.8	6.1	6.6
4	7.2	1.7	1.6
5	1.4	0.4	-
6	0.1	0.1	-
7	0.1	-	-
Valid Responses	1122	1122	320

Respondents were asked to indicate which group their approximate total household income fell into. The results are given in Table 17.

Table 17
Household Income Groups
(% of respondents)

Income Group	% of households
$0 - $9,999	4.5
$10,000 - $19,999	19.8
$20,000 - $29,999	24.0
$30,000 - $49,999	29.9
$50,000 or more	21.8
Valid Responses	1021

Respondents were told that the distance from the Christchurch Square to the bridge over the Lower Waimakariri River is approximately 12 kilometres. The respondents were then asked to indicate approximately how far they live from the Lower Waimakariri River. Table 18 provides the responses.

Table 18
Distance from Lower Waimakariri River
(% of respondents)

Distance from Lower Waimakariri River	% of respondents
1 to 10 km	39.3
11 to 20 km	41.0
21 to 30 km	4.2
Over 30 km	15.5
Valid Responses	1036

Table 19 provides information on the area where the respondents live. A higher proportion of "non-respondents" indicated they live in the Christchurch City area. However the way in which the question was written in the mail questionnaire may have influenced the proportion of respondents who indicated they live in an "other urban area". In many cases, respondents provided this response when from inspection of the sample address list, they were shown to live in a suburban area of Christchurch, such as Riccarton, the previous Waimairi District, Hornby, etc. This reflects an interpretation of the words "Christchurch City" as that area which was formerly designated as within the Christchurch City Council boundary prior to local body/boundary reorganisation. This appears to have resulted in a higher than expected sample proportion of respondents/non-respondents in this area. The expected distribution of households within the survey area was for approximately 75 per cent of households to be in Christchurch City and the remaining 25 per cent in other urban and rural areas. The random non-respondent survey indicated that 75.5 per cent of non-respondents are in the Christchurch area, confirming that the actual distribution of mail questionnaire respondents was appropriate. If the distribution had been inappropriate, the non-respondent sample would have disclosed a much higher proportion of Christchurch City non-respondents.

Table 19
Area Where Respondent Lives
(% of respondents)

Area	Mail Questionnaire: % of respondents	Non-Respondent Sample: % of respondents
Christchurch City	52.7	75.5
Other Urban Area	28.9	14.3
Rural	18.4	10.2
Valid Responses	1137	314

The ethnic group of the respondent is described in Table 20.

Table 20
Ethnic Group of Respondent
(% of respondents)

Ethnic Group	% of respondents
European	95.3
Pacific Island	0.4
Maori	2.5
Other	1.9
Valid Responses	1123

3.5 Survey of Users

3.5.1 General Results

The survey of "Users" was based on a population provided by the Canterbury Regional Council. The population was made up of those people who had made submissions to the Council in favour of the higher water quality standard being imposed. Of the 512 "Users" in the sample, 326 respondents provided usable questionnaires. This is a response rate of 63.7 per cent. This is much higher than would normally be expected from a mail survey but as this sample is a restricted group of the population and it has been selected based on a perceived interest in the subject, the response rate is understandable.

Table 21 indicates the proportion of the respondents who had visited the Lower Waimakariri River in the last two years. Not all respondents had visited (8.0 per cent (26 respondents) had not).

Table 21
"User" Respondents Who Had Visited the Lower Waimakariri River During the Last Two Years
(% of respondents)

	Visited Lower Waimak in Last Two Years (% of respondents)
Yes	92.0
No	8.0
TOTAL	100.0
Valid Responses	326

The respondents were asked to identify the activities they had participated in on the Lower Waimakariri River. Table 22 provides the responses. In comparison with the responses recorded in Table 3 (for the users from the general survey), the results from the "Users" survey indicate a much stronger set of users than in the general population. A higher proportion of the "User" respondents were involved in each activity listed and the involvement was more long term with a higher proportion of the "Users" falling into the >20 times in the past two years category. The only category which was lower for the "Users" was "Picnicking". This is a reflection of the way the population was chosen which would include a higher proportion of those people involved in the more active river pursuits.

Table 22
"User" Activities on the Lower Waimakariri River
(% of those who had visited)
(% of those doing each activity)

Activity	% Participating	Number of Days (%)			
		1-5	6-10	12-20	>20
Fishing	52.7	24.7	12.7	15.2	47.5
Picnicking	26.7	60.0	28.8	6.3	5.0
Walking	55.7	36.5	15.0	11.4	36.5
Windsurfing	0.7	-	50.0	-	50.0
Canoeing	6.0	61.1	22.2	17.7	5.6
Yachting	19.3	24.1	12.1	8.6	53.4
Jetskiing	2.7	50.0	-	25.0	25.0
Powerboating	16.3	40.8	24.5	14.3	20.4
Birdwatching	8.0	41.7	25.0	12.5	20.8
Other	23.7	35.2	21.1	19.7	23.9
Valid Responses	300				

Respondents were asked to indicate the effect they thought the pollution in the Lower Waimakariri had on the water. The responses are given in Table 23.

Table 23
Effect of Pollution on the Water Quality
(% of "user" respondents)

Pollution Effect	Valid Responses	Yes (%)	No (%)	Don't Know (%)
Murkier	306	93.8	1.3	4.9
Smelly	307	90.2	3.3	6.5
Greasy	278	74.5	3.6	21.9
Taste Different	255	56.5	0.4	43.1
An Increased Health Risk	322	94.1	-	5.9

A higher proportion of the "User" respondents thought that the pollution did have the suggested effects on the water than did the general population. The response was particulary high for the "murkier" and "smelly" factors. The "taste different" response was very similar to that for the general survey.

Respondents were asked to indicate whether any of the pollution factors influenced whether they visited the Lower Waimakariri River. The results for the "Users" are given in Table 24. These results indicate that the proportion of "Users" who are influenced by the pollution is approximately double the proportion of the general population (Table 5). However, a large proportion of the "Users" continue to visit the Lower Waimakariri River.

Table 24
Factors Influencing Whether Visit the Lower Waimakariri River
(% of "user" respondents)

Factor	% Influenced by Factor
Murkiness	44.5
Smell	54.6
Greasiness	29.4
Taste	15.4
Health Risk	60.0
Valid Responses	325

Respondents who are influenced by the Lower Waimakariri River pollution were asked if they go to alternative sites. Of those, 75.7 per cent indicated that they do go to alternative sites. The most common activities and alternatives are listed in Table 25.

Table 25
Alternative Sites Used by "User" Respondents Influenced by Lower Waimakariri Pollution
(% of "user" respondents for each activity)

Activity / Alternative Site	% Using Alternative Site
A. Fishing (119 respondents)	
Sea / beach	29.4
Rakaia River	29.4
Ashley River	13.4
Middle and Upper Waimakariri	19.3
Lakes	15.1
Hurunui	7.6
Rivers - general	4.2
Rangitata	5.0
Other	14.3

Activity / Alternative Site	% Using Alternative Site
B. Picnicking (81 respondents)	
Sea / beach	27.2
Parks / Tracks / Gardens	21.0
Ashley River	19.8
Middle and Upper Waimakariri	18.5
Groynes	17.3
Rakaia	8.6
Other	23.5

Table 25 Continued

Activity / Alternative Site	% Using Alternative Site
C. Walking (84 respondents)	
Sea / beach	32.1
Parks / Tracks / Gardens	50.0
Ashley River	6.0
Middle and Upper Waimakariri	17.9
Groynes	7.1
Rakaia	4.8
Other	11.9

Activity / Alternative Site	% Using Alternative Site
D. Powerboating (25 respondents)	
Sea / beach	60.0
Lakes	24.0
Middle and Upper Waimakariri	24.0
Other	24.0

Activity / Alternative Site	% Using Alternative Site
E. Swimming (74 respondents)	
Sea / beach	40.5
Ashley River	16.2
Public Swimming Pool	39.2
Middle and Upper Waimakariri	21.6
Other	17.6

Respondents were provided with a "Water Quality Ladder" which indicated that the current state of the river is at Step D which indicates that the water is OK for boating and fishing. The new standards are intended to raise the water quality to Step C on the scale, where the water is OK for swimming as well. All respondents were asked to indicate what effect this change would have on the range of activities listed in terms of whether the respondents would do "More" of an activity, "No Change" or "Less". The results for the "User" respondents are given in Table 26.

Table 26
Effect on "User" Respondent Activities
Following Improvement in Water Quality
(% of "user" respondents)

Activity	Valid Responses	% Doing More	% No Change	% Doing Less
Fishing	253	70.4	29.2	0.4
Picnicking	210	71.0	28.6	0.5
Walking	216	60.6	38.9	0.5
Windsurfing	96	11.5	88.5	-
Canoeing	113	32.7	67.3	-
Yachting	129	34.9	64.3	0.8
Jetskiing	95	14.7	85.3	-
Powerboating	116	27.6	72.4	-
Birdwatching	115	33.9	66.1	-
Swimming	196	79.1	20.4	0.5
Other	106	38.7	60.4	0.9

As the number of valid responses varied considerably for each activity reported in Table 26, it may be appropriate to adjust the proportional responses on the assumption that those who did not respond on each activity category were those who did not participate in that activity and therefore their activity would not have increased or decreased. Applying this assumption and setting the response rate to 326 yields the results given in Table 27. To the extent that some people may take up the activity in the future and choose to use the Lower Waimakariri River as a result of improved water quality, then Table 27 will tend to understate the proportion who may "do more".

Table 27
Effect on "User" Respondent Activities Following Improvement in Water Quality Adjusted to Constant Response Rate
(% of "user" respondents)

Activity	Adjusted Valid Responses	% Doing More	% No Change	% Doing Less
Fishing	326	54.6	45.1	0.3
Picnicking	326	45.7	54.0	0.3
Walking	326	40.2	59.5	0.3
Windsurfing	326	3.4	96.6	-
Canoeing	326	11.3	88.7	-
Yachting	326	13.8	85.9	0.3
Jetskiing	326	4.3	95.7	-
Powerboating	326	9.8	90.2	-
Birdwatching	326	12.0	88.0	-
Swimming	326	47.5	52.2	0.3
Other	326	12.6	87.1	0.3

Fishing, picnicking, walking and swimming would be the activities most affected by an improvement in water quality. The proportion of the "User" respondents who would increase their level of activity is approximately double that for the general population sample (Table 8) (except for picnicking, where a high proportion of the general population sample would increase their activity).

3.5.2 Willingness to Pay (WTP) Results for "User" Respondents

A high proportion (77.1 per cent) of the "User" respondents indicated that they would be willing to pay an extra dollar in rates for improved water quality in the Lower Waimakariri River. These respondents were analysed to ascertain their level of WTP.

The user survey was conducted to provide information on differences in willingness to pay between users and non-users of the Lower Waimakariri River. The general population survey showed that there were insignificant differences in willingness to pay for people who had used the Lower Waimakariri River in the previous two years and those who had not. Because the sample for the user survey was drawn from those users who had made submissions on water quality in the Lower Waimakariri River, or from users who are members of clubs or other bodies closely associated with the Lower Waimakariri River, it was expected that the user survey willingness to pay would exceed the willingness to pay of users in the general survey.

Responses to the contingent valuation survey were analysed using maximum likelihood logit regression procedures, following identical procedures to those used for the general survey. No correction was undertaken for differences in response rate by dollar amount in the contingent valuation question.

Table 28 presents estimates of welfare change contingent upon improvement of Lower Waimakariri River water quality from Class D to Class C for the User Survey population. The variable names are the same as for the general survey.

Table 28
Results for User Survey

	1	2	3	4	5	6
Constant	5.2894	3.9876	3.8229	1.6840	0.7171	0.4801
LN($)	-1.0921	-.9668	-.9831			
(t-score)	(-5.95)	(-4.42)	(-3.97)			
$				-.01046	-.00844	-.00880
(t-score)				(-5.66)	(-3.77)	(-3.65)
FISHMORE			.66834			.73076
(t-score)			(1.44)			(1.62)
WALKMORE		1.3257	1.2144		1.3734	1.2320
(t-score)		(3.48)	(2.62)		(3.74)	(2.73)
MEDIAN WTP	$127 [$60] {$43}	$141	$161	$160 [$90] {$63}	$183	$194
95% ci	$96 $183	-	-	$132-$205 {$44-$79}	-	-
MEAN WTP	n.a. [$143] {$124}	n.a.	n.a.	$177 [$123] {$111}	$206	$213
95% ci bound	-	-	-	$70-infinity {$93-$133}	-	-
n	236	166	139	236	166	139

Square brackets [] show results for users from the main survey using Dataset 1, which is directly comparable, since no adjustments for response rate were made to the user survey.
Curly brackets {} show aggregate results for the main survey (Table 11).
n.a. not available.

The measures of willingness to pay obtained from the user survey are consistently greater than the corresponding measures for users in the general survey. Consequently, while the proportions of "high value" and "low value" users in the population are not known, so that no firm conclusions can be drawn, user responses in the general survey do not appear to be biased toward "high value" users. In other words, there is no evidence of within-group selection resulting in upwardly biased measures of value for the user group. Consequently, the search for bias in responses will be concentrated on between group (user and non-user, as well as other significant independent variables) response rate differences.

3.6 Non-Respondent Bias

3.6.1 Visiting Lower Waimakariri River

The non-respondent survey indicates that the rate of visiting the lower Waimakariri River for the population as a whole is 37.9% Combining this information with the user and non-user estimates of mean willingness to pay presented in Table 4 provides estimates of true population mean willingness to pay. These estimates and corresponding measures which are not adjusted for response rate are presented in Table 29.

Table 29
Impact of Response Rate Differences Between Users and Non-users on Mean Willingness to Pay for Improved Water Quality in the Lower Waimakariri River

	Linear, Dataset 1	Linear, Dataset 2	Logged, Dataset 1	Logged, Dataset 2
Raw Mean	$111	$102	$124	$117
Adjusted Mean	$106	$101	$122	$116

Clearly, the difference in response rate between those who have visited the lower Waimakariri River in the last two years and those who have not does not have a significant impact on aggregate willingness to pay.

3.6.2 Independent Variables

Table 30 shows the means of independent variables included in functions fitted to explain willingness to pay. The "General survey means" are the mean values for those cases retained for analysis in the model fitting stage. The "Adjusted means" are the means for the independent variables for the whole population, after adjusting for differences in these variables in the general and non-respondent surveys.

Table 30
Independent Variable Means

Variable	General survey mean	Adjusted mean
WALKMORE	.238	.383
FISHMORE	.225	.310
USE	.215	.287
KIDS	.748	.725
CHCH	.522	.755

In order to determine the effects of sample selection, Models P, Q and R derived using Dataset 2 in the general survey were re-estimated using means of independent variables adjusted by incorporation of non-respondent data. The results are reported in Table 31.

Table 31
Benefit Estimates Based on Raw and Adjusted Mean Values for Independent Variables

	Median Willingness to Pay		Mean Willingness to Pay	
	Raw	Adjusted	Raw	Adjusted
Model N	$62	-	$102	-
Model P	$65	$85	$ 99	$118
Model Q	$65	$80	$100	$110
Model R	$67	$98	$101	$123

The adjustments have a uniform effect of increasing the benefit measures, although the increases appear to be insignificant, given the order of magnitude of confidence bounds estimated for Model N[1]. While the median willingness to pay has increased a little higher than the upper bound of the confidence interval, the adjusted mean willingness to pay remains within the 95 per cent confidence interval derived for the original model and data.

[1] Model N has a 95% confidence interval on the median of $44 ~ $77, and a bound on the 95% confidence interval for the mean of $72 ~ $153.

CHAPTER FOUR
CONCLUSION

The use of the contingent valuation method to identify the Willingness to Pay of Canterbury residents for improved water quality in the Lower Waimakariri River has resulted in a mean willingness to pay of about $102 per respondent household per annum with the 95 per cent confidence interval being a range of $72 to $153. If any bias is present in the measure, the estimate of mean willingness to pay is too low. However, no statistically significant bias influences were detected.

In order to place this estimate into a chronological context, it is necessary to examine the discounted mean WTP over time, say a ten year period. Given an estimate of the number of households in the Canterbury Region at 130,500 (no population growth) and a discount rate of eight per cent, the present value of the benefits is estimated to be $96.4 million. The 95 per cent confidence interval on this estimate is within the range of $68.0 million to $144.6 million. This can be compared with the present value of the cost of upgrading discharges to the river (Page 1 of this report) which was estimated as within the range of $10.1 million to $17.2 million. On this basis, the perceived "value" of upgrading the water quality, as expressed through WTP, clearly exceeds the cost of water quality improvement. In addition to the information available on WTP, the research indicates that Canterbury residents would make more use of the river resource if the water quality was improved.

The results of this research therefore strongly support policy actions which contribute to an upgrade of the Lower Waimakariri River water quality.

From a resource management perspective, the value of the resource improvement can be seen to exceed the cost of the improvement and, therefore, policies which require better management of the resource can be justified on economic as well as aesthetic grounds.

It should be noted that although this research used the rate paying concept as the vehicle for the Willingness to Pay analysis, this does not imply that the cost of any improvement to the water quality should be funded by rates, or by any other method. The question as to how the costs should be allocated was not addressed by this research. Options range from complete loading of the costs on those responsible for the discharges to the river, through cost sharing schemes with general rate payers, to full loading onto the Canterbury Regional Council rating structure. More research and discussion of the cost loading issue is required before advice on such issues can be offered.

If should also be noted that the costs which have been assessed as associated with the improvement of the water quality are not necessarily the total costs that would be involved in improving the water quality to the standard expected by the public as corresponding to water standard "C" on the Water Quality Ladder. Reduction of faecal coliform bacteria (the process costed for the analysis) may make the water safe for swimming (Step "C") however, discolouration and odours may still be present which will restrict use of the water for swimming, at least in the public perception. Both "murkiness" and "smell" were rated highly as the main effects of pollution. If these aspects were not improved at the same time as the

faecal coliform bacteria count was lowered, then the public perception may be that no, or very little, improvement in water quality had been achieved. They would therefore not be prepared to pay the amount previously stated and the resource use would not increase.

Therefore, further research on the costs of improving the clarity of the discharges to the water and the odours associated with it would be required. Of course, where the new discharge option required removal of the discharge from the river in order to reduce the faecal coliform bacteria level, then the associated issues of murkiness and odour would also be resolved.

In the cost analysis undertaken, the least cost options for reducing the faecal coliform bacteria levels involved processes which would be likely to improve the water clarity and reduce odours and therefore the costs presented are not expected to alter significantly given the additional criteria.

Another factor which should be considered with respect to the cost of achieving an improvement to the water quality is the "partial" nature of the cost analysis undertaken for this research. While the estimates of the direct costs are complete, the consequences of applying those costs to the current dischargers have not been considered. For example, it may be that current dischargers will find that the imposition of those costs make their operation uneconomic. In this case, closure of their facilities may result and it may be that the cost of closure should be considered as a cost associated with upgrading the Lower Waimakariri River water quality. To the extent that loss of the economic activity was not replaced by alternative uses for the resources employed, then some additional costs could be assessed. However, over the longer term, it is probable that the resources released by an activity closure would be taken up by other activities, and the net effect would be zero, perhaps even positive. However, no analysis at this level has been undertaken and the implications of imposing the water upgrade costs on current dischargers, other river users or the regional population have not been examined.

Overall, the study has presented an interesting application of the Willingness to Pay concept. The results have significant implications for regional policy with respect to, not only the Lower Waimakariri River, but also for other resource degradation issues. Where resource uses are contemplated by future developments, or indeed by existing activities, the valuation of the resource by the public needs to be included in the evaluation of the resource using activity. Where necessary, resource use costs can be imposed on developments based on a public perception of "current state value" and resource using activities can then be expected to pay the "true cost" of the resources they wish to use.

The Resource Management Act (1991, S.32) requires economic evaluation of both private and public costs and benefits. The WTP analysis contributes significantly to such evaluations.

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APPENDIX

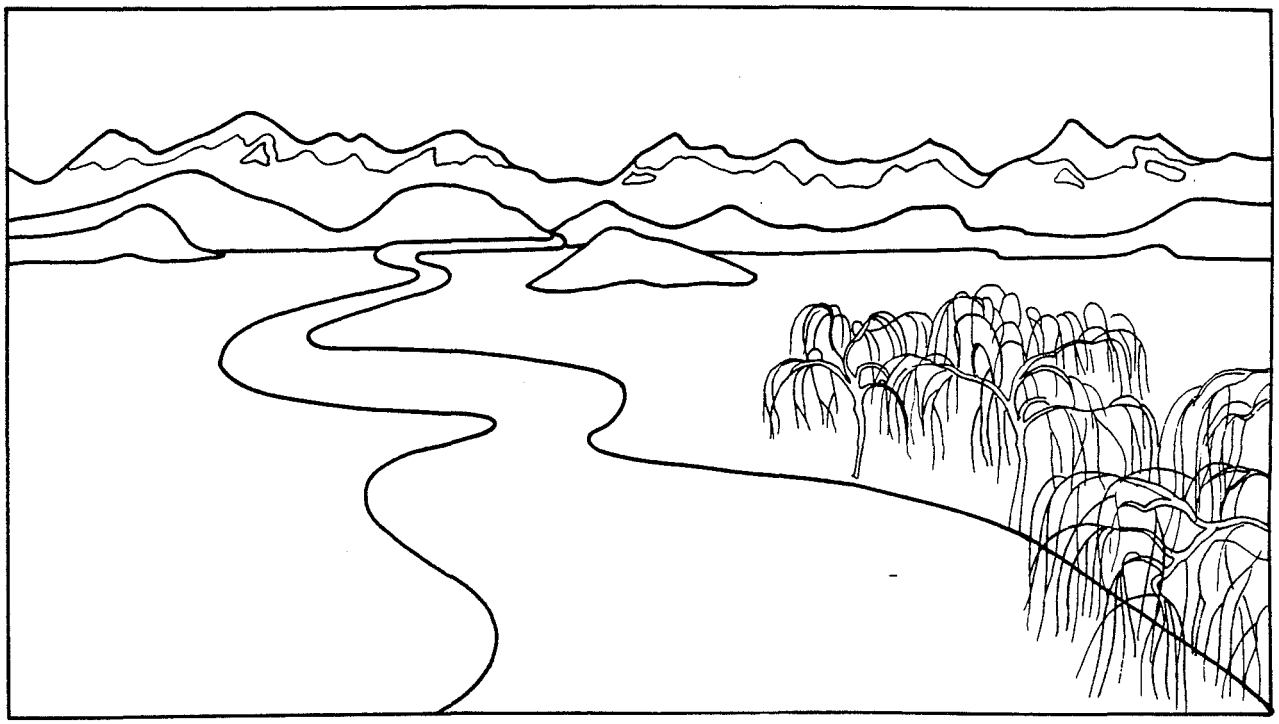
SURVEY QUESTIONNAIRES

LOWER

WAIMAKARIRI RIVER

WATER QUALITY

STUDY



Agribusiness and Economics Research Unit
and Centre for Resource Management
PO Box 84
Lincoln University
CANTERBURY

Lincoln University

Te Whare Wānaka O Aoraki

P.O. Box 84
Lincoln University
Canterbury
New Zealand
Telephone: Christchurch (03)252 811

Fax:
Vice Chancellor & Registry (64)(03)252 965
Library & Departments (64)(03)252 944

WAIMAKARIRI RIVER WATER QUALITY STUDY

Your name has been selected at random to participate in a survey on water quality measures on the lower Waimakariri River. This area is popular for many recreation activities. During 1991 the Canterbury Regional Council decided to introduce new water quality standards for the lower Waimakariri River. The objective of these new standards is to ensure the water quality is improved, thus allowing a greater range of recreation activities on the river.

Researchers at Lincoln University are keen to obtain information on use of the river and the effects of water quality on Canterbury people. We seek your assistance with this research and ask that you take the time to complete and return the survey form.

Your response is essential to ensure that accurate information on Canterbury views is obtained. **It is essential to the success of our study that you complete the form even if you do not visit the lower Waimakariri River.**

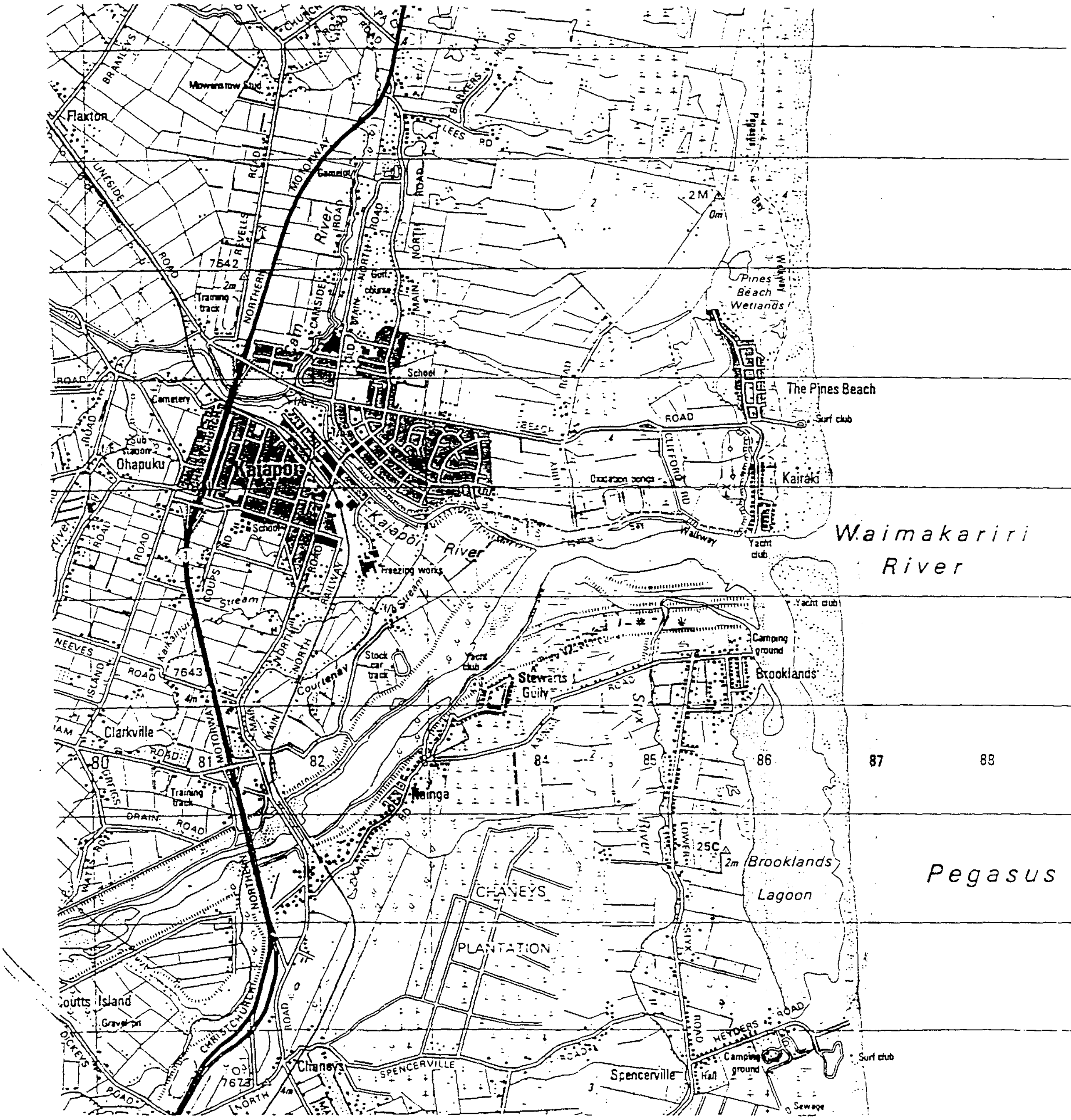
All information you provide is **strictly confidential.** The questionnaire is numbered only to allow us to identify people who have not replied so that they may be reminded. The completed questionnaire should be returned in the **Freepost** envelope provided. No stamp is required.

Thank you for your assistance.

Ron Sheppard
Assistant Director
Agribusiness and Economics Research Unit
LINCOLN UNIVERSITY

Lindsay Saunders
Research Manager
Centre for Resource Management
LINCOLN UNIVERSITY

The lower Waimakariri is the stretch of river between the bridge on State Highway One and the sea, including Brooklands Lagoon. The map below shows the area we are interested in.



1. Have you visited the lower Waimakariri River during the last two years? Please tick the appropriate box.

Yes ☐
No ☐

If you answered no please indicate why you haven't used this area.....
.....

If you answered No to question 1, please go to question 3.

2. If you have visited the lower Waimakariri River during the past two years, about how many days have you spent on the following recreation activities during that time? Remember we are only interested in your recreation **downstream** of the Highway One bridge.
Please write the approximate number of days in the boxes.

Fishing	[	]	days
Picnicking	[	]	days
Walking	[	]	days
Windsurfing	[	]	days
Canoeing	[	]	days
Yachting	[	]	days
Jetskiing	[	]	days
Powerboating	[	]	days
Birdwatching	[	]	days
Other	[	]	days

3. The lower Waimakariri River is polluted. Please tell us what effects you believe pollution has on lower Waimakariri water quality. Please tick the appropriate boxes.

Pollution makes the water:

Murkier	Yes ☐	No ☐	Don't know ☐
Smelly	Yes ☐	No ☐	Don't know ☐
Greasy	Yes ☐	No ☐	Don't know ☐
Taste different	Yes ☐	No ☐	Don't know ☐
An increased health risk	Yes ☐	No ☐	Don't know ☐

4. Do any of the following features influence whether you visit the lower Waimakariri River ? If yes, please tick the appropriate boxes. If no, please go to question 6.

Murkiness	Smell	Greasiness	Taste	Health risk
☐	☐	☐	☐	☐

5. (a) If pollution on the lower Waimakariri River does influence you, do you go to alternatives sites ?

Yes ☐
No ☐
Don't know ☐

If you answered No please go to question 6.

5. (b) Which alternative sites do you travel to? Please write in the names of the alternative sites.

Alternative Sites

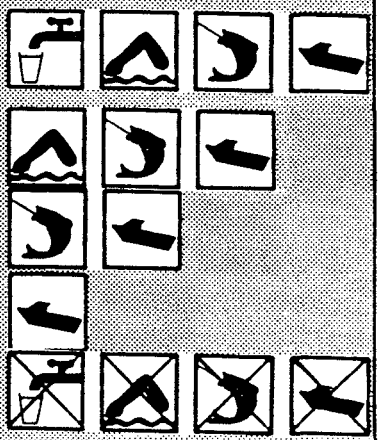
Fishing.....
Picnicking .....
Walking .....
Windsurfing .....
Canoeing .....

Yachting .....
Jetskiing .....
Powerboating .....
Birdwatching .....
Swimming .....
Other (please name the other activities and sites) .....
.....
.....

Lower Waimakariri River water is unsafe for swimming. During 1991 the Canterbury Regional Council decided to introduce new water quality standards for this river to make it safe for swimming. The new standards will move the lower Waimakariri River from Step D to Step C on the Water Quality Ladder.

Water Quality Ladder

10	A	Best possible
9		
8	B	Safe to drink
7		
6	C	Safe for swimming
5		
4	D	Okay for boating and fishing
3		
2	E	Okay for boating
1		
0	F	Worst possible



6. Please indicate what effects improvement in water quality to Step C on the 'Water Quality Ladder' will have on your use of the lower Waimakariri River.

Fishing	More ☐	No Change ☐	Less ☐
Picnicking	More ☐	No Change ☐	Less ☐
Walking	More ☐	No Change ☐	Less ☐
Windsurfing	More ☐	No Change ☐	Less ☐
Canoeing	More ☐	No Change ☐	Less ☐
Yachting	More ☐	No Change ☐	Less ☐
Jetskiing	More ☐	No Change ☐	Less ☐
Powerboating	More ☐	No Change ☐	Less ☐
Birdwatching	More ☐	No Change ☐	Less ☐
Swimming	More ☐	No Change ☐	Less ☐
Other	More ☐	No Change ☐	Less ☐

Water quality in the lower Waimakariri River depends upon many things which happen in the area that drains into the river. Among the things that lower water quality are the large populations of wildlife living on or near the river, agricultural run-off, business wastes, and taking water for household use, irrigation and for farm animals to drink. The actions of many people and many different activities all help to lower the standard of water in the lower Waimakariri River.

However, one way of achieving water quality step C is to treat business wastes to a higher level. In order that water quality step C is achieved, the Canterbury Regional Council is considering spending rate income to install and run treatment facilities. This would mean an increase in rates for all Canterbury Regional Council ratepayers. People living in rental accommodation would have rate increases passed on in their rent.

7. Would your household be willing to contribute $1 extra rates (or rent) each year to improve water quality in the lower Waimakariri River to step C? Please tick the appropriate box.

Yes ☐ No ☐

If you said NO, please briefly explain why. .....
.....
.....

8. Suppose there was an opinion poll tomorrow to decide whether rates should be increased to improve lower Waimakariri River water to step C. Assume that your household has one vote. Tick the box beside the choice you prefer:

Choice A Water quality at step D (the current level) and pay the same annual rates (rent) as now. ☐

Choice B Pay an additional $ rates (rent) each year and have water quality at step C. ☐

To help us analyse the results we would like you to tell us about your household.

9. How many people live in your household?
[ ] people age 18 years and over [ ] people under 18 years

10. What is your approximate total household annual income?

$0 -$9 999	☐
$10 000 - $19 999	☐
$20 000 - $29 999	☐
$30 000 - $49 999	☐
$50 000 or more	☐

11. It is approximately 12km from the Christchurch Square to the bridge over the Lower Waimakariri River. Approximately how far do you live from the lower Waimakariri River [ ] kilometres?

12. Which area do you live in ?

Christchurch City	☐
Other urban area	☐
Rural	☐

13. Which ethnic group do you personally belong to (tick all boxes that apply)?

European	☐	Maori	☐
Pacific Islander	☐	Other	☐

Please write any comments which you feel would be valuable in understanding how your household values the lower Waimakariri River.

.....
.....
.....
.....
.....

Thank you for your assistance, the information you have provided will be valuable in improving our understanding of recreation usage and the values people attach to the lower Waimakariri River.

AGRIBUSINESS
& ECONOMICS
RESEARCH UNIT

LINCOLN COLLEGE
CANTERBURY
NEW ZEALAND

PO Box 84
LINCOLN UNIVERSITY

Phone Christchurch (03)252 811
Telephone:(64)(03)325 2811
Facsimile: (64)(3) 325 3847

LOWER WAIMAKARIRI RIVER WATER QUALITY STUDY

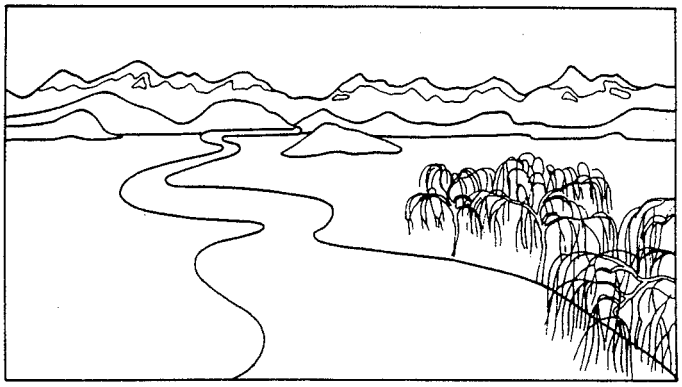
As your name was recently selected to participate in a study on the new water quality standards for the lower Waimakariri River, you will have recently received this survey:

LOWER

WAIMAKARIRI RIVER

WATER QUALITY

STUDY



Researchers at Lincoln University are keen to obtain information on use of the river and the effects of water quality on Canterbury people.

We seek your assistance with this research and ask that you take the time to complete and return the survey form. If you have already completed this survey we thank you for your contribution.

Thank you for your assistance.

Ron Sheppard
Assistant Director
AGRIBUSINESS & ECONOMICS RESEARCH UNIT

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