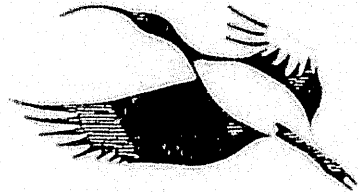# Water quality improvement in the Darling River

A contingent valuation study

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Water quality improvement in the Darling River
A contingent valuation study

1. Executive Summary

- The Department of Water Resources undertakes cost benefit analyses of proposed projects but often environmental evaluation is misunderstood, considered too complex and/or not sufficiently important for inclusion in these studies

- To address these problems the department recently undertook a review of environmental evaluation methodologies and their potential contribution in water resource management decision making

- There is a range of methods whereby values for otherwise unpriced environmental goods can be obtained, such as the travel cost, contingent valuation, hedonic pricing and ecosystem approaches. Each method is suitable for a different resource valuation problem

- Water quality in river systems has been of public concern for some time. In December 1991 there was the world's largest recorded blue green algal bloom stretching for 1000 km along the Barwon Darling river system. Clearly considerable resources are needed to minimise future occurrences of such blooms

- A contingent valuation methodology was applied to the question of the value the public places on improved water quality in the Darling River

- The sample interviewed was 150 households in each of the Sydney, the Darling River and the rest of New South Wales regions. A discrete choice willingness to pay question was asked, meaning that respondents were asked if they would pay $x ($50, $100, $200) to improve water quality in the Darling River

- The results indicate that households in the Sydney region are willing to pay a median of $118 as a once off payment. This is very similar to the $105 willing to be paid by households in the rest of New South Wales

- However households in the Darling Region are willing to pay a higher median amount of $157. This is not an unexpected result as these households are directly adversely affected by algal blooms

- Another sample of 100 households was taken from the Sydney region and asked an open ended willingness to pay question "how much will respondents pay?". The results indicate a much lower median willingness to pay of $20. Aggregated this means that Sydney households alone are willing to pay a once off total amount of $26 million to improve water quality in the Darling River

- The results from the two versions of the willingness to pay question in the contingent valuation study indicate the importance of wording the willingness to pay question and interpreting the dollar values given. They do not mean that one result is invalid or the method itself is unreliable, and highlight the importance of careful survey preparation and interpretation of results

- The results confirm to the policy maker that the public considers pollution in general and river pollution in particular to be major environmental issues

- This study supports the use of the contingent valuation methodology as input into allocating physical and financial resources to major environmental issues facing the department. This approach requires time for preparation and implementation and lends itself to thorough analyses and complex issues in decision making

2. Abstract

This study looked at the willingness to pay for improved water quality in the Darling River. The contingent valuation method used a telephone survey of 550 households of New South Wales. Two forms of willingness to pay question were asked, a two stage discrete choice and an open ended question, which gave quite different median willingness to pay results. The study confirms for the policy maker that the public is concerned about river pollution and is prepared to pay to improve water quality.

3. Introduction

The Department of Water Resources is required to provide cost benefit analyses of proposed projects. However, establishing values for unpriced goods such as environmental goods is often misunderstood, considered too complex and/or not sufficiently important. As its role as resource manager evolves the department will need to pay increased attention to environmental evaluation.

Current issues in water resource management include;

- wetland management, the extent of agricultural development and practices, rehabilitation of wildlife and fish habitats, flooding regimes

- water quality, in streams, rivers, estuaries, wetlands

- environmental flows, irrigation versus environmental requirements

- soil conservation and its affects on water quality

- recreation and its demands on wetlands, rivers, fish and wildlife habitats

- flooding, urban and rural development versus habitat requirements

- riparian zone management

In recognition of the importance of natural resource management and the demand for evaluation of resources, the DWR initiated an appraisal of monetary valuation methods such as travel cost, hedonic pricing and contingent valuation, and their suitability to evaluate aspects of water resource issues. As a case study, a contingent valuation survey was undertaken to apply one environmental evaluation method to a current problem in water resource management.

The contingent valuation method uses a survey approach to establish respondents' willingness to pay a monetary amount to fund hypothetical changes in the quality or quantity of a resource, or willingness to accept compensation to forgo some resource or improvement in that resource. An advantage of the contingent valuation method is that it can be used to estimate use and non use values of a resource.

The method is subject to the same biases as any survey method and has been criticised for its hypothetical nature. However, with careful attention to the questionnaire design and sampling, it can provide acceptable estimates of the magnitudes of values for aspects of the environment. Other criticisms are levelled at the suitability of the contingent valuation approach for valuing pure public goods compared to private goods and lack of validation techniques (Bennett 1992, Peterson 1992, Blamey and Common 1993)

With these criticisms in mind considerable attention was paid initially to subject matter, interview method, sample and questionnaire design. For a government department dealing with politically sensitive environmental issues there are in fact practical benefits in the hypothetical nature of the

study. The subject of water quality improvement was one that had received comprehensive and continuing media attention; therefore there was the reasonable expectation that respondents were familiar with it and could provide a fair estimate of the value to them of improved water quality.

4   Theoretical concepts

4.1   Consumer surplus

Economic value is defined as anything that adds to human well-being (Wilks 1990). The total economic value of a good is the maximum amount that individuals are willing to pay to avoid going without the good. The maximum willingness to pay is indicated by the amount actually paid plus the amount that buyers would be willing to pay to obtain the good. This additional monetary amount is the consumer surplus.

The consumer surplus can be calculated from the demand curve for a good, which is the total quantity demanded by all consumers for the good at different prices. Along this curve a rise in price results in the substitution of alternative goods. The consumer surplus is the area measured under the demand curve but above the market price in figure 1.

Total economic value, and total willingness to pay are represented by the whole area under the demand curve.

FIGURE 1: CONSUMER SURPLUS

Price
($)

Consumer Surplus

10

Actual Payments

0   50   Quantity
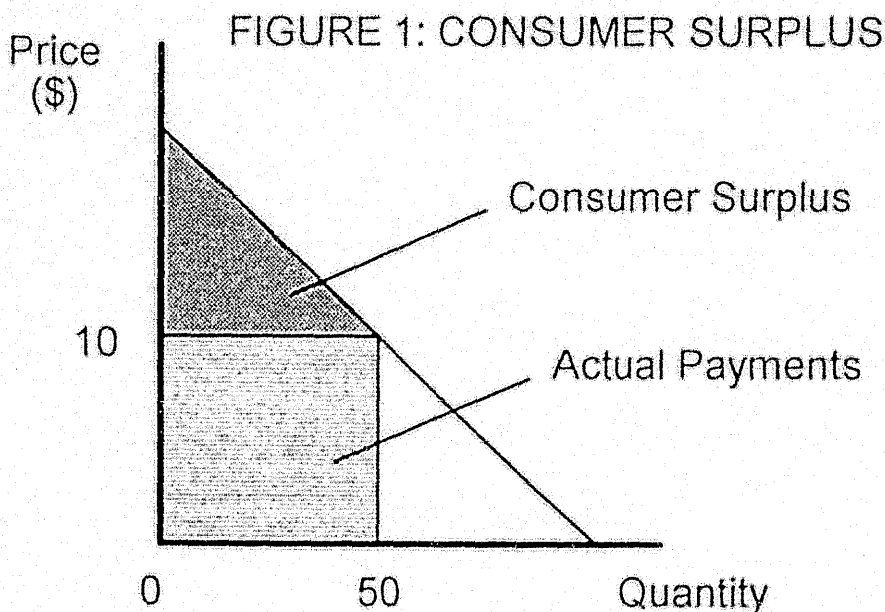
This Marshallian demand curve assumes that income is constant rather than holding the level of utility constant.

Under the Hicksian demand curve income adjustments are made to ensure that all points along the demand curve provide the same utility to the consumer. The Hicksian demand curve demonstrates two measures of the gain or loss that hold utility constant at the initial level (compensating variation and surplus), and two measures that hold utility constant at some specified alternative level (equivalent variation and surplus).

The compensating measures use the initial utility level as the reference level so the consumer needs to be willing to accept compensation to move to a less preferred situation or willing to pay to obtain a more preferred situation. Equivalent measures use the alternative welfare level as a reference level so

the consumer must be willing to pay to avoid a less preferred situation or willing to accept compensation to forego a more preferred situation (Wilks 1990)

For example, if a proposed irrigation development causes loss of wildlife habitat, there are two ways of measuring the value of losses to those that enjoy the habitat. One is to determine the individuals' willingness to accept compensation to tolerate the industrial development (compensating measure). The other is to estimate the amount of money the individual would be willing to pay to avoid any habitat loss (equivalent measure)

Theoretically the two methods provide similar results, with the Marshallian approach tending to underestimate consumer surplus compared to the Hicksian approach (Sinden and Worrell 1979). The difference is small if,
* income elasticity of demand for the good is small
* the good is a small proportion of the individuals' budget or
* the good has close substitutes

Applying this economic theory the willingness to pay study undertaken here looks at the compensating surplus. Respondents are willing to purchase a preferred situation where the quantity of the good to be purchased, such as a limited improvement in water quality, is constrained. A compensating variation would be where the consumer is free to vary the quantity of the good under discussion

However in reality values for willingness to accept a loss are higher than willingness to pay for a gain (Knetsch and Sinden 1984, Knetsch 1993). Knetsch (1993 p 13) writes "The assumption that people feel the same about the willingness to pay for a gain and the compensation demanded to accept a loss has long been a staple of economic practice and policy analyses. No reckoning of any difference is made or thought necessary. As a result, the more conveniently measured willingness to pay has become the measure of choice for both gains and losses

There is, however, little data to support this traditional view of equivalence or the presumption that willingness to pay measures adequately assess the value of losses. Instead, the empirical evidence from many controlled tests consistently shows that losses matter much more to people than gains, and that reductions in losses are more valuable than foregone gains"

Under the philosophy that people "own" a right to a clean Darling River, such a study would look at willingness to accept compensation. There is no doubt that undertaking this contingent valuation study as a willingness to pay question can be expected to underestimate rather than overestimate values

4 2 Use and non use benefits

Non market environmental benefits can be categorised in two ways, use and non-use benefits

Use benefits accrue from the physical use of environmental resources such as visiting a wetland, recreational fishing or enjoying a view. Benefits from agriculture, forestry and fisheries are also classified as use benefits

Non-use benefits are the psychological benefits obtained from environmental resources without direct use of the resource

Wilks (1990 p. 6) classifies non use benefits into five types and describes them thus;

- existence value; the value obtained from the knowledge that an environmental amenity exists or the knowledge that culturally important resources are protected.

- vicarious value; the value obtained from the indirect consumption of an environmental good through the media for example.

- option value; the value obtained by retaining the opportunity to use an environmental amenity at some future date.

- quasi-option value; the value of the opportunity of obtaining better information by delaying a decision that may result in irreversible environmental loss. Such benefit may be obtained by the benefit associated with the possibility that future technologies or knowledge may enhance the value of a natural resource.

- bequest value; the value the current generation obtains from preserving the environment for future generations.

This study does not attempt to identify or separate use and nonuse values. However, respondents in the Darling River region are more likely to be concerned about use values than those in the Sydney and rest of NSW samples. This is supported by the fact that the Darling River is the major water supply source for the Darling region and there were few respondents in the other samples who had actually visited the Darling River in the last five years. Thus most Sydney and the rest of NSW region respondents would value non use benefits.

A number of studies (Walsh et al (1990), Rahmatian (1987). Stone (1991)) have indicated that use benefits are valued much lower than non use benefits which is in conflict with the results of this study.

5.   The Study

5.1 Background

In December 1991 there was an extensive blue green algal presence along 1000 km in the Barwon - Darling River. In fact it was the world's largest recorded riverine blue-green algal bloom. (New South Wales Blue - Green Algae Task Force 1992). There was intense media coverage of the bloom as well as considerable journalistic interest in the causes of apparently declining water quality in general, and in the Barwon -Darling river system in particular. Many of the newspaper articles were informative and served to educate readers about the causes of algal blooms but more importantly the blame was ultimately correctly placed squarely on a variety of activities in the catchments of the rivers, rather than on specific water users.

Blue green algae growth is encouraged by a combination of a number of factors such as,
- high nutrient levels, significantly nitrogen and phosphorous
- high water temperature (above 20 degrees Celsius)
- high alkaline and low carbon dioxide concentrations
- abundant zooplankton
- low flows
- low turbidity resulting in increased light intensity.

The report of the Blue - Green Algae Task Force stresses that management of the blue green algal problem must be cost effective and that the benefits of minimising blooms and their impacts should at least equal the costs. This study applies the contingent valuation method to quantify those benefits of improved water quality in the Darling River.

Figure 2   Barwon - Darling blue green algal bloom December 1991

algal blooms Dec 1991
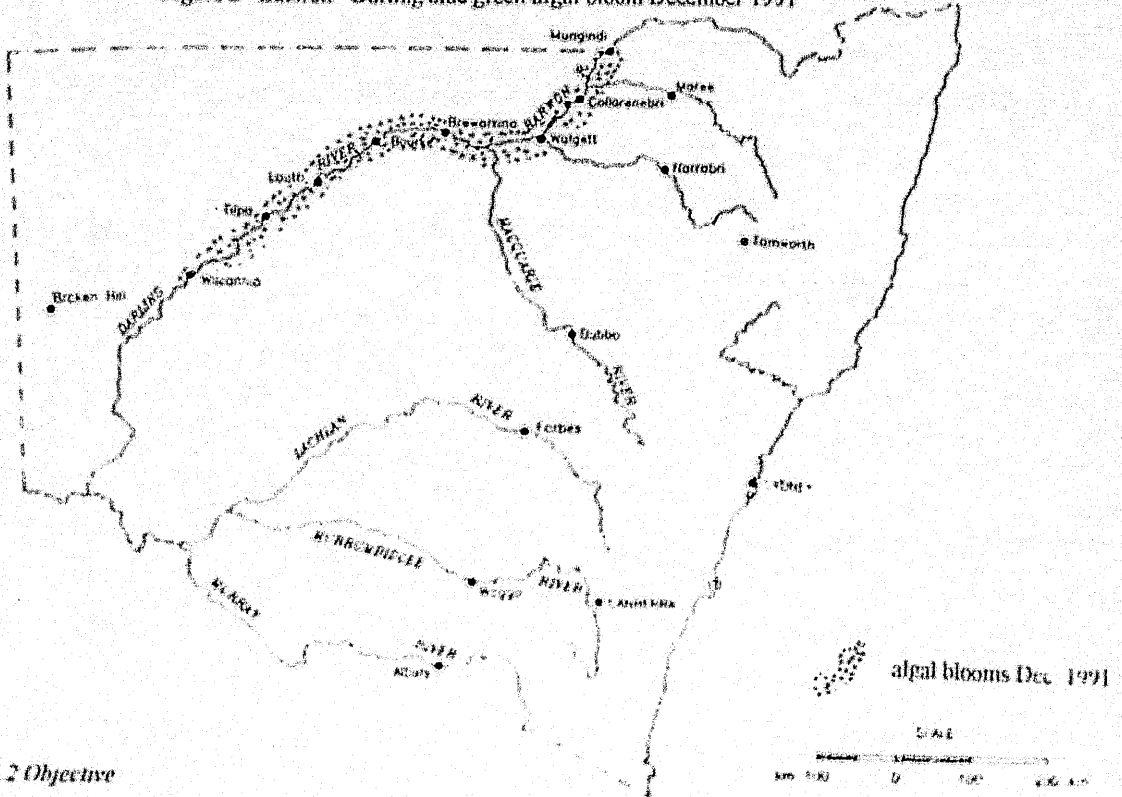
5.2 Objective

The contingent valuation study had two objectives. One was to explore a methodology suitable for addressing environmental evaluation issues facing the department Thus the study looked at establishing a value held by the New South Wales' public for improved water quality in the Darling River The second objective looked at two forms of the willingness to pay question to assess their effect on results

5.3 Sampling

The survey was broken into two components:
- those households that were asked a two stage discrete choice willingness to pay question (survey A) and
- those that were asked an open ended willingness to pay question (survey B)

In all other respects the questionnaires were identical

Survey A sampled 450 households from New South Wales as follows.

Table 1   Sample size by Region

Region	sample size (households) Survey A
Sydney	150
Darling River	150
Rest of New South Wales	150
Total	450

8

Survey B sampled 100 households in the Sydney region.

AGBMcNair undertook the sample design and interviewing which was by telephone. The Sydney and rest of NSW samples were selected by the Random Digit Dialling (RDD) system. For the Darling River Region, they used a random sample from the Oz On Disk file, which is a computerised database derived from the white pages telephone directory. This is preferred to the RDD system because it is more efficient in selecting respondents living close to the Darling River. Telephone numbers were randomly selected from subscribers in Bourke, Louth, Menindee, Poonearie, Tilpa, Trevallyn, Wentworth and Wilcannia.

5.4 Questionnaire design

Considerable time and effort were spent on questionnaire design and pretesting. Because the interviewing was being undertaken by telephone the problem was to develop a willingness to pay scenario that conveyed sufficient accurate information in a short time frame without creating confusion or disinterest.

The final form of the questionnaire was almost the same as that used in the pretesting. Feedback from the interviewers in the first pretest indicated that the descriptive passages concerning the willingness to pay scenario were clear and well understood by respondents. Thus the time taken in the early preparation to refine the description was well worth while. Feedback also indicated that generally respondents appeared interested in the subject.

The survey was based on the household response with the payment coming from household income rather than individual incomes. It was felt that this would more accurately reflect willingness to pay among those respondents not specifically earning money.

5.5 Willingness to pay question

To introduce the subject of the Darling River and its location, respondents were asked if they had "travelled to western NSW and seen the Darling River in the last 5 years?" They were prompted if necessary by the following information,

> *"The Darling River starts near Bourke in far north New South Wales. It flows over 2,000 km in western New South Wales through the towns of Bourke, Louth, Wilcannia and Menindee into the Murray River near the Victorian border and is a major source of water for western New South Wales."*

The willingness to pay scenario was presented as follows,
> *"Currently the water quality in the Darling River is often poor due to pollution. During summer there are many blue green algal blooms. When there is an algal bloom people can't swim or fish in the river. People and animals should not drink the water. However, the water can still be used for irrigation.*
>
> *The water quality in the Darling River could be improved if pollution into the river was reduced. This would require better sewerage treatment for towns along the river and less polluted runoff from farms, industries and towns. Then the river water would be OK for swimming, boating and fishing. People should still not drink the untreated water but animals could.*
>
> *Improving the water quality requires money for scientific and farm management research, education, improved sewerage treatment and tighter restrictions on industrial waste.*
>
> *The money needed would be collected through a once off surcharge on State taxes."*

In the final questionnaire of survey A respondents were asked,
> *"Given other expenses and your household income would your household be willing to pay a once off surcharge of $x ($50, $100, $200) to improve water quality in the Darling River?*

If the respondent answered "yes" they were then asked,
> *"What if the cost to your household of improving the water quality turned out to be higher, would you be willing to pay a once off surcharge of $y? ($100, $200, $400)*

If they answered "no" they were asked,
> *"What if the cost to your household of improving the water quality turned out to be lower, would you be willing to pay a once off surcharge of $z? ($20, $50, $100)*

In survey B respondents were asked the open ended question,
> *"Given other expenses and your household income would your household be willing to pay a once off surcharge to improve water quality in the Darling River? If Yes, How much would you be willing to pay?"*

5.6 Payment vehicle

The questionnaire used the payment vehicle of state taxes Respondents were told that an improvement in water quality in the Darling River required a once off surcharge on state taxes A once off charge was considered to minimise problems of discounting future costs State taxes could be expected to draw protest votes, as could other forms of taxes or rates

5.7 Pretesting

Much thought was given to the need for focus grouping and/or pretesting Early informal discussions indicated that the subject of water quality in the Darling River was readily understood so focus grouping was not undertaken However it is acknowledged that a different, more complex or less well defined subject might well need such discussions

Two pretests were carried out, interviewing 20 households in the Bourke region and 60 in the Sydney region Pretesting was used to fine tune the questionnaire and to establish appropriate ranges for the willingness to pay amounts

6.   Study results

6.1 Willingness to pay values

This study used survival analysis to predict, as dollar values rise, the point at which a household would no longer be willing to pay for water quality improvement

Four functional forms, the Weibull, exponential, log normal and log logistic were fitted to the data using maximum likelihood regression techniques to obtain an estimated "survival function"

The Weibull distribution was chosen as the best parametric fit It had the highest log-likelihood statistic and was considered to have the consistently best parametric estimator

The discrete choice willingness to pay question (Survey A) gave a median willingness to pay as follows,

Table 2: Median willingness to pay by Region

Region	Household willingness to pay	standard error
Sydney	$ 118	13
Darling River	$ 153	14
Rest of New South Wales	$ 105	12

These results indicate that respondents in the Darling River region are placing a higher value on improved water quality than respondents in Sydney and the rest of New South Wales

The 25th and 75th percentiles indicate the spreads of willingness to pay values between regions

Table 3: Spread of household willingness to pay by Region

Region	Percentile (Standard Error)		
	25	50	75
	$	$	$
Sydney	45 (7)	118 (13)	253 (27)
Darling River	65 (8)	153 (14)	299 (27)
Rest of New South Wales	40 (6)	105 (12)	227 (2)

The open ended willingness to pay question (Survey B) gave quite a different median value of $20 (with a 95% confidence interval of $10-$30) A zero willingness to pay was offered by 21% of the sample while 80% of the sample would pay less than $50

Respondents under the age of 35 years show a higher estimated willingness to pay than those over 35 years

Table 4: Median willingness to pay by age

Age in years	$	standard error
18-24	156	49
25-34	159	27
35-44	113	27
45-54	87	21
55+	85	14

Respondents not in the labour force had the lowest estimated median willingness to pay while blue collar workers and upper white collar workers had higher and similar willingness to pay levels

Different levels of education had little effect on willingness to pay. However as income increases there is a tendency for the median willingness to pay to increase.

Table 5: Median willingness to pay by household income

Annual household income	$	standard error
< $20,000	92	15
$20,000-$30,000	89	19
$30,001-$40,000	186	29
$40,001-$60,000	123	27
$60,000+	156	44
not stated	91	35

6.2 Attitudinal questions

Incorporated in the survey were a number of attitudinal questions designed to provide a contextual framework for the willingness to pay scenario.

To summarise;
- generally the respondents considered the government was not spending enough on improving education and training facilities, fighting crime, reducing pollution, improving community health, road works and unemployment but was spending the right amount or too much on defence. (Note that the order of this list was rotated by the interviewers)

- Air pollution was considered to create the worst problems for the Sydney and rest of NSW sample but water pollution created the worst problems for the Bourke sample.

- Across the three regions pollution problems in the rivers are considered to be worse than pollution problems in the oceans.

6.3 Behavioural questions

A behavioural question was asked on behalf of the DWR Marketing and Public Relations section to provide a benchmark for a phosphate awareness program that was about to be launched. The results indicate that while a small majority of respondents claimed to use phosphate free detergents a large number did not know whether they did or not (26%).

The question on using unbleached toilet paper or other environmentally friendly cleaning products is very similar to a behavioural question asked in the Resource Assessment Commission's contingent valuation survey of the Kakadu Conservation Zone held in 1990. (The RAC question asked "Do you regularly buy unbleached toilet paper or environmentally friendly cleaning products") The RAC response was yes by 71% of the national sample, this survey's yes response was 86%.

A good majority of households (about 80%) in all sample regions recycle glass and/or paper and/or plastic despite the fact that there is little provision for local council recycling collection in the Darling River region.

There was no difference in willingness to pay between those classified as environmentally aware (those answering "yes" or "sometimes" to phosphate free use, or "yes" to recycling) and those not environmentally aware.

7.   Validity

The contingent valuation method is subject to a number of potential biases that can reduce the reliability of results (Edwards and Anderson (1987)) A well thought out questionnaire and survey design will minimise these.

7.1 Interviewer bias

Interviewer bias can occur in telephone interviews and personal interviews where the interviewer, consciously or otherwise influences the respondents' answers. This can occur when the respondents attempt to please the interviewer by providing "correct" or "acceptable" answers or the interviewer leads a response. In this survey all interviewers were professional and well briefed. Each interviewer conducted interviews from all three sample regions, interviewed for survey B and all versions of survey A. Analysis of the interviewers' results does not indicate the presence of interviewer bias

7.2 Starting point bias

Starting point bias occurs when the initial dollar amount presented influences the respondents' answers. To minimise this effect two pretests were undertaken to establish reasonable dollar ranges for the discrete choice survey

The first pretest consisted of 20 interviews in Sydney and 20 in the Bourke region. To establish a reasonable payment frame respondents were asked a two stage discrete choice question and then an open ended question that is, would they pay $100 and if "yes" would they pay $200 and again if "yes" then how much more

If the initial $100 was too high, they were asked if they would pay $50 and if not they were asked how much they were willing to pay. The aim was to establish an appropriate range of values that reflected willingness to pay. For the Bourke sample respondents gave a range of $0-$500 while the range for the Sydney sample was $0-$600

The second pretest interviewed 40 respondents in Sydney. It dropped the open ended question but kept the two stage discrete choice question, asking one Sydney sample of 20 if they were willing to pay $50, $100 or $25, and asking the other Sydney sample of 20 if they were willing to pay $200, $500 or $100.

Analysis of the Sydney pretest results indicated a willingness to pay of about $120 - $140. These results were used to design the dollar values in the final questionnaire

However the percentage responding "yes" in the pretests was higher given a higher starting value, and more so at $100 than $50. The results of the combined Sydney sample of 60 did indicate some starting point bias

The final questionnaire started at three different willingness to pay amounts in an attempt to minimise any such bias. The ranges were supported by information gathered in the pretesting

Survival analysis was conducted for each of the sample groups corresponding to the three starting points. The final results indicate that this range of dollar values influenced the willingness to pay amount and that there is some starting point bias in this survey

Table 6:   Spread of household willingness to pay by starting point of sample

Starting point of sample	Percentile		
	20 $	50 $	80 $
$50, $100, $20	23	69	155
$100, $200, $50	26	86	211
$200, $400, $100	108	224	385

A common criticism of the open ended question is that the public finds it difficult to value environmental goods as they have no comparison framework in which to make a decision. In survey B the median willingness to pay focuses on $20, which is the same as the quarterly environmental levy paid by the sample to the Sydney Water Board. It is quite conceivable that this levy influenced respondents' values

7 3 Payment vehicle bias

Payment vehicle bias can occur when respondent's willingness to pay is influenced by the specified payment vehicle. This is reflected in some zero bids which in fact are considered protest bids against the payment vehicle. To establish if zero bids were protest bids the questionnaire asked why a zero bid was offered. Interviewers were requested to probe fully to determine whether the recorded zero amount was a genuine valuation of the subject or a protest bid. The zero answers were coded as follows with the protest bids asterisked.

- Can't afford it/no money/saving money
- * pay enough taxes already
- people causing problem should pay
- river users should pay
- don't use much water/it's not up to us/doesn't concern me
- * don't trust them to allocate funds/mismanagement of funds
- need more information before I would pay
- * government should find some other way
- local river very polluted - clean that first/too far away
- * already pay environmental levy

The four categories of protest responses accounted for 84 respondents in survey A and were taken out of the final analysis. The protest responses in both Survey A and B were fairly evenly distributed across regions

7 4 Strategic bias

Strategic bias occurs when the respondents reply in a manner designed to influence the outcome of the survey, rather than reflecting their true willingness to pay. In a telephone interview this is minimised given the short time frame of the survey

As well the use of a discrete choice question minimises the opportunity for respondents to give unrealistic answers

However, in the weeks before the survey was held there were two occurrences that were considered likely to influence overall results. One was the lack of water flowing in the Darling River due to drought. This was expected to increase antagonism towards the department as well as to upstream

users. It was uncertain as to how this would affect results, whether it would increase protest votes, increase awareness of water quality and/or increase demand for improved water quality.

The other occurrence was the adverse publicity in the media given to the Sydney Water Board concerning its expenditure and lack of perceived effectiveness of the environment levy. It was anticipated that this publicity could dampen stated willingness to pay or increase protest votes. The existence of an environmental levy in the Sydney region could influence strategic behaviour in understating willingness to pay, or provide a benchmark for willingness to pay. The results suggest that the benchmark concept and the dampened willingness to pay occurred in the answers to the open ended question.

7.5 Sampling bias

Because the interviewing was by telephone the population being sampled was households with a telephone. In the Darling River region the population was further limited to households with listed telephone numbers although it would be expected that the number of unlisted phone numbers would be very small in the area.

In the Sydney and rest of New South Wales regions the survey again would exclude households without phones but unlisted numbers would have the same probability of being included.

The effect of this sampling method on final results is unknown but expected to be small.

7.6 Non response bias

Of the 593 telephone calls that did not result in a completed questionnaire the greatest number (383) were refusals to participate. While no details were kept on these refusals it cannot be assumed that they were all willing to pay nothing. The overall effect on the results is unknown.

7.7 Information bias

The amount and content of information can influence the results of a survey (Bergstrom, Stoll and Randall 1989,1990).

As mentioned considerable thought went into providing a well-balanced view of water quality given the time and comprehension limitations of a telephone interview. The improved water quality scenario was considered realistic given likely funds available from a once off surcharge and the complexity of improving quality. The fact that there was no confusion reported by interviewers and the varying and plausible reasons given for zero bids support the view that a well balanced, well understood scenario was presented.

8. Conclusion

Valuing the environment is a process fraught with difficulty and scepticism. Many consider it unnecessary and impossible to place a value on aspects of the environment. However both environmentalists and economists have faced the frustration of decisions being based on inadequate recognition of unquantified costs and benefits.

The first objective of this study was to determine if this contingent valuation technique can be applied to environmental evaluation issues facing the department. This study indicates that the contingent valuation is one method that can be used and is appropriate for the type of problem posed here, that is what are people willing to pay to improve an aspect of their environment, water quality. This study demonstrates that people do value an improvement in water quality.

Contingent valuation is of particular use where issues require thorough analysis and are complex. It can be applied when the issue is potentially divisive, politically touchy or where possible solutions involve large expenditures.

Given the nature of the procedure the results should be interpreted as estimates. The results of this survey indicate there is no doubt that people do value better water quality, whether they are situated close to the river and using the water, or whether they are far away and presumably valuing a non use benefit.

The second objective was to determine the effect of two different forms of the willingness to pay question. There is no doubt that the different questions have resulted in significantly different answers.

The next question is whether these two answers cast doubt on the validity of the method, or serve to highlight the importance of wording the question and interpreting the answers.

Given the careful questionnaire design, the representativeness of the sample, and minimal effects of the numerous possible biases, it is fair to anticipate that 50 % of the population will pay at least the $20 estimate from the open ended question. Aggregated for Sydney alone this means a once off payment of $26 million. In all probability, as indicated by the discrete choice question, a large number of the population will pay more, therefore the results of the open ended questionnaire can be considered a minimum amount.

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Water quality improvement in the Darling River

A contingent valuation study

Questionnaire

DARLING RIVER CVS ANALYSIS

INTRODUCTION: Hello, I'm............ ....from AGB McNair the research company. We are talking to a cross section of people in New South Wales on behalf of the Department of Water Resources about how much they value publicly funded projects? Your views will be used to help policy makers make more informed decisions.

Let me begin by saying that most of the questions have to do with your attitudes and opinions. There are no right or wrong answers.

This interview is completely confidential. Your name will not be associated with these answers.

Q.1 First I'm going to read a list of several issues which have been of concern to taxpayers. For each, please tell me if you feel that the amount of money governments are spending is too much, the right amount or too little.

ROTATE	TOO MUCH	RIGHT AMOUNT	TOO LITTLE	DK
1) Improving education and training opportunities	1	2	3	9
2) Fighting crime	1	2	3	9
3) Reducing pollution	1	2	3	9
4) Defence	1	2	3	9
5) Improving community health	1	2	3	9
6) Roadworks	1	2	3	9
7) Unemployment	1	2	3	9

Q.2 As you are aware pollution can lower the quality of our environment. For example air is polluted through car exhausts, land through garbage dumps and water through sewerage.

Which type of pollution do you think creates the worst problems in Australia - air pollution, land pollution or water pollution?

Air pollution	1
Land pollution	2
Water pollution	3
Combination	4
Couldn't say/All are bad	5
Don't know	9

Q.3 Which do you think is worse, the pollution problem in NSW rivers or the pollution problem in the oceans off the NSW coast?

Pollution problem in NSW rivers	1
Pollution problem in oceans off NSW	2
Couldn't say/Both are bad	3
Don't know	9

I would now like to ask you some questions about the Darling River

[IF SYDNEY INTERVIEW GO TO Q.5b]
[IF NOT A BOURKE/WILCANNIA INTERVIEW GO TO Q.4b]

Q.4a Do you live within a half hour drive of the Darling River?

Yes	1 ➤ Q.5a
No	2 ➤ Q.15

Q.4b Do you live within two hours drive of the Darling River?

Yes	1
No	2 ➤ Q.5b

Q.5a   Do you use the Darling River in any of the following ways? READ OUT

                                                                        YES
Recreation   1
Drinking water, including town drinking water supply   2
In your house or garden, including for cooking   3
For animals   4 ──► Q.6a
Irrigation   5
Other (SPECIFY)

                                                                         8

Q.5b   Have you travelled to western NSW and seen the Darling River in the last 5 years?
        PROMPT IF NECESSARY: The Darling River starts near Bourke in far north NSW. It flows over
        2,000kms in western NSW through the towns of Bourke, Louth, Wilcannia and Menindee into the
        Murray River near the Victorian border and is a major source of water for western NSW

        Yes   1
        No   2 ──► Q.6a

Q.5c   Did you undertake any activities on, in or along the banks of the river?

        Yes   1
        No   2 ──► Q.6a

Q.5d   What were those activities?

        Sightseeing   1
        Water skiing   2
        Picnicing   3
        Fishing   4
        Swimming   5
        Other (SPECIFY)

                                                                         8

Q.6a   Currently the water quality in the Darling River is often poor due to pollution. During summer there are
        many blue green algal blooms. When there is a bloom people can't swim or fish in the river. People
        and animals should not drink the water. However, the water can still be used for irrigation. PAUSE

        The water quality in the Darling River could be improved if pollution into the river was reduced. This
        would require better sewerage treatment for towns along the river, and less polluted run off from
        farms, industries and towns. Then the river water would be OK for swimming, boating and fishing.
        People should still not drink the untreated water but animals could. PAUSE

        Improving the water quality requires money for scientific and farm management research, education,
        improved sewerage treatment and tighter restrictions on industrial waste. PAUSE

        The money needed would be collected through a once off surcharge on state taxes

        Given other expenses and your household income would your household be willing to pay a once off
        surcharge of [VERSION 1 $50, VERSION 2 $100, VERSION 3 $200] to improve water quality in the
        Darling River

        Yes   1
        No   2 ──► Q.6c

Q.6b   What if the cost to your household of improving the water quality turned out to be higher, would you be willing to pay a once off surcharge of [VERSION 1 $100, VERSION 2 $200, VERSION 3 $400]

Yes 1
No .... 2 ──► Q.8

Q.6c   What if the cost to your household of improving the water quality turned out to be lower, would you be willing to pay a once off surcharge of [VERSION 1 $20, VERSION 2 $50, VERSION 3 $100]

Yes .... 1 ──► Q.8
No 2

Q.7a   Why is your household not willing to pay a [VERSION 1 $20, VERSION 2 $50, VERSION 3 $100] once off surcharge to improve the water quality of the Darling River?

VERSION 4: Q.6a & Q.6b TO REPLACE Q.6a-Q.7b

Q.6a   Currently the water quality in the Darling River is often poor due to pollution. During summer there are many blue green algal blooms. When there is a bloom people can't swim or fish in the river. People and animals should not drink the water. However, the water can still be used for irrigation. PAUSE.

The water quality in the Darling River could be improved if pollution into the river was reduced. This would require better sewerage treatment for towns along the river, and less polluted run off from farms, industries and towns. Then the river water would be OK for swimming, boating and fishing. People should still not drink the untreated water but animals could. PAUSE

Improving the water quality requires money for scientific and farm management research, education, improved sewerage treatment and tighter restrictions on industrial waste. PAUSE

The money needed would be collected through a once off surcharge on State taxes.

Given other expenses and your household income would your household be willing to pay a once off surcharge to improve water quality in the Darling River IF YES: How much would you be willing to pay?

None   000

AMOUNT $ ──► GO TO Q 8

Q.6a   Why is that? (PROBE FULLY)

7b   How much would your household be willing to pay as a once off surcharge?

None.   000

AMOUNT $

The next few questions are about household products and recycling

8   Does your household use Phosphate free detergents?

Yes   1
No   2
Sometimes   3
Don't know   9

9   Does your household use unbleached/recycled paper or other environmentally friendly cleaning
       products?

Yes   1
No   2
Don't know   3

10   Does your household recycle paper, glass or plastic products?

Glass   1
Paper   2
Plastic   3

No   4

11   Does your local council provide collections of paper, glass and plastic for recycling?

Paper   1
Glass   2
Plastic   3

None   4

Finally, I have a few questions about yourself and your household. These questions enable us to be sure that
we are speaking to a good cross section of the community

12   What is the highest level of education you have so far obtained? READ OUT

Primary School   1
Secondary School   2
TAFE/Technical Qualification   3
University/Tertiary Qualification 4

13   Could you please tell me your employment status?

Employed   1

Unemployed   2
Retired   3
Student   4   ➔ Q.15
Home duties   5
Other (SPECIFY)

                                  8

Q.14   In which of the following Industry categories do you work? READ OUT

Agriculture 1
Manufacturing........................ 2
Construction........................... 3
Wholesale and Retail 4
Transport and Storage............. 5
Finance, Property & Business Services 6
Something else (please describe)

.... 7

Q.15   Into which of the following age groups do you fall?

18-24 years   1
25-34 years   2
35-44 years   3
45-54 years   4
55-64 years   5
65+ years   6

Q.16   Can you please tell me the number of people in your household aged 16 years or over?

Q.17   And how many people are there in your household aged under 16 years?

Q.18   What is the occupation of the main income earner in your household? CODE FROM
OCCUPATION SHEET INTO THE FOLLOWING CODE FRAME

Lower blue collar (cleaner, fruit picker, window washer)   01
Lower blue collar (removalist, truck driver, roadworker)   02
Upper blue collar (carpenter, butcher, cook)   03
Upper blue collar (policeman, nurse, technical officer, foreman) 04
Lower white collar (sales, business owner, clerical)   05
Upper white collar (engineer, chemist, senior manager)   06
Upper white collar (solicitor, company director, doctor)   07
Student, housewife, home duties   08
Retired, pensioner, unemployed (SPECIFY)

                                                                 09

Refused   97
Other   98

Don't know   99

Q 19   Into which of the following broad pre-tax income brackets does your household fall into? READ OUT

$10,000pa or less 01
$10,001 - $15,000pa 02
$15,001 - $20,000pa 03
$20,001 - $25,000pa 04
$25,001 - $30,000pa 05
$30,001 - $40,000pa 06
$40,001 - $60,000pa 07
$60,001 - $80,000pa 08
Over $80,000pa 09
Refused 10
Don't know 99

Q 20   RECORD SEX:

Male 1
Female 2

Thank you very much for your help.

I have conducted this interview. It is a full and to the best of my knowledge, accurate recording and has been completed in accordance with my interviewing and ICC/ESOMAR guidelines

Respondent's Telephone Number

Interviewer ID   [ ][ ][ ][ ][ ][ ]

Date