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GCES NON-USE VALUE STUDY

GCES Non-Use Values Final Study Summary Report

Prepared for:

Glen Canyon Environmental Studies
Non-Use Value Committee

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CHAPTER 1
OVERVIEW AND SUMMARY

The operation of Glen Canyon Dam has been the focus of an ongoing controversy. Operations that increase the value of electric power produced at the dam tend to result in substantial daily fluctuations in river levels below the dam. These fluctuations have been found to result in a decrease in the size and number of beaches and changes in the habitat of both terrestrial and aquatic species, including endangered fish species. In addition, dam operations have tended to reduce the quality of recreation on the river downstream from Glen Canyon Dam.

Changes made in the operations of the dam to benefit the downstream environment and the quality of recreation will reduce the value of power produced at the dam. This conflict over dam operations can be partially evaluated by measuring the relative economic value placed on electric power, recreation, and preservation of river-related resources downstream from Glen Canyon Dam. The Glen Canyon Environmental Studies (GCES) has sponsored a series of economic studies to measure these three values in a theoretically consistent way. This summary report describes the results of the GCES Non-Use Value Study, a study of values associated with preserving the river-related resources on the Colorado River downstream from Glen Canyon Dam. Non-use values are values that members of the public hold for environmental resources for reasons other than personal use. People may value resources they do not personally plan to use because they wish to see others, either of the present or future generations, have the opportunity to use them; because they are sympathetic to the plight of animals; because they simply enjoy knowing that those resources will continue to exist; or for other reasons.

Non-use values were measured for three of the nine alternatives evaluated in the Glen Canyon Dam Environmental Impact Statement (GCDEIS). These three alternatives include the moderate fluctuating flow alternative, the low fluctuating flow alternative, and the seasonally adjusted steady flow alternative. These alternatives were selected because together they covered a large portion of the range of alternatives evaluated in the GCDEIS and because it seemed likely that one of these alternatives (or something very similar) would eventually be selected as the preferred alternative in the GCDEIS.

Non-use values were measured using a contingent valuation mail survey. In a contingent valuation survey, respondents are asked questions about how much they would be willing to pay to either maintain or acquire a preferred level of some attribute of the environment. In the non-use value survey, respondents were first asked if they would vote in favor of a referendum on a proposal to change dam operations if passage of the proposal would cost

them nothing. Those in favor of the proposal were then asked how they would vote if passage of the proposal cost them a specified amount of money. Responses to this second question were used to make inferences about the value, or willingness-to-pay, placed by respondents on the proposal being evaluated.

For each of three alternatives mentioned above, willingness-to-pay was measured for a national sample as well as for a sample of individuals residing in areas served by power produced at Glen Canyon Dam (the "marketing area"). Proposals in the national samples included descriptions of the impacts the proposal would have on the number and size of beaches, archaeological sites and American Indian traditional uses, native fish, trout, electric bills for consumers of power produced at Glen Canyon Dam, and farm incomes. In the national sample, willingness-to-pay was measured by asking respondents whether they would vote for a proposal to change dam operations if passage meant they would have to pay increased taxes. In the marketing area sample, proposals included descriptions of the proposal's impacts on the number and size of beaches, archaeological sites and American Indian traditional uses, native fish, and trout. Willingness-to-pay in the marketing area was measured by asking respondents how they would vote on a proposal to change dam operations if passage increased their monthly electric utility bill. Responses from residents in the marketing area may carry additional validity, since these people will pay higher utility bills if dam operations are changed.

Estimated willingness-to-pay in the national sample for each of the three alternatives evaluated is shown in Table 1-1. Estimated willingness-to-pay for the market area is shown in Table 1-2 (see Chapter 5 for details on calculation).

Table 1-1
Summary of Estimated Willingness-to-Pay -- National Sample

Water Release Alternative	Average Annual Value Per Household[a]	Aggregate Annual Value[b] (Millions of Dollars)
Moderate fluctuating flow (Version 1)	$13.56	$2,286.4
Low fluctuating flow (Version 2)	$20.15	$3,375.2
Seasonally adjusted steady flow (Version 3)	$20.55	$3,442.2

[a] Best estimates based on "Definitely Yes" models, adjusted to reflect values of nonrespondents and to reflect the belief that the respondent would actually have to pay if the proposal passed. For details see Chapter 5.

[b] Levelized annual values extrapolated to the national population. See Chapter 5 for additional details on the procedures used to calculate these numbers.

Table 1-2
Summary of Estimated Willingness-to-Pay -- Marketing Area Sample

Water Release Alternative	Average Annual Value Per Household[a]	Aggregate Annual Value[b] (Millions of Dollars)
Moderate fluctuating flow (Version 5)	$22.06	$62.2
Low fluctuating flow (Version 6)	$21.45	$60.5
Seasonally adjusted steady flow (Version 7)	$28.87	$81.4

[a] Best estimates based on "Definitely Yes" models, adjusted to reflect values of nonrespondents and to reflect the belief that the respondent would actually have to pay if the proposal passed. For details see Chapter 5.

[b] Levelized annual values extrapolated to the population of households residing in areas served by utilities with firm power contracts for power produced at Glen Canyon Dam. See Chapter 5 for additional details on the procedures used to calculate these numbers.

CHAPTER 2
CONCEPTUAL CONTEXT

Glen Canyon Dam has been producing electric power for over 30 years. For most of this time, typical power operations resulted in large daily fluctuations in the level of the Colorado River downstream from the dam. Concern about the environmental consequences of these daily fluctuations resulted in the initiation of the Glen Canyon Environmental Studies (GCES). The initial phase of GCES demonstrated a link between the operation of the dam and downstream environmental conditions. This link and continued concern about the effects of dam operations led then Secretary of the Interior Lujan, in 1989, to order the preparation of an environmental impact statement for the operations of Glen Canyon Dam. At this time, the GCES were directed to further document effects of dam operations on the downstream environment for use in the preparation of the Glen Canyon Dam Environmental Impact Statement (GCDEIS).

From the early days, the GCES recognized that in addition to affecting the natural environment, the operations of Glen Canyon Dam also affect the human environment. The initial phase of the GCES targeted the effects of dam operations on downstream recreation, including whitewater rafting and fishing. In a review of the initial GCES research, the National Academy of Sciences identified two additional aspects of the human environment for future study. These areas included the impact of changes in dam operations on the value of power produced at that dam and the existence, ~~or~~ non-use, values of resources affected by dam operations.

2.1 THE RELATION BETWEEN POWER PRODUCTION AND DOWNSTREAM RESOURCES

Glen Canyon Dam is an energy-constrained hydroelectric facility. This means that in a typical year, the annual release from the dam is not sufficient to sustain peak generation for the entire year. The economic benefits of energy-constrained hydroelectric facilities are maximized by concentrating water releases during periods of highest electrical demand. Historically, Glen Canyon Dam has been operated in this way. The consequence of this type of operation has been substantial daily fluctuations in the river flows below Glen Canyon Dam. These daily fluctuations tended to result in a net loss of sediment in the Colorado River below Glen Canyon Dam, resulting in a decrease in the size and number of beaches, and changes in habitat for both terrestrial and aquatic animals, including endangered species of fish. Daily fluctuations in water levels were also documented to decrease the quality of rafting and fishing on the Colorado River below Glen Canyon Dam (Bishop et al., 1987).

These linkages form the basis for conflicts over issues of dam operation. A change in dam operation that decreases the range of daily fluctuations is likely to reduce impacts to the downstream resources and to increase the quality of recreation. On the other hand, such a change will also reduce the value of the power produced at Glen Canyon Dam. From an economic perspective, this problem can be addressed by measuring the relative values placed on power, recreation, and the protection of resources affected by the operations of Glen Canyon Dam. To this end, GCES has carried out a series of economic studies designed to measure each of these values.

The value associated with environmental preservation is often referred to as "non-use value."[1] While the concept may be unfamiliar to non-economists, it has been a part of economic theory for over 30 years. Beginning with an article written by John Krutilla (1967), economists have come to recognize that economic values for public resources may not be limited to direct use values. For a variety of reasons, people may value environmental resources even though they do not benefit from directly consuming produced goods or recreational opportunities. They may, for example, be sympathetic toward animals, altruistic toward others in the current generation or future generations, or be concerned about maintaining the resource for future personal use. It is now widely agreed among economists (see, for example, Freeman 1993) that the value of a public resource may include non-use values in addition to the more traditionally measured use values. It follows that a full accounting of the values associated with changes in dam operations will include the non-use values, if they are present, as well as direct use values.

It should be noted that the value of a resource, regardless of the motivation for the value, is commonly referred to as a "total value." The values measured in this report are total values in that respondents were asked about their willingness-to-pay for a change in dam operations. Theoretically, the values expressed by survey respondents could arise from any one (or all) of the following motivations: a direct use of the resource (for example, rafting the Colorado River or hiking along the river below Glen Canyon Dam), a desire to preserve the option for future direct uses, and a desire to preserve the resources even in the absence of current or future use. Practically speaking, we suspect that non-use value is likely to be the primary motivation for total value of the resources affected by the operation of Glen Canyon Dam. For this reason, although the survey technically measures a total value, it is referred to in this report as a non-use value.

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[1] The term non-use value is used in this report to denote a value placed on a resource in the absence of any direct or indirect use of the resource. This type of value is sometimes referred to as passive use value. Non-use value could be a result of any or all of the following motivations: simply knowing the resource exists (existence value), a desire to maintain the resource for potential personal future use (option value), or a desire to have the resource available for others current and potential future use (bequest value).

CHAPTER 3
NON-USE VALUE STUDY PROCESS

The Glen Canyon Non-Use Value Study is the third component of the GCES Economic Studies. Previous studies have resulted in estimates of the economic value of downstream recreation (Bishop et al., 1987) and the value of power produced at the dam (GCES Power Resource Committee, 1995). The GCES Non-Use Value Study is the product of a series of distinct research steps conducted over the last five years.

At each step, the study was guided by the GCES Non-Use Value Committee. The committee consisted of representatives of federal agencies, American Indian tribes, and power consumer groups. A peer review panel consisting of four nationally prominent resource economists reviewed research plans and results at each key stage in the research. In addition, the Office of Management and Budget (OMB), which is required to approve all federally sponsored surveys, provided insightful suggestions during the approval process.

3.1 THE RESEARCH PLAN

The initial step in the GCES Non-Use Value Study was the completion of a report assessing the feasibility of estimating total values associated with the preservation of environmental resources in and along the Colorado River below Glen Canyon Dam. This effort was initiated in 1990 and completed in 1991. The report concluded that a total-value study, including the measurement of non-use values, should be a component of the GCES economic studies (Bishop and Welsh, 1992). The report further concluded that while the prospects appeared favorable, such a study should proceed in phases and be subjected to a peer review process at the conclusion of each phase. Subsequent phases would be recommended only with the approval of committee members and peer reviewers.

3.2 QUALITATIVE RESEARCH

The Non-Use Value Study was initiated with a qualitative research effort involving focus groups and in-depth personal interviews. The qualitative research phase had several objectives. These included:

- Exploring whether potential survey respondents could focus on affected resources as distinct from the Grand Canyon in its entirety;

- Exploring whether potential survey respondents care about the status of the affected resources;
- Exploring whether individuals geographically distant from Glen Canyon Dam care about the status of the affected resources;
- Exploring alternative methods for describing the environmental effects of dam operations; and
- Evaluating the performance of prototype survey instruments.

The qualitative research reinforced the conclusion of the original research plan. In particular, the results suggested that many citizens across the United States were concerned about the status of the affected resources. Issues of particular concern included beaches and vegetation, archeological sites, American Indian traditional use areas, native fish, trout, and price impacts to consumers of power produced at Glen Canyon Dam. Furthermore, the qualitative research also suggested that the study could be implemented using a mail survey instrument for primary data collection. In the summer of 1993, the results of the qualitative research phase and prototype mail survey instruments were reviewed by the both the GCES Non-Use Value Committee and an external peer review panel, and a decision was made to proceed with a pilot test.

3.3 PILOT TEST

The fall of 1993 was spent finalizing the design of survey instruments to be used in the pilot test and securing clearance from OMB to proceed with implementation of a pilot test. Implementation of the pilot test began in January 1994. Purposes of the pilot test included evaluating the performance of mail survey instruments, examining methodological concerns related to the validity of the contingent valuation method, and testing survey implementation procedures. The results of the pilot test suggested that the survey instrument and implementation procedures would result in valid estimates of non-use values associated with resources affected by the operation of Glen Canyon Dam. After review by the external peer review panel, a decision was made to proceed with a final study.

The final study design is the end product of an extensive research process that has been overseen at every step by the GCES Non-Use Value Committee. This review process provided valuable insights from a broad range of perspectives. In addition, members of the committee worked closely with members of the GCDEIS team to ensure that the survey instruments contained accurate descriptions of the expected consequences of each dam operation alternative. We believe the input from the committee, peer reviewers, and OMB has greatly enhanced the quality and overall validity of the GCES Non-Use Value Study.

CHAPTER 4
DESIGN AND IMPLEMENTATION OF THE NON-USE VALUE STUDY

The GCDEIS evaluated nine different dam operations alternatives in detail, including a no-action alternative. For the non-use survey, the no-action alternative was defined as the baseline (or current) dam operation condition. This baseline condition allowed substantial fluctuations in daily flows. Under the baseline, flows could range from 3,000 cubic feet per second (cfs) to 31,500 cfs between Easter and Labor Day and from 1,000 cfs to 31,500 cfs between Labor Day and Easter. Given the similarities in resource impacts between several of the nine alternatives and the depth of detail required to describe them, the GCES Non-Use Value Committee recommended that only three main alternatives be considered for the final study.

1. Moderate fluctuating flow alternative - featuring a moderate reduction in the magnitude of the daily fluctuations;
2. Low fluctuating flow alternative - featuring substantial reductions in the magnitude of the daily fluctuations; and
3. Seasonally adjusted steady flow alternative - providing steady flows on a seasonally adjusted or monthly basis.

These three alternatives covered most of the range of alternative dam operations being studied and were considered to include the set of alternatives most likely to contain the eventual preferred alternative. For more detailed information on alternative dam operations, refer to the GCDEIS (U.S. Bureau of Reclamation, 1995).

4.1 EXPERIMENTAL DESIGN

The experimental design included seven versions of a mail questionnaire, two samples, and a follow-up telephone interview with nonrespondents. Because any alternative water release from Glen Canyon Dam would affect resources found in the Grand Canyon National Park, the sampling frame included all residents of the United States. Two separate random samples were identified within this frame: a national sample and a marketing area sample. The national sample consisted of residents of the United States. The marketing area sample was a subset of the national sample. Members of the marketing area sample lived in areas served by power produced at Glen Canyon Dam. There were two primary differences between surveys administered to the marketing area sample and those administered to the national sample.

First, the surveys differed in the payment vehicle used to solicit non-use values in the contingent valuation question between the national sample and the marketing area sample. For the national sample, the payment vehicle consisted of an annual payment in increased taxes. For residents of the marketing area, increases in utility bills were used as a payment vehicle. Surveys administered to each sample also differed in the description of resources affected by the dam operation alternative. In the national sample, the survey contained a description of the environmental and power cost impacts of the operations alternative described. In contrast, the marketing area survey described only the environmental impacts of the dam operation alternative.

Separate survey versions were designed in order to address the three water release alternatives, resulting in a total of six survey versions (three for the national sample and three for the marketing area sample).

One additional survey version was developed for the national sample to examine in more detail the effects on the study of including the impacts that water flow alternatives would have on power costs.

Thus a total of seven versions of the Glen Canyon Studies non-use mail value questionnaire were developed to be administered to two samples. Table 4-1 identifies the differences between questionnaire versions.

Table 4-1
Identification of Glen Canyon Studies Non-Use Mail Questionnaire Versions

Questionnaire Version	Water Release Alternative
National Sample	
Version 1	Moderate Fluctuating Flow
Version 2	Low Fluctuating Flow
Version 3	Seasonally Adjusted Steady Flow
Version 4	Seasonally Adjusted Steady Flow with Moderate Fluctuating Flow Impact Costs to Power
Marketing Area Sample	
Version 5	Moderate Fluctuating Flow
Version 6	Low Fluctuating Flow
Version 7	Seasonally Adjusted Steady Flow

4.2 SAMPLING

The sampling frame included all residents of the United States. Two separate random samples were identified within this frame: a national sample and a marketing area sample. This design ensured that estimates of non-use values would reflect both the values held by United States residents as well as those values held by the individuals who would be affected by changing power values.

Both the national sample and the marketing area sample were purchased from Survey Sampling, Inc., an independent firm that specializes in maintaining national marketing databases. A sample of 5,950 individuals was selected: 3,400 for the national sample and 2,550 for the marketing area sample (Table 4-2). Four of the seven questionnaire versions were administered to the national sample, and three were administered to the marketing area sample. Each version was administered to 850 sample points.

The sample for the follow-up telephone survey consisted of the portion of national and marketing area samples for which no final mail disposition had been reached. Interviews were attempted with 1,708 individuals: 1,102 from the national sample and 606 from the marketing area sample (Table 4-2).

Table 4-2
Sample Sizes for the Glen Canyon Studies Mail Surveys and Follow-up Telephone Interviews

Questionnaire Version	Sample Size	
	Mail Survey	Telephone Survey
National Sample		
Moderate Fluctuating Flow (Version 1)	850	286
Low Fluctuating Flow (Version 2)	850	267
Seasonally Adjusted Steady Flow (Version 3)	850	272
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	850	277
Total	3,400	1,102
Marketing Area Sample		
Moderate Fluctuating Flow (Version 5)	850	207
Low Fluctuating Flow (Version 6)	850	205
Seasonally Adjusted Steady Flow (Version 7)	850	204
Total	2,550	606
Overall Total	5,950	1,708

4.3 SURVEY IMPLEMENTATION PROCEDURES

Mail questionnaires were administered using the Dillman (1978) method which included the following procedures:

1. An advance, introductory letter on U.S. Bureau of Reclamation letterhead, signed by the GCES manager. The letter explained the study and advised that a questionnaire would be sent within the week.

2. A survey mailing package containing a copy of the questionnaire, background information materials, a cover letter on U.S. Bureau of Reclamation letterhead, a stamped return envelope, and a $3 cash incentive.

3. A thank you/reminder postcard sent to all respondents, thanking those who had already responded to the survey and encouraging those who had not responded to please do so.

4. A second survey package containing a second copy of the questionnaire and background materials, a different cover letter, and a stamped return envelope.

5. A third survey package delivered via certified mail. This package also contained a copy of the questionnaire and background materials, a different cover letter, and a stamped return envelope.

The mail survey implementation began in October 1994 and was concluded in early January 1995. All mail survey versions were administered concurrently.

Follow-up telephone interviewing began on January 19, 1995, four weeks after the final survey mailing. Telephone interviews were attempted for all nonrespondents for whom telephone numbers could be obtained. All telephone interviews were conducted by experienced interviewers using Computer Assisted Telephone Interviewing (CATI) software at an in-house telephone laboratory in Madison, Wisconsin.

4.4 DATA PROCESSING

The disposition of all mail questionnaires was entered into a tracking database. The categories consisted of a completed questionnaire, an undeliverable questionnaire, a deceased individual, or a refusal. Completed questionnaires went through three stages of data processing: editing, data entry, and cleaning. Completed questionnaires were coded and prepared for data entry by data editors. Open-ended responses were coded, missing data were checked, and all fields were checked to ensure that invalid codes were not included. Missing data were studied to determine if the correct skip patterns had been followed. After editing, data entry personnel entered the completed questionnaires into an SPSS database. All data were subjected to 100 percent verification. All verified data were subjected to a cleaning process using a series of computer programs that identified out-of-range data points for each variable and cross-checked related questions. A survey research supervisor also inspected missing data for each of the survey variables.

All responses to the telephone survey were directly entered into computer files as the interview was carried out. Upon completion of the telephone survey effort, the CATI system

was used to clean the data. A data editor reviewed each completed interview, provided response codes to open-ended questions, and conducted consistency checks. Upon completion of the cleaning and coding process, the data were exported from the CATI system and imported to an SPSS data file.

4.5 RESPONSE RATES

Response rates for completed mail surveys are calculated as a percentage of deliverable questionnaires. The study achieved a response rate of 66 percent for the national sample, and 75 percent for the marketing area sample (Table 4-3).

Table 4-3
Glen Canyon Studies Non-Use Mail Survey Response Rates

	Sample Size	Out of Scope[a]	Completed Surveys	Response Rate[b]
National Sample				
Moderate Fluctuating Flow (Version 1)	850	188	426	64%
Low Fluctuating Flow (Version 2)	850	202	431	66%
Seasonally Adjusted Steady Flow (Version 3)	850	1,196	439	67%
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	850	190	432	65%
Total	3,400	776	1,728	66%
Marketing Area Sample				
Moderate Fluctuating Flow (Version 5)	850	219	467	74%
Low Fluctuating Flow (Version 6)	850	226	467	75%
Seasonally Adjusted Steady Flow (Version 7)	850	200	489	75%
Total	2,550	645	1,423	75%

[a] Includes cases where the addressee was deceased or the survey mailing was returned as undeliverable.

[b] Calculated as a percentage of deliverable questionnaires (sample size minus out-of-scope cases).

Response rates to the telephone survey of nonrespondents are shown in Table 4-4. Telephone interviews were completed with 35 percent of nonrespondents from the national sample, and with 46 percent of nonrespondents to the marketing area sample. The overall response rates for the combined mail and telephone survey are shown in Table 4-5.

Table 4-4
Glen Canyon Studies Non-Use Telephone Survey Response Rates

	Sample Size	Out of Sample[a]	Withdrawn from Sample[b]	Completed Interviews	Response Rate[c]
National Sample					
Moderate Fluctuating Flow (Version 1)	286	90	9	66	35%
Low Fluctuating Flow (Version 2)	267	92	6	53	31%
Seasonally Adjusted Steady Flow (Version 3)	272	79	9	69	37%
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	277	80	14	63	34%
Total	1,102	341	38	251	35%
Marketing Area Sample					
Moderate Fluctuating Flow (Version 5)	207	57	7	62	43%
Low Fluctuating Flow (Version 6)	205	63	7	58	43%
Seasonally Adjusted Steady Flow (Version 7)	194	42	6	74	51%
Total	606	62	20	194	46%

[a] Includes disconnected, no listing available, wrong phone numbers, and cases where the identified respondent was unavailable for the study duration, unable to participate due to physical or mental impairment, deceased, or had moved.

[b] Includes cases pulled from the sample before a final disposition was reached because a mail questionnaire was received during implementation of the telephone survey.

[c] Calculated as a percentage of available (reachable) respondents.

Table 4-5
Glen Canyon Studies Non-Use Survey Response Rates for the Mail and Telephone Surveys Combined

	Sample Size	Out of Scope[a]	Completed Surveys	Response Rate[b]
National Sample				
Moderate fluctuating flow	850	197	480	74%
Low fluctuating flow	850	211	472	74%
Seasonally adjusted steady flow	850	198	491	75%
Seasonally adjusted steady flow with moderate fluctuating flow impact costs to power	850	196	485	74%
Total	3,400	802	1,928	74%
Marketing Area Sample				
Moderate fluctuating flow	850	224	521	83%
Low fluctuating flow	850	233	508	82%
Seasonally adjusted steady flow	850	207	543	84%
Total	2,550	664	1,572	83%

[a] Includes cases identified as out of scope in either the mail or the telephone survey.
[b] Calculated as a percentage of deliverable questionnaires (sample size minus out of scope).

CHAPTER 5
RESULTS

5.1 SUPPORT OF CHANGED DAM OPERATION ALTERNATIVES

The valuation portion of the survey began by describing the consequences of a proposed change in the operation of Glen Canyon Dam. Descriptions of the environmental impacts were designed to be consistent with the ones used in the GCDEIS. In the national sample, the consequences of the proposed change also included a description of expected impacts to users of power produced at Glen Canyon Dam.

Immediately following the description of the alternative, or proposal, two valuation questions were asked. The first question (Question 2) asked respondents how they would vote on a proposal to change the operations of Glen Canyon Dam if passage of the proposal cost them nothing ($0).

The first column in Table 5-1 shows the distribution of responses to alternative proposals at no-cost. In the national sample, the proportion of respondents who would support the no-cost proposal was lowest for the moderate fluctuating flow proposal (Version 1) and highest for the low fluctuating flow proposal (Version 2). Support for the seasonally adjusted steady flow proposal (Version 3) was lower than for the low fluctuating flow proposal (Version 2). Although the Version 3 alternative is more favorable than Version 2 for trout and native fish, it has much higher price impacts to consumers of power produced at Glen Canyon Dam. Focus groups conducted during the survey design process indicated that potential survey respondents would be concerned about price impacts to power users (indeed, this result was an important factor in the decision to include power impacts as part of the description of impacts). The lower level of support for the Version 3 proposal might reflect a judgment by respondents that the higher price impacts in Version 3 more than offset any additional environmental gains.

This interpretation is further strengthened by the level of support shown for Version 4. Version 4 contained a description of the environmental impacts of the seasonally adjusted steady flow alternative but with the lower price consequences of the moderate and low fluctuating flow alternatives. The proposal in Version 2 and the proposal in Version 4 differ only in the environmental consequences. Support for proposals in Versions 2 and 4 are virtually identical, indicating that respondents found these two proposals equally acceptable.

Table 5-1
Support of Water Release Alternatives

Survey Version	Yes, Would Support the Proposal at No Cost	No, Would Not Support the Proposal at No Cost	Would Choose not to Vote	Number of Cases
National Sample				
Moderate Fluctuating Flow (Version 1)	71%	17%	12%	402
Low Fluctuating Flow (Version 2)	83[a]	9	8	408
Seasonally Adjusted Steady Flow (Version 3)	77[b]	12	11	414
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	81[a,b]	9	10	411
Marketing Area Sample				
Moderate Fluctuating Flow (Version 5)	76%	17%	7%	434
Low Fluctuating Flow (Version 6)	85[a]	8	7	437
Seasonally Adjusted Steady Flow (Version 7)	85[a]	9	6	467

[a,b] The percentage of "yes" responses were compared within the national and marketing area samples; they were not compared between the two samples. Within the sample, percentages that share superscripts are not significantly different ($z < 1.64$).

A similar pattern is observed in the marketing area sample. Support for the proposal at no cost was lowest for the moderate fluctuating flow proposal (Version 5) and significantly higher for the low fluctuating and seasonally adjusted steady flow alternatives (Versions 6 and 7, respectively).

These results indicate that mail survey respondents were sensitive to the details contained in the proposals, and that these details determined whether they would support the proposal at no cost.

The second valuation question (Question 3) asked respondents how they would vote if passage of the proposal cost them a specified amount. Question 3 was asked only of those respondents who were willing to vote for the proposal at no cost. Respondents were presented with a randomly selected dollar amount and then asked how they would vote if passage of the proposal were to cost them that amount. Figure 5.1 presents the wording of Question 3.

Figure 5-1
Willingness-to-Pay Question Format (National Sample)

The higher electric rates described earlier cannot make up for all the revenue lost as a result of this proposal. Taxpayers would have to make up the difference. How would you, as a taxpayer, vote on this proposal? As you think about your answer, please remember that if this proposal passes, you would have less money for household expenses or to spend on other environmental issues.

3. Would you vote for this proposal if passage of the proposal would cost your household $ ____ in increased taxes **every year** for the foreseeable future? *(CIRCLE ONE NUMBER)*

1	**Definitely No**	**-**	**I would definitely vote against the proposal.**
2	**Probably No**	**-**	**I would probably vote against the proposal.**
3	**Not Sure**	**-**	**I am not sure if I would vote for the proposal.**
4	**Probably Yes**	**-**	**I would probably vote for the proposal.**
5	**Definitely Yes**	**-**	**I would definitely vote for the proposal.**

Responses to this question were evaluated using two different approaches. In the first approach, respondents choosing the "Definitely Yes" category in Question 3 were considered to have voted "YES." Respondents choosing the "Definitely No," "Probably No," "Unsure," and "Probably Yes" categories were classified as having voted against the proposal ("NO"). Under the second approach, respondents choosing either the "Definitely Yes" or the "Probably Yes" category were considered to have voted in favor of the proposal and those choosing "Unsure," "Probably No," and "Definitely No" were considered to have voted against the proposal.

Question 3 data were analyzed using logistic regression. For this study, the logistic regression model estimated the probability that a respondent would vote in favor of a proposal as a function of several variables. These variables reflect the perceived reality and

validity of the valuation process, and respondents' understanding of the critical features of the proposal. Also included was a dummy variable reflecting which proposal was being evaluated, a series of environmental attitude items, respondent education and income, and the cost to the respondent if the proposal were to pass (Tables 5-2 and 5-3). The definition of variable used in the models are presented in Table 5-4.

Positive coefficients in Tables 5-2 and 5-3 indicate that respondents are more likely to vote in favor of the proposal when the value of the associated variable is increased. The variable "score" for example, reflects the score respondents received on a set of true or false questions asked about the components of the survey materials. The coefficient on "score" is positive and significant for all the econometric models shown in Table 5-2, indicating that respondents who achieved higher scores were more likely to vote "Yes" for the proposed dam operation alternative. The probability of voting **in favor** of a proposal was typically increased by:

- Higher expectations of visiting the Grand Canyon in the future;
- Better understanding of the survey materials;
- A belief that the study results would be used to determine future dam operations;
- Attitudes favoring the environment;
- Higher levels of income; and
- Higher levels of education.

The probability of voting **against** the proposal was typically increased by:

- A belief that the respondent would actually pay money if the proposal passed; and
- The cost to respondent if the proposal passed.

Table 5-2
Estimated Logistic Regression Model Parameters for the National Sample[a]

Variable	Definitely Yes Models	Definitely / Probably Yes Models
constant	**-3.8933** (0.9670) P=0.000	**-2.4317** (0.7142) P=0.001
score	**1.4920** (0.9489) P=0.116	**2.4681** (0.6729) P=0.000
taxincrease	**-0.3774** (0.1761) P=0.032	**-0.3698** (0.1557) P=0.018
useresults		**0.2239** (0.1458) P=0.125
futuregc	**0.1801** (0.0948) P=0.058	**0.1521** (0.0763) P=0.046
factor1	**-0.2954** (0.1095) P=0.007	**-0.3585** (0.0823) P=0.000
factor2	**0.6938** (0.1124) P=0.000	**0.5070** (0.0861) P=0.000
factor3	**-0.1530** (0.0903) P=0.090	**-0.1169** (0.0747) P=0.118
factor4	**0.1892** (0.0964) P=0.050	
school	**0.1946** (0.0814) P=0.017	
income		**0.000008** (0.000003) P=0.004
D2	**0.2355** (0.2493) P=0.345	**0.3266** (0.2024) P=0.107
D3	**0.3360** (0.2477) P=0.175	**0.2316** (0.2031) P=0.254
D4	**0.4552** (0.2432) P=0.062	**0.3855** (0.2006) P=0.055
annbid1	**-0.0101** (0.0015) P=0.000	**-0.01111** (0.0011) P=0.000
-2 * Log Likelihood	919.6081	1203.4691
Chi-squared	158.9979 P=0.000	223.6875 P=0.000
Correctly predicted responses	82.45%	70.16%
Number of observations	1,094	1,039

[a] Standard errors are reported in parentheses. Reported probabilities are associated with a 2-tailed test. Appropriate probabilities for a 1-tailed test are calculated by dividing reported probabilities by 2.

Table 5-3
Estimated Logistic Regression Model Parameters for the Marketing Area Sample[a]

Variable	Definitely Yes Models	Definitely / Probably Yes Models
constant	-4.0312 (0.9989) P=0.000	2.5619 (0.8281) P=0.002
score	1.3772 (0.9191) P=0.134	1.7688 (0.7490) P=0.018
utilityincrease		-0.5393 (0.2194) P=0.014
useresults	0.6777 (0.1919) P=0.000	0.6125 (0.1642) P=0.000
futuregc	0.2556 (0.1210) P=0.035	0.5445 (0.0940) P=0.000
factor1	-0.5568 (0.1143) P=0.000	-0.3542 (0.0878) P=0.000
factor2	0.5250 (0.1081) P=0.000	0.5919 (0.0904) P=0.000
factor3	-0.2864 (0.0888) P=0.001	-0.3008 (0.0793) P=0.000
factor4	0.3942 (0.1037) P=0.000	0.1722 (0.0899) P=0.056
income	0.000009 (0.000004) P=0.029	
D6	-0.1796 (0.2297) P=0.434	0.4786 (0.2017) P=0.018
D7	0.1936 (0.2194) P=0.378	0.3045 (0.1919) P=0.113
annbid1	-0.0163 (0.0018) P=0.000	-0.0161 (0.0013) P=0.000
-2 * Log Likelihood	765.8547	962.2454
Chi-squared	213.8576 P=0.000	328.1274 P=0.000
Correctly predicted responses	80.18%	74.47%
Number of observations	908	948

[a] Standard errors are reported in parentheses. Reported probabilities are associated with a 2-tailed test. Appropriate probabilities for a 1-tailed test are calculated by dividing reported probabilities by 2.

Table 5-4
Model Variable Definitions

Variable	Definition
constant	constant = 1
score	Quiz score computed from mail survey true/false questions. Maximum score = 1.
taxincrease	Question 7 in the national version of the mail survey. (Do you believe your taxes will increase if this proposal passes?) 0 = no, 1 = yes
utilityincrease	Question 7 in the marketing area version of the mail survey. (Do you believe your utility bills will increase if this proposal passes?) 0 = no, 1 = yes
useresults	Question 8 in the mail survey. (Do you think public officials will consider the results of this study, along with other evidence, in deciding how Glen Canyon Dam should be operated in the future?) 1 = no, 2 = yes
futuregc	Question 23 in the mail survey and question 13 in the phone survey. (How likely do you think it is that you will visit the Grand Canyon National Park in the future?) 1 = not at all likely, 4 = very likely
factor1	Factor score created from combined mail and telephone survey data. Heavy loading items include: question 12 (nep scale), items 1,3,5,8, and 10. Labeled "Impacts of human intervention on nature." Expected sign: -
factor2	Factor score created from combined mail and telephone survey data. Heavy loading items include: question 13 (economic/environmental issues), items 1,3,4, and 6. Labeled "Economic security." Expected sign: +
factor3	Factor score created from combined mail and telephone survey data. Heavy loading items include: question 12 (nep scale), items 12 and 13. Labeled "Limits to growth." Expected sign: -
factor4	Factor score created from combined mail and telephone survey data. Heavy loading items include: question 12 (nep scale), items 2 and 9. Labeled "Human ingenuity will ensure balance." Expected sign: +
school	Question 26 in the mail survey and question 17 in the telephone survey. Respondent education, coded in categories where 1 = eight years or less and 6 = post graduate work.
income	Question 30 in the mail survey and question 19 in the telephone survey. House hold income. Recoded from categories to midpoint values.

(Continued)

Table 5-4
Model Variable Definitions

Variable	Definition
D2	Dummy variable for national survey version. 1 = low fluctuating flow (Version 2), 0 = other
D3	Dummy variable for national survey version 1 = seasonally adjusted steady flow (Version 3), 0 = other
D4	Dummy variable for national survey version. 1 = seasonally adjusted steady flow with moderate flow price impacts (Version 4), 0 = other
D6	Dummy variable for marketing survey version. 1 = low fluctuating flow (Version 6), 0 = other
D7	Dummy variable for marketing survey version. 1 = seasonally adjusted steady flow (Version 7), 0 = other
annbid1	Annual cost of proposal.

5.2 Estimated Willingness-To-Pay

The parameters of the estimated logistic regression models specify the distribution of willingness-to-pay. Estimates of willingness-to-pay can be calculated using the following formula:

$$\overline{WTP} = \frac{\ln\left(1 + \exp\sum_{i=1}^{n-1} B_i * X_i\right)}{-B_n}$$

where B_1 represents the constant; B_2 through B_{n-1} represent coefficients on all the variables except the cost of the proposal; and B_n is the coefficient on the cost of the proposal. In calculating the mean willingness-to-pay, all of the non-cost variables must be set at appropriate levels. In carrying out this calculation, the relevant national-sample averages and marketing-area sample averages from the mail survey data were used. The one exception was the variable that measured whether respondents really believed they would have to pay if the proposal passed. This variable was set at a level that indicated respondents believed they would have to pay if the proposal passed. This step served to correct for the upward bias that would otherwise have been present because some respondents indicated they did not really

believe they would have to pay the stated amount if the referendum passed. Dummy variables representing the various proposals were set at appropriate levels in order to determine mean willingness-to-pay for the different proposals. Mean willingness-to-pay values are reported in Table 5-5 for the national sample, and in Table 5-6 for the marketing area sample.

Table 5-5
Annual Estimated Mean Willingness-to-Pay for a Change in Dam Operations for the National Sample[a]

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Moderate Fluctuating Flow (Version 1)	$23.96	$107.31
Low Fluctuating Flow (Version 2)	$29.45	$128.75
Seasonally Adjusted Steady Flow (Version 3)	$32.11	$122.32
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	$35.52	$132.82

[a] Reported values were calculated for all cases where respondents supported a change in dam operations at zero cost and believed their tax bills would increase with the passage of the referendum.

Table 5-6
Annual Estimated Mean Willingness-to-Pay for a Change in Dam Operations for the Marketing Area Sample[a]

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Moderate Fluctuating Flow (Version 5)	$32.43	$100.11
Low Fluctuating Flow (Version 6)	$28.14	$124.93
Seasonally Adjusted Steady Flow (Version 7)	$37.59	$115.68

[a] Reported values were calculated for all cases where respondents supported a change in dam operations at zero cost and believed their utility bills would increase with the passage of the referendum.

5.3 CALCULATION OF POPULATION AVERAGE WILLINGNESS-TO-PAY

The means reported in Tables 5-5 and 5-6 represent the average willingness-to-pay only for those respondents to the mail survey who voted in favor of the proposal at no cost. Determining an average value that can be aggregated across relevant populations requires taking into account the values held by three additional groups: (1) respondents to the mail survey who indicated they would vote against the proposal at zero cost; (2) respondents to the mail survey who would choose to not vote on the proposal, and; (3) non-respondents to the mail survey.

Mail survey respondents who voted against proposal even at zero cost provided a clear indication that they did not place a positive value on the proposal. In the analyses that follows, these individuals are assigned a willingness-to-pay amount of zero.

Mail survey respondents who chose not to vote either for or against the proposal may have been expressing a protest against the valuation process. It could be argued that these individuals should be excluded from the analysis, since they chose not to participate in the valuation process. On the other hand, if these respondents had been forced to vote on the proposal, it is very likely that some would have voted in favor of the proposal and expressed a positive value. In the analysis that follows, all individuals choosing the "Not Vote" options were assumed to have willingness-to-pay of zero.

Accounting for nonrespondents to the mail survey raises more complex issues. Recall that telephone interviews were carried out with these nonrespondents. The results of this telephone survey indicated that nonrespondents tended to have lower incomes, lower educational attainment, lower probabilities of future visits to the Grand Canyon, and slightly less environmentally oriented attitudes than respondents to the mail survey. While it might be reasonable to assume that some nonrespondents would have expressed a positive willingness-to-pay if they had completed the mail survey, it is also reasonable to assume that the average willingness-to-pay for nonrespondents would have been less than the average willingness-to-pay for the mail survey respondents.

Assigning willingness-to-pay values to nonrespondents was carried out in two ways. The first approach used the mail survey data to estimate a model predicting whether a respondent would vote in favor of the proposal at zero cost. This model was then applied to data collected during the telephone interview with mail survey nonrespondents to estimate the probability that they would have voted in favor of the proposal at zero cost. Next, an average willingness-to-pay for nonrespondents was estimated using the models reported in Tables 5-2 and 5-3 but evaluated at relevant average values from the telephone survey of nonrespondents. The second approach simply assumed that all nonrespondents to the mail survey had a zero willingness-to-pay. The results of both approaches are reported here.

The population average willingness-to-pay was calculated as a weighted average of the estimated or assumed willingness-to-pay values for four groups:

- Mail survey respondents who would vote for the proposal at zero cost;
- Mail survey respondents who would either not vote for the proposal at zero cost or who would choose not to vote;
- Nonrespondents to the mail survey estimated, or assumed, to support the proposal at zero cost; and
- Nonrespondents to the mail survey estimated, or assumed, to either not support the proposal at zero cost or not vote.

The weight for each component of population average willingness-to-pay is the proportion of each of these groups in the sample. Details of the calculation of population average willingness-to-pay are presented in Tables 5-7, 5-8, 5-9 and 5-10. A summary of population average willingness-to-pay is presented in Table 5-11 for the national sample and in Table 5-12 for the marketing area sample.

Table 5-7

Weighted Mean Values for Willingness-to-Pay for a Change in Dam Operations
National Sample Definitely Yes Models

	Response Rate Weights	Support Weight	Total Weight	Estimated Mean Willingness to Pay	Contribution to Weighted Mean	Population Weighted Average Willingness to Pay
Moderate Fluctuating Flow Alternative (Version 1)						
Mail Respondents	0.6435					
Support at $0 cost		0.71	0.456885	$23.96	$10.95	
Not support / not vote		0.29	0.186615	$0.00	$0.00	
Nonrespondents	0.3565					
Support at $0 cost		0.65	0.230377	$11.75	$2.71	
Not support / not vote		0.35	0.126123	$0.00	$0.00	
			1.000000			$13.65
Low Fluctuating Flow Alternative (Version 2)						
Mail Respondents	0.6651					
Support at $0 cost		0.83	0.552033	$29.45	$16.26	
Not support / not vote		0.17	0.113067	$0.00	$0.00	
Nonrespondents	0.3349					
Support at $0 cost		0.79	0.265388	$14.65	$3.89	
Not support / not vote		0.21	0.069512	$0.00	$0.00	
			1.000000			$20.15
Seasonally Adjusted Steady Flow Alternative (Version 3)						
Mail Respondents	0.6713					
Support at $0 cost		0.77	0.516901	$32.11	$16.60	
Not support / not vote		0.23	0.154399	$0.00	$0.00	
Nonrespondents	0.3287					
Support at $0 cost		0.75	0.245912	$16.08	$3.95	
Not support / not vote		0.25	0.082788	$0.00	$0.00	
			1.000000			$20.55
Seasonally Adjusted Steady Flow Alternative With Moderate Flow Price Impacts (Version 4)						
Mail Respondents	0.6545					
Support at $0 cost		0.81	0.530145	$35.52	$18.83	
Not support / not vote		0.19	0.124355	$0.00	$0.00	
Nonrespondents	0.3455					
Support at $0 cost		0.80	0.276606	$17.94	$4.96	
Not support / not vote		0.20	0.068894	$0.00	$0.00	
			1.000000			$23.79

Table 5-8

Weighted Mean Values for Willingness-to-Pay for a Change in Dam Operations
Marketing Area Sample Definitely Yes Models

	Response Rate Weights	Support Weight	Total Weight	Estimated Mean Willingness to Pay	Contribution to Weighted Mean	Population Weighted Average Willingness to Pay
Moderate Fluctuating Flow Alternative (Version 5)						
Mail Respondents	0.7401					
Support at $0 cost		0.76	0.562476	$32.43	$18.24	
Not support / not vote		0.24	0.177624	$0.00	$0.00	
Nonrespondents	0.2599					
Support at $0 cost		0.75	0.195211	$19.54	$3.81	
Not support / not vote		0.25	0.064689	$0.00	$0.00	
			1.000000			$22.06
Low Fluctuating Flow Alternative (Version 6)						
Mail Respondents	0.7484					
Support at $0 cost		0.85	0.636140	$28.14	$17.90	
Not support / not vote		0.15	0.112260	$0.00	$0.00	
Nonrespondents	0.2516					
Support at $0 cost		0.84	0.212124	$16.73	$3.55	
Not support / not vote		0.16	0.039476	$0.00	$0.00	
			1.000000			$21.45
Seasonally Adjusted Steady Flow Alternative (Version 7)						
Mail Respondents	0.7523					
Support at $0 cost		0.85	0.639455	$37.59	$24.04	
Not support / not vote		0.15	0.112845	$0.00	$0.00	
Nonrespondents	0.2477					
Support at $0 cost		0.85	0.209951	$23.01	$4.83	
Not support / not vote		0.15	0.037749	$0.00	$0.00	
			1.000000			$28.87

Table 5-9

Weighted Mean Values for Willingness-to-Pay for a Change in Dam Operations
National Sample Definitely / Probably Yes Models

	Response Rate Weights	Support Weight	Total Weight	Estimated Mean Willingness to Pay	Contribution to Weighted Mean	Population Weighted Average Willingness to Pay
Moderate Fluctuating Flow Alternative (Version 1)						
Mail Respondents	0.6435					
Support at $0 cost		0.71	0.456885	$107.31	$49.03	
Not support / not vote		0.29	0.186615	$0.00	$0.00	
Nonrespondents	0.3565					
Support at $0 cost		0.65	0.230377	$80.45	$18.53	
Not support / not vote		0.35	0.126123	$0.00	$0.00	
			1.000000			$67.56
Low Fluctuating Flow Alternative (Version 2)						
Mail Respondents	0.6651					
Support at $0 cost		0.83	0.552033	$128.75	$71.07	
Not support / not vote		0.17	0.113067	$0.00	$0.00	
Nonrespondents	0.3349					
Support at $0 cost		0.79	0.265388	$98.95	$26.26	
Not support / not vote		0.21	0.069512	$0.00	$0.00	
			1.000000			$97.33
Seasonally Adjusted Steady Flow Alternative (Version 3)						
Mail Respondents	0.6713					
Support at $0 cost		0.77	0.516901	$122.32	$63.23	
Not support / not vote		0.23	0.154399	$0.00	$0.00	
Nonrespondents	0.3287					
Support at $0 cost		0.75	0.245912	$93.34	$22.95	
Not support / not vote		0.25	0.082788	$0.00	$0.00	
			1.000000			$86.18
Seasonally Adjusted Steady Flow Alternative With Moderate Flow Price Impacts (Version 4)						
Mail Respondents	0.6545					
Support at $0 cost		0.81	0.530145	$132.82	$70.41	
Not support / not vote		0.19	0.124355	$0.00	$0.00	
Nonrespondents	0.3455					
Support at $0 cost		0.80	0.276606	$102.52	$28.36	
Not support / not vote		0.20	0.068894	$0.00	$0.00	
			1.000000			$98.77

Table 5-10

Weighted Mean Values for Willingness-to-Pay for a Change in Dam Operations
Marketing Area Sample Definitely / Probably Yes Models

	Response Rate Weights	Support Weight	Total Weight	Estimated Mean Willingness to Pay	Contribution to Weighted Mean	Population Weighted Average Willingness to Pay
Moderate Fluctuating Flow Alternative (Version 5)						
Mail Respondents	0.7401					
Support at $0 cost		0.76	0.562476	$100.11	$56.31	
Not support / not vote		0.24	0.177624	$0.00	$0.00	
Nonrespondents	0.2599					
Support at $0 cost		0.75	0.195211	$67.53	$13.18	
Not support / not vote		0.25	0.064689	$0.00	$0.00	
			1.000000			$69.49
Low Fluctuating Flow Alternative (Version 6)						
Mail Respondents	0.7484					
Support at $0 cost		0.85	0.636140	$124.93	$79.47	
Not support / not vote		0.15	0.112260	$0.00	$0.00	
Nonrespondents	0.2516					
Support at $0 cost		0.84	0.212124	$88.73	$18.82	
Not support / not vote		0.16	0.039476	$0.00	$0.00	
			1.000000			$98.29
Seasonally Adjusted Steady Flow Alternative (Version 7)						
Mail Respondents	0.7523					
Support at $0 cost		0.85	0.639455	$115.68	$73.97	
Not support / not vote		0.15	0.112845	$0.00	$0.00	
Nonrespondents	0.2477					
Support at $0 cost		0.85	0.209951	$80.69	$16.94	
Not support / not vote		0.15	0.037749	$0.00	$0.00	
			1.000000			$90.91

Table 5-11
Summary of National Sample Population Weighted Average Willingness-to-Pay

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Values Imputed for Nonrespondents[a]		
Moderate Fluctuating Flow (Version 1)	$13.65	$67.56
Low Fluctuating Flow (Version 2)	$20.15	$97.33
Seasonally Adjusted Steady Flow (Version 3)	$20.55	$86.18
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	$23.79	$98.77
Zero Values Assumed for Nonrespondents[b]		
Moderate Fluctuating Flow (Version 1)	$10.95	$49.03
Low Fluctuating Flow (Version 2)	$16.26	$71.07
Seasonally Adjusted Steady Flow (Version 3)	$16.60	$63.23
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	$18.83	$70.41

[a] Adjusted to reflect values of nonrespondents and to reflect a belief that respondents would actually pay if the proposal passed.

[b] Adjusted to reflect a zero dollar value for nonrespondents and to reflect a belief that respondents would actually pay if the proposal passed.

Table 5-12
Summary of Marketing Area Sample Population Weighted Average Willingness-to-Pay

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Values Imputed for Nonrespondents[a]		
Moderate Fluctuating Flow (Version 5)	$22.06	$69.49
Low Fluctuating Flow (Version 6)	$21.45	$98.29
Seasonally Adjusted Steady Flow (Version 7)	$28.87	$90.91
Zero Values Assumed for Nonrespondents[b]		
Moderate Fluctuating Flow (Version 5)	$18.24	$56.31
Low Fluctuating Flow (Version 6)	$17.90	$79.47
Seasonally Adjusted Steady Flow (Version 7)	$24.04	$73.97

[a] Adjusted to reflect values of nonrespondents and to reflect a belief that respondents would actually pay if the proposal passed.

[b] Adjusted to reflect a zero dollar value for nonrespondents and to reflect a belief that respondents would actually pay if the proposal passed.

5.4 AGGREGATION

The household average willingness-to-pay values were aggregated across relevant populations. At the time the sample was purchased, Survey Sampling, Inc. estimated there were 94,836,300 households in the United States.[1] A total of 1,500,000 households were estimated to reside in the marketing area (Energy Information Administration, 1991).

The procedures used to aggregate the population average household willingness-to-pay are consistent with the aggregation procedures used to develop the estimates of recreational values and power values reported in the GCDEIS. Aggregation was carried out using a fifty-year time period from 1991 to 2040. The gross national product (GNP) price deflator series reported by the GCES Power Resources Committee was used to construct estimates of

[1] The estimate of the total number of U.S. households from SSI is slightly lower than estimates provided by U.S. Census Bureau. For example, in 1993 the Census Bureau estimated a total of 96,391,000 households in the United States.

average household willingness-to-pay for each year from 1991 to 2040. Since projections of the future number of U.S. households were not readily available, increases in the number of households were based on the rate of increase in the population. For the national sample, the rate of increase in the number of households was calculated using U.S. Census estimates of the total U.S. population. In the marketing area, the rate of increase in the number of households was estimated using U.S. Census estimates of total population for the states of Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada.

Household series were constructed so that the 1994 estimated number of households was 94,836,300 for the nation, and 1,500,000 from the marketing area. Consistent with the work of the GCES Power Resources Committee, population growth was assumed to occur only during the first 20 years of the 50-year aggregation period.[2]

For each proposal analyzed, the estimated annual value per household was multiplied by the corresponding estimated number of households to arrive at an estimate of the annual total value associated with the alternative. Present value and levelized annual value estimates were calculated using a discount rate of 8.50 percent. The interest rate used by the federal water agencies in economic analyses is specified by the Water Resources Council in accordance with Section 80(a) Public Law 93-251. That rate reflects the average yield during the preceding fiscal year on United States interest-bearing securities which have terms of 15 years or more remaining to maturity rounded to the nearest one-eight percent. Changes in the rate are limited to no more than one-forth percent per year. This is intended to eliminate the effects of short-term changes, and thus more appropriately reflects the relatively long-term period of economic analysis for water resource projects. The rate is provided annually by the Treasury Department for each fiscal year based on the average yield for the preceding fiscal year. For fiscal year 1992 (beginning with October of 1991) the rate is 8.50 percent. This rate is used for all economic analyses in the Glen Canyon Dam EIS. Levelized annual values are presented in Tables 5-13 and 5-14 for the national and marketing area samples.

[2] This assumption was made to reflect the fact that while the GCES Power Resources Committee escalated costs throughout the 50-year period, electrical loads were held constant after the twentieth year.

Table 5-13
Aggregate Levelized Annual Willingness-to-Pay for Changes in Dam Operations for the National Sample (Millions of Dollars)

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Values Imputed for Nonrespondents[a]		
Moderate Fluctuating Flow (Version 1)	$2,286.4	$11,316.4
Low Fluctuating Flow (Version 2)	$3,375.2	$16,302.9
Seasonally Adjusted Steady Flow (Version 3)	$3,442.2	$14,435.2
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	$3,984.8	$16,544.1
Zero Values Assumed for Nonrespondents[b]		
Moderate Fluctuating Flow (Version 1)	$1,834.1	$ 8,212.6
Low Fluctuating Flow (Version 2)	$2,723.6	$11,904.3
Seasonally Adjusted Steady Flow (Version 3)	$2,780.5	$10,591.1
Seasonally Adjusted Steady Flow with Moderate Flow Price Impacts (Version 4)	$3,154.0	$11,793.8

[a] Adjusted to reflect values of nonrespondents and to reflect respondents' stated belief that they would actually pay if the proposal passed.
[b] Adjusted to reflect a zero dollar value for nonrespondents and to reflect respondents' stated belief that they would actually pay if the proposal

Table 5-14
Aggregate Levelized Annual Willingness-to-Pay for Changes in Dam Operations for the Marketing Area Sample (Millions of Dollars)

Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models
Values Imputed for Nonrespondents[a]		
Moderate Fluctuating Flow (Version 5)	$62.2	$196.1
Low Fluctuating Flow (Version 6)	$60.5	$277.3
Seasonally Adjusted Steady Flow (Version 7)	$81.4	$256.5
Zero Values Assumed for Nonrespondents[b]		
Moderate Fluctuating Flow (Version 5)	$51.5	$ 158.9
Low Fluctuating Flow (Version 6)	$50.5	$224.2
Seasonally Adjusted Steady Flow (Version 7)	$67.8	$208.7

[a] Adjusted to reflect values of nonrespondents and to reflect respondents' stated belief that they would actually pay if the proposal passed.

[b] Adjusted to reflect a zero dollar value for nonrespondents and to reflect respondents' stated belief that they would actually pay if the proposal passed.

5.5 DISCUSSION OF ASSUMPTIONS USED

The values reported in Tables 5-13 and 5-14 span a relatively large range. A substantial portion of this range is a direct result of various assumptions that could be made during the process of calculating population average willingness-to-pay. We believe that the best estimates of willingness-to-pay are those that are based on the "Definitely Yes" models and for which values were imputed for nonrespondents. These best estimates for the national sample are presented in Table 5-15. Best estimates for the marketing area sample follow in Table 5-16. A large number of decisions were made during survey design, implementation, and data analysis. In this section we discuss these decisions, the justification for them, and their implications.

Table 5-15
Best Estimates of Willingness-to-Pay for Changes in the Operation of Glen Canyon Dam -- National Sample

	Population Weighted Willingness-to-Pay Per Household	Levelized Annual Value[a]
Moderate Fluctuating Flow	$13.65	$2,286.4
Low Fluctuating Flow	$20.15	$3,375.2
Seasonally Adjusted Steady Flow	$20.55	$3,442.2

[a] Millions of dollars. Details for this calculation can be found in Chapter 5 of the full technical report.

Table 5-16
Best Estimates of Willingness-to-Pay for Changes in the Operation of Glen Canyon Dam -- Marketing Area Sample

	Population Weighted Willingness-to-Pay Per Household	Levelized Annual Value[a]
Moderate Fluctuating Flow	$22.06	$62.2
Low Fluctuating Flow	$21.45	$60.5
Seasonally Adjusted Steady Flow	$28.87	$81.4

[a] Millions of dollars. Details for this calculation can be found in Chapter 5 of the full technical report.

Proposed federal regulations governing contingent valuation studies of non-use values strongly support the use of a single-bounded dichotomous choice framework. The GCES Non-Use Values Study used a modified version of the single-bounded dichotomous choice question format. Instead of asking respondents to simply vote "Yes" or "No" to a proposal, they were asked to indicate how they would vote on a five-point scale. The five-point scale ranged from "Definitely No" to "Definitely Yes." This decision was based partially on early results from a criterion validity study (Champ, 1994) showing that individuals who are more sure of their preferences seem to provide "better" contingent valuation responses.

Respondents were also given a chance to "opt out" of the contingent valuation question. Respondents were first asked if they would vote in favor of the proposal if passage of the proposal cost them nothing. They were provided with three response categories: "No," "Yes," and "I would choose not to vote on this proposal." All individuals choosing the first category ("No") were assigned a willingness-to-pay of zero. Some might argue that respondents voting against the proposal at zero cost were actually indicating they held a negative value for the proposal. There is no easy way to investigate this issue in a quantitative manner short of contacting these individuals and asking about their willingness-to-pay to avoid implementation of the proposal. We suspect that such an effort would reveal very small, if not zero, willingness-to-pay to maintain current dam operations. During the qualitative research, we saw no indication that respondents felt that they would experience a decrease in utility as a result of a change in the operations of Glen Canyon Dam. Results clearly indicated that, with the possible exception of impacts to power consumers, respondents in the national sample were either indifferent to or in favor of changes in the operations of Glen Canyon Dam. This finding did not support assigning negative values to individuals who voted against the proposal at zero cost and we feel justified in assigning zero willingness-to-pay to these respondents.

Making assumptions about willingness to pay for respondents choosing the third category ("Choose not to vote") was more problematic. Based on the qualitative research, we suspect that at least a portion of these respondents elected not to vote because they did not want to vote in favor a proposal that increased electricity prices for residents of the marketing area, not because they felt the proposal had no value. In fact, the results of the qualitative research led us to believe that it's probable that some respondents who objected to the payment vehicle may have a positive value for changes in dam operations. However, in the absence of information about these values, these respondents were assigned a willingness-to-pay of zero.

The logistic regression equations reported in Tables 5-2 and 5-3 were used to estimate willingness-to-pay values for survey nonrespondents. Some might argue that all nonrespondents to the mail survey should be assigned a zero value, thereby decreasing the estimated average willingness-to-pay by approximately 20 to 30 percent. However, a substantial effort was made to contact nonrespondents to the mail survey via telephone and

collect data that would address issues of potential nonresponse bias. These data were combined with the models estimated from the mail survey data to provide our best estimate of the willingness-to-pay of nonrespondents. Thus, in the presence of a model and sufficient data from nonrespondents to the mail survey, it would be inappropriate to simply assume that all nonrespondents to the mail survey had a willingness-to-pay of zero.

Finally, the portion of the sample identified as out-of-scope was excluded from the analysis for this report. The calculation of aggregate willingness-to-pay implicitly assumed that the distribution of willingness-to-pay among out-of-scope individuals is identical to the estimated distribution of willingness-to-pay for respondents to the mail and telephone surveys. The only other feasible assumption would be that all out-of-scope sample points have a willingness-to-pay of zero. We are not aware of any precedent for assigning a zero willingness-to-pay to out-of-scope members of the original sample. In fact, a strong argument could be made that some of these individuals would express a positive willingness-to-pay if they could have been contacted. Consequently, it seemed more appropriate to exclude the out-of-scope cases as was done in the analysis contained in this report.

CHAPTER 6
VALIDITY OF RESULTS

The estimates of willingness-to-pay reported in the preceding chapter could play a significant role in judging the economic merits of operational alternatives for Glen Canyon Dam, provided that they can be considered valid measures of economic values. The question of whether CV is capable of yielding valid economic values is among the most hotly contested issues in economics today, with distinguished economists lining up on both sides. This controversy is all the more confusing to outsiders because some of the most vehement opponents of CV are econometricians from among America's best universities. Much of the body of this criticism is found in various chapters of the book edited by Hausman (1993). In the current context, it is appropriate to ask whether the contingent values reported here are sufficiently valid measures of economic values to be used in judging the merits of Glen Canyon Dam operational alternatives. In addressing this question, we begin with an historical perspective on the contingent valuation method. Still relatively new and controversial, contingent valuation has already been both widely applied and subjected to intense scientific scrutiny. Though the controversy continues, contingent valuation has won a considerable amount of support among academic economists and public decision makers, provided that high standards are met in study procedures and the results conform reasonably well to prior expectations based on economic theory. Later sections will outline why we believe that the results reported for this study meet these standards.

6.1 HISTORICAL PERSPECTIVE

During the last 20 years, the contingent valuation method has become a common tool for measuring the economic benefits of non-marketed goods. While there has always been some controversy over the accuracy of the method, by the mid-1980's it was widely accepted as a legitimate tool used to estimate economic benefits for inclusion in benefit-cost studies. The contingent valuation method was endorsed for use in benefit-cost analysis of federal water projects by the U.S. Water Resources Council in 1983. Since that time it has been used to support policy analysis by numerous federal agencies including agencies in the U.S. Departments of the Interior and Agriculture, the Army Corps of Engineers, and the Environmental Protection Agency.

The debate over contingent valuation intensified since it was applied to evaluate the damages attributable to the Exxon Valdez oil spill (Carson et al., 1992). The Exxon Valdez study made it clear that the inclusion of non-use values could greatly increase the liability of parties

responsible for releases of oil and toxics harmful to public resources. The magnitude of these damage estimates made it inevitable that the method would be further challenged.

Though the present study was prepared for policy analysis rather than litigation, the debate over using contingent valuation for damage assessments raised issues relevant to interpreting the results of the GCES Non-Use Value Study. If high-quality contingent valuation studies are sufficiently valid to be used in litigation, presumably they are sufficiently valid to be used for economic appraisal of the alternatives for operating Glen Canyon Dam. If the reassessment of contingent valuation in the context of litigation identified major flaws, then the implications of such findings for the current policy analysis effort must also be carefully considered.

Particularly since the Exxon Valdez spill, several prominent American economists (see, for example, Hausman, 1993) have taken a firm stand against contingent valuation, especially for assessing damages. On the other hand, other economists of at least equal standing in the profession have voiced support for the method. For example, the National Oceanic and Atmospheric Administration (NOAA) Panel on Contingent Valuation, a group co-chaired by two Nobel laureates in economics, was commissioned by the U.S. Department of Commerce to formally consider the usefulness of contingent valuation in damage assessments (U.S. Department of Commerce, 1993). It concluded:

> We think it is fair to describe such information *[i.e., the results of contingent valuation studies meeting standards proposed by the panel]* as reliable by the standards that seem to be implicit in similar contexts, like market analysis for new and innovative products and the assessment of other damages normally allowed in court proceedings. (Arrow et al., 1993, statement in italics added for clarity.)

Although the debate over CV continues, many economists have concluded that CV studies, if carried out well, are capable of producing estimates of willingness-to-pay (WTP) that are sufficiently accurate to be useful in estimating WTP for environmental interventions like the ones in this study. This was the overall conclusion of the NOAA Panel on Contingent Valuation (U.S. Department of Commerce, 1993), for example. In summary, well-done CV studies have considerable credibility, while poorly-done studies may have none at all.

One benefit of the controversy over contingent valuation has been a growing consensus regarding the criteria to be used to assess the validity of contingent valuation studies. These criteria fall under two general headings, known in technical terms as content and construct validity criteria. Content validity criteria deal with study procedures. One would not expect a study that was poorly designed and executed to produce valid results. Construct validity criteria deal with whether results from the study under review conform to prior expectations based on economic theory.

If responses are to be interpreted as valid expressions of economic values, then theory would lead the researcher to expect them to be related to other variables in certain ways.

6.2 CONTENT VALIDITY

Content validity refers to the degree to which the design and execution of a contingent valuation study promotes an accurate statement about willingness-to-pay by survey respondents. Bishop and McCollum (1995) have attempted to synthesize current thinking on the content validity of contingent valuation studies. They drew on the work of the NOAA Panel on Contingent Valuation and recent works by contingent valuation researchers, including that by Mitchell and Carson (1989), Cummings et al. (1986), and Hanemann (1994), to suggest a series of questions that should be asked in assessing the content validity of contingent valuation studies. These include:

1. Was the true value clearly and correctly defined?

2. Were the environmental attributes relevant to potential subjects fully identified?

3. Were the potential effects of the intervention on environmental attributes and other economic parameters adequately documented and communicated to respondents?

4. Were respondents aware of their budget constraints and the existence and status of environmental and other substitutes?

5. Was the context for valuation fully specified and incentive compatible?

6. Did survey participants accept the scenario? Did survey respondents believe the scenario?

7. Were the survey questions, other than those designed to elicit values, adequate and complete?

8. Was the survey mode appropriate?

9. Were qualitative research procedures, pretests, and pilots sufficient to find and remedy identifiable flaws in the instrument and associated materials?

10. Given the study objectives, were adequate procedures employed to choose study subjects, assign them to treatments (if applicable), and encourage high response rates?

11. Was the econometric analysis adequate?

12. Were the written materials describing the study adequate?

The degree of content validity will vary from study to study. Granted, the answers to some of these questions are a matter of professional judgement. However, studies for which more of these questions can be answered in the affirmative will have higher levels of content validity.

Turning to the GCES Non-Use Value Study, answering these questions in enough detail to be meaningful is beyond the scope of this summary report. The full technical report on this study addresses them in detail. Here it must suffice to say that the detailed review of the study design and implementation process will answer nearly all of these questions in the affirmative, suggesting that the study has a high degree of content validity.

6.3 CONSTRUCT VALIDITY

Construct validity assessment offers another strategy for judging the accuracy of contingent values. Given the potential role of non-use values in this study, convergent validity comparisons were not relevant. However, theoretical validity testing was a high priority from the beginning. To re-emphasize a basic point of this chapter, the stronger the linkages are between a study's results and economic theory, the firmer the foundation is for interpreting CV values as economic values. Weaknesses identified during theoretical validity testing could indicate flaws in study design that were not detected when content validity was assessed or they could be symptomatic of unknown factors outside the theory that are influencing results. In either case, the link between observed CV values and the theoretical ideal is weakened.

Bishop et al. (1994) proposed that a distinction be made between "rudimentary" and "advanced" theoretical validity tests. Rudimentary tests use regression analyses, contingency tables, and other such procedures to explore whether prior expectations about the relationships between responses to CV questions and other types of data were met by the study's results. For rudimentary tests, it is worth explicitly recognizing that an important role exists for common knowledge and intuition as well. An example from market demand estimation would be the commonly made assumption that meats like beef and pork are substitutes for each other. There is no reason in theory for this hypothesis, but it would certainly be supported by introspection and casual observation. Likewise, one might hypothesize that members of environmental organizations would have higher values for

environmental improvements than non-members. Thus, relationships between CV question responses and income, socioeconomic characteristics, self-reported past behavior (e.g., having visited the area where the environmental resource is located), and attitudinal measures are often evaluated in rudimentary tests. To the extent that such relationships are significant and accompanied by expected signs, the study is judged to have higher construct validity.

In contrast to the rudimentary tests, advanced theoretical validity tests involve prior expectations about the relationships between contingent values, most often from the same study. Scope tests, one example of advanced tests, have been much discussed lately. The credibility of the advanced tests is enhanced if the survey instrument (or instruments) has high content validity and the values to be compared come from independent samples. Passing advanced tests is potent evidence that CV survey responses are rooted to a significant degree in decision processes consistent with economic theory.

Bishop et al. (1994, pp. 22-23) suggest that results from rudimentary and advanced tests should be interpreted in the following way:

> We propose that studies be categorized into a three-level hierarchy expressing increasing degrees of construct validity. At the lowest level would be studies that either have not included any construct validity tests or have failed to pass rudimentary tests . . . Such studies may still be useful for scientific purposes or as exercises involving the training of students, but should be used in policy analysis and litigation only with the heaviest caveats. The second level of the hierarchy would involve studies that have achieved a fair amount of success in the rudimentary tests, but that either do not have the budget to support advanced testing or have not succeeded in passing advanced tests. Second-level studies may be usable in cost-benefit analyses, since normally such analyses are simply interested in determining whether the benefits of an intervention exceed the costs. Of course, suitable caveats would need to be introduced into such studies. Unless benefits exceed costs by a fairly wide margin or vice versa, potential imprecision in second level studies may mean that the issue of whether benefits exceed costs remains open. Second level studies may be less useful for litigation, where relatively precise estimates of value are needed to assess damages, but they may still be useful in preliminary damage assessments . . . Third level studies are studies that have conducted and achieved substantial success in sophisticated rudimentary tests and/or have conducted and passed advanced tests. Provided that such studies are judged to have a high degree of content validity as well, they would have the highest level of credibility for benefit-cost analysis and litigation.

To consider the level of the current study in this hierarchy, consider first how well the study performed in rudimentary tests. Logistic equations presented in Tables 5-2 and 5-3 indicate that willingness-to-pay is strongly related to factors such as income, education,

environmental attitudes, and expectations of future visits to the Grand Canyon in ways that are quite consistent with prior expectations.

Several advanced tests were passed as well. First, theory would lead one to expect that responses to CV questions should not be sensitive to seemingly innocuous wording changes. Pilot test results confirmed that values did not change in statistically significant ways when minor wording changes in the survey and changes in the order of the information were introduced.

A second advanced test relates to prior expectations about how changes in the price of electricity would affect respondents' WTP estimates. Recall that for the national sample in the final study, each version contained descriptions of the environmental benefits and changes in the price of electricity. Furthermore, for increasingly severe restrictions on power generation--from the moderate fluctuating flow alternative to the low fluctuating flow alternative, and then the seasonally adjusted steady flow alternative--increasing levels of environmental improvements were associated with increasing electricity costs. Based on the focus groups results, we were confident that environmental improvements were viewed by many potential respondents as positive attributes of the alternatives, whereas increasing price impacts were often viewed as negative impacts. In the pilot study, WTP estimates increased as more stringent constraints on dam operations were introduced. We tended to interpret this as evidence that environmental concerns outweighed empathy for power consumers. However, an alternative interpretation arose in reviewing the pilot results. It was suggested that higher contingent values expressed for the seasonally adjusted steady flow alternative may have resulted because respondents used the costs of electricity as a cue to the value they should express for that proposal. This concern was addressed by including an additional experimental survey version, Version 4, in the final study. Version 4 contained the environmental impacts of the seasonally adjusted steady flow alternative (Version 3),but the power impacts of the low fluctuating flow alternative (Version 2). That is, the environmental effects in Versions 3 and Version 4 were identical, while the power price impacts in Version 4 were lower than in Version 3. If respondents weighed environmental positives against power price impact negatives in a theoretically consistent way, then Version 4 ought to have generated higher values than Version 3. On the other hand, if the price impacts were providing a cue for respondents then, contrary to what would be expected based on theory and the focus groups, Version 4 ought to have had a lower value than Version 3. As we saw in the preceding chapter, Version 4's value was larger, supporting the theoretical validity of the study.

Finally, several scope tests were applied to the pilot and final survey results. In both the pilot test and the final survey, the portion of respondents who would support proposals if the cost to them were zero varied significantly across proposals in ways that were consistent with prior expectations. In the pilot survey for the national sample, among those who would vote for the proposals at zero cost to them, mean WTP for the seasonally adjusted steady flow

alternative was rather consistently higher than the mean WTP for the moderate fluctuating flow alternative based on the various statistical tests performed. Furthermore, in the national sample pilot test, Version 8, which was identical to the seasonally adjusted steady flow alternative (Version 3) except that impacts to Native Americans, trout, and native fish were deleted, produced a lower value than Version 3. This lower value was marginally significant in the Definitely Yes models and quite significant in the combined Definitely / Probably Yes models, confirming prior expectations.

Interpretation of the scope tests was somewhat more complicated in the final survey. Some changes made to the scenarios between the pilot survey and the final survey reduced the likelihood of finding significantly different values for the seasonally adjusted steady flow alternative compared to the modified fluctuating flow alternative. For example, the description of the seasonally adjusted steady flow alternative was modified to make it less environmentally beneficial. In particular, the pilot version indicated that endangered native fish populations would increase. To conform to more recent conclusions in the GCDEIS, the final version said that "Native fish . . . would most likely increase in numbers. However, competition from non-native species may still limit the growth of native fish populations." (See Appendix C of the full technical report for additional changes in the scenario between the pilot and final surveys.) Also, the statistical tests performed during the pilot study had the benefit of the greater statistical precision associated with using a multiple-bounded CV question; the final study did not. Because the multiple-bounded approach is still relatively new and unproven, a decision was made to implement the final survey using the traditional single-bounded approach. This reduced the statistical precision of the final estimates, making scope more difficult to demonstrate.

Tables 5-2 and 5-3 list the dummy variables used in the logistic regression models to identify the different survey versions (variables D2-D7). Significance tests of these dummy variables can be interpreted as scope tests. D3 has the expected sign but is not significant. In other words, for the national sample, the estimated distribution of values for the seasonally adjusted steady flow alternative was not significantly different from the distribution for the moderate fluctuating flow alternative. However, the difference is close to significant with P=0.175 and P=0.254 for the Definitely Yes and the Definitely/Probably Yes models, respectively.

It is also worth noting that these two alternatives are less than perfect as scope tests because the environmental improvements are counterbalanced by heavier power price impacts. Not only does the dummy variable D4 stand counter to the hypothesis that respondents were basing their values on cues provided by the power impacts (as we learned above), it also serves as a clearer scope test because it combines the environmental improvements of the seasonally adjusted steady flow alternative with the power impacts of the low fluctuating flow alternative. And D4 is statistically significant (P=0.062 for the Definitely Yes model and P=0.055 for the Definitely/Probably Yes model). In summary, based on both the pilot

study results and the significance of D4, we conclude that our study passes scope tests for the national sample.

For the marketing area, results of the final study also show some signs of passing scope tests, but the evidence is somewhat less compelling. The positive result is for D6 which is significant at P=0.018 for the Definitely/Probably Yes model. For that model, the estimated WTP for the low fluctuating flow alternative is significantly larger than for the moderate fluctuating flow alternative. However, that result does not carry over to the Definitely Yes model. There, D6 is not only insignificant, but has the wrong sign. D7, the dummy variable for the seasonally adjusted steady flow alternative, is not significant in either model, but comes close in the Definitely/Probably Yes model (P=0.113). Combined with the lack of demonstrated sensitivity to scope for the marketing area in the pilot survey, the case for stating that the marketing area sample has passed advanced tests is somewhat weaker than for the national sample.

We conclude that the national survey should be categorized as a Level 3 study in the framework proposed above. That is, the national sample results are of sufficient validity to be used in decision making with minimal reservations. Though the scope test results are mixed for the marketing area sample, its strong showing in the rudimentary tests and the one positive scope test is encouraging. In terms of construct validity, it should probably be placed toward the bottom of Level 3 or at the very top of Level 2.

6.4 CONCLUSION

A content-valid CV study is rooted throughout in a clear theoretical definition of the true value of the intervention. Using well-documented evidence of the respondent-relevant effects of the intervention, a sound study will effectively communicate the potential effects of the intervention to respondents. It includes whatever information respondents might need regarding substitutes for the environmental resources in question and reminds them of their budget constraints if necessary. It also includes a fully specified and incentive-compatible context for valuation. The sound study does all this in ways that potential respondents will accept and, if possible, believe. Looking beyond the scenario, a content-valid survey instrument includes well-designed questions to support construct validity testing and achieve other goals. The mode chosen for administering the survey must be appropriate for the complexity of the scenario and the ultimate goals of the study. Prior to administration, the instrument must be subjected to sufficient qualitative investigation, pretesting, and, if needed, pilot testing to eliminate as many problems as possible. Econometric analysis of the results must be adequately performed and the final results effectively reported. We believe that the GCES Non-Use Value Study meets these standards well.

A construct-valid CV study has passed both rudimentary and advanced theoretical validity tests. The valuation equations estimated in this study showed a high degree of consistency between study results and prior expectations. Furthermore, with the caveats expressed at the end of the last section about the marketing area surveys, we were able to achieve considerable success in passing scope tests.

Our conclusion, then, is that the GCES Non-Use Value Study has demonstrated sufficiently high levels of content and construct validity to be used in choosing the criteria for operating Glen Canyon Dam in the future. Integrating the results of this study with results of the power and recreation valuation studies should help to judge the economic implications of alternative criteria for operation of Glen Canyon Dam.

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