Valuing Grand Canyon Riparian Resources

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Glen Canyon Dam has been producing electric power since 1964. In a typical year, the annual volume of water to be released from the dam is not sufficient to sustain peak generation for the entire year. The economic benefits of energy-constrained hydroelectric facilities such as Glen Canyon Dam are maximized by concentrating water releases during periods of highest electrical demand. Until recently, this type of power operation caused 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) in 1982. 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 on the Grand Canyon River environment 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 that 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 (National Academy of Sciences, 1987) stressed that a complete economic analysis of changes in dam operations must consider impacts to the value of power produced at Glen Canyon Dam, and the impact of changes in dam operations on the existence, or passive use, values placed on resources affected by dam operations. To this end, GCES included 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." 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.

In this paper we present the results of a study to measure non-use values for environmental impacts of changes in the operations of Gen Canyon Dam. In Section 2 we present an overview of the study. In Section 3 we present the results and in Section 4 we present conclusions.

Section 2: Overview of Study

We carried out the GCES non-use value study using a consensus-based process. Each step was overseen by the GCES Non-Use Value Committee. The committee consisted of representatives of major stakeholders in the operation of Glen Canyon Dam. These included Bureau of Reclamation, National Park Service, U.S. Fish and Wildlife Service, Western Area Power Administration, Colorado River Energy Distributors Association, and Native American tribes. Recommendations of the GCES Non-Use Value Committee at critical milestones of the study were submitted for approval to an administrative review panel consisting of administrative and policy representatives from major agencies involved in the GCES. Additional review and oversight was provided by an external review panel[1]. This external review panel provided review and guidance at key milestones. Finally, because of the Paperwork Reduction Act, survey instruments were reviewed and approved by the OMB staff twice during the course of the study. We have summarized the major milestones in Figure 1. As part of an overall audit of the GCES program, the results of the final study were reviewed by the General Accounting Office (GAO 1996).

This study process was initiated with the preparation of a study prospectus. This prospectus identified major issues that would have to be addressed and recommended a phased approach for carrying out the research. This phased approach included a qualitative research phase, a pilot test and final implementation. The objectives of qualitative research phase included:

- Determining the geographic extent of concern about river-related resources downstream from Glen Canyon Dam
- Developing and testing survey materials

During this qualitative research phase, a series of eight focus groups were held around the country. Topics discussed during these focus groups included:

- A general discussion of information, knowledge, attitudes, and beliefs about the Grand Canyon that participants brought with them to the focus group discussion.

- Presentation and evaluation of information describing how Glen Canyon Dam has altered the flows of the Colorado River in the Grand Canyon. Participants were also asked to

[1] Ann Fisher, Myrick Freeman, Alan Randall, and Kerry Smith.

predict how these changes in flow patterns might have affected the ecosystem associated with the Colorado River in the Grand Canyon.

- Presentation and evaluation of information describing how the construction and operation of Glen Canyon Dam has affected the ecosystem associated with the Colorado River in the Grand Canyon.

- A contingent valuation exercise to determine whether participants could express, in monetary terms, values for various dam operation alternatives.

Based on the focus group discussions we concluded that it was possible to direct most participants' attention to the river-related environment, rather than the Grand Canyon as a whole and that participants were generally able to understand the ways in which dam impacts affect the river-related environment. Furthermore, at least some participants in each group were able to express preferences for the environmental impacts of alternative dam operations. Given these results the GCES Non-Use Value committee recommended proceeding with a pilot test, with approval for a final study to await the favorable completion of a pilot test.

The pilot study was an important step in the design of the survey instruments needed to estimate the non-use values associated with changing operations at Glen Canyon Dam. Based on the results of the initial eight focus groups, we prepared drafts of possible survey instruments (referred to here as the base instruments). We refined these draft instruments using feedback obtained through a series of additional focus groups and in-depth interviews.

Early in the study design process, the GCES Non-Use Value Committee decided to tie the Non-Use Value Study to the GCDEIS. This meant that the Non-Use Value study would value changes in the riparian environment from conditions and trends during the period of peaking power operations[2]. We developed the descriptions of the environmental impacts used in the pilot test in close collaboration with the physical and biological researchers preparing the GCDEIS. Since much of the GCES research to support the final GCDEIS had not been completed and/or reported at the time of the pilot test, the descriptions of impacts were based on then current knowledge of how the eight possible alternative dam operations would affect the downstream environment relative to the conditions and trends occurring during the "peaking operations" that existed prior to 1991. The preliminary nature of the descriptions of environmental impacts was judged not to be a major problem for implementing the pilot test. While it was clear that the

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[2] The term "peaking power" is used somewhat loosely here. Prior to 1991, minimum flows from Glen Canyon dam were restricted to 1,000 cubic feet per second (cfs) between Labor Day and Easter and 3,000 cfs between Easter and Labor Day. Maximum flows were restricted to 31,500, somewhat less than the maximum possible release of 33,200 cfs. In October 1991, an interim flow operation was begun. Under interim flows, minimum releases ranged from 5,000 to 8,000 cfs depending on the time of day and the amount of water to be released from the dam during a particular month. Ramp rates, the rate of change in releases were restricted to 2,500 cfs per hour for increases in releases and 1,500 cfs per hour for decreases. Prior to 1991, there were no restrictions on ramp rates.

understanding of the environmental impacts would undoubtedly change as the GCDEIS moved from the draft version to the final version, it was also felt that these changes were unlikely to be dramatic. Thus, the descriptions developed for the pilot tests were expected to be fairly close approximations of the impacts that would ultimately be evaluated in a final study. Furthermore, the primary purpose of the pilot test was methodological. Thus the pilot test was designed to answer basic questions about performance of the general survey instruments, not to generate final estimates of non-use values. As a result the preliminary descriptions of environmental impacts were felt to be sufficient for the purposes of the pilot test.

Ultimately the GCES Non-Use Value Committee decided to evaluate three of the eight GCDEIS alternatives: a moderate fluctuating flow, a low fluctuating flow, and a steady flow. Compared to the baseline conditions, the moderate fluctuating flow alternative imposed a small reduction in the allowed daily fluctuation. The low fluctuating flow alternative imposed larger reductions in fluctuations and in the steady flow alternative, daily flows were held constant.[3]

These three alternatives were chosen for use in the pilot test because they spanned the range of alternatives that were considered likely candidates for ultimate selection as the preferred alternative and because the effects of these alternatives were fairly distinct from each other. The five alternatives not chosen were either extremely unlikely to be chosen as the preferred alternative in the GCDEIS or were similar in impacts to one of the three chosen alternatives.

A set of base survey instruments was developed for each of the three flows evaluated and for administration to members of a national sample and members of a sample from the area where power from Glen Canyon Dam is marketed. The base instruments were similar in many ways, but differed depending on which GCDEIS water flow alternative was under consideration.

The pilot study had two overall goals; to evaluate the technical feasibility of estimating non-use values and to provide information for planning the final survey should it be authorized.

To evaluate the technical feasibility of estimating non-use values it was important to evaluate performance of the survey instruments under field conditions, to "put them through their paces," so to speak. The performance of a CV instrument can be judged on a variety of criteria (Arrow et al. 1993).

Perhaps the most important, is that a CV survey should be sensitive to what we shall term the "scale" and "scope" of the resource impacts of alternative operating regimes for Glen Canyon Dam.[4] We use "scale" to refer to the degree or extent of resource impacts relative to the base

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[3] While the steady flow alternative required constant daily flows, the daily flow was adjusted to allow higher flows during the spring and early summer and lower flows during the late summer fall and winter.

[4] The definitions of scope and scale used in this report evolved during evaluation of the proposed pilot study by the Office of Management and Budget. More specifically, we wish to acknowledge Richard Belzer and

case. Scope, on the other hand, refers to the array of resources considered. An instrument that is narrow in scope might cover only beaches and vegetation while an instrument with broader scope would include American Indian sites, native fish, and other resources as well. We accommodated tests of scale by comparing estimates of value for the outcomes of three alternative dam operations. We described the outcomes of each alternative in terms of impacts to beaches, impacts to wildlife habitat, impacts to native fish, impacts to Native American traditional use areas, and impacts to consumers of power produced at Glen Canyon Dam. We accommodated a test of scope by designing one version of the survey in which respondents were told that changes in the operations of the dam would affect only beaches and wildlife habitat.

While an ideal CV instrument would be sensitive to scope and scale, minor changes in the description of the good being valued should not produce statistically significant differences in estimated values. Thus, the second objective of the pilot test was to determine whether estimated values were sensitive to minor changes in the description of the good being valued. This second pilot test objective was accommodated by designing one version of the survey that differed only in minor details from the base instruments.

A third objective of the pilot test was to determine whether values solicited from individuals who might have to pay higher utility bills as a result of changes in dam operations (residents of the marketing area), were different from those outside of the marketing area. Values of residents of the marketing area were judged to have special relevance. First, those receiving power from Glen Canyon Dam tend to reside in areas closer to the study area. Consequently they might be expected to know more about the issues and would be more likely to have pre-formed opinions about dam operations prior to receiving the valuation survey. Secondly, the valuation context is much less hypothetical for residents of the marketing area than for other respondents. Because of educational efforts by electric utilities serving the marketing area, many marketing area residents were aware that they would experience higher utility bills if operations of Glen Canyon Dam were changed.

The fourth objective of the pilot test was to explore the use of a "multiple-bounded" contingent valuation questioning format (Welsh and Poe 1998). Since the proposed sample sizes for the pilot test were fairly small, the GCES Non-Use Value Committee worried that the single-bounded dichotomous choice referendum format (as suggested by the NOAA panel) might not have sufficient statistical power to find sensitivity to scope and scale. Thus, the GCES Non-Use Value Committee considered increasing the statistical power in the pilot test by using a double-bounded questioning format (Hanemann et al. 1991) However, implementation of a double-bounded question was difficult in the context of a mail survey. Budget constraints prevented consideration of in-person interviews and the complexity of the information presented to the

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Richard Theroux for suggesting the concepts. Scope has been used by the NOAA Panel on Contingent Valuation and appears in the proposed NOAA damage assessment regulations, but to our knowledge, the concept of scale and the useful distinction between scope and scale which we applied here have not been previously discussed in the literature.

respondents prevented consideration of telephone interviews. As a compromise, the GCES Non-Use Value Committee decided to use a multiple-bounded questioning format for the bulk of the pilot test, but to include a single bounded version of the survey instrument to gauge the performance of the multiple-bounded instruments.

The fifth and final objective of the pilot test was to explore the role of empathy by members of the national sample for marketing area residents who would experience higher utility bills as a result of changes in operations of Gen Canyon Dam. This objective was accommodated by designing one version of the pilot test instrument in which respondents were told that utility bills of marketing area residents would not be affected by changes in the operations of the dam. A summary of the nine survey versions used in the pilot test is presented in Table 1. The design of the pilot test was approved both by the GCES Non-use Value Committee and by OMB. Implementation took place during January, February and March of 1994.

Upon successful completion of the pilot test (the results of which are discussed in the next section) the GCES Non-Use Value Committee recommended proceeding with a final study. In contrast to the pilot study in which the primary objectives were methodological in nature, the primary purpose of the final study was policy oriented, namely producing estimates of non-use values for three of the dam operations alternatives described in the GCDEIS.

During the time required for the pilot test implementation and analysis, the scientific understanding of the environmental impacts of changes in dam operations had continued to evolve. Two changes in the scientific understanding are very important in understanding the results of the final study. First, when the pilot test was designed, scientists felt that the three GCDEIS alternatives evaluated in pilot test would result in different outcomes in terms of impacts to beaches and wildlife habitat. By the time the final study was designed, scientists predicted that these three alternatives would have the same impact on beaches and wildlife habitat. Second, scientists became less optimistic about the prospects for native fish under the steady flow alternative. When the pilot test was designed, scientists felt the seasonally adjusted steady flow alternative would result in increased populations of native fish. By the time the final study was prepared, scientists were concerned that the steady flow alternative would also improve conditions for non-native fish that might compete with the native fish. Thus in the final study, the description of the environmental impacts of the steady flow alternative was modified to indicate that while there would be an improvement in conditions for native fish, competition from non-native fish might limit growth in the population of native fish. This evolution of the scientific understanding tended to blur the distinction between the outcomes of various alternatives evaluated in the final Non-Use Value Study.

The final study differed from the pilot test in other ways. While the pilot test used small sample sizes and relied heavily on the multiple bounded questioning format, the final study used larger sample sizes and relied on the single bounded dichotomous choice questioning format. Furthermore, the final study design included a telephone follow-up with non-respondents to the mail survey. Data collected during the telephone follow up was used to adjust value estimates for

non-response. Finally as mentioned earlier, the primary purpose of the final study was to estimate values for policy while the primary purpose of the pilot test was to test the performance of the survey instrument.

Section 3: Results

The pilot test was implemented during the winter and spring of 1994. Across all survey treatments, the response rate averaged 63 percent (Table 2). Response rates were highest for versions 4 and 5, 73 percent and 78 percent respectively. Versions 4 and 5 were the two versions administered to residents in the marketing area. We suspect that the higher response rate for these two versions reflects a higher saliency of the topic to residents of the marketing area. These individuals live closer to the Grand Canyon and these individuals were informed in the survey materials that changes in the operations Glen Canyon Dam would cause their utility bills to increase.

The survey materials for the pilot test consisted of a package of background materials that the respondents were asked to read prior to filling out the survey. These materials were intended to ensure that all respondents had a clear understanding of the issues related to the valuation context. The survey began with a short "quiz" in which the respondents were asked a series of true/false questions related to the major points covered in the background material. This quiz had two purposes. The first was to encourage respondents to read the background materials prior to competing the valuation portion of the survey. The second was to demonstrate that respondents properly understood the valuation context prior to the valuation exercise. Following the true-false quiz, respondents were presented with a description of a proposal to change operations at Glen Canyon Dam. This proposal described the environmental implications of the change in terms of beaches, wildlife habitat, trout populations, and native fish populations. In the versions administered to the national samples the proposal also described the electric price impacts to residents of the marketing area.

After reading the proposal, respondents were first asked if they would vote in favor of the proposal if passage of the proposal did not cost them anything (Table 3). Because sample sizes are relatively small, with one exception, differences between the percent voting in favor of the proposal at no cost can not be declared significantly different. The percent voting in favor of the reduced scope proposal is dramatically lower than for any other proposal. This difference is significant at $\alpha = .01$ level for six of the seven comparisons and at $\alpha = .10$ for the other. We take this as evidence that respondents to the survey generally found the reduced scope proposal to be less attractive than the other proposals.

Those respondents voting in favor of the proposal at zero cost were asked how they would vote on the proposal if passage of the proposal cost them various amounts. To enhance the statistical precision in the pilot test, the bulk of the survey versions used a multiple-bounded questioning format (Figure 2). One treatment used a traditional single-bounded contingent valuation question (Figure 3).

Logistic regression models were estimated for the multiple-bounded treatments. Estimation of the models required several steps. First, for each respondent, the response for each dollar amount in the multiple bounded question was recoded into a single yes/no response. In one set of models, "Definitely Yes" was coded as a yes response and "Probably Yes", "Unsure", "Probably No" and "Definitely No" were coded as a no response. In another set of models "Definitely Yes" and "Probably Yes" were coded as a yes response and, "Unsure", "Probably No" and "Definitely No" were coded as a no response. Next the recoded data were analyzed using a bounded logistic regression procedure (Hanemann et al. 1991, and Welsh and Poe, 1998).

The patterns of mean willingness-to-pay (WTP) exhibit patterns consistent with nearly all *a priori* expectations. In the national sample, mean WTP increases as one moves from the moderate fluctuating flows (version 1- smallest environmental benefits), to steady flows (version 3 - largest environmental benefits). Thus mean WTP appears to be sensitive to the scale of the environmental benefits. Mean WTP does not appear to be sensitive to minor changes in the wording of the survey ($58.2 for version 3 versus $53.4 for Version 6). Dropping the most important attributes (a test of scope as defined above) results in a large decrease in mean WTP ($58.2 for version 3 versus $42.0 for Version 8). Finally, in the marketing area, mean WTP was higher for the steady seasonal flows than for the moderate fluctuating flows, again suggesting that respondents were sensitive to scale of the environmental benefits.

The only result not consistent with *a priori* expectations is found in the comparison between Version 3 and Version 9. Scenarios in these two versions were identical with one exception. Respondents to version 3 were told that changes in the operations of the dam would increase utility bills for individuals living in the marketing area. Evidence from focus groups conducted during the survey design process suggested that some respondents felt empathy for the residents of the marketing area and were somewhat uncomfortable with voting for a proposal that would impose substantial costs on marketing area residents. Various members of Non-Use Value Committee expressed concerns about inclusion of the price impacts as part of the valuation context. One concern was that individuals might reject the valuation context because of empathy for marketing area residents. A second concern was that including the effect of empathy for marketing area residents might result in a double counting of negative impacts on electric power consumers.[5] Version 9 explored the role of the price impacts by dropping the reference to these price increases. Respondents to version 9 were told that electric prices would remain the same in the marketing area and that general taxes would be used to make up for the loss in the value of power. Because of empathy for marketing area residents it was suspected that WTP for Version 9 would be greater than mean WTP for Version 3. The results of the pilot test did not support this hypothesis. In fact, it turned out that mean WTP for Version 9 was lower than for any other version administered to a national sample. Finally, consistent with a number of other studies

[5] A separate study was conducted to measure the economic losses in the production of electric power caused by changes in the operations of the dam. Including price impacts in the non-use value study scenarios raises the possibility that these losses might be double counted in a benefit cost analysis.

mean WTP was higher when estimated from a single bounded question than from a multiple-bounded question.

In the pilot test we used two procedures to test hypotheses. The first test was a log likelihood ratio test of the hypothesis of equality in the logistic regression parameters for each model. For the second test we used Monte Carlo techniques (Krinsky and Robb, 1996) to generate 1,000 estimates of mean WTP for each model. These distributions were used to test the hypothesis of equality using the technique of convolutions (Poe et al. 1994). The results of these tests are shown in Tables 5 and 6.

In the national sample, there are six possible likelihood ratio tests of the hypothesis of scale. Using a likelihood ratio test we find that steady flow and the moderate fluctuating flow scenarios produced significantly different models for both the Probably Yes and Definitely Yes coding of the data. Likewise in the Probably Yes model, the steady flow scenario produced significantly different models than the low fluctuating flow scenario. We take these results as evidence the survey instruments have passed a test of scale, with scenarios describing larger impacts to affected resources generating different distribution of WTP than scenarios describing smaller impacts to affected resources. There are two log likelihood tests of scope. The significance of this test is $\alpha \cong .165$ in the Definitely Yes model. However, in the Probably Yes model the test of scope is easily passed. A similar result is observed in the marketing area sample. The probably yes model produces significantly different parameters for the steady flow scenario than for the moderate fluctuations scenario, while a significant difference is not observed for the definitely yes model. We take these results as evidence that the survey instruments were sensitive to the scope of the injury.

The test of minor wording changes suggests that minor wording changes did not result in significantly different models. Finally, dropping the information about price impacts caused a significant change in the estimated logistic regression models.

While the likelihood ratio test allows us to test the hypothesis of equality of parameters in models, it does not provide a direct test of the equivalence of WTP in the various models. To carry out this test we used Monte Carlo methods to generate empirical distributions of WTP for each of the models and then tested the hypothesis of equality of mean WTP using the convolutions procedure (Poe et al. 1994). In the national sample, we can not reject the equality of mean WTP for the moderate and fluctuating flow alternatives. Steady flows appear to produce a higher WTP than low fluctuating flows, however the hypothesis of equality is only rejected for the probably yes model, but not for the definitely yes model. Steady flows produce significantly higher mean WTP than low moderate fluctuating flows.[6] In the marketing area, WTP is

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[6] The convolution test of mean WTP assumes an alternate hypothesis of inequality. If we use *a priori* expectations regarding the relative magnitude of WTP from the various models we could use a one sided alternative hypothesis. That is to say we might hypothesize:
WTP(moderate fluctuations) < WTP(low fluctuations) < WTP(Steady). We calculate the significance level of the

significantly higher for the steady flows in the probably yes model, but not for the definitely yes model. We take these tests as evidence that the mean WTP is sensitive to the scale of the environmental good, particularly between the moderate fluctuating flows and the steady flows. The test of minor changes in wording does not reject the hypothesis of equality in mean WTP at α=.10 level.[7] On the other hand, the test of reduced scope indicates that WTP is significantly lower for the reduced set of environmental benefits.

As mentioned earlier, the only statistically significant pilot test result **not** consistent with prior expectations was the test of empathy. Recall that during the qualitative research phase, respondents tended to view the imposition of higher utility bills on marketing area residents as a negative feature of the alternative dam operations. Thus dropping these impacts should increase the desirability of any alternative, all else equal. However to accomplish this task, we had to tell respondents something about what would happen to users for electricity produced at the dam. This was because the context for the valuation was that dam operations that would produce higher levels of environmental benefits would reduce the value of electricity produced at the dam. Thus in the version that dropped the marketing area price impacts, respondents were simply told that prices would be held constant for those receiving power from the dam and the reduction in the value of power would be made up through an increase in taxes. Based on discussions after the pilot test it was felt that the result of lower value when price impacts were dropped may have been due to respondents rejecting the idea of paying for the change in operations when those receiving power from the dam were held harmless in terms of power bills.

Overall the results of the pilot test were favorable for conducting a final study. Values appeared to be sensitive to the scale and scope of the environmental good, and values were not sensitive to minor changes in wording. Because of these favorable results a decision was made to proceed to a final study.

The final study was implemented from October 1994 through January 1995. Survey procedures included an advance letter, an initial survey mailing, a reminder postcard and up to two additional mailings of the survey to non-respondents. The final survey mailing was sent via certified mail. The final study focused on three alternative dam operations, a moderate fluctuating flow alternative, a low fluctuating flow alternative and a steady flow alternative. Each alternative was evaluated by independent samples selected from a national sampling frame and a separate marketing area sampling frame. One additional alternative was included in the final study to further explore the issue of empathy by members of the national sample for individuals in the marketing area that would be adversely affected by the price impacts caused by changes in the operation of Glen Canyon Dam. This additional scenario was evaluated by members of a

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one tailed test by dividing the reported significance level by 2. Doing this has the potential to change one test result; the comparison of mean WTP for moderate and fluctuating flows in the definitely yes model. This significance level of the 1 tailed test is .09 which would allow one to declare this difference significant at the .10 level.

[7] Use of a two tailed test would be appropriate here since we had no prior expectations as to how minor changes in wording would be expected to affect mean WTP.

national sample. This final scenario included the environmental impacts of the steady flows with the price impacts of the moderate fluctuating flow alternative.

After completion of the mail survey procedures, we attempted to contact each non-respondent to complete a short telephone interview. This telephone follow-up was conducted in February of 1995. During the telephone follow-up we collected a small amount of information about the respondent and encouraged the respondent to complete and return the mail survey. Response rates are shown in Tables 7, 8 and 9. Approximately 66% of respondents in the national sample returned a mail survey while approximately 75% of respondents from the marketing area did so. If we consider both the mail survey and the telephone interview, we heard from about 74% of respondents in the national sample and 83% of the respondents in the marketing are a sample.

As in the pilot test, respondents in the final study were asked to read some background materials describing the valuation context. The survey began with a true-false quiz that served to remind the respondents of the baseline condition. After answering these questions, respondents were presented with a scenario describing one of the flow alternatives. Respondents were asked if they would support the alternative at zero cost to them (Table 10). In the national sample, the proportion of respondents who would support the no-cost proposal was lowest for the moderate fluctuating flow proposal and highest for the low fluctuating flow proposal. Support for the steady flow proposal was lower than for the low fluctuating flow proposal. Although the steady flow proposal is more favorable than the low fluctuating proposal 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 steady flow proposal might reflect a judgment by survey respondents that the higher price impacts of the proposal more than offset any additional environmental gains.

This interpretation is further strengthened by the level of support shown for the proposal that combined the environmental impacts of the steady flow proposal with the price impacts of the moderate fluctuating flow proposal. This version differed from the steady flow alternative only in terms of the price impacts. Likewise this version differed from the moderate and fluctuating flow alternatives only in terms of the environmental consequences. Thus, in the national sample, when we hold the price impacts constant we see a significant increase in the percentage of respondents favoring the proposal at zero cost when we move from the moderate fluctuations to either the low fluctuations for the steady flow. Both the steady flow and the low fluctuations have about the same level of support. However, when we hold the environmental benefits constant at the steady flow level and increase the price impacts, respondents are less likely to support the proposal. A very similar response pattern is observed in the marketing area sample. A significantly larger percentage of respondents are willing to support either the low fluctuating flow or the steady flow alternative than the moderate fluctuating flow alternative.

All respondents voting in favor of a proposal at zero cost were asked how they would vote if passage of the proposal increased their taxes (national sample) or utility bills (marketing area sample) by a specified amount (Figure 4). Thus, unlike the pilot test, the final study employed a single-bounded question.[8] While a single-bounded question was used, we still allowed respondents to express degrees of certainty regarding their answers to the valuation question. These response categories were chosen because of research suggesting that respondents most sure of their answer are more likely to give responses that are consistent with inferences based on revealed preference methods (Champ et al. 1997).

Responses to the valuation 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.

The estimated logistic regression model predicted 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. Cases with missing data for any variable used in the model were excluded from this analysis. Results are presented in Table 11 for the national sample models and in Table 12 for the marketing area models. Variable definitions are found in Table 13. In general it is found that 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 as reflected in a higher score on the "quiz"
- A belief that the study results would be used to determine future dam operations;
- Attitudes favoring the environment
- Higher levels of income
- Higher levels of education.

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

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[8] External reviewers were impressed with the performance of the multiple bounded format in the pilot test. However, at the time the final study was implemented very little additional research had been done using this method. Consequently the external reviewers strongly suggested use of a single bounded question for the final study.

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

In calculating the mean willingness-to-pay from the logistic regression models, the values for the non-cost variables were (with one exception) set at the relevant national-sample averages and marketing-area sample averages obtained from the survey data. 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 14.

The means reported in Table 14 represent the average willingness-to-pay only for those respondents voting in favor of the proposal at no cost. To determine an average value that can be aggregated across relevant populations we took account of 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 a proposal even at zero cost provided a clear indication that they did not place a positive value on the proposal. Consequently we assigned these individuals a zero willingness-to-pay.

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. However, in the absence of any information about the potential values these individuals might have, we also assigned these individuals a zero willingness-to-pay.

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. (Welsh et al. 1995) 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 (Welsh et al. 1995). By applying this model to data collected during the telephone interview of nonrespondents we estimated the proportion of non-respondents that would have voted in favor of the proposal at zero cost had they completed a mail survey. Next, an average willingness-to-pay for nonrespondents was estimated using the models reported in Tables 11 and 12 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 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.

A summary of population average willingness-to-pay is presented in Table 15 and levelized[9] annual values are presented in Table 16. The values reported in Tables 15 and 16 span a relatively large range. This range reflects the large number of decisions which were made during survey design, implementation, and data analysis.

For several reasons 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.

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

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[9] The levelized annual value is the value that discounted over a specified time period would produce a present value equivalent to a variable series of values discounted over the same time period. Levelized values were calculated to facilitate a benefit cost analysis of changes in dam operations. Levelization procedures followed those used in the GCES power economic researchers and the GCES recreation researchers. These included a fifty year time frame, an escalation in the number of households in the U.S. during the first 20 years of the analysis period, use of the GNP implicit price deflator to produce estimates of future values and the use of an 8.5% discount rate.

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 it is likely 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 11 and 12 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, in the calculation of population weighted average willingness to pay we excluded the portion of the sample identified as out-of-scope. 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.

Section 4: Conclusions

The results of the GCES Non-Use Value study suggest there is a large perceived benefit associated with the environmental impacts of changes in the operations of Glen Canyon Dam. What do these values imply for the operations of the dam? To assess this question we must compare the size of non-use values to the impacts on the value of power produced at Glen Canyon Dam. In a separate study, GCES researchers estimated the reductions in the value of power associated with each of the flows considered in the Non-UseValue study. (GCES Power Economics Committee 1995) Table 17 contains the power impacts and the non-use value impacts for the three alternatives.

If we consider only the values from individuals living in the marketing area the economic case for changes in the operation of the dam is strong. For the moderate fluctuating flow scenario non-use values slightly exceed the largest estimate of forgone power benefits. In the low fluctuating flow scenario, non-use values are approximately one-third more than the high end of the estimate of forgone power benefits but are four times as large as the low end of the forgone power benefits. For the steady flow alternative, non-use values from residents of the marketing area are slightly less than smallest estimate of foregone power benefits. Thus if we consider only the values of those residing in the marketing area, we believe the results present a strong case for a change in dam operations to moderate fluctuating flows. Respondents to the marketing area survey are the people who will likely bear the costs of the changes, and this makes their responses particularly credible.

When the national values are considered, the economic case for changes in dam operations is overwhelmingly positive. Non-Use values on a national basis exceed lost power benefits by at least a factor of ten for all the alternatives.

Clearly, an economic analysis of a change in dam operations will depend, in part, on the relative emphasis placed on the power values and the non-use values. Given the controversy surrounding the validity of the non-use values measured using contingent valuation, what advice can be given to assist decision-makers? We would suggest that decision-makers keep several factors in mind. First, we believe the GCES Non-Use Value Study has high content and

construct validity, which has produced results with a high level of validity. Second, the non-use values have been constructed and aggregated using very conservative procedures. Many features of the study design and implementation process have had the effect of reducing the estimated non-use values. Third, the non-use values expressed by members of the marketing area sample have special relevance. The contingent valuation exercise was less hypothetical for residents of areas receiving power produced at Glen Canyon Dam. These individuals will actually pay higher utility bills if dam operations are changed, and they tended to be aware of this fact. Still, even when calculated using conservative procedures, the willingness-to-pay expressed by marketing area residents alone is nearly large enough to justify either the moderate or low fluctuating flow proposals. Finally, the national sample non-use values are so large in magnitude relative to power values that they would have to be reduced by more than an order of magnitude to reverse the outcome of a comparison of non-use values and power values. We think that the high level of content and construct validity of the non-use values, combined with conservative estimation and aggregation techniques, make it extremely unlikely that the national non-use values are overestimates by more than an order of magnitude.

Table 1: Pilot Test Experimental Design - Overview				
Version	Flow Alternative	CV Question Format	Sample	Valuation Context
Version 1	Moderate fluctuating flow - small environmental benefits	multiple bounded	National	all resources
Version 2	Low fluctuating flow - moderate environmental benefits	multiple bounded	National	all resources
Version 3	Steady flow - large environmental benefits	multiple bounded	National	all resources
Version 6	Steady flow - large environmental benefits	multiple bounded	National	all resources
Version 7	Steady flow - large environmental benefits	single bounded	National	all resources
Version 8	Steady flow - large environmental benefits	multiple bounded	National	only vegetation, sediments, and power impacts
Version 9	Study flow - large environmental benefits	multiple bounded	National	excludes power impacts
Version 4	Moderate fluctuating flow - small environmental benefits	multiple bounded	Marketing Area	all resources
Version 5	Steady flow - large environmental benefits	multiple bounded	Marketing Area	all resources

Table 2: Pilot Test Response Rates[a]				
	Initial Sample	Out of Scope[b]	Completed Surveys	Response Rate[c]
National Sample				
Version 1: Moderate Fluctuations	250	24	138	61%
Version 2: Low Fluctuations	250	39	131	62%
Version 3: Steady Flows	250	30	127	58%
Version 6: Steady Flows - minor wording changes	250	35	126	59%
Version 7: Steady Flows - single bounded	250	42	118	57%
Version 8: Steady Flows - reduced scope	250	28	133	60%
Version 9: Steady Flows - no power price impacts	250	34	126	58%
Marketing Area				
Version 4: Moderate Fluctuations	250	46	149	73%
Version 5: Steady Flows	250	35	168	78%
Total	2250	313	1216	63%

[a] Response rates are calculated from the last day that completed questionnaires were included in the data set, April 12, 1994.
[b] Includes cases where the addressee was deceased or the survey mailing was returned as undeliverable.
[c] Calculated as a percentage of deliverable questionnaires (sample size minus out of scope cases).

Table 3: Support of Proposal at Zero Cost				
	Percentage Voting in Favor	Percentage Voting Against	Percentage Voting Choosing not to vote	Sample Size
National Sample				
Version 1: Moderate Fluctuations	74%	18%	8%	129
Version 2: Low Fluctuations	80%	14%	7%	118
Version 3: Steady Flows	74%	14%	12%	111
Version 6: Steady Flows - minor wording changes	67%	18%	15%	113
Version 7: Steady Flows - single bounded	76%	16%	7%	110
Version 8: Steady Flows - reduced scope	56%	31%	14%	124
Version 9: Steady Flows - no power price impacts	82%	10%	8%	115
Marketing Area				
Version 4: Moderate Fluctuations	80%	13%	7%	134
Version 5: Steady Flows	78%	14%	8%	157

Table 4: Summary of Mean Pilot Test Mean WTP			
	Definitely Yes Model	**Definitely/Probably Yes Model**	**Sample size**
National Sample			
Version 1: Moderate Fluctuations	$42.3	$69.2	85
Version 2: Low Fluctuations	45.9	73.6	83
Version 3: Steady Flows	58.2	95.5	73
Version 6: Steady Flows - minor wording changes	53.4	91.9	67
Version 7: Steady Flows - single bounded	121.8[a]	121.8[a]	
Version 8: Steady Flows - reduced scope	42.0	66.1	66
Version 9: Steady Flows - no power price impacts	33.3	57.0	80
Marketing Area			
Version 4: Moderate Fluctuations	$26.2	$47.5	94
Version 5: Steady Flows	30.2	54.6	112

a This value was derived from a single bounded dichotomous choice question. It is included in this table only for purposes of comparison with the multiple bounded results.

Table 5: Results of Statistical Testing for Pilot Test - Definitely Yes Model			
	Convolutions approach		Likelihood Ratio Test[a]
National sample	Significance level[b]	95% CI[c]	χ^2
Moderate Fluctuations versus Low Fluctuations	0.67	(-11,13)	1.6
Steady Flows versus Low Fluctuations	0.18	(-6,29)	2.1
Steady Flows versus Mod. Fluctuations	0.05	(0,32)	5.0
Test of minor wording changes	0.58	(-24,13)	0.4
Test of reduced scope	0.07	(-2,34)	3.6
Test of Empathy	0.00	(9,41)	10.5
Marketing Area			
Steady Flows versus Mod. Fluctuations	0.40	(-5,12)	0.8

[a] Each treatment the model included only two parameters. Thus the likelihood ratio test for any pairwise comparison has two degrees of freedom. Critical χ^2 chi-square values are 5.99 at the $\alpha = .05$ level and 4.60 at the $\alpha = .10$ level.

[b] The convolutions approach tests the hypothesis of equality of the means. The reported significance level is the α level for a two tailed test of equality.

[c] Empirical confidence intervals constructed by dropping the lowest 2.5 percent and upper 2.5 per cent of the convolution of the two distributions.

Table 6: Results of Statistical Testing for Pilot Test - Probably Yes Model			
	Convolutions approach		Likelihood Ratio Test[a]
National sample	Significance level[b]	95% CI[c]	χ^2
Moderate Fluctuations versus Low Fluctuations	0.40	(-4,10)	2.3
Steady Flows versus Low Fluctuations	0.00	(5,22)	16.2
Steady Flows versus Moderate Fluctuations	0.00	(9,25)	20.1
Test of minor wording changes	0.21	(-3,15)	1.9
Test of reduced scope	0.00	(8,25)	24.3
Test of Empathy	0.00	*	63.5
Marketing Area			
Steady Flows versus Moderate Fluctuations	0.05	(0,10)	8.5

[a] Each treatment the model included only two parameters. Thus the likelihood ratio test for any pairwise comparison has two degrees of freedom. Critical χ^2 values are 5.99 at the $\alpha = .05$ level and 4.60 at the $\alpha = .10$ level.

[b] The convolutions approach tests the hypothesis of equality of the means. The reported significance level is the α level for a two tailed test of equality.

[c] Empirical confidence intervals constructed by dropping the lowest 2.5 percent and upper 2.5 per cent of the convolution of the two distributions.

* Convolution does not include zero.

Table 7: Final Study Mail Survey Response Rates				
National Sample				
	Sample Size	Out of Scope[a]	Completed Surveys	Response Rate[b]
Moderate Fluctuations	850	188	426	64%
Low Fluctuations	850	202	431	66%
Steady Flow	850	196	439	67%
Steady Flow with Moderate Flow Price Impacts	850	190	432	65%
Total	3,400	776	1,728	66%
Marketing Area				
Moderate Fluctuations	850	219	467	74%
Low Fluctuations	850	226	467	75%
Steady Flow	850	200	489	75%
Total	2,550	645	1,423	75%

[a] Includes cases where the addressee was deceased or the survey materials were returned as undeliverable.
[b] Calculated as a percentage of deliverable questionnaires (sample size minus out-of-scope cases).

Table 8: Final Study Telephone Follow-up Response Rates					
National Sample					
	Sample Size	Out of Sample[a]	Withdrawn from Sample[b]	Completed Interviews	Response Rate[c]
Moderate Fluctuations	286	90	9	66	35%
Low Fluctuations	267	92	6	53	31%
Steady Flow	272	79	9	69	38%
Steady Flow with Moderate Flow Price Impacts	277	80	14	63	34%
Total	1,102	341	38	251	35%
Marketing Area					
Moderate Fluctuations	207	57	7	62	43%
Low Fluctuations	205	63	7	58	43%
Steady Flow	194	42	6	74	51%
Total	606	162	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 telephone survey 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 9: Final Study Overall Response Rates				
National Sample				
	Sample Size	Out of Scope[a]	Completed Surveys	Response Rate[b]
Moderate Fluctuations	850	197	480	74%
Low Fluctuations	850	211	472	74%
Steady Flow	850	198	491	75%
Steady Flow with Moderate Flow Price Impacts	850	196	485	74%
Total	3,400	802	1,928	74%
Marketing Area				
Moderate Fluctuations	850	224	521	83%
Low Fluctuations	850	233	508	82%
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).

Table 10: Support of Alternative at Zero Cost				
National Sample				
	Support Proposal at Zero Cost	Not Support Proposal at Zero Cost	Choose Not to Vote	Number of Cases
Moderate Fluctuations	71%[a]	17%	12%	402
Low Fluctuations	83[b]	9	8	408
Steady Flow	77[c]	12	11	414
Steady Flow with Moderate Fluctuations Price Impacts	81[b,c]	9	10	411
Marketing Area				
Moderate Fluctuations	76%[a]	17%	7%	434
Low Fluctuations	85[b]	8	7	437
Steady Flow	85[b]	97	6	467

[a,b,c] The percentages of "yes" responses were compared <u>within</u> the national and marketing area samples; they were not compared <u>between</u> the two samples. Within the sample, percentages that share the same superscript are not significantly different ($Z < 1.64$).

Table 11: 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 12: 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 13: 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 13: 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.

Table 14: Mean Willingness-to-Pay [a]				
	National Sample		Marketing Area Sample	
Water Release Alternative	Definitely Yes Models	Definitely / Probably Yes Models	Definitely Yes Models	Definitely / Probably Yes Models
Moderate Fluctuating Flow	$23.96	$107.31	$32.43	$100.11
Low Fluctuating Flow	$29.45	$128.75	$28.14	$124.93
Steady Flow	$32.11	$122.32	$37.59	$115.68
Steady Flow with Moderate Flow Price Impacts	$35.52	$132.82	NA[b]	NA[b]

[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.

[b] This treatment was not carried out in the marketing area sample.

Table 15: Population Weighted Average Mean Willingness-to-Pay				
	Willingness to Pay Values Imputed for Nonrespondents[a]			
	National Sample		**Marketing Area Sample**	
Water Release Alternative	**Definitely Yes Models**	**Definitely / Probably Yes Models**	**Definitely Yes Models**	**Definitely / Probably Yes Models**
Moderate Fluctuating Flow	$13.65	$67.56	$22.06	$69.49
Low Fluctuating Flow	$20.15	$97.33	$21.45	$98.29
Steady Flow	$20.55	$86.18	$28.87	$90.91
Steady Flow with Moderate Flow Price Impacts	$23.79	$98.77	NA[c]	NA[c]
	Zero Willingness to Pay Assumed for Nonrespondents[b]			
	National Sample		**Marketing Area Sample**	
Moderate Fluctuating Flow	$10.95	$49.03	$18.24	$56.31
Low Fluctuating Flow	$16.26	$71.07	$17.90	$79.47
Steady Flow	$16.60	$63.23	$24.04	$73.97
Steady Flow with Moderate Flow Price Impacts	$18.83	$70.41	NA[c]	NA[c]

[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.
[c] This treatment was not carried out in the marketing area sample.

Table 16: Levelized Population Weighted Average Mean Willingness-to-Pay				
	Willingness to Pay Values Imputed for Nonrespondents[a]			
	National Sample		**Marketing Area Sample**	
Water Release Alternative	**Definitely Yes Models**	**Definitely / Probably Yes Models**	**Definitely Yes Models**	**Definitely / Probably Yes Models**
Moderate Fluctuating Flow	$2,286.4	$11,316.4	$62.2	$196.1
Low Fluctuating Flow	$3,375.2	$16,302.9	$60.5	$277.3
Steady Flow	$3,442.2	$14,435.2	$81.4	$256.5
Steady Flow with Moderate Flow Price Impacts	$3,984.8	$16,544.1	NA[c]	NA[c]
	Zero Willingness to Pay Assumed for Nonrespondents[b]			
	National Sample		**Marketing Area Sample**	
Moderate Fluctuating Flow	$1,834.1	$ 8,212.6	$51.5	$ 158.9
Low Fluctuating Flow	$2,723.6	$11,904.3	$50.5	$224.2
Steady Flow	$2,780.5	$10,591.1	$67.8	$208.7
Steady Flow with Moderate Flow Price Impacts	$3,154.0	$11,793.8	NA[c]	NA[c]

[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.
[c] This treatment was not carried out in the marketing area sample.

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Table 17: Benefits and Costs of Changes in the Operations of Glen Canyon Dam.			
Water Release Alternative	**Power Impacts**	**Market Area Non-Use Values**	**National Non-Use Values**
Moderate Fluctuating Flow	-$36.7 to -$54.0	$62.2	$2,286.4
Low Fluctuating Flow	-$15.1 to -$44.2	$60.5	$3,375.2
Steady Flow	-$88.3 to -$123.5	$81.4	$3,442.2

Figure 1

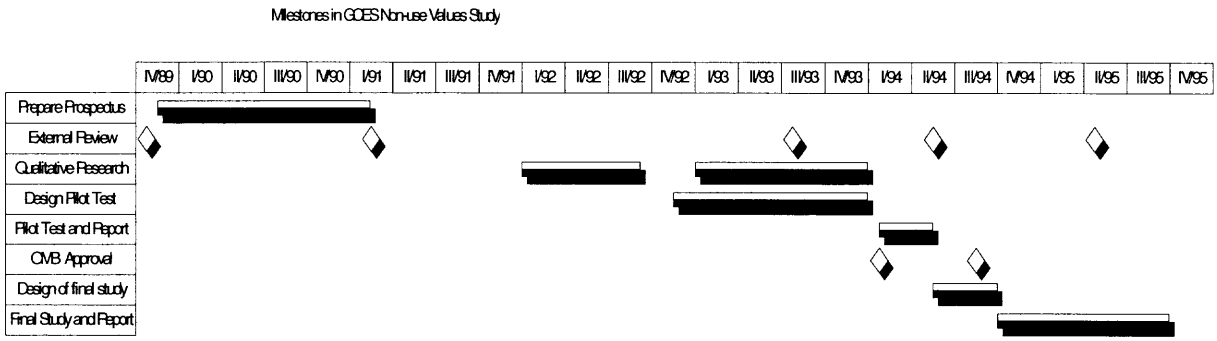
Milestones in GOES Non-use Values Study
IV/89
I/90
II/90
III/90
IV/90
I/91
II/91
III/91
IV/91
I/92
II/92
III/92
IV/92
I/93
II/93
III/93
IV/93
I/94
II/94
III/94
IV/94
I/95
II/95
III/95
IV/95
Prepare Prospectus
External Review
Qualitative Research
Design Pilot Test
Pilot Test and Report
OMB Approval
Design of final study
Final Study and Report

Figure 2: Example of multiple bounded questioning format used in pilot test

If 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. How would you vote on this proposal if passage of the proposal would cost your household these amounts **every year** for the foreseeable future? *(CIRCLE ONE LETTER FOR EACH DOLLAR AMOUNT TO SHOW HOW YOU WOULD VOTE)*

Cost to you per year?	**Approx. cost per month?**	Definitely Yes	Probably Yes	Not Sure	Probably No	Definitely No
10¢	1¢	A	B	C	D	E
50¢	4¢	A	B	C	D	E
$1	8¢	A	B	C	D	E
$5	42¢	A	B	C	D	E
$10	83¢	A	B	C	D	E
$20	$1.67	A	B	C	D	E
$30	$2.50	A	B	C	D	E
$40	$3.33	A	B	C	D	E
$50	$4.17	A	B	C	D	E
$75	$6.25	A	B	C	D	E
$100	$8.33	A	B	C	D	E
$150	$12.50	A	B	C	D	E
$200	$16.70	A	B	C	D	E

Figure 3: Example of single bounded questioning format used in pilot test

If 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. How would you vote on this proposal if passage of the proposal would cost your household $_____ **every year** for the foreseeable future? *(CIRCLE ONE NUMBER)*

1 Yes - I would vote for the proposal to change operations at Glen Canyon Dam even though I would have to pay more taxes.

2 No - I would vote against the proposal.

Figure 4: Example of valuation question used in final study

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.**

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