CREATING AN INTERDISCIPLINARY FRAMEWORK FOR ECONOMIC VALUATION: A CVM APPLICATION TO DAM REMOVAL

DISSERTATION

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ABSTRACT

Contingent valuation (CV) is a commonly used method for estimating the value of non-market goods. This study attempted to create a more interdisciplinary framework for economic valuation, specifically for estimating the economic benefits of dam removal, and is part of an on-going research program at the Ohio State University on the economics of river restoration (Hitzhusen, 2003). The case study for this dissertation was the Ballville Dam located in Sandusky County, in northwest Ohio. A CV survey and several variants were developed to test several methodological considerations.

The first methodological issue considered was that of incentive compatibility, as it relates to both the dichotomous-choice (DC) and open-ended (OE) elicitation formats used in contingent valuation. Two versions of the CV survey were mailed to Sandusky County residents; one with a DC willingness-to-pay question (WTP) and the other with an OE willingness-to-pay question. Mean WTP for the DC survey was $50.86 and for the OE survey was $48.42.

The second part of the study examined the topic of stable versus constructive preferences. A new elicitation format, structured elicitation groups (SEG), was developed and a lab experiment using both a "mail survey" and SEG was run in order to test (1) whether preferences are being constructed during the contingent valuation elicitation process and (2) if that is the case, whether the SEG methodology accounts for such preferences. Results confirmed that the knowledge and awareness levels of SEG

participants were significantly different pre-and post-survey and also suggested that SEG participants may have less difficulty with the OE WTP format.

Finally, the study estimated mean WTP as $50.86 per household in Sandusky County and $50.91 per household within a 30-mile radius of the dam. The aggregated low-bound estimates of total social benefits based on these estimates were $863,000 and $12.3 million respectively, while the estimated cost of removal was $10.2 million. By improving the techniques used to estimate the benefits of dam removal, the decision-making process with respect to dam removal can be improved and the potential for applying benefit transfer methods to these estimated benefits can also be explained.

Dedicated to my Marmalot and Papa-rocks

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CHAPTER 1

INTRODUCTION

1.1 Research problem

Over the past two centuries the installation of dams, built mainly for economic reasons such as power generation, water supply, irrigation, or flood control, has transformed America's rivers. There are now over 76,000 registered dams (two meters or higher) and an estimated two million dams of smaller size. In many cases the installation of these dams has led to environmental changes in both the river and the surrounding habitat. There has also been evidence of some dams directly influencing the decline of commercially important fish, as well as threatening the existence of endangered species (Heinz Center, 2002). More attention has been given recently to the effects of dams on the environment due to changing social values, safety issues related with aging structures, and an increase in scientific information on the long terms effects of dams (Heinz Center, 2002).

When assessing the discounted future flow of economic values for a dam, the typical life expectancy of the structure is normally 50 years. On the formal list of dams maintained by the United States Army Corps of Engineers (USACE), more than 22,000 (30 percent) are already over 50 years old, and by the year 2020 over 60,000 (80 percent) will have exceeded the typical life expectancy. In many cases, the structural integrity of

the dam is not only compromised or obsolete, but the dam is also no longer being used. Of the 76,000 dams officially accounted for in the United States, more than half will be up for license renewal in the next decade (Liggett, 2002), and for many, structural obsolescence will require that a decision be made to either remove or restore the dam.

In Ohio alone there are over 50,000 dams, though the majority of them are so small they are not regulated by the State of Ohio. There are 2,694 that fall under the jurisdiction of the Ohio Dam Safety Laws. One of these dams is the Ballville Dam in Fremont, Ohio, which is one of several dams currently being studied under a grant from the Great Lakes Protection Fund. The Ballville Dam will be the primary focus of this study.

Ninety percent of dams in the United States are privately owned, and currently there are very few resources and guidelines available to dam owners looking to remove or restore a dam. Development of guidelines and tools, as well as establishing dam removal/restoration protocols, would assist dam owners and restoration advocates assess, apply for, and implement dam removals and/or alternative management strategies that improve water quality and restore in stream habitat in a way that maximizes public welfare.

1.2 Research objectives

When proposing a change in the quantity, or quality, of a good or service, such as dam removal, it is important to assess both the costs and revenues associated with the proposed change. One problem with this type of analysis is that it may fail to accurately account for the non-market values of the resource in question (i.e. dam removal). A good

is said to have non-market value when society receives benefits, or incurs losses, from the good, but there is no observable market where those values, or losses, can be expressed. Omission or undervaluation of such values may lead to an underestimation of the true social benefits of the good in question. In the case of dam removal there is a wide array of complex issues that must be examined in order to make a comprehensive decision, including among others; ecology of the watershed, local riparian species, public recreation, economics of the local communities, and property rights.

Over the years a variety of techniques for valuing non-market goods have been developed, with the most commonly used methods being; the travel cost method, hedonic pricing and contingent valuation. The travel cost method is the oldest method of non-market valuation and seeks to value non-market goods through the use of consumption behavior in related markets (Hanley and Spash, 1993). This method relies on the assumption of *weak complimentarity*, which implies that when the cost of consuming the services of the environmental good are zero, then the marginal utility of the environmental good is also zero. Because of this assumption, the travel cost method can only measure use-values, and is used mainly to model and value outdoor recreation such as fishing, hunting, or boating.

On the other hand, hedonic pricing works with establishing a statistical relationship between levels of an environmental good or service and a market, typically the housing or labor markets. The method relies on the assumption that the representative individual has a utility function that is *weakly separable,* and *weak complimentarity* is also assumed. Weak separability implies that the marginal rate of substitution between two goods, *a* and *b*, in an individual's utility function, is

independent of the quantities of all other goods. Because of both of these assumptions, hedonic pricing also cannot measure non-use values. While both of these methods have the potential to work in certain dam removal scenarios, the particular application of this study involves a dam with few potentially affected properties and limited recreational activity. For this study, contingent valuation, explained in detail in Chapter 2, has been chosen as the method that most accurately measures both the use and non-use values of the proposed removal of the Ballville Dam.

This study will attempt to quantify the expected benefits of dam removal, specifically the Ballville Dam, to individual welfare. The specific objectives of this study are to:

(1) Design and implement a contingent valuation survey that determines the willingness-to-pay (WTP) of individuals for dam removal and river restoration. Using the survey results, estimate a total value/bid function with a set of explanatory variables.

(2) Design and implement a structured elicitation group (SEG) and compare the results to those obtained from the random mail surveys.

(3) Perform a cost-benefit analysis using the results obtained from both elicitation formats. Generalize the results of the cost-benefit analysis to define a list of policy requirements dam removal and explore the potential for benefit-transfer.

The main hypotheses of this study are:

(1) With respect to contingent valuation methodology, open-ended questions can be used to gain willingness-to-pay estimates that encourage

respondents to answer truthfully, or in other words, are incentive compatible.

(2) As an alternative to the traditional philosophy of stated preferences, the philosophy of constructed preferences may more accurately describe the contingent valuation elicitation process in scenarios with complex and/or novel goods.

(3) The use of structured elicitation groups may provide an efficient alternative to randomly-selected mail surveys.

(4) Inclusion of non-market benefits and costs increases the probability of economic viability associated with dam removal from a cost-benefit analysis perspective.

The purpose of the second chapter will be to generally discuss contingent valuation methodology, and more particularly, the survey designed for and used in this study. Chapter three will discuss the results from the random mail surveys. The dichotomous-choice econometric estimations will be discussed in chapter four. The fifth chapter will examine the notion of incentive compatibility and present a sketch of a possible open-ended WTP question that may provide an alternative to the currently favored discrete dichotomous choice WTP. In order to test the hypothesis, a practical application using both question formats will be tested on a dam removal scenario.

Chapter six will discuss the notion of stable versus constructed preferences and how in the case of many contingent valuation scenarios the notion of constructed preferences may make more sense. In order to test this hypothesis, another dam removal application will be done using structured elicitation groups and the results will be

compared to those from the random mail surveys. Chapter seven will use a cost-benefit analysis to compare projected costs of dam removal with the estimated benefits of environmental improvements as suggested by the results of the contingent valuation estimation. Policy implications and results obtained from the methodological changes examined in this study will be discussed in chapter eight, and finally Appendix A will discuss the applicability of benefit-transfer methods in the case of dam removal.

1.3 Description of the dam

The Ballville Dam, which spans the Sandusky River, is located in Northwest Ohio in Sandusky County (See Figure 1.1). It was built in 1911 by the Ohio Power Company to be used as a source of hydroelectricity. It is an intermediate sized dam that rises 10.5 meters (m) at its maximum height and reaches approximately 122 m across the river (See Figure 1.2 and Figure 1.3). The dam is located almost 17 kilometers (km) from the mouth of the Sandusky River, and just over 2.5 km south-west of the City of Fremont.

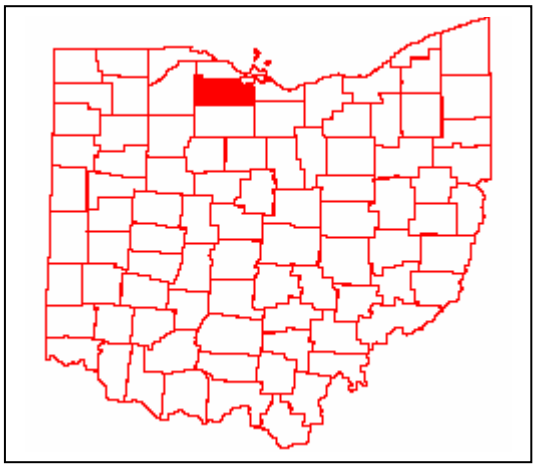

Figure 1.1: Location of Sandusky County in Ohio

In 1959, the dam was sold to the City of Fremont, Ohio and though it is no longer used for generating hydroelectric power, the reservoir behind the dam currently serves as a sole source water supply for Fremont. There is interest in removing the dam because of the potential for improved river quality and increased spawning habitat for walleye as well as the fact that the dam structure is currently in need of repairs. The main issues under consideration are; (1) river quality restoration and increased fish spawning habitat, (2) safety, and (3) water supply for the City of Fremont.

Figure 1.2: Downstream view of the Ballville Dam

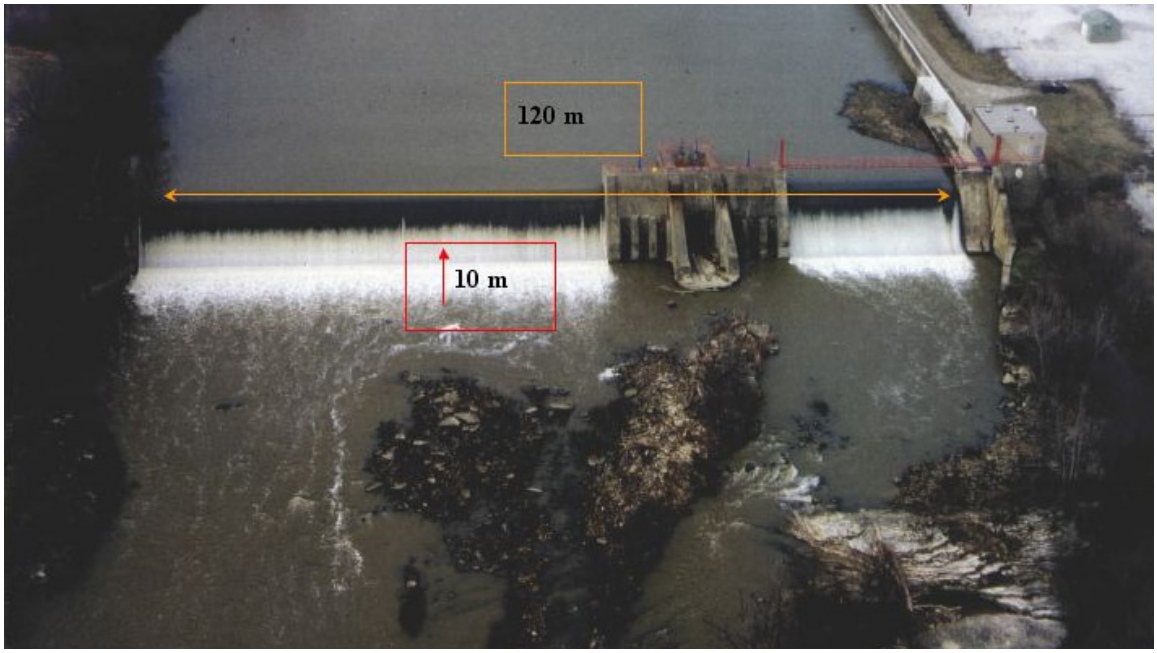

Figure 1.3: Aerial view of the Ballville Dam

In a discussion with Bob Gable, the ODNR Scenic River Program Director, he stated that the removal of the Ballville Dam would undoubtedly improve stream habitat for many different species of fish including; Lake Erie walleye (*Stizostedion vitreum*), smallmouth bass (*Microplerus dolomieu*), redhorse suckers (*Moxostoma robustum*), rock bass (*Ambloplites rupestris*), and darters (*Percina and Etheostoma*), as well as a variety of other in-stream organisms such as mollusks, aquatic insects and crustaceans. He also noted that the only environmental concern associated with removing the structure would be the possibly negative impacts associated with the downstream migration of the fine sediments deposited behind the dam.

The Sandusky River is one of three rivers used for spawning by Lake Erie walleye, and the Ballville Dam is the first major barrier on the Sandusky River for these migrating fish. The ideal habitat for walleye spawning is a fast flowing stream with pebble to boulder substrate. Upstream from the Ballville Dam is an estimated 33 km of this habitat, which if opened up by removing the dam would represent a 9-fold increase in habitat area and could increase the current population of larval walleye within the Sandusky River by up to 58 times (Cheng, 2001). Not only does the Ballville Dam truncate the available walleye spawning habitat, but it also prevents migration of river gravel to spawning areas downstream.

The second issue is dam safety. The Ballville Dam is currently classified as a Class 1 (High hazard) dam, meaning that some loss of life is probable if the dam were to fail. This is because sudden failure of the dam may generate such a high peak discharge that it would overtop the dike and floodwall which protects the more heavily developed areas downstream. Also, according to the ODNR Dam Safety Office the dam does not

currently meet maintenance regulations under the Ohio Dam Safety Laws due to inadequate spillway capacity and the need for seawall stabilization. The cost of repairs is estimated to be around $700,000 (Brice, 2000).

Finally, the reservoir behind the dam is the sole source of municipal water for the City of Fremont. It has become a concern of the city that the reservoir behind the dam is shrinking due to sediment build-up, and in its current condition it will not be able to meet the expected water demands of the city by 2030. According to Evans et al. (2002) from 1911 to 1993 the reservoir lost 78% of its storage capacity due to sedimentation and based on projected water needs for the city versus continued loss of storage capacity, the study estimates inadequate water supply for the city within three to five years.

In 1999, Fremont hired the engineering firm of Finkbeiner, Pettis and Strout to address concerns of the city relative to its ability to meet minimum safe drinking water standards, the ability of the reservoir to meet current and future water needs, and the availability of an emergency water supply in case of contamination. While the study initially examined five alternative scenarios for solving the water issues of Fremont, two scenarios emerged as the most viable options; (1) leaving the dam in place, dredging the sediment behind the dam and adding a supplemental up-ground reservoir, or (2) removing the dam and building a sole source up-ground reservoir.

The final recommendation of the firm was to remove the dam and build a new sole source up-ground reservoir. Since the beginning of this study, Fremont has begun the process of building a new up-ground reservoir. The land has been purchased and the reservoir construction is scheduled for completion in 10 years (2014). This fact that this

decision has already suggests that the cost of the up-ground reservoir is not likely to considered a “cost” of dam removal

CHAPTER 2

METHODS

2.1 Contingent valuation methodology

It is well known that society values public goods such as the environment, parks, roadways and water quality, but that these resources often lack relevant observable markets where their value can be expressed (McFadden and Leonard, 1993). This type of resource is called a non-market good. When estimating the social benefits of non-market goods, economists use two main valuation methods; revealed preferences, through which they observe behavior and infer values based on those observations, and stated preferences, where questions are posed to respondents and inferences are made based on those responses. The contingent valuation (CV) method is the most commonly used form of stated preferences.

The method was first used by Davis (1963) and by 1995 had been used in over 2000 studies (Carson et al., 1995). Contingent valuation provides a direct method through which the stated preferences of individuals can be calculated by asking a sample population their willingness-to-pay for an increase in a public good contingent on the creation of a market where all payments are hypothetical (Bishop, Heberlein, and Kealy, 1983; Freeman, 1993). Individual WTP estimates can then be aggregated to estimate the total economic value of the good to society.

It has been argued by researchers that there is a fundamental difference in the way people answer actual versus hypothetical questions (Haab and McConnell, 2002). Respondents may choose not to take hypothetical questions seriously if they believe they will never have to pay the dollar value placed by them on the good or service. Standard economic theory states that the way an individual chooses to answer a CV survey will be a function of (1) his/her perceived payment obligation, and (2) his/her expectation of the provision of the good (Mitchell and Carson, 1989). From these assumptions it follows that a respondent's true preferences will be revealed only when he/she believes that provision of the good is indeed contingent on his/her revealed willingness-to-pay (WTP) and that payment will be required if the good is provided.

The primary objective of CV is usually to obtain an accurate estimation of the benefits (or costs) of a change in the quality or quantity of a public good. To achieve this, the CV survey must meet both the requirements of economic theory as well as the methodological imperatives of survey research (Mitchell and Carson, 1989). In order to follow economic theory, the survey must correctly use a hypothetical market setting to obtain benefit (or cost) measures for the good being estimated. Methodology requires that the survey scenario be easy to understand, meaningful to those being surveyed, and contain a minimum of incentives that might lead to biased results.

One of the weaknesses of contingent valuation is that the data, and ultimately the results are prone to bias, caused both by survey design and by individual respondents. Respondent bias falls into four main categories; strategic, information, misinterpretation, and non-response. These biases will be discussed in greater detail in a subsequent section of dissertation. Even with concerns about biases, contingent valuation is

currently recommended for use by Federal agencies as the primary method for performing cost-benefit analysis (U.S. Water Resource Council, 1983) and for valuing natural resource damages (U.S. Department of the Interior, 1986).

2.2 Survey sample selection methods

For this study, the sample populations chosen to receive the CV survey were randomly selected subsets of (1) individuals residing in Sandusky County and (2) individuals living within a 30 mile radius of the dam, but not residing in Sandusky County. The Experian MarketShare Online database was used to download names and addresses for both samples. A concern for any mail survey is obtaining accurate and up-to-date addresses in order to ensure that all individuals in the population have an equal chance of being randomly selected for the survey. The Experian website obtains address information from several different sources and helped minimize selection bias by offering the most complete list possible. According to the last census (2001), there were 23,717 households in the county, and the database includes 20,989 head of household records for Sandusky County.

From the database of Sandusky County, a random sample of 724 individuals was chosen. This sample was chosen because it is believed that individuals in Sandusky County would be most affected by dam removal. As noted previously, the main considerations with respect to the removal of the dam are (1) the water supply for the City of Fremont, (2) safety and (3) the potential for restoring river quality and increasing fish spawning habitats. Sandusky County residents were chosen based on the belief that

they would be more familiar and knowledgeable on these issues and most impacted by the potential changes.

Similarly, a database was obtained for individuals living within a thirty-mile radius of the dam but not in Sandusky County. An area with a thirty-mile radius includes portions of the following Ohio counties: Sandusky, Erie, Hancock, Huron, Lucas, Ottawa, Seneca, and Wood. A random sample of 250 was chosen from the 280,494 head of households listed in the database. Of these 250 individuals, 29 resided in Sandusky County and were added to the Sandusky County sample, leaving 221 individuals living outside of Sandusky County but within a 30-mile radius of the dam. The sample is smaller than the one drawn for Sandusky County because of the assumption that individuals living farther from the dam will be less familiar with the good being valued, and also less likely to be affected positively, or negatively, by the removal of the dam. Individuals less familiar and/or less knowledgeable about the dam may also have a more difficult time translating their preferences, if any, into dollar terms.

The reason individuals outside of Sandusky County are included in the survey is because it is believed that the potential restoration of river quality and increased fish spawning habitat may affect a more general population. Lake Erie is one of the most popular places in the United States for walleye fishing, and according to the Ohio Department of Natural Resources (ODNR) has a reputation as the 'Walleye Capital of the World'. In a conversation with the author, acting Lake Erie Fisheries Programs Administrator, Roger Knight, stated this reputation was gained in the 1980s due largely to reef fishing in the lake.

Since the 1980s, water clarity has increased and subsequently the walleye population has declined to a moderate level. There has also been evidence that walleye feeding behavior has changed. It is not completely clear why this has happened, though it has been suggested that it is partially related to the zebra mussel population now present in the lake. Whatever the cause, the result has affected the sport fishing industry, and anglers have had to search for new techniques and practices to catch walleye in the Lake. If this trend continues, it is believed that an increase in walleye larvae in the Sandusky River may be valued by Lake Erie anglers as well as Sandusky River anglers. A study by Hushak et al. (1990) found that the average one-way driving distance for Lake Erie walleye anglers was 117 kilometers (70 miles). This study suggests that a larger population than just that of Sandusky County would benefit from the removal of the dam if a linkage between dam removal and the Lake Erie walleye population could be established.

While currently the walleye spawning in the Sandusky River contributes only slightly to the general lake population, it is believed that if poor hatch rates in the lake become more frequent, the contributions of larvae from the river will become more important to sustaining the lake population. At this time though a direct connection between the potential increase in spawning habitat and the Lake Erie walleye population has not been established. If this linkage exists it may affect both willingness-to-pay values and the population affected by the proposed dam removal. This study will not focus on WTP for potential increases in walleye populations in the lake due to the relative uncertainty of the issue, and this decision will also lead to more conservative WTP estimates.

2.3 Survey description

The actual CV survey is composed of five subcategories: personal knowledge, self reported behavior, opinion attitudes, willingness-to-pay and demographics. Because the Ballville Dam is located on the Sandusky River, the survey focuses only on perceptions of that particular river. The first three questions of the survey asked (1) whether the respondent had ever heard of the Ballville Dam and (2) whether they had ever read or heard about removing dams for either safety reasons or to improve environmental quality. If the respondent answered no to all three questions, then it is possible that any WTP value given by the respondent was constructed during the survey process.

Respondents were next asked to state their perceptions of the environmental and recreational quality of the Sandusky River. They then listed participation levels for a variety of recreational activities that exist on the river such as boating, fishing and swimming. In order to account for the possibility of a substitute good, individuals were asked whether they also recreate on a nearby river with similar recreational opportunities, the Maumee River.

Before directly asking respondents how much they would be willing to pay for the removal of the dam, several questions were asked that encouraged respondents to reflect on why dam removal may or may not be important to them. These questions focused on eliciting opinion attitudes, and asked how important improving the Sandusky River was to the individual for (1) environmental reasons and (2) for recreational purposes. Respondents were also asked to fill out a table using the information provided

in the survey, as well as their own knowledge, to estimate how they felt dam removal would affect a number of categories (See Figure 2.1).

Category	Effect of Dam Removal				
	<More Negative				More Positive>
	1	2	3	4	5
Fish populations					
Fishing on the Sandusky					
Fishing on Lake Erie					
Recreational opportunities					
Safety					
Water quality					
Water supply					

Figure 2.1: Survey chart on effects of dam removal

The survey also allowed for the possibility that some individuals may have a negative willingness-to-pay for dam removal, due to the likely loss of some recreational opportunities and "lake aesthetics" provided by the existing reservoir. In order to account for that, the last question before the WTP questions asked "If funding were found for the dam removal project, would you like to see the dam removed? (The cost of the project for you is zero.)", and respondents then checked whether they were in favor of, or against the project.

There were two versions of the survey: one used an open-ended (OE) question, and the other used a single dichotomous choice (DC) question with a fixed bid value

(Appendix B contains the version for $10; other versions were identical except for the bid value). A pre-test with a stochastic payment card approach was used to estimate expected WTP, and based on the results the bid values chosen were; $10, $20, $50, $75 and $100. Approximately 22% of the sample received the following bid offerings; $10, $20, $50, $75, while 11% of the sample received a bid offering of $100. Pre-test results suggested that $100 was a threshold value for most respondents and for that reason was offered with a lower frequency. Bid offerings were assigned randomly and individuals received the same bid value in both the first and second mailing. Everything else was identical in the surveys, to ensure that both OE and DC respondents were valuing the same good.

2.4 Survey distribution

A total of 974 surveys were mailed on March 1, 2004, using procedures that closely followed those developed by Dillman (1978) in his total design method. Each survey included a personalized cover letter and a return envelope with postage. The survey was four pages long, printed front and back on an 11x17 piece of paper, and folded for a booklet appearance. Approximately three weeks after the first mailing, March 23, 2004, a second mailing of the survey was sent out with a second cover letter that again encouraged individuals to respond.

There are both advantages and disadvantages to using a mail survey. The first disadvantage is that they are self-administered, meaning that respondents are required to read and understand the survey without any interviewer help. Studies have found the reading level of Americans is surprisingly low, and therefore, unless the questionnaire

description is clear and concise, or the individual happens to be well educated, it is possible that the respondent may misinterpret or misunderstand key points in the scenario (Mitchell and Carson, 1989). Self administration also means that the use of skip patterns is not an option, where the choice of follow-up question varies based on the respondent's answer to the previous question.

Mitchell and Carson (1989) state that the mail survey method is the one most likely to encourage strategic behavior on the part of respondents. The first reason for this is respondents have time to formulate an optimal strategic response. Unlike a face-to-face interview, mail survey respondents can take as little or as much time as they want to think about each question. Mail survey respondents also have access to the entire questionnaire, allowing them to skip through the survey and read the entire questionnaire before they start to fill it out. This option may allow them to determine the purpose of the WTP question before answering.

Mail surveys are commonly used in contingent valuation studies, but tend to suffer from low response rates and the related potential non-response bias. A National Oceanographic and Atmospheric Administration (NOAA) Blue Ribbon Panel (1993) recommends response rates of at least 70% for surveys. When designing the survey package there are several ways to increase mail survey response rates. First, it is important to make sure that the sampling frame is composed of a list of up-to-date names and addresses. The sponsorship of a noncommercial identity, such as a university or government body gives credence to the survey and shows the respondent that his/her response is important and valued. (Dillman, 1978; Heberlein and Baumgartner, 1978) Finally, a contingent valuation survey done by Heberlein and Baumgartner (1978) found

that a mail survey can reach response rates of 90% or more when "respondents perceive the CV's purpose to be *directly connected* with their interests" (Bishop, Heberlein, and Kealy, 1983).

CHAPTER 3

SURVEY RESULTS

3.1 Distribution and response rates

Response rates for mail surveys are typically calculated by dividing the number of returned surveys by the number of surveys mailed out minus undeliverable surveys. As shown on the next page in Table 3.1, the total response rate across all three surveys was 30%, with higher response rates from Sandusky County. This result was consistent with expectations due to the relatively local nature of the issue and the fact that outside of Fremont there has been little publicity on the proposed removal of the dam. While the total response rate does not meet the 70% recommended by the NOAA, the key characteristics of the sample population are similar enough to those of the population in question as be sufficient for the purpose of analysis.

Two versions of the survey were used; one contained an open-ended (OE) question, and the other, a single dichotomous choice (DC) question with a fixed bid value. Different bid values used in the DC survey were; $10, $20, $50, $75, and $100, and Table 3.2 shows the allocation of responses across bid values for the combined Sandusky DC and 30-mile radius[1] DC surveys.

[1] 30-mile radius respondents are defined as those within 30-miles of the dam but outside of Sandusky County.

	SanDC	SanOE	30DC	Total
Mailed	478	275	221	974
Undeliverable	61	18	25	104
Undeliverable rate	0.128	0.066	0.113	0.107
Response 1st mail	85	44	18	147
Response 2nd mail	61	29	25	115
Response rate 1	0.207	0.171	0.092	0.169
Response rate 2	0.146	0.113	0.128	0.132
Total response rate	0.350	0.284	0.219	0.301

Table 3.1: Survey distribution and return rate

Bid Value					
$10	$20	$50	$75	$100	Total
35	49	43	26	18	171

Table 3.2: Number of responses to DC survey by bid value (non-response not included)

3.2 Perceptions of dams, the Ballville Dam, and the Sandusky River

Initially, respondents were asked questions about their knowledge and perception of the Ballville Dam and the Sandusky River. Ninety-three percent of individuals living in Sandusky County had heard of the Ballville dam before receiving the survey, while only 33% of individuals living outside of the county but within a 30-mile radius of the dam had heard of it. The survey also asked whether or not the respondent had ever read

or heard about projects to remove dams to address safety concerns, or to improve the environmental quality of a river. Sixty-two percent of Sandusky County respondents had heard about removing dams for safety reasons, while 66% had heard about removing dams for environmental reasons. Alternately, only 30% and 42.5% of respondents living within a 30-mile radius had heard of dam removal for each reason respectively.

In order to gain some information about general attitudes towards the environment, respondents were asked if they were a member of any environmental organizations. Eleven percent claimed membership in at least one environmental organization, and of these, the majority (68%) participated in activities or programs offered by their organization(s) only occasionally or less. This result suggests that potential bias based on environmental beliefs leading to inflated WTP estimates is unlikely.

Respondents were then asked to give their perceptions of the Sandusky River in terms of both environmental and recreational quality. Eighty-six percent of in-county respondents rated the environmental quality of the river as good or better, while 96% of 30-mile radius respondents felt that way. Results were similar for recreational quality with 81.6% of respondents from Sandusky County and 83% of 30-mile radius respondents giving it a rating of good or better. Table 3.3 and Table 3.4 on the next page show the breakdown of responses for those two questions.

How would you rate the environmental quality of the Sandusky River?	SanDC n=137	SanOE n=69	30DC n=29
Extremely good	0.04	0.04	0.03
Very good	0.29	0.36	0.38
Good	0.55	0.44	0.55
Not very good	0.10	0.13	0.03
Not good at all	0.02	0	0

Table 3.3: Perceptions of environmental quality of the Sandusky River

How would you rate the recreational quality of the Sandusky River?	SanDC n=138	SanOE n=69	30DC n=30
Extremely good	0.05	0.01	0.03
Very good	0.23	0.32	0.27
Good	0.54	0.48	0.53
Not very good	0.15	0.15	0.13
Not good at all	0.01	0.03	0.03

Table 3.4: Perceptions of recreational quality of the Sandusky River

The Ballville Dam is currently rated a high hazard dam by the State of Ohio and there are approximately $700,000 worth of repairs that the Ohio Department of Natural Resources has suggested be completed. Before receiving the survey, 30% of respondents in Sandusky County were aware of these safety concerns, but only 5% of respondents within a 30-mile radius were aware of them. This result is consistent with the expectation that individuals living closer to the dam would be more knowledgeable with respect to specifics of the dam.

3.3 Recreational activity on the Sandusky River

This section of the survey asked respondents to fill in the number of times they had engaged in a variety of recreational activities on the Sandusky River over the past year. Mean results for most activities are higher for respondents living in Sandusky County, though the mode for all activities is zero, suggesting the majority of respondents had not participated in any recreational activities on the river in the last year.

A follow-up question asked if respondents recreated on the Maumee, a nearby river with similar characteristics, in order to determine whether a potential substitute good existed. Only 8% percent of Sandusky County respondents participated in recreational activities on the Maumee while over 18% of respondents outside the county did. This is consistent with the results for participation levels on the Sandusky by 30-mile radius respondents and suggests that their recreational level may be lower because they are using a substitute good. Table 3.5 provides the mean recreation levels of respondents.

Activity	SanDC n=144		SanOE n=72		30DC n=37	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Boating/Canoeing	1.31	2.63	1.26	2.66	0.36	1.61
Swimming	0.37	1.55	0.51	1.77	0.31	1.09
Fishing from shore	1.58	2.91	1.36	2.76	0.38	1.37
Fishing from a boat	1.03	2.49	1.06	2.59	0.13	0.79
Picnicking/Hiking	1.19	2.42	1.58	3.03	0.36	1.25
Other	0.59	1.94	0.97	2.73	0.36	1.14

Table 3.5: Participation in recreational activities on the Sandusky River

3.4 Demographics

As Table 3.6 shows, approximately half of respondents (55%) live in urban or suburban areas, while the rest (45%) live in a rural area or a small village. When asked how long they had lived at their current residence, 18% of respondents answered less than five years, while 50% claimed residence of 15 years or more. Also, 52% of respondents lived 5 miles or less from the river, suggesting they might have more information than the average individual on river quality, etc.

Household location	SanDC n=142	SanOE n=72	30DC n=39	Total n=253
City of Fremont	0.24	0.22	0	0.20
Urban	0.11	0.14	0.28	0.15
Suburban	0.24	0.10	0.28	0.21
Rural	0.32	0.47	0.28	0.36
Other (normally a village)	0.09	0.07	0.15	0.09

Table 3.6: Place of residence

Table 3.7 reports the highest level of education received by respondents and shows that 92% of all respondents have at least a high school diploma, while 26% have a bachelor's degree or higher. The average age of all respondents was 53.3 as shown in Table 3.8.

Level of Education	SanDC n=144	SanOE n=71	30DC n=40	Total n=256
8th grade or less	0.01	0	0.05	0.01
Some high school	0.03	0.14	0.10	0.07
High school diploma	0.41	0.29	0.23	0.35
Some college	0.25	0.18	0.28	0.23
Associate degree	0.07	0.10	0.08	0.08
Bachelor's degree	0.24	0.24	0.10	0.17
Graduate level degree	0.01	0.06	0.18	0.09

Table 3.7: Education levels

Age	SanDC n=145	SanOE n=69	30DC n=39	Total n=254
20-29	0.04	0.04	0.05	0.04
30-39	0.14	0.17	0.05	0.14
40-49	0.26	0.17	0.28	0.24
50-59	0.19	0.33	0.26	0.24
60-69	0.21	0.19	0.21	0.20
70 or above	0.14	0.10	0.15	0.13
MEAN	53.3	52.3	54.5	53.3

Table 3.8: Age levels

Ninety-six percent of respondents were white, which was expected due to the homogeneity of the general population with respect to race. Respondents also listed African-American (0.8%), Latin-American (1%) and Other (2%), which includes Native Americans. As is common in many CV surveys the percent of male respondents (70.4%)

was higher than that of females (29.6%). This result was not unexpected due to the sample frame used in this survey. The survey was mailed to the individual listed as the head of household, which is commonly a male. If gender is determined to be a statistically significant variable, then some sort of adjustment to actual population means will be necessary to account for this difference between the sample population and the general population.

Approximately 51% of respondents stated they were employed full-time, while another 31% were retired. No definitions of employment types were included in the survey, so the numbers given are based on how individuals perceived themselves. Respondents with "other" employment listed their occupations as; disabled, student and homemaker.

Employment	SanDC n=145	SanOE n=71	30DC n=39	Total n=255
Employed Full-time	0.50	0.46	0.62	0.51
Employed Part-time	0.04	0.03	0	0.03
Self-Employed	0.08	0.11	0.08	0.09
Unemployed	0.03	0.03	0.03	0.03
Retired	0.30	0.34	0.26	0.31
Other	0.05	0.03	0.03	0.04

Table 3.9: Types of employment

Respondents were asked to state their approximate household income, before tax deductions, in 2003. Table 3.10 on the next page shows the percent of respondents that

fell into the listed income brackets. The average gross annual income across all respondents was $52,760, and the average number of individuals contributing to an individual household's income was 1.45.

Estimated Annual Income	SanDC n=128	SanOE n=61	30DC n=35	Total n=224
Less than $20,000	0.13	0.17	0.20	0.15
$20,000-$39,999	0.21	0.20	0.14	0.20
$40,000-$59,999	0.31	0.22	0.20	0.27
$60,000-$79,999	0.17	0.22	0.26	0.20
$80,000-$99,999	0.11	0.10	0.09	0.10
More than $100,000	0.06	0.10	0.11	0.08
MEAN	51,880	53,280	54,580	52,760

Table 3.10: Estimated annual income for 2003

Table 3.11 compares the survey results to U.S. Census Data for 2000. The comparison shows that survey respondents were more likely to be male, white and more educated than the general population. While the results of this study are not identical to the general population statistics, they are similar enough for the sample population to be representative of the population in question.

Variable	Sandusky County	US Census (Sandusky)	Total	US Census (Ohio)
Male (percent)	.71	.49	.70	.49
Female (percent)	.29	.51	.30	.51
White (percent)	.97	.92	.96	.85
African-American (percent)	0	.03	.01	.12
Latin-American (percent)	.01	.07	.01	.02
Other (including Native Am.) (percent)	.02	.03	.02	.02
High school diploma (percent)	.93	.82	.92	.83
Bachelor's degree or higher (percent)	.26	.12	.26	.21
Average household size	2.59	2.56	2.56	2.49
Home ownership (percent)	.90	.75	.90	.69

Table 3.11: Representative comparison

Respondents were asked whether they would be in favor of, or against, removing the dam if the cost of the project to them would be zero. This was done to determine whether respondents had a negative WTP for dam removal. As shown in Table 3.12, 88% of 30-mile respondents favored dam removal, while only 70% of Sandusky County preferred to see the dam removed when the cost to them was zero. This is consistent with expectations that individuals in Sandusky County would be more likely to perceive dam removal as having a negative impact.

If funding were found for the dam removal project, would you like to see the dam removed?	SanDC n=137	SanOE n=67	30DC n=34
I would be IN FAVOR of removing the dam	0.69	0.72	0.88
I would be AGAINST removing the dam	0.31	0.28	0.12

Table 3.12: Results when cost of project is zero

3.5 Non-response rates for WTP question

Table 3.13 on the next page shows the proportion of DC respondents that stated a particular reason for giving a zero WTP value. After answering the willingness-to-pay question, respondents who voted against the project were asked to state why they voted against it. Respondents were provided with the five options listed in Table 3.13, and space was provided after the "other" choice. Approximately 23% of all respondents who gave a zero WTP listed their reason as "other". Included in this category were reasons such as; "it's not my problem", "not enough information provided", "dam removal would be detrimental for environment and/or recreation"," I don't care", "I don't know enough to make a decision", "it doesn't affect me either way", and "time will remove the dam at zero cost".

Reason for zero WTP response	SanDC n=77	30DC n=17	Total n=94
Removing the dam, restoring the river and increasing fish populations is not worth this much to me	0.09	0.12	0.10
I cannot afford to pay this amount	0.14	0.41	0.19
I do not believe the dam should be removed	0.40	0.12	0.33
I want the dam removed, but I don't want to pay for it	0.17	0.06	0.15
Other	0.21	0.29	0.23

Table 3.13: Reason for zero WTP

Similarly, respondents to the open-ended WTP questions were also asked a follow-up question which said, "Please tell us why you chose that dollar amount." Answer choices were not given, and all respondents were given the option of writing a reason down, not just those who stated they had a willingness-to-pay of zero. After all the surveys had been received, reasons stated by respondents giving a zero WTP value were written down and sorted into the categories shown in Table 3.14.

Reason for zero WTP response	SanOE n=32
The removal of the dam doesn't affect me	0.34
I cannot afford to pay anything	0.25
I do not believe the dam should be removed	0.13
I want the dam removed, but I don't want to pay for it	0.19
Other	0.09

Table 3.14: Reason for zero WTP

One interesting difference between the responses from both survey formats is that only 13% of respondents to the Sandusky OE survey stated that the dam should not be removed, while the most common response (34%) for zero WTP in was that the removal of the dam didn't affect respondent personally. On the other hand, Sandusky DC respondents were most likely to state that they didn't want the dam removed as their primary reason for a zero WTP (40% chose this response). Unfortunately, the proportion of OE respondents answering the question a particular way was too small to use a t-test to determine if these differences were statistically significant.

CHAPTER 4

ECONOMETRIC ANALYSIS

4.1 Theory

This section will discuss the econometric model and methods used to estimate the benefits of removing the Ballville Dam. It will discuss the theoretical background of willingness-to-pay, then develop the model used for regression analysis and finally present the WTP estimates.

First, consider the individual preference maximization problem. From Haab and McConnell (2002), define $u(\mathbf{x}, \mathbf{q})$ as the preference function, where $\mathbf{x} = x_1 \ldots x_m$ is a vector of private goods, and $\mathbf{q} = q_1 \ldots q_n$ is a vector of public goods. It is also assumed that there is a vector of prices, $\mathbf{p} = p_1 \ldots p_m$. Individuals maximize utility such that $\mathbf{px} \leq y$ where y is the fixed amount of money, or income, available to the individual.

The function $V(\mathbf{p},\mathbf{q},y) = \max u(\mathbf{x},\mathbf{q})$ is called the indirect utility function and provides the maximum utility achievable at a given level of prices and income. The dual of the indirect utility function is the minimum expenditure function, where $m(\mathbf{p},\mathbf{q},u) = \min \mathbf{px}$. One of the properties of these two functions is that the solution to the expenditure minimization problem is equal to the minimum income required to achieve

the maximum utility level for a given set of prices. These two equations provide the basic theoretical structure of welfare estimation.

It is possible to view contingent valuation as a way to estimate the change in the expenditure function or the indirect utility function (Haab and McConnell, 2002). This study will focus on the concept of willingness-to-pay, which is defined as the maximum amount of income an individual will pay in exchange for an improvement in circumstances, or the maximum amount the individual will pay to avoid a decline in circumstances.

Let us examine how these functions are related to willingness-to-pay by examining changes in **q**. (Noting that it is also possible to describe changes with respect to **p**.*)* Using the indirect utility function, WTP can be written as the amount of income that compensates for an increase in a public good **q**:

$$V(\mathbf{p}, \mathbf{q}^*, y - WTP) = V(\mathbf{p}, \mathbf{q}, y) \tag{4.1}$$

This equation assumes that $\mathbf{q}^* \geq \mathbf{q}$ and that more of **q** is preferred to less.

Similarly, we can look at WTP using the expenditure function:

$$WTP = m(\mathbf{p}, \mathbf{q}, u) - m(\mathbf{p}, \mathbf{q}^*, u) \tag{4.2}$$

where $u = V(\mathbf{p},\mathbf{q},y)$. In this case, WTP is the amount of income an individual would give up to make himself/herself indifferent between the original state and the updated state. The original state has income y and level of the public good **q**, while the updated state has income level y-WTP and a higher level, **q***, of the public good (Haab and McConnell, 2002).

By definition a public good is non-rival, meaning that one individual's consumption of the good does not in any way affect the ability of others to also consume

the good. It should be noted though that dam removal is more of an impure public good, which is normally defined as one that in theory should be non-rival, but in reality may suffer from congestion problems. While some of the benefits of dam removal could be seen as pure public goods (e.g. improved river aesthetics, scenic river restoration), there are others where overuse by consumers could easily lead to congestion and reduced utility for the individual (e.g. fishing, boating).

In the case of dam removal it appears that an increased likelihood of congestion occurs mainly in the case of recreational activities on the river, yet results from the mail surveys showed that the mode for all recreational activities was zero. This suggests that in the case of the Ballville Dam, recreating on the river is not a common activity for the majority of respondents and therefore congestion problems may not be as likely to occur. This result speaks only to recreational participation on the river with the dam still in place though, and it is also necessary to examine whether participation levels could change after dam removal in such a way that the likelihood of congestion increases.

To address this issue another survey question asked about improving recreation on the Sandusky River. Results from that question showed that over 80% of Sandusky County residents viewed improving recreation as no more than "somewhat important" and approximately 87% of 30-mile radius respondents felt the same way. This may suggest that in the case of the Ballville Dam, recreational participation levels are not likely to be affected by dam removal and therefore the issue of congestion should not complicate the validity of the WTP estimates.

4.2 Turnbull estimation

Table 4.1 shows the frequencies of "no" responses for the Sandusky County (DCS) dichotomous choice and Sandusky County plus 30-mile radius (AllDC) surveys. Using these proportions, the Turnbull distribution-free lower bound estimate of mean WTP can be estimated (Haab and McConnell, 2002). A dichotomous choice WTP question offers individual *i* a yes/no choice to an offered bid value t_j. If individual *i* answers "yes" then the researcher knows that the individual's *WTP* is greater than or equal to t_j. Alternately, if the individual answers "no", then all the researcher can infer is that $WTP_i < t_j$.

The probability of a randomly chosen respondent with $WTP_i < t_j$ is therefore

$$\Pr(WTP_i < \$t_j) = F_j \tag{4.3}$$

where F_j is the cumulative distribution function for WTP and is assumed to be monotonically increasing in bid value. Sometimes though, the proportion of "no" responses does not increase with bid value, and in those cases the Turnbull distribution-free estimator can be used to guarantee monotonicity.

From Haab and McConnell (2002), a lower bound estimate of WTP can be found by multiplying each bid value by the probability of WTP being above the price:

$$E_{LB}(WTP) = \sum_{j=0}^{M^*} t_j f_j \tag{4.4}$$

where M^* is the highest offered bid value and $f_j = (F_{j+1} - F_j)$.

DCS				AllDC		
Bid	No	Total		Bid	No	Total
10	15	29		10	19	39
20	14	39		20	18	49
50	27	42		50	31	48
75	12	21		75	14	28
100	9	13		100	12	18
WTP_{LB}[a]	$36.38				$38.95	
ΔWTP	$2.57					
t-stat	0.276					

[a] Turnbull lower-bound mean WTP

Table 4.1: Frequency of "no" response and Turnbull WTP estimates

The difference in lower bound mean WTP between DCS and AllDC is $2.57, which is insignificantly different from zero at the 0.05 level using a one-tailed test (t=0.276). Also, Table 4.2 includes the Turnbull lower bound mean and median willingness-to-pay estimates for both data sets with and without the inclusion of non-responses to the willingness-to-pay question. The lower bound on the range of median WTP for all data sets is $15-50. In other words, this is the range of the price for which the probability of a "no" response is equal to 0.5.

Data Set	Mean WTP	Median WTP Range
DCS w/ non-responses	$36.38	$10-50
DCS w/o non-responses	$38.47	$10-50
AllDC w/ non-responses	$38.95	$10-50
AllDC w/o non-responses	$40.99	$10-50

Table 4.2: Turnbull lower bound mean and median WTP estimates

4.3 Econometric model

From Haab and McConnell (2002), the standard model used to analyze dichotomous choice responses for CV surveys is the random utility model (RUM), with the basic framework of the model developed by Hanemann (1984). For this analysis a linear utility function is assumed, meaning the deterministic part of the preference function is linear in income and covariates

$$v_{ij}(y_j) = \boldsymbol{\alpha}_i \mathbf{z}_j + \beta_i(y_j) \tag{4.5}$$

where y_j is income, $\mathbf{z}_j$ is an m-dimensional vector of characteristics related to individual *j,* and $\boldsymbol{\alpha}_i$ is an m-dimensional vector of parameters, so that $\boldsymbol{\alpha}_i \mathbf{z}_j = \sum_{k=1}^{m} \alpha_{ik} z_{jk}$. Contingent valuation questions ask the respondent to choose between the current state and a future state that includes the proposed change as well as a required payment (bid value). Utility in the current state is

$$v_{0j}(y_j) = \boldsymbol{\alpha}_0 \mathbf{z}_j + \beta_0 y_j, \tag{4.6}$$

while the deterministic utility under the proposed CV change is

$$v_{1j}(y_j - b_j) = \boldsymbol{\alpha}_1 \mathbf{z}_j + \beta_1(y_j - b_j) \tag{4.7}$$

where b_j is the bid price offered to the j^{th} respondent. Therefore the change in deterministic utility can be described as

$$v_{1j} - v_{0j} = (\boldsymbol{\alpha}_1 - \boldsymbol{\alpha}_0)\mathbf{z}_j + \beta_1(y_j - b_j) - \beta_0 y_j. \tag{4.8}$$

Assuming a constant marginal utility of income between the two states $\beta_0 = \beta_1$, the difference in utility becomes

$$v_{1j} - v_{0j} = \boldsymbol{\alpha}\mathbf{z}_j - \beta b_j \tag{4.9}$$

where $\boldsymbol{\alpha} = \boldsymbol{\alpha}_1 - \boldsymbol{\alpha}_0$ and $\boldsymbol{\alpha}_i \mathbf{z}_j = \sum_{k=1}^{m} \alpha_k z_{jk}$. Based on that, the probability of a yes response becomes

$$\Pr(yes_j) = \Pr(\boldsymbol{\alpha}\mathbf{z}_j - \beta b_j + \varepsilon_j > 0) \tag{4.10}$$

where $\varepsilon_j = \varepsilon_{1j} - \varepsilon_{0j}$. To facilitate model estimation using LIMDEP it is assumed that ε_j are independently and identically distributed (i.i.d.) with mean zero and variance of 1. Let $\theta = \varepsilon / \sigma$, and then $\theta \sim N(0,1)$.

Finally, define WTP under the linear random utility model defined in equations (4.7) and (4.8) as

$$\boldsymbol{\alpha}_1 \mathbf{z}_j + \beta(y_j - WTP_j) + \varepsilon_{j1} = \boldsymbol{\alpha}_0 \mathbf{z}_j + \beta y_j + \varepsilon_{j0} \tag{4.11}$$

and solving this equation for WTP yields

$$WTP_j = \boldsymbol{\alpha}\mathbf{z}_j / \beta + \varepsilon_j / \beta . \tag{4.12}$$

The linear model was chosen over other random utility models for two main reasons. First, a log linear in income random utility model was run, but resulted in the decreased significance of some variables and a lower chi-squared statistic. Secondly, the exponential model does not allow for negative willingness-to-pay and results from the survey suggest that in this particular study there are a substantial number of individual respondents who may have a negative WTP for dam removal.

4.4 Empirical estimation-Variable selection

As discussed previously, the survey contained not only a WTP question, but also a variety of other questions relating to dam knowledge, preferences, and demographics. When the survey was designed, each question included was believed to be relevant for

interpreting WTP values. After running multiple regressions, specific variables were chosen based on their statistical significance and economic descriptiveness (See Table 4.3 below).

Variable	Variable Description
WTP	Willingness to pay for dam removal
AWARE	1=aware of the dam before reading survey, 0=Was not
BID	Dollar value offered in DC WTP question (10, 20, 50, 75 or 100)
CHANGE	1=might change answers with more information, 0=Does not
CONCREC	Rating of concern about improving recreational quality of Sandusky
EORGS	1=member of environmental organization(s)
USEH2O	1=household uses Fremont City water, 0=Does not

Table 4.3: Variables used in dichotomous choice econometric models

The variable AWARE was included to account for the possibility that some respondents may have been unaware of the existence of the Ballville Dam before they received the survey. Respondents who were already aware of the dam would be more likely to have opinions and perceptions of the dam not solely based on information contained in the survey. Another issue mentioned previously is water supply. In order to differentiate between Fremont City water users and non-users, the dummy variable USEH2O was included.

The model also included a dummy variable for participation in environmental organizations, EORGS, as a measure of the respondent's attitude about the environment in general. In order to more specifically describe a respondent's preference for

improving recreational quality on the Sandusky River, the variable CONCREC was included.

At the end of the survey an evaluation was included that asked individuals to rate the quality of the survey and to also rate their confidence level with respect to their responses. The dummy variable CHANGE is included to account for individuals who felt that more information may have led to them answer the WTP question differently.

4.5 Parameter estimation results: Sandusky DC

The results of estimations on two different dichotomous choice data sets are included in this section. First, a regression was run on responses from Sandusky County residents, and then a second analysis was run on all responses to the DC survey. Because surveys were mailed to either Sandusky County residents or residents within a 30-mile radius but not in Sandusky County there is no chance of overlap or duplication between the data sets. Combining the data simply provides an all-inclusive set of residents living within a 30-mile radius of the dam. Regressions were also run on only the 30-mile radius data, but small sample size did not allow for a sufficiently comprehensive analysis.

Table 4.4 gives the parameter estimates from the probit model on the Sandusky County data. The Chi-squared statistic represents a test of significance for the full model, where the null hypothesis assumes that the constant and all parameters are equal to zero. The tabled Chi-squared (d.f.= 6) is 18.55 at the 99% confidence level, so the null hypothesis is rejected.

All coefficients have the expected sign. The probability of a "yes" vote decreases as bid value (BID) increases. WTP is also negatively related to knowledge of the

Ballville Dam (AWARE), and the dummy variable (CHANGE) for respondents who stated that they might have answered survey questions differently with more information. The probability of a "yes" is increasing in importance with improving recreational quality on the Sandusky River (CONCREC), and is positively related to participation in environmental organizations (EORGS). All parameter estimates, except the constant, are significantly different from zero at the 0.05 level of confidence. Mean WTP for the DC survey is $42.93 if non-responses are considered a "no" and $50.86 if non-responses are omitted from the analysis. The parameter estimates between the two models were almost identical, yet the former value provides a lower bound estimate of MWTP values by assuming a zero WTP for all respondents who chose not to answer the willingness-to-pay question.

Marginal effects were also estimated for the model. The largest marginal effects for the Sandusky DC model were created by the dummy variables AWARE and EORGS, with the marginal effects being described as a result of the individual being part of a particular group. In the case of AWARE, individuals who were aware of the existence of the dam before receiving the survey had a probability of answering yes to the offered bid value that was 0.38 lower than those individuals who had never heard of the dam. For example, if individuals who responded "no" to the AWARE question had a 0.5 probability of answering "yes" to the offered bid value, then individuals who answered "yes" to the AWARE question would have a probability of answering "yes" to the offered bid value of 0.12. Similarly, individuals who were members of an environmental organization (EORGS) had a probability of answering "yes" to the offered bid value that was 0.327 higher than non-members.

A one percent increase in the value of recreation on the Sandusky River assigned by a respondent leads to a 0.26 percent increase in the probability that he/she will answer yes to the offered bid value. The marginal effect of bid value (BID) was relatively small with the probability of a yes response decreasing by only 0.004 percent for every one percent increase in bid value.

Variable [a]	Coefficient	t-Value	Marginal effect
CONSTANT	-0.87	-1.36	
AWARE	-1.10**	-2.11	-0.38
CONCREC	0.65***	4.42	0.26
CHANGE	-0.77***	-2.58	-0.30
EORGS	0.90**	2.13	0.33
USEH2O	0.48*	1.73	0.19
BID	-0.01**	-2.34	-0.004
MWTP		$42.93	
Log Likelihood		-70.08	
Chi-squared		45.61	

[a] Sample size = 134
* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Table 4.4: Probit regression results for Sandusky DC

4.6 Parameter estimation results: AllDC

Similarly, a probit regression was run on the AllDC data which combined both Sandusky County and a 30-mile radius. The results are shown in Table 4.5 on the next page. The Chi-squared statistic is again greater than the tabled Chi-squared (d.f =6) at the 99% level, so the null hypothesis is rejected. Results are similar those from the Sandusky County analysis, and all parameters have the expected sign. The probability of

a yes vote decreases as bid value (BID) increases and is negatively related to knowledge of the dam (AWARE) and to CHANGE. On the other hand, the probability of a yes is positively related to USEH2O, and is increasing in concern for improving the recreational quality of the Sandusky River (CONCREC) and participation in environmental organizations (EORGS). Mean WTP is $44.21 assuming WTP non-responses are considered a "no" vote and $56.35 when WTP non-responses are not included in the analysis.

Variable [a]	Coefficient	t-Value	Marginal effect
CONSTANT	-1.18***	-2.28	
AWARE	-0.86***	-2.97	-0.32
CONCREC	0.65***	4.99	0.26
CHANGE	-0.83***	-3.28	-0.32
EORGS	0.98***	2.45	0.35
USEH2O	0.51**	1.91	0.20
BID	-0.01**	-2.36	-0.003
MWTP		$44.21	
Log Likelihood		-90.83	
Chi-squared		55.40	

[a] Sample size = 171
** Significant at the .05 level
*** Significant at the .01 level

Table 4.5: Linear regression results for AllDC [a]

Marginal effects were again calculated for the model to further examine how WTP was affected. The variables with the largest marginal effects were AWARE and EORGS, both dummy variables. Individuals who knew of the existence of the dam had a probability of answering "yes" to the offered bid value that was 0.321 lower than those who did not.

Similarly, the probability of answering "yes" to the offered bid value was 0.35 higher for individuals who were members of an environmental organization (EORGS) than for non-members. The marginal effect of the bid value (BID) was almost identical to that of the Sandusky DC model with the probability of a "yes" response decreasing by only 0.003 percent for every one percent increase in bid value.

One interesting finding was that no variable used as a proxy measure for distance from the Ballville Dam was found to be significant in either regression. Three proxy variables were tried; a measure of miles from the river (MILES), a dummy variable for living in or outside the city of Fremont (FREMONT), and a dummy variable SANDUSKY, which differentiated between respondents living in or outside Sandusky County. Expectations were that individuals living farther from the dam, or outside of the county, would have a lower WTP for the removal of the dam because they would be less likely to use the river and/or less likely to enjoy the benefits of dam removal.

There are two possible explanations for this result. First, some individuals living farther from the dam may have a lower WTP because of the reason mentioned above, but other individuals may have a higher WTP because they do not perceive any, or as many, negatives (i.e. loss of recreation on the reservoir, loss of water supply) because they live further away. Secondly, mean willingness-to-pay was almost identical between the two analyses ($42.93 and $44.21), which suggests that distance from the dam may simply not be a significant variable in determining MWTP for removing the Ballville Dam.

Another finding was that no key demographic variables (e.g. gender, education, income) were found to be significantly related to willingness-to-pay, even though economic theory suggests that in many cases these would be relevant variables for

explaining variation in WTP. Instead, variables that measured preferences for the environment (EORG) and for improving recreation (CONCREC) were the variables most likely to explain variation in a respondent's willingness-to-pay.

Lastly, respondents who indicated that they might have responded differently given more information were significantly less likely to vote "yes" to their assigned bid value. In both regressions, respondents who answered "yes" to the CHANGE question had a probability of answering "yes" to the assigned bid value that was approximately 0.30 lower than respondents who did not feel that more information would affect their answers. This result will be discussed in greater detail in Chapter 6.

CHAPTER 5

OPEN ENDED VS. DICHOTOMOUS CHOICE WTP

5.1 Introduction

As mentioned in Chapter 2, contingent valuation (CV) is the most commonly used method for obtaining willingness-to-pay values for non-market goods and services. It does this through the creation of a hypothetical but realistic market, which includes a good to be supplied and a payment mechanism. Standard economic theory states that the way individuals choose to answer a CV survey will be a function of (1) their perceived payment obligation, and (2) their expectation for provision of the good in question (Mitchell and Carson, 1989). If both of these assumptions hold, then theoretically an individual will respond to the survey in a way that maximizes his expected utility (Carson et al., 2000).

The objective of a contingent valuation survey is to elicit a respondent's true value for the proposed resource change, or in other words, the maximum amount the good is worth to the respondent before he/she would prefer to simply not have the good (Mitchell and Carson, 1989). In the past, various elicitation formats have been tried in an effort to obtain an accurate estimation of the respondent's true willingness-to-pay. Two of the primary protocols for willingness-to-pay elicitation are dichotomous choice (DC) and open-ended (OE) mechanisms. The open-ended question directly elicits a point

estimate of the value by asking: "How much are you willing to pay for X?", while the dichotomous choice offers individuals a price they can accept or reject: "Would you be willing to pay $__ for X?"

Due to the hypothetical nature of the WTP question, a required element of any elicitation format is incentive compatibility, meaning that the format provides rules to encourage full and truthful responses from individuals (Cummings et. al., 1997). Traditionally, open-ended WTP questions have been suspected of having incentive compatibility problems because they are prone to strategic bias, which occurs when individuals answer in an attempt to influence the outcome. Because of strategic bias, open-ended mechanisms may have a disincentive for respondents to tell the truth (Arrow et al., 1993). On the other hand, dichotomous choice mechanisms, at least in theory, have the necessary properties to make them incentive compatible (Haab and McConnell, 2002).

The most popular form of strategic bias is "free-riding," where an individual will understate his/her WTP for a public good with the expectation that others will state values high enough for the good to be provided. In contingent valuation this is likely to occur when respondents believe they will have to pay the value they reveal, but also believe there is a high probability the good will be provided even if they understate their value. A second form of strategic bias occurs when individuals overstate their value because they want the good to be provided but they believe there is a high probability they will never actually have to pay.

According to Carson et al. (2000), many of the early CV studies that used open-ended questions were expected to fail because it was believed individuals would give

extremely high willingness-to-pay answers. That was not the case though, and in fact, the discrete choice format consistently produces higher WTP estimates when compared to the open-ended format (e.g. Boyle et al., 1996).

5.2 Background on OE vs. DC

The discrete dichotomous choice question uses a large number of predetermined prices t_j, chosen to bracket the expected maximum WTP amounts of most respondents for the resource in question (Mitchell and Carson, 1989). Prices are assigned randomly to individuals in the sample, and each individual is asked whether or not he/she is willing to pay the randomly assigned price. The method is often preferred over its open-ended counterpart not only because it is theoretically incentive compatible, but also because it eliminates the option of large response values and reduces both non-response and zero value responses.

The DC format, while currently the recommended for use in contingent valuation studies, does have several flaws. First, it yields less information from each respondent relative to the OE format, which obtains a respondent's actual WTP value. Instead, the dichotomous choice format only narrows down the range of the respondent's true willingness-to-pay for the good (Mitchell and Carson, 1989). Similarly, it is inefficient relative to other elicitation methods, including the OE format, because it requires a significantly higher number of observations to achieve the same level of statistical precision. Using an open-ended format allows for significant efficiency gains by requiring a much smaller sample size to achieve the same level of statistical precision. The NOAA Blue Ribbon Panel (Arrow et al., 1993) recommends the use of in-person

interviews for CV surveys. Following this recommendation and using a dichotomous choice format would most likely be costly and the use of an OE format could lead to substantial cost savings.

According to Loomis (1997), the DC format may also encourage biases due to the yes/no nature of the format, such as symbolic voting, where individuals vote "yes" not because they would pay the price, but to register support for the particular environmental good or service in question (Brown et al., 1996). Another bias, "yea-saying", where a bid offering is accepted as a cue of what is a reasonable payment, may also be encouraged by the DC format (Mitchell and Carson, 1989).

The dichotomous choice method also requires the researcher to make assumptions about how to parametrically specify the function used to obtain the mean WTP value (Mitchell and Carson, 1989). And while median willingness-to-pay is much less sensitive to distributional assumptions, it requires both a large sample size, and the correct choice of predetermined prices t_j. The use of open-ended questions would eliminate potential problems related to distributional assumptions made by the researcher.

The Gibbard-Satterthwaite result (1973, 1975), one of the core results of mechanism design theory, states that no response format that allows for more than a binary response can be incentive compatible without assuming restrictions on preferences. This result is essentially a negative one though, and as noted by Carson et al. (2000), it does not say that *all* or *even any* binary discrete choice formats are incentive compatible, simply that it is the only format that is potentially incentive compatible.

Examining current valuation literature (Green et al., 1998), there are three conditions any elicitation format must meet in order to be incentive compatible. The format must be consequential, compelled and decoupled. Consequential implies a decisive implementation frame, or in other words, respondents must believe there is a positive probability of project/policy implementation and that this probability is positively related to the survey plurality. Compelled payments simply mean that if the good is provided, the agency providing the good can require payment for it. Finally, a decoupled payment vehicle must be used. This means if the good is provided, its cost will be distributed across all consumers by a formula that does not depend on an individual's response to the WTP question. Green et al. (1998) argue that the open-ended format requires an additional condition in order to be incentive compatible; uncertain cost, where the true cost of the project is unknown to the respondent and may lie above or below their true willingness-to-pay value.

Green et al. (1998) believe that both the dichotomous choice, and open-ended elicitation formats can be incentive compatible if framed to successfully meet the criteria outlined above. In order to test the practicality of the OE format, this study provides an application that compares results of the DC and OE formats applied to the subject of dam removal, using mail surveys sent to a randomly selected set of individuals living in Sandusky County, Ohio (See Sections 2.3 and 2.4). The sample was split; one group of individuals received a dichotomous choice WTP question, while the other sub-set received an open-ended WTP question. Other parts of the survey were identical, suggesting that any difference in the results was caused by the WTP question format. The actual wording of both the DC and OE questions are provided below:

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost we can determine whether enough people would vote for the proposition to justify putting it on the ballot. If the project does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for the project.

Suppose your household would have to make a one-time payment of $10 to the trust fund to help cover the cost of the dam removal project. If an election were held today, would you vote for or against the project?

- ☐ I would vote FOR the dam removal project
- ☐ I would vote AGAINST the dam removal project

Figure 5.1: Dichotomous choice question

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost of the dam removal project, we can determine whether enough people would vote for the proposition to justify our putting it on the ballot.

Once we have determined the actual cost, we will compare your response to it. If your response is greater than or equal to the actual cost, then we will assume you would vote for the project. If your response is less than the cost we will assume you would vote against the project. If the proposition does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for the project.

Suppose your household would have to make a one-time payment to the trust fund in order to cover the cost of the project. What is the maximum amount you would be willing to pay for the dam removal project?

$_____

Figure 5.2: Open-ended question

5.3 OLS model

The ordinary least squares (OLS) model was used to analyze responses for the open-ended CV surveys. In a least squares regression the objects of estimation are the unknown parameters in the equation $y_i = \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i$. It is important to distinguish between

$\boldsymbol{\beta}$ and ε_i, which represent population quantities, and the sample estimates, denoted **b** and e_i. From Greene (1993), the estimate of $E[y_i \mid x_i]$ is denoted

$$\hat{y}_i = \mathbf{x}_i'\mathbf{b}. \tag{5.1}$$

The disturbance associated with the *i*th data point is

$$\varepsilon_i = y_i - \mathbf{x}_i'\boldsymbol{\beta}. \tag{5.2}$$

For any value of **b**, the residual is

$$e_i = y_i - \mathbf{x}_i'\mathbf{b}. \tag{5.3}$$

From this,

$$y_i = \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i = \mathbf{x}_i'\mathbf{b} + e_i. \tag{5.4}$$

For the purposes of this study,

$$WTP_i = \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i = \mathbf{x}_i'\mathbf{b} + e_i. \tag{5.5}$$

5.4 Empirical estimation and variable selection

Utilizing economic theory and previous empirical evidence, several explanatory variables were chosen to be included in the model. Multiple regressions were then run on the open-ended data to make the final choice of specific variables based on their statistical significance and theoretical correctness. The variables included in the open-ended model are defined in Table 5.1.

Variable	Variable Description
WTP	Willingness-to-pay for dam removal
FISHB	Number of times fishing from a boat on the Sandusky River in the last year
EDU	Highest level of education
CONCEV	Rating of concern about improving environmental quality of Sandusky
CONCREC	Rating of concern about improving recreational quality of Sandusky
MAUMEE	1=Recreate on the Maumee River, 0=Does not
MILE	Number of miles respondent resides from the Sandusky River
SWIM	Number of times swimming in the Sandusky River in the last year
USEH2O	1=Household uses Fremont City water, 0=Does not

Table 5.1: Variables used in open-ended econometric model

In order to more specifically describe a respondent's preference for improving environmental and recreational quality on the Sandusky River, the variables CONCEV and CONCEV were included. The dummy variable, MAUMEE, was also included to account for the possibility of respondents using a substitute good when recreating. Both SWIM and FISHB measure the level of times an individual participated in a particular recreational activity on the Sandusky River the previous year. The variable MILE was used to measure distance from the Sandusky River to the respondent's residence. Finally, the dummy variable USEH2O was included to differentiate between Fremont City water users and non-users. Table 5.2 below includes descriptive statistics for each of the variables in the model.

Variable [a]	Mean	Std. Dev.	Minimum	Maximum
FISHB	1.15	2.66	0	9
EDU	4.14	1.60	2	9
CONCEV	3.03	1.15	1	5
CONCREC	3.19	0.99	1	5
SWIM	0.49	1.62	0	9
USEH2O	0.25	.43	0	1

[a] Sample size = 57

Table 5.2: Descriptive statistics for variables included in the OE model

5.5 Results

One notable difference between the OE and DC formats is the difference in response rates to the WTP question. Nineteen percent of OE respondents did not answer the WTP question, while only 4% of DC respondents left the WTP question blank. A simple chi-squared test was performed, where the null hypothesis assumed response rates between the two elicitation formats were equal. Based on the tabled chi-squared statistic, the null hypothesis was rejected at the 99% level.

Mitchell and Carson (1989) point out that respondents not familiar or experienced with the good in question may find it difficult to "pick a value out of the air", without some sort of help. For that reason, the OE format often produces large numbers of non-responses or protest zero responses to the WTP question (Desvousges, Smith, and McGivney, 1983). Table 5.3 shows the distribution of OE WTP values, the results of which are consistent with the findings of Desvousges et al. (1983), while Figure 5.1 graphs the frequency distribution of the willingness-to-pay values (not including non-response).

No Value	Zero Dollar Value	Positive Dollar Value
0.19	0.60	0.21

*Sample size = 72

Table 5.3: Distribution of OE WTP values

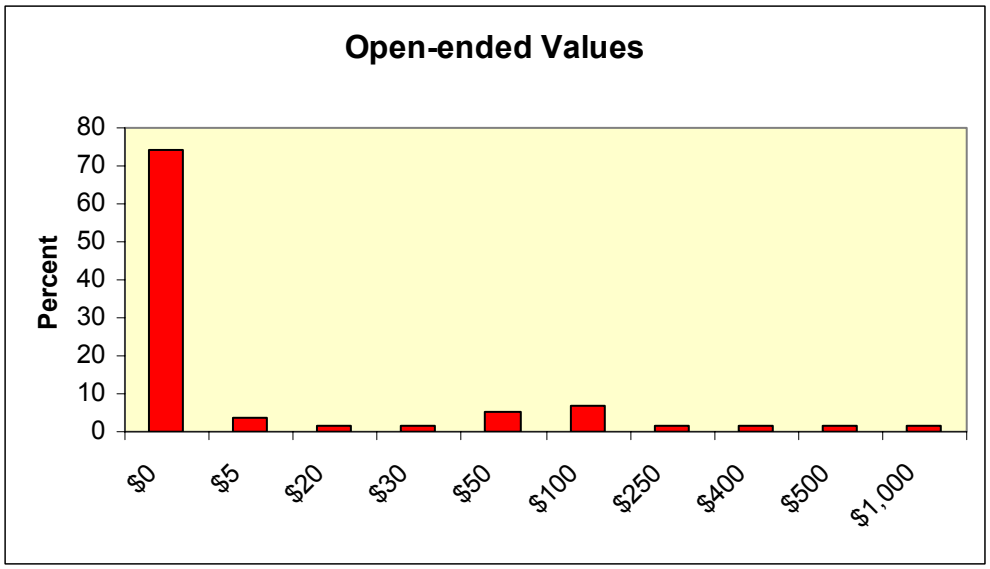

Figure 5.3: Frequency distribution of OE WTP values

Results of the OLS regression for the open-ended responses are shown in Table 5.4 on the next page. All variables were significant at the 0.05 level or greater and all had the expected sign, except for CONCREC which was positive and significant in the DC model but negative and significant in this model. Mean WTP is $48.42 with blank WTP values not included and $38.87 when blank WTP responses were included. The adjusted R-squared for the model was 0.37, which means that just over one-third of the WTP variation was explained by the variation in the six variables used in the regression.

Variable [a]	Coefficient	t-Value
CONSTANT	-46.49	-0.63
CONCEV	68.31***	3.11
CONCREC	-84.91***	-3.29
EDU	27.47**	2.48
FISHB	31.02***	3.96
USEH2O	103.51***	2.55
SWIM	-33.37***	-2.61
MWTP		$48.42
R-Squared		0.43
Adjusted R-Squared		0.37

[a] Sample size = 57
* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Table 5.4: OLS regression results for Sandusky OE

5.6 Comparison of results (DC versus OE)

According to Balisteri et al. (2001), one of the discoveries of experimental economics is that not only does the structure of the institution used to elicit bids matter, but that theoretical incentive compatibility does not guarantee that the true demand will be revealed by the market institution. A comparison of values obtained from both dichotomous choice (DC) and open-ended (OE) elicitation formats reveals that the DC format almost always produces larger value estimates (Schulze et al., 1996). Balistreri et al. (2001) did a review of six contingent valuation studies comparing DC and OE elicitation formats. They found that the methods of the "average study" differed by a factor of 7.0, while the "median study" showed a difference of 1.9.

Using either the mean or median results from the Balisteri et al. study (2001), it appears that in those six studies the difference in values produced by the two formats is large. All of those studies were lab experiments which compared one of the formats (either DC or OE) to auction values. The one experimental study that did directly examine DC versus OE questions (Loomis et al., 1997) did not find a statistically significant difference between the two formats, perhaps because the sample size was too small (Balisteri et al., 2001). This study, in contrast, is a practical application of the methodology that uses a real-world scenario to compare the values produced by each format.

A comparison of the mean and median WTP values obtained from each data set are shown in Table 5.5 below. As seen, the difference in means between the DC and OE survey formats is not substantial. However, the difference in median WTP values between the two formats is more noticeable due to the high number of zero WTP values in the OE model.

Survey	Mean	Median
DC-Sandusky	$50.86	$15-50
DC-All	$50.91	$15-50
OE-Sandusky	$48.42	$0

Table 5.5: Comparison of mean and median WTP estimates

In order to further compare both the DC and OE formats, a regression was run on both data sets using the same independent variables, with the results of both regressions

shown in Table 5.6 below. It is interesting to note that in the OE model all of the coefficients are significant at the 0.05 level, while in the DC model the only parameter estimate other than bid value that is significant is CONCREC.

Variable	Sandusky OE n=57	Sandusky DC n=137
CONSTANT	-46.49	-1.69***
BID	---	-0.01***
CONCEV	68.31***	0.20
CONCREC	-84.91***	0.39**
EDU	27.47***	-0.002
FISHB	31.03***	0.02
USEH2O	103.51***	0.27
SWIM	-33.37**	-0.19

* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Table 5.6: Comparison of OE and DC regression results

It is difficult to speculate as to why these two surveys, identical in every respect expect for the WTP question and sent to a random population, lead to such different median results. Whatever the reason, it may suggest that there is a fundamental difference in the mental process used by an individual to answer an OE WTP vs. DC WTP question. While purely speculative, the OE question requires individuals to "pull a number out of the air" or not answer at all. For those individuals that choose to answer, the decision to write a dollar value may force them to reflect on their preferences more seriously before choosing a value. Conversely, DC respondents need only check "yes"

or “no” to a given value, and unless the value is high, may not spend much time reflecting on whether or not the decision accurately reflects their preferences.

CHAPTER 6

STRUCTURED ELICITATION GROUPS

6.1 Introduction

A common assumption among many economists is that "each individual has stable and coherent preferences" (Rabin, 1998). It is also accepted that "people know their preferences" (Freeman, 1993), that they have the ability to maximize those preferences, and they will choose the option that does so (Payne et al., 1999). Under these assumptions, the use of mail surveys sent to a random sample population may indeed provide accurate estimates of willingness-to-pay (WTP). In fact, a growing number of researchers believe that the assumptions of well-defined preferences work only when individuals are familiar and experienced with the good being valued, and even if individuals are familiar with the good, it is less likely that they have experience in valuing it, at least in a monetary sense (Payne et al., 1999). Under these assumptions, it is perhaps more appropriate to examine a constructive view of preferences.

The two major tenets of constructive preferences are (1) expressions of preference are generally constructed at the time the valuation question is asked and (2) the construction process is shaped by the properties of the decision task and the ability of the respondent to process the information (Payne et al., 1992; Slovic, 1995). In other words, values given by respondents are not based on well-defined preferences, but rather,

on information stored in memory and information gained at the time the valuation question is asked.

6.2 Constructive preferences in contingent valuation

It is clear there are many examples of goods for which a respondent's WTP would be based on prior experiences and well-defined values; an apple, a gallon of gas, or a visit to the doctor. Fischhoff, Slovic, and Lichtenstein (1980) argue that "people are most likely to have clear preferences regarding issues that are familiar, simple, and directly experienced." Experience provides a chance for the individual to learn not only about a good, but to also gain knowledge of their value for it. Payne et al. (1999) believe that if an individual has a chance to think about and/or obtain an experience with the good prior to the valuation question, then basic economic assumptions hold, i.e. preferences exist to be uncovered.

It may not be reasonable to assume though that most CV scenarios are "familiar, simple and experienced." In fact, Fischhoff (1997) argues that individuals cannot have pre-existing preferences for any specific CV scenario because even the best-specified proposal, on the most familiar topic, still contains information that is inevitably new to the respondent. In that case, any previous experiences or knowledge on the issue may simply serve as a starting point for the more complex and novel issue being considered (Fischhoff and Furby, 1988).

There is a wide variety of goods for which WTP values have been elicited using contingent valuation surveys, and environmental concerns are only a sub-set. The results produced in a search engine to the query "contingent valuation" resulted in such topics

as; women's preferences in health care (Sampietro-Colom et al., 2004), valuing public libraries (Aabo and Strand, 2004), the value of public outdoor recreation areas (Huhtala, 2004) and breeding objectives for the South German heavy horse (Edel and Dempfle, 2004). It is likely that there exists a spectrum of goods, as shown in Figure 5.1, across which different elicitation methods prove more, or less, effective. This variation is likely to be based not only on the good being valued, but also the sample population being surveyed.

Take for example the contingent valuation study of breeding objectives for the South German heavy horse (Edel and Dempfle, 2004). It is likely that for a random individual this topic would be unfamiliar, and answering a WTP question on a breeding scenario would indeed be difficult. The individual would have to be informed about the relative conformation and performance traits of the breed, such as; quality of the limbs and hoofing, temperament traits like 'pleasantness' and 'coolness', quality of the gait walk and the trait 'willingness to work'. He/she would then have to take that knowledge and apply it to the survey questions.

The authors chose instead to use a stratified random sample of all registered breeders in Bavaria. The study states, "The results show a remarkably stable preference structure across all strata" that supports "well known traditional orientation of heavy horse breeders and their attempt to preserve and improve typical characteristics of the breed" (Edel and Dempfle, 2004). These results suggest that because survey participants were all local registered breeders, experienced and familiar with the topic in question, not only were their preferences well defined, but they were stable across the sample.

Current valuation methodology does little to account for the fact that in some cases though researchers may need to do a general survey of relatively uninformed individuals, such as cases where individuals may not be aware of a proposed change that could affect them personally (i.e. construction of a hazardous waste disposal site nearby, removing a dam) and in doing so, may in some cases fail to elicit WTP values that accurately reflect the preferences of the respondent.

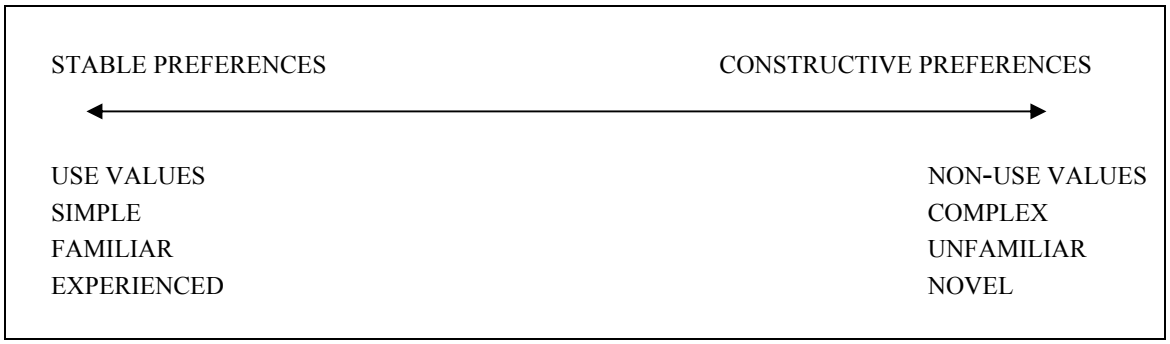

Figure 6.1: Spectrum of goods

Due to the relatively complex nature of many non-market goods for which contingent valuation attempts to assess WTP values, it is hypothesized that the constructive preference philosophy is a more plausible argument. Therefore, the ability of the researcher to provide an approach that accounts for these issues would be imperative to obtaining an accurate estimate of respondents' WTP values, and under this assumption, the use of a random mail survey may fail to provide accurate estimates of an individual's WTP.

In this section an attempt is made to develop and test a WTP elicitation format that accounts for, and helps respondents construct more defensible preferences; structured elicitation groups (SEG). If an individual's preferences are well-defined, then a slight variation in the structure, but not content, of the elicitation format should not significantly alter stated WTP. In other words, well-defined preferences should remain stable regardless of the elicitation process. On the other hand, if individuals are constructing preferences at the time the question is being asked, there may be a difference in the WTP values obtained from the two response formats, and/or respondents' perceptions of the process and their stated WTP value. In order to test the hypothesis two treatments are conducted; a random mail survey (previously discussed) and a structured elicitation group.

Because it is extremely difficult to validate the WTP values obtained from either elicitation format, it is difficult to determine which values are "better". The point is that if an elicitation process successfully encourages individuals to provide more thoughtful and rational preferences, then their WTP values will reflect that. In other words, the quality of the process is just as important as the quality of the results. To measure the quality, or content validity, of both elicitation formats, questions were included in both the mail survey and SEG handout that allow for within-group and across-group comparisons.

6.3 Comparison of mail surveys and structured elicitation groups

It is commonly accepted that mail surveys suffer from a number of biases. Mitchell and Carson (1989) break down these biases into four main categories: incentives

to misrepresent responses, implied value cues, improper sampling design, and scenario misspecification, which is the focus of this study.

Scenario misspecification occurs when a respondent does not understand the given scenario in the way intended by the researcher. If this happens, it is possible the respondent may provide a WTP value for something different than what the researcher is asking. This type of bias could be caused by several things including; confusing presentation of the good or service, lack of knowledge on the part of the respondent, a complex scenario, or other factors (Fischhoff et al., 1999). In any case, it is extremely difficult for the researcher to know exactly what a particular respondent understood and exactly what question he/she answered when giving his/her WTP value. In the case of a scenario that involves a complex and/or unfamiliar good, it is important that the respondent correctly understands exactly what he/she is being asked to value. The use of structured elicitation groups may help minimize the risk of scenario misspecification by allowing for question clarification and providing value tasks.

Another problem with mail surveys is that respondents are often unwilling to make tradeoffs, perhaps due to uncertainty of preferences or indifference to the choices offered. This avoidance of tradeoffs is reflected in behaviors such as selection of the status-quo, the use of a "protest" zero vote, or delaying choice (Luce, 1998). The potential for avoiding tradeoffs may be minimized by using structured elicitation groups to provide time and tools to analyze the objectives, scenarios, and attributes of the problem. In the case of environmental goods, it is likely that even if an individual has a strong value for the resource he/she may have difficulty expressing that value in

monetary terms. If this translation is biased, then the response value will not provide an accurate description of the individual's true value for the good.

6.4 Structured elicitation group: Fremont, Ohio

For the first attempt, participants were recruited through local churches and sessions were held at a local church, Fremont St. Joseph's Catholic Church. One of the major difficulties encountered though was setting up the group sessions. Initially two local clergy associations were contacted though the mail, one in Fremont and one in the nearby town of Gibsonburg. The Gibsonburg group responded and asked for more information, but after a second mailing, e-mailing and attempts to contact the group by phone, no direct contact with any member of the group was ever made.

The Fremont clergy group asked the author to attend their monthly meeting and give a short presentation. While the group was attentive, receptive and appeared to grasp the general concepts of the proposed study, there was little interest expressed in actually going forward with the group sessions in any of the individual churches. Several individuals did provide follow-up information and three of these individuals were contacted. Two never responded, but the third received permission from his church, St. Joseph's, and agreed to help.

Information on the session was put in the church bulletin, mailed as a flyer to other local churches, and a press release written by the author was printed in the local newspaper. In order to keep the article as neutral as possible, it stated, "The goal of this study is not to advocate removal or restoration [of the dam], but to improve the methodology used to make such a decision. This is not a public meeting or focus group."

A donation of $15 was made to the Sandusky County Food Bank for each individual that participated and successfully completed the survey.

The SEG took place on August, 18, 2004 at 6:00pm in the parish hall of St. Joseph's Catholic Church in Fremont with 18 participants. The session included the use of individual workbooks, group questions, and a professional reader and a facilitator, who were meant to reduce the cognitive demands for individuals participating in the sessions by making the required tasks more manageable and keeping the session moving.

The handouts used in the group sessions were almost identical to the mail survey, but also included two valuation tasks where individuals worked alone to rank various alternatives related to the effects of dam removal. These tasks were meant to facilitate the decision process by encouraging individuals to understand the various options available and also the consequences of their decision. In order to ensure no overlap between the SEG and the mail survey, individuals were asked not to participate in the session if they had filled out a mail survey on the proposed dam removal in the last six months.

6.5 Results of the Fremont structured elicitation group

Both the results of the survey and the attitude of participants during the session suggest that self-selection bias is present. Results of the random mail survey showed that if funding were found to remove the dam, 70% of Sandusky County residents were in favor of dam removal. In contrast, only 11% of respondents in the SEG stated that they would be in favor of having the dam removed if the cost of the project was zero. This difference suggests that individuals who had a negative WTP for dam removal were the

overwhelming majority (89%) of participants in the SEG, but results of the random mail survey suggest this is highly unrepresentative of the general population.

Table 6.1 provides a comparison of the demographic statistics for the SEG, the mail survey and the U.S. census data on Sandusky County. Demographically, SEG participants are not representative of the local population, nor are they similar in most cases to the demographics of the mail survey respondents. This dissimilarity makes any comparison between the two formats extremely difficult.

The one exception is that the male/female ratio of the structured elicitation groups was much more representative of the population than the mail survey. Gender is a demographic statistic that is often difficult to match to the general population in mail surveys due the structuring of sample frames, which typically list only the head of household who is often male.

Variable	Sandusky SEG	Sandusky Mail Survey	US Census (Sandusky)
Male (percent)	.56	.71	.49
Female (percent)	.44	.29	.51
White (percent)	1.0	.97	.92
African-American (percent)	0	0	.03
Latin-American (percent)	0	.01	.07
Other (including Native Am.) (percent)	0	.02	.03
High school diploma (percent)	1.0	.93	.82
Bachelor's degree or higher (percent)	.35	.26	.12
Average household size	2.0	2.59	2.56
Home ownership (percent)	.94	.90	.75

Table 6.1: Comparison of demographic statistics

On a 5-point Likert scale, the average SEG participant stated that he/she had a knowledge level about dams of 3.0 and an awareness of the issues most important to them with respect to dam removal of 3.56. For both questions, 28% of respondents rated themselves as a 5.0. This high level of pre-session knowledge and awareness among participants coupled with their opposition to removal of the Ballville Dam made a within group comparison to measure construction of preferences almost impossible.

Of the 18 participants only one had a positive WTP for dam removal and as would be expected from these results, median WTP was zero. Due to the high WTP of one individual, the mean WTP for dam removal was $29.41.

6.6 Problems encountered with the methodology

Difficulty of implementation of any methodology would typically be considered a flaw. It appears though that in the case of structured elicitation groups there are several distinct elements that determine whether this methodology can be easily implemented or not; accessibility, importance of the issue, funding and self-selection.

If the study is being done by a local organization, citizen's group or government, then the notion of soliciting participation from local citizens does not seem that far fetched. The concept of social capital plays directly into this. Consider the idea of an individual with ties to the community asking for individuals to participate in SEGs versus an unknown outsider asking for the same thing. It is not difficult to imagine who is more likely to be successful. The closer the researcher or researching organization is to the local community, the easier it should be to set up the group sessions. A caveat for relying too heavily on social capital is that it may potentially lead to biased results if the

researcher were to draw too heavily from friends, co-workers, or others who share similar beliefs or characteristic traits.

Another element is the importance or emotionalism of the issue being considered. Is it something that everyone is aware of and talking about? Is it an issue that a decision has to be made on in the very near future? If the answer is yes to either of these questions, then citizens may be more likely to participate in the study simply because the want their say on the issue. On the other hand, and in the case of the Ballville Dam, the estimated time frame for removal is far in the future (10 years), and several members of the clergy association with whom the author spoke didn't see the point in doing anything now. Lack of interest and time delays in the project both may lead to difficulty in implementing this format.

In cases where there is no accessibility, little interest and/or an uncertainty about when the project might be implemented, compensation may be necessary to induce individuals to participate a session. If groups are not able to be set up through the existence of social capital, then the researcher may have no choice but to offer a monetary incentive. This could be done several ways. First, as in many experiments, it could be done on a per person basis. Flyers with recruitment info would provide a time and place and anyone interested could show up. The problem with this method is the potential for self selection, either because of interest in the topic, or because of availability.

In the case of the Fremont SEG, both the newspaper article and distributed flyers mentioned the topic of the session and the former detailed to some degree the issues surrounding the Ballville Dam. An alternative option would be to recruit individuals to

participate in a "survey experiment" but not inform them of what the topic would be. While this does not correct for the issue of availability, it may to some degree correct for self-selection bias.

It should be noted though that in the case of the Fremont SEG, even with flyers and a newspaper article, only 18 people attended, 16 of which had an anti-dam removal agenda. Without informing individuals of the topic in this case would have led to perhaps only 2 or 3 participants, which again confirms that the amount of money offered was not sufficient for a neutral or uninformed citizen to attend.

Secondly, a donation could be made to either a local church, PTA scholarship fund, athletic boosters club, or organization (United Way, 4-H, Red Cross etc.) in exchange for that organization agreeing to have *x* number of individuals show up at a specified time and place to participate in the session. The offer of $*x* to a scholarship fund at the local high school in exchange for participating in a hour study might be considered more pleasant than baking cookies for the concession stand or selling candy bars. This hypothesis is tested in the following section.

6.7 Willingness to participate in a structured elicitation group

In order to estimate what would be a sufficient amount of money to induce individuals to participate in an elicitation group, a survey was done at an Ohio vocational high school, which was chosen for several reasons. First, school employees are not linked together by a common bond such as religion, volunteerism, or environmental preferences. Working at the school is a job as opposed to voluntary participation in a church or local organization. Secondly, school employees offer a diverse cross section of

the population by including a variety of ages, incomes, ethnicities, and gender, among others. The survey included secretaries, janitors, teachers and administrators, who also represent a variety of skill levels and occupations.

Half of the surveys offered a $30 donation and the other half offered a $50 donation. These values were chosen because the $15 donation offered at the Fremont SEG was apparently not a sufficient amount to induce an unbiased individual. The actual survey appears in Figure 6.2. Surveys were handed out to employees at the Ashland County West Holmes Career Center and they were asked to complete the survey and return it to a mailbox in the teachers lounge.

Suppose someone approached you and asked whether you would be willing to fill out a survey that concerns the environment. The survey would be filled out after school one day and would take a little over an hour. In exchange, $50 would be donated to the school scholarship fund for each individual that participated and successfully filled out the survey. For example, if 50 school employees stayed after, $2500 would be donated to the scholarship fund.

1. Would you be willing to participate in the survey?
☐ Yes
☐ No

2. If you answered yes, how likely would it be that you would actually show up?
☐ Extremely likely
☐ Very likely
☐ Likely
☐ Not very likely
☐ Not likely at all

3. If you answered no, what dollar value would it take for you to agree to participate?
$_____

Figure 6.2: Survey used to determine willingness to participate in a SEG

Fifty-three individuals responded to the survey, with 25 answering the $30 question and 28 responding to the $50 question. The responses to the Yes/No participation question as well as the "likeliness-to-participate" question are shown in Table 6.2. The results of the survey suggest not only that school employees are a group of individuals who would be willing to participate in a structured elicitation group, but also that they would be at least "very likely" to participate. Individuals who answered "No" to either survey did so because a schedule conflict prevented them from participating in an after school session.

Responses	$30 n=25	$50 n=28
YES	0.96	0.93
Extremely likely	0.43	0.56
Very likely	0.39	0.19
Likely	0.17	0.26
Not likely	0	0
Not likely at all	0	0

Table 6.2: Responses to the willingness-to participate survey

6.8 Structured elicitation group: Student experiment

In a second attempt to test (1) whether preferences are being constructed during the elicitation process and (2) if that is the case, whether SEG methodology accounts for such preferences, a lab experiment was run using undergraduate and graduate students at the Ohio State University. The purpose of the experiment was to test the methodology rather than simply eliciting WTP for dam removal.

In order to make the survey instruments "lab-friendly" the dam removal scenario was changed to a hypothetical one. All of the facts were the same as those used in the previously described Ballville Dam surveys, but students were asked to imagine themselves as a resident of a hypothetical town facing a dam removal decision. Name changes used in the hypothetical description given to students are included in Table 6.3 below. Examples of the experimental "mail survey" and SEG handout are included in Appendices D and E respectively.

	Real Scenario	Hypothetical Scenario
Town	Fremont	Montey
River	Sandusky	Sandy
Dam	Ballville	Village
Lake	Lake Erie	Big Lake

Table 6.3: Changes from real to hypothetical scenario

Two experiments were run using students from two classes offered by the Agricultural, Environmental and Developmental Economics (AEDE) Department and the School of Natural Resources. The first used an undergraduate natural resources class, and the second used a graduate level benefit-cost analysis class. Each section was split in half and assigned to two separate rooms. During each session, one group filled out a "mail survey" while the other students participated in a structured elicitation group.

Students who completed the "mail survey" were handed an envelope containing a cover letter and the survey. They were not allowed to talk to each other and were given no instructions other than those provided in the cover letter and on the survey. The "mail

survey" respondents were allowed to work at their own pace and were free to leave once they had completed the survey. While not identical to an actual mail survey, the simulation did allow for self-administration and participants also had access to the entire questionnaire, meaning that the researcher lacked the ability to prevent individuals from skipping through the survey and reading the entire questionnaire before they started to fill it out. This ability may have allowed them to determine the purpose of the WTP question before answering.

Students participating in a structured elicitation group were given a survey handout and were asked to follow the instructions of the facilitator. The handout was identical to the one used in the Fremont SEG except for the name changes mentioned previously. Table 6.4 below shows the total number of participants in each session.

Session	Mail Survey	SEG	Total
A	16	11	27
B	6	6	12
Total	22	17	39

Table 6.4: Number of participants in experimental sessions

While all participants in the experimental sessions were Ohio State University students enrolled in an AEDE course, several demographic questions were included in the survey (See Table 6.5). Income levels and type of employment questions were not included though because it was known that all participants were students, even though some held part time jobs.

Variable	Mail Survey (percent)	SEG Survey (percent)
Male	.50	.47
Female	.50	.52
White	.59	.47
African-American	.09	.23
Latin-American	.04	0
Asian-American	.09	.23
Non-American	.18	.06
Some college	.58	.53
Bachelor's degree	.23	.18
Graduate level degree	.18	.29
Age 20-29	.77	.77
Age 30-39	.23	.17
Age greater than 39	0	.06

Table 6.5: Demographic statistics from experimental sessions

6.9 Results from student experiment

Both the "mail survey" and SEG handouts asked an initial series of five questions, the goal of which was to ascertain the respondents' pre-survey levels of knowledge and perceptions of dam removal. The original reason for including these questions was to allow for a with-in group comparison of pre- and post-survey perceptions of knowledge level and awareness with respect to dam removal. One interesting finding though was the difference in perceived levels of pre-survey knowledge between the groups.

Because individuals were randomly assigned to either the "mail survey" or the SEG, the expectation was that pre-survey perceptions of dam removal would be similar,

but this was not the case. As shown in Table 6.6 and Table 6.7 below, individuals were asked to characterize their level of knowledge about dams and also rate how aware they were of the dam removal issues that mattered most to them. Answers were given on a 5-point Likert scale, with "1" being "Very little knowledge" or "Not at all aware", and "5" being "A lot of knowledge" or "Extremely aware" depending on the question.

How would you characterize your level of knowledge about dams?	Mail Survey	SEG
1 (Very little knowledge)	0.32	0.47
2	0.18	0.24
3 (Moderate amount of knowledge)	0.32	0.30
4	0.13	0
5 (A lot of knowledge)	0.05	0
MEAN	2.41	1.82

Table 6.6: Pre-survey rating of knowledge level

How aware are you of the issues that matter most to you when thinking about dam removal?	Mail Survey	SEG
1 (Not at all aware)	0.14	0.18
2	0.23	0.47
3 (Aware)	0.27	0.35
4	0.27	0
5 (Extremely Aware)	0.09	0
MEAN	2.95	2.18

Table 6.7: Pre-survey rating of awareness level

A two-tailed t-test was used to test the null hypothesis (H_0 = no difference in means) at the 0.05 level of significance for each question. The null hypothesis was not rejected for the knowledge questions (p=0.10), but was rejected for the question on awareness (p=0.03). While it is possible that even with random assignment between the groups, those individuals assigned to the "mail survey" actually had a higher level of knowledge and awareness about dam removal, that explanation is unlikely. It is difficult to know exactly why this occurred, but one possible explanation is the presence of a moderator in the SEG. If participants perceived the moderator as "an expert", which was likely, it may have caused individuals to answer this question by rating themselves *relative* to an expert.

6.10 Willingness-to-pay values

An open-ended willingness-to-pay question was used in both the "mail survey" and the SEG handout. This was done for two reasons; (1) there were not a sufficient number of participants to allow for a dichotomous choice question, and (2) to further test the use of an OE-WTP format. The question was the same one used in the OE mail surveys discussed in Chapter 5.

Willingness-to-pay values for the SEG participants ranged from $10-500 with an average WTP of $133.82 and a median of $50. The majority of individuals when asked why they chose their dollar value stated that it was the most they could afford given their income. It should be noted that all SEG participants filled in the WTP question, which will be discussed later in comparison with the results of the "mail survey".

"Mail survey" respondents gave willingness-to-pay values ranging from $5-3000, with a mean of $237.35 and a median of $50. There were several problems with WTP values offered by "mail survey" respondents. One individual stated that he/she did not want to see the dam removed, but then offered a positive WTP value. Another individual stated his/her reason for choosing his/her dollar amount was because "it was my favorite number". After eliminating both those WTP values as well as the $3000 value which appeared to be an outlier, mean WTP for the "mail survey" was $102.06 and the median was $50. Two of the twenty-two respondents did not answer the willingness-to-pay question and were not included in the calculations.

This apparent inability of "mail survey" respondents to answer the WTP question is consistent with both the findings of the real mail survey and expectations that individuals have a difficult time "picking a value out of the air", as noted by Mitchell and Carson (1989). Valuation did not appear to be an issue for SEG participants though, as noted previously. This difference may be due to the valuation task included in the SEG handout. It is interesting to see that this difference occurred in spite of the fact that all experiment participants had at least some level of knowledge from previous class work regarding non-market valuation and willingness-to-pay.

6.11 With-in group comparisons

After completing the willingness-to-pay questions, respondents in both groups were again asked to rate their knowledge and awareness levels. A with-in group comparison of pre-survey and post-survey results was done for both "mail survey" respondents and SEG participants. Results are shown in Table 6.8 and Table 6.9.

How would you NOW characterize your level of knowledge about dams and the Village Dam in particular?	Mail Before n=6	Mail After n=6	SEG Before n=18	SEG After n=18
1 (Very little knowledge)	0.50	0	0.47	0.12
2	0	0.17	0.24	0
3 (Moderate amount of knowledge)	0.17	0.67	0.30	0.53
4	0.33	0.17	0	0.24
5 (A lot of knowledge)	0	0	0	0.06
MEAN	2.33	3	1.82	3.09

Table 6.8: Comparison of pre- and post-survey rating of knowledge

To what extent do you feel that you've identified the issues that matter most to you when thinking about removing dams?	Mail Before n=6	Mail After n=6	SEG Before n=18	SEG After n=18
1 (Not at all well)	0.17	0	0.18	0
2	0	0.17	0.47	0.18
3 (Well)	0.33	0.5	0.35	0.53
4	0.33	0.33	0	0.12
5 (Extremely well)	0.17	0	0	0.18
MEAN	3.33	3.17	2.18	3.29

Table 6.9: Comparison of pre- and post-survey rating of awareness

One-tailed t-tests were used to compare with-in group means pre-survey and post-survey. The null hypothesis (H_0 = no difference in means) was tested at the 0.05 level of significance. In the case of the SEG, the null hypothesis was rejected for both the knowledge ($p = 0.00$) and awareness ($p = 0.00$) questions. There were a limited number of observations for the mail survey, but that withstanding, the null hypothesis could not be rejected for either the knowledge ($p = 0.17$) or the awareness ($p = 0.40$) questions.

6.12 Empirical estimation for SEG and "mail survey" experiments

An ordinary least squares (OLS) model was used to analyze responses for the open-ended WTP questions from both the SEG and "mail survey" (See Chapter 5). A best sub-set analysis was run using the MINITAB software program to assist in making the final choice of specific variables based on their statistical significance and theoretical correctness. Variables included in the SEG model are described in Table 6.10.

Variable	Variable Description
WTP	Willingness-to-pay for dam removal
AAWARE	Rating of post-survey awareness of dam removal issues
ACOMFORT	Rating of comfort in writing a dollar value in valuation task
AGE	Age bracket of respondent

Table 6.10: Variables used in experimental SEG model

AAWARE was included to account for post-survey ratings by the respondent on how well they felt they had identified the issues that matter the most to them when considering the issue of dam removal. In order to more specifically describe a respondent's comfort level in writing a dollar value to describe their preferences for dam removal, ACONFID was used in the model. The variable AGE was included to account for differences in age levels among respondents.

Results of the OLS regression on the experimental SEG data are included in Table 6.11. The adjusted R-squared for the model was 0.67 and all parameter estimates were significant at the 0.10 level or higher. All variables had the expected sign.

Willingness-to-pay is positively and significantly related to two post-survey responses; awareness levels of dam removal issues (AAWARE) and level of comfort writing a dollar value (ACOMFORT). The one demographic characteristic included in the model (AGE) is also positively and significantly related to WTP values.

Variable [a]	Coefficient	t-Value
CONSTANT	-462.23***	-4.28
AAWARE	70.37**	2.54
ACOMFORT	52.74*	1.99
AGE	92.87***	2.87
MWTP		$133.82
R-Squared		0.73
Adjusted R-Squared		0.67

[a] Sample size = 17
* Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Table 6.11: Linear regression results for experimental SEG

Two OLS regressions were run on the "mail survey" data. The first used the same variables included in the SEG regression just discussed, but not a single coefficient was significant at the 0.10 level. In an effort to find a model that more adequately fit the "mail survey" data set, a best sub-set analysis was performed using MINITAB. One model was found that included statistically significant variables, but there was no theoretical or rational explanation for including them in an explanatory model. Therefore even though every attempt was made to find a suitable regression equation, one could not

be found that met both the constraints of being theoretically relevant and statistically significant.

6.13 Comparison of SEG and "mail survey" results

The small sample size limits the comparative ability of the experiment, but that being acknowledged upfront, there are still several comparisons which can be made. The first involves the ability of participants to properly complete the open-ended WTP question. Not a single structured elicitation group participant failed to answer the question, nor were any of the values determined to be protest bids or outliers. "Mail survey" respondents, as described previously, appeared to have either greater difficulty with the valuation task or took it less seriously. This supports the belief that participating in a SEG not only allowed individuals to better understand their preferences for dam removal, but also made expressing those preferences in dollar terms less difficult.

Next, the statistically significant differences in pre- and post-survey means of questions relating to knowledge and awareness levels of SEG participants supports the notion that individuals are learning during the process and are also identifying the issues that are most important to them when making a decision about dam removal. This is consistent with expectations, and similar findings from the "mail survey" could not be substantiated. In fact, at least one "mail survey" respondent stated that "the information I read raised more questions than answers".

A third area of comparison is that of the econometric results. A simple OLS regression showed that the variation in three variables was able to account for almost 70% of the variation in WTP from the structured elicitation groups. Two of those

variables corresponded with how aware the participant was of what mattered most to him/her and comfort level with writing a dollar value to describe those preferences. The mail survey data was more difficult, and a reasonable econometric model could not be developed. Two speculative reasons as to why this may have occurred are (1) individuals took the exercise less seriously and answered questions without giving them much thought, or (2) the survey process was sufficiently complex and respondents found questions difficult to complete.

The latter speculation does not match the results of a survey question though that asked respondents to rate how difficult it was to complete the valuation task. "Mail survey" respondents rated their difficulty on average as 1.5 on a five-point Likert scale where 1 was the least difficult. In fact, the average rating of SEG participants was a slightly higher 2.1, though this does not necessarily suggest they had great difficulty with the tasks because the nature of the format involved a higher level of active participation. It might also suggest that SEG participants took the process more seriously. A final speculation is that besides such obvious format differences as the inclusion of a question/answer period and valuation tasks, the presence of an "expert" facilitator may have also encouraged SEG to view the process more as a learning experience. Conversely, "mail survey" respondents may have viewed the survey not as a learning process, but as a challenge or test of their knowledge.

If a replication of this experiment was to be performed, or a similar experiment was to be conducted in the future, there are several simple corrections that could improve the process. First, increase sample size. This would allow for a variety of improvements

including increased degrees of freedom, potential decreases in problems with multicollinearity, and greater explanatory power.

The second improvement relates to the previous suggestion in that a larger sample would also allow for increased diversification of participants. Even if sessions were run in a lab setting with students, it would be useful to include more students from disciplines other than AEDE and the School of Natural Resources. This would allow for a test of the methodology on participants who most likely would have little or no knowledge of such issues as non-market valuation or willingness-to-pay.

The inclusion of several more pre- and post-survey personal rating questions may also allow for increased comparison between and within-groups. Finally, randomization of the samples may be improved by not disclosing any information about either part of the session until individuals have been assigned to the specific location of either the "mail survey" or the elicitation group.

6.14 Future research involving SEG

The results and findings of this section put forward two specific directions that future research could follow. The first relates to the continued development of a new elicitation format, structured elicitation groups, by continuing to use it in context with dam removal scenarios. In order to test the hypothesis that preferences are indeed being constructed during the elicitation process two treatments could be conducted; a random mail survey (simulation) and a structured elicitation group with individually administered surveys. These treatments would each be conducted on three different dam removal scenarios; a simple small dam removal, a relatively complex small dam removal and a

complex small dam removal. All treatments would be conducted in a lab setting. Testing the SEG against a "mail survey" on three different dam removal scenarios of varying complexity would provide insight as to whether the constructive view of preferences exists for dam removal scenarios and if so, whether SEG captures this across the three scenarios.

It is also likely the use of SEG can be extended to capture values for a variety of non-market goods and services. While dam removal is certainly not the most complex environmental issue facing society it is also not the most simple. It is not a difficult, unfamiliar topic such as measuring the health affects of poor air quality, nor is it a common topic such as valuing a fishing license. In the spectrum of environmental goods, dam removal would likely fall somewhere in the middle. Assuming the results of SEG are successful with respect to dam removal, at a minimum, structured elicitation groups could be used for goods less complex or novel than dam removal.

CHAPTER 7

COST-BENEFIT ANALYSIS OF DAM REMOVAL

7.1 Introduction

Cost-benefit (C-B) analysis is a common economic tool used by decision-makers choosing between policy alternatives (Boardman et al., 1996), and in its most general sense is defined as a technique designed to determine the economic feasibility of a project or plan by quantifying its costs and benefits. This broad definition has resulted in the application of C-B analysis in a variety of fields, and in particular, environmental management. The protocol was first used by United States federal water agencies, including the U.S. Army Corps of Engineers (USACE) and quickly spread to other public goods such as wildlife, recreation, health, and air quality. The protocols of cost-benefit analysis are long established, reasonably precise and since the 1970s have been required as part of environmental regulations by the United States government.

Cost-benefit analysis should include all of the costs and benefits associated with each policy alternative. As mentioned previously though, there are many non-use goods for which obtaining dollar estimates can be extremely difficult (i.e. estimating the value of an endangered species) or are not even recognized as having value at the time the study is being conducted (Whitelaw and MacMullan, 2002). One of the first federal uses of C-B analysis by the USACE was to assess the costs and benefits of dam construction.

But it was only in the 1970s and 1980s, after the majority of dams had been built in the United States that C-B analysis began to focus on the importance of non-use values. Shifting social values has recently increased the attention given to the effects of dams on the environment (Heinz Center, 2002). In an era where many dams are becoming structurally obsolete and/or are no longer economically viable, it is imperative that any assessment of the costs and benefits of maintaining the structures include non-use values.

With respect to dam removal, cost-benefit analysis is important because it provides a structured process for identifying and measuring both the positive and negative effects of dam removal. It accounts for the impacts removal would have on various stakeholders in a way that allows comparisons to be made and tradeoffs to be assessed (Heinz Center, 2002). In spite of the difficulty and uncertainty associated with any cost-benefit analysis of dam removal, decision-makers and local citizens frequently rely on the results for insight into the potential consequences of removing a dam (Whitelaw and MacMullan, 2002).

7.2 Purpose [2]

One of the difficulties in tailoring existing cost-benefit analysis procedures to dam removal is determining a point of reference. Conventionally, a point of reference is defined as the no-action alternative against which all beneficial and/or adverse affects are measured (Heinz Center, 2002). In the case of dams though, not taking action may not be a viable alternative if the structural integrity of a dam is obsolete and/or compromised.

[2] It is important to note that this cost-benefit analysis is structured only to examine the costs and benefits of small dam removal and makes no assertions about removal of large dams. The term small dam and large dam are used generically in this study. There are five factors that generally determine the classification of a dam – height, width, acre-feet of impounded water, location in the country and size of the river.

Therefore, the definition of a "no-action" alternative for dam removal must include whatever actions are necessary to comply with regulations and meet safety standards. It is possible those actions may include such things as; repairs to the structure, spillway enhancements or dam maintenance. Were the dam to be removed, the elimination of these maintenance fees would fall on the benefit side of the analysis.

In the case of the Ballville Dam, the "no-action" alternative includes a number of repairs required to comply with Ohio Dam Safety regulations, the sum of which is in excess of $700,000. An assessment of the dam completed this spring by the ODNR Dam Safety Office (2004) showed that none of these repairs had been completed and that the condition of the dam has worsened since the last assessment, which suggests an even higher cost for the "no-action" alternative.

Another issue to consider is the valuation of both market and non-market goods that are economically relevant to the analysis. It is assumed that the goal of society is to maximize social welfare through maximizing the weighted sum of utilities across all individuals, and that utility is gained through consumption of both market and non-market goods. The environmental impacts of a project count as long as (1) they affect positively, or negatively, the utility of at least one individual, and/or (2) they change the level or quality of a commodity that has a positive value to society (Hanley and Spash, 1993). For the purpose of this study, benefits will be defined as increases in the quantity or quality of a good that generates a positive utility, or a reduction in the price at which it is supplied. Similarly, a decrease in the quality or quantity of the good, or an increase in its price, will be defined as a cost.

Goods such as services provided by the dam, or services provided to undertake the actual removal (i.e. labor, machines), are all market goods. For these goods, market transactions provide the data necessary to calculate estimated costs. As discussed previously though, there exist a number of goods for which markets do not exist; non-market goods, such as recreational opportunities and environmental changes. The preceding chapters have discussed several methods for obtaining benefit estimations for a given change in the quality (quantity) in non-market goods and services, and the results obtained in those estimations will now be used to perform a cost-benefit analysis for the removal of the Ballville Dam.

7.3 Structure of a cost-benefit analysis

The first objective of a cost-benefit analysis is to define the project and identify the project impacts. The project should be defined in terms of the proposed change (i.e. dam removal) and affected population (i.e. Sandusky County residents). In some cases the affected population is straightforward, but in the case of dam removal defining the population of individuals affected by the change is a bit more difficult. Are only individuals who live within sight of the dam counted, or is any individual on a state or national level who values river restoration or improving water quality included?

In the case of the Ballville dam, the size of the affected population was based on the ability of the researcher to access data, as well the specific characteristics of the dam. The size of the dam indicated that the impact of removal would be more local (as opposed to national), but the potential linkage of increased spawning habit to Lake Erie walleye populations suggests a larger population might be affected if a direct link

between the river and Lake Erie is confirmed. Based on that information, two affected populations were chosen; Sandusky County, and a 30-mile radius around the dam. For the purposes of this analysis, aggregation of costs and benefits will be done for both populations.

7.4 Estimating the cost of removing the Ballville Dam

Three major areas of cost have been identified with respect to dam removal. First, there are a number of costs that occur as a direct result of dam removal and relate to the actual removal of the physical structure; project design, monitoring, removal of the structure, management of stored sediment, stream channel reconstruction and stabilization and disposal of waste materials (Graber et al., 2001).

At the time of this study, no dam the size of the Ballville Dam has been removed in the State of Ohio, though it has been done elsewhere in the United States. A study by Finkbeiner et al. (1999) estimated the cost of removing the dam to be between $7 million and $10 million dollars, not including dredging and disposal of reservoir sediments. The cost estimate for removing the Ballville Dam structure is broken down into sub-categories in Table 7.1. Total construction cost estimates have been updated into 2004 dollars

PROBABLE COST OF BALLVILLE DAM REMOVAL [a]

ITEMS	AMOUNT
Cofferdams	$100,000.00
Dewatering	$156,000.00
Concrete Demolition (Dam and Seawall)	$6,468,345.00
Removal of Sluice Gates, Miscellaneous Pipe & Chlorination and Screen Building	$150,000.00
River Bank Grading	$20,370.35
River Bank Stabilization	$35,000.70
Hauling and Disposal (10-mile trip)	$732,945.00
Seeding and Site Restoration	$200,000.00
SUBTOTAL CONSTRUCTION COST	$7,862,661.05
CONTINGENCIES – 15%	$1,137,338.95
TOTAL CONSTRUCTION COST	$9,000,000.00 ($1999) $10,237,090.00 ($2004)

[a] All estimates were taken from Finkbeiner, Pettis & Strout (1999), Exhibit VI.

Table 7.1: Estimated cost of removing the physical structure

The second major cost is the loss of dam services. In cases where the dam and/or reservoir are still being used in an economic capacity such as power generation or as a water supply, this cost would be equal to the cost of providing an alternative source that provides at least the same level and quality of output. In the case of the Ballville Dam, the reservoir behind the dam is the sole source of water for the city of Fremont, Ohio, although it appears that this "loss" of water supply may not fall on the cost side of the analysis in this particular study. Recently the city of Fremont made the decision to go

forward with the building of an up-ground reservoir. The land has already been purchased and the estimated completion date is 2014. The up-ground reservoir must be built before the dam is likely to be removed, and for this reason, the cost of the up-ground reservoir will not be considered a "cost" of dam removal.

The final cost category includes any external costs of removal, or in other words, the effect dam removal may have on the surrounding environment. As previously discussed, this may include such effects as the temporary degradation of downstream habitat due to sediment flow and/or loss of aesthetics. If dam removal were to permanently change the landscape, it is possible that residents with properties bordering the river or dam reservoir may face decreased property values due the change in aesthetic view. According to the study by Finkbeiner et al. (1999) there are approximately 30 residences and 2 commercial establishments adjacent to the reservoir above the Ballville Dam. The largest projected impact on these residences would be the loss of a "lake type" atmosphere, but the study suggests that it may not be significant due to the limited use of the reservoir for recreational purposes.

Potential external costs that often involve a high degree of uncertainty include (1) whether sediment behind the dam is contaminated (2) how sediment moves after the dam has been breached, (3) whether the movement of the sediment has a positive or negative effect on downstream habitat and (4) estimating the length of time required for sediment stabilization and regeneration of riparian vegetation. Both sediment contamination and movement are topics that in a worst case scenario could be very costly, and in other cases may be a trivial issue. Very few studies have attempted to address this uncertainty and improve cost estimates.

The interdisciplinary nature of this particular study has allowed for interaction with a hydrologic engineer, geologist and aquatic biologist also doing research on the Ballville Dam. Working with these individuals has provided valuable information not only on the sediment and contamination issues discussed above, but also on the effects of dam removal on spawning habitats and aquatic species which will be discussed later.

In the case of the Ballville Dam contamination of sediments is a problem —there are DDT residues in the sediments from the 1940's and 1950's, and in 1988 there was an upstream toluene spill. In e-mail correspondences with geologist Dr. James Evans, he stated that "The overall quality of the sediments is probably good enough to allow a release if the dam were removed." Unfortunately, the criteria used in determining if sediment is contaminated often vary by agency, and at this point it is unclear how the sediment behind the Ballville Dam would be classified. The cost estimate to sample and test for contaminated materials in the sediment may be as high as $200,000 based on Ohio Environmental Protection Agency (OEPA) requirements (Finkbeiner et al., 1999).

Based on the available information at the time of this study, a worst case scenario would be to dispose of the dredged sediment in a landfill as a precautionary measure. A cost estimate for this scenario was done by Finkbeiner et al. (1999) and estimated at approximately $5-8 million, with one-third to one-half of that cost being landfill disposal. If the material were to be disposed of in some other fashion (e.g. another fill site, left in place) then the cost would decrease significantly. On the other hand, if it is found the sediments do contain hazardous materials that require special handling and disposal, the dredging costs would increase substantially.

On the other hand, if the sediments are not considered hazardous, Dr. Tim Granata, a hydrologic engineer, suggests two options for the sediments in the reservoir, both of which involve sediment movement downstream. First, the dam could be notched and drawn-down slowly during the dry season. Grasses and trees would then be planted on the banks of the former reservoir to stabilize the sediment and the creation of a series of steps would reduce the energy of the river and help maintain channel stability. Under this scenario, the only sediments moving downstream would be those in the deepest part of the river channel and they would cause only minimal disruption to downstream habitat.

The alternative is to not restore the channel and allow the sediments to freely travel downstream. The sediments will affect the downstream habitat and spawning grounds for an estimated 1-2 years before the entire load is washed downstream to Lake Erie. The disruption caused by this scenario, while greater than the previous, is not permanent and the scenario itself would be significantly less costly. With a restoration initiative and planting, it is estimated that the sediments will take less than two years to stabilize. Planting of vegetation on the riverbanks and a clear-cut river channel to transport sediments also will prevent the existence of mudflats.

7.5 Estimating the benefits of removing the Ballville Dam

The primary benefit of most dam removals is the restoration of environmental services. Dam removal allows the river or stream to flow freely again, and reconnects what was previously upstream and downstream sections of a river. In economic terms, the values of restored environmental functions associated with dam removal fall into two

main categories: use values and non-use values. Use values are defined as the economic measure of valuable environmental services that result from environmental functions (Heinz Center, 2002).

An example of a use value for removal of the Ballville Dam is the recovery and/or expansion of the fish spawning habitat leading to an increase in the harvestable fish population. This increase in population could be converted into increased recreational opportunities to sport fishermen. Other use values may include increased canoeing and kayaking opportunities, or the creation of a riverfront revitalization project. Use values can be obtained through a variety of methods including travel cost, hedonic pricing and contingent valuation.

Individuals may also derive utility from the removal of a dam even if they never visit the restored stream or river. These values are not directly related to the economic functions of the dam or waterway, and are known as non-use values. Often they are called intrinsic values as they are valued simply for their own existence, or the knowledge that the resource will be saved for future generations (Heinz Center, 2002). Included in the general definition of intrinsic values are, existence values and bequest values.

Existence value is frequently mentioned with respect to endangered resources, or when the proposed action may affect a resource in an irreversible way. Similarly, bequest value relates to the notion of preserving the good for use by future generations. The only way to obtain monetary values for intrinsic values is through the use of a stated preference method. Because contingent valuation, a stated preference method, is able to elicit both use and non-use values, it was chosen for this study.

As mentioned previously, the "no-action" alternative in the case of the Ballville Dam was approximately $700,000 worth of repairs. Were the dam to be removed, the elimination of these repair costs would also fall under social benefits. Finally, Table 7.2 summarizes the economically relevant costs and benefits as they associate with those affected by the proposed removal of the Ballville Dam.

AFFECTED INTEREST	COST	BENEFIT
DAM OWNER	• Cost of physical removal of the dam • Possible cost of sediment deposition	• No upkeep and maintenance fees • Eliminate dam safety concerns • Potential for additional commerce during spawning runs
SOCIETY:		• Scenic River restoration/preservation • Improve river aesthetics
RECREATION	• Loss of boating on the reservoir	• Gain access to longer river length • Increase opportunity for canoeing, kayaking • Increase fishing opportunities
ENVIRONMENT	• Short term impacts relative to existing sediment removal or natural transport downstream	• Restore river habitat • Restore river continuum • Improve water quality • Increase available fish spawning habitat
PROPERTY VALUES	• Loss of "lake" aesthetics for nearby property owners • Short term existence of mudflats	• Improve river aesthetics once mudflats disappear • Improve "view" without dam structure

Table 7.2: Costs and benefits of dam removal by affected interest (Ballville Dam)

7.6 Social benefits estimation results

The population over which the mean willingness-to-pay values are aggregated is the total number of identifiable households for each sample. The U.S. Census Bureau listed 23,717 households (2000) in Sandusky County. Estimating the total number of households within a 30-mile radius of the dam was slightly more difficult due to the partial inclusion of eight different counties in the sample. Based on the best estimates, the number of households within a 30-mile radius is 309,529.

Table 7.3 lists the economic value estimates of dam removal to both Sandusky County residents and to all residents living within a 30-mile radius of the dam. Value estimates are also broken down by elicitation format; dichotomous-choice (DC), and open-ended (OE).

	Observations	Mean WTP	Households	Estimated Total Value [a]
DC-Sandusky	134	$50.86	23,717	$1,206,246.62
DC-30 mile	175	$56.35	309,529	$17,442,522.65
OE-Sandusky	57	$48.42	23,717	$1,148,377.15

a. These estimates do not include non-response to the WTP question and are based solely on surveys where the WTP question was answered.

Table 7.3: Mean WTP and estimates of total social benefits

An important step in the estimation of total social benefits is the calculation of a lower-bound estimate. The results of the Turnbull Estimation (see Section 4.3) were used to calculate a lower-bound estimate of total benefits and are shown in Table 7.4.

	Observations	Turnbull Mean WTP	Households	Estimated Total Value [a]
DC-Sandusky	134	$36.38	23,717	$862,824.48
DC-30 mile	175	$38.95	309,529	$12,056,154.50

Table 7.4: Turnbull mean WTP and lower-bound estimates of total social benefits

The study found no significant difference in WTP values between only Sandusky County residents and Sandusky County residents plus those living within a 30-mile radius of the Ballville Dam. Even with this similarity, the aggregate benefits are significantly greater for the 30-mile radius due to the larger population of the region. The Turnbull low bound estimate of social benefits for the 30-mile radius is over $12 million, a value that exceeds the estimated cost of removing the dam (excluding sediment dredging and disposal and the cost of building a supplemental water supply). On the other hand, the low bound estimate of benefits to Sandusky County is approximately $860,000, which is much less than the estimated cost of removing the dam.

In the case of the Ballville Dam, it appears that a population much larger than the City of Fremont or even Sandusky County would benefit from the removal, but the question remains, who would actually pay the removal costs? The City of Fremont owns the dam, and most likely would be responsible for most, if not all, of the removal cost, though recent informal discussions with the ODNR suggest they may help pay some of the costs. This study has demonstrated that the net benefits of dam removal to a 30-mile radius which includes Sandusky County are $13-17 million using conservative estimates, but the estimates for Sandusky County alone are a much lower $0.8-1.2 million. These

distributional considerations are important not only for this particular scenario, but should be a factor in any decision-making process involving dam removal.

A potential extension of any cost-benefit is a benefit-transfer application, where the economic information derived from a specific study site (i.e. benefit-cost results) is adapted and used at another site (policy site) with sufficiently similar resources, conditions and demographics. Appendix A examines the benefit-transfer method and develops a number of protocols for assessing the applicability of benefit-transfer in the specific context of dam removal.

CHAPTER 8

SUMMARY AND CONCLUSIONS

8.1 Study rationale and objectives

More attention has been given recently to the effects of dams on the environment. This is due in part to changing social values, safety issues related with aging structures, and an increase in scientific information on the long terms effects of dams (Heinz Center, 2002), all of which have contributed to a growing national trend of dam removal. On the formal list of dams maintained by the United States Army Corps of Engineers (USACE), 30 percent are already over 50 years old, and by the year 2020, over 80 percent will have exceeded this typical dam life expectancy. Of the 76,000 dams officially accounted for in the United States, more than half will be up for license renewal in the next decade (Liggett, 2002), and for many of these, structural obsolescence will require that a decision be made to either remove or restore the dam.

At the present time though, there are a limited number of resources and guidelines available to assist individuals or groups looking to remove or restore a dam. Providing guidelines and resources that account for the variety of non-market goods often associated with dam removal will assist both dam owners and restoration advocates make decisions that not only improve the environment, but also do it in a way that maximizes the total benefits to society.

The specific focus of this study is to examine the costs and benefits of removing the Ballville Dam, and to gain an understanding of the variables that affect willingness-to-pay (WTP) for such a project. There were several motivating factors for considering removal of the dam. First, the Ohio Department of Natural Resources expressed its desire to have the dam removed in order to restore river quality and increase the amount of fish spawning habitat available to migrating Lake Erie walleye. The Sandusky River is one of three rivers used for walleye spawning, and the Ballville Dam is the first major barrier on the Sandusky River for these migrating fish. Removal of the dam would allow access to an estimated 33 kilometers (km) of spawning habitat upstream.

The second issue is dam safety. According to the ODNR Dam Safety Office, the dam does not currently meet maintenance regulations under the Ohio Dam Safety Laws due to inadequate spillway capacity and the need for seawall stabilization. Dam removal would eliminate both the safety concerns and the need for repairs. Finally, the reservoir behind the dam is the sole source of municipal water for the City of Fremont, Ohio. It has become a concern of the city that the reservoir behind the dam is shrinking due to sediment build-up, and in its current condition it will not be able to meet the expected water demands of the city by 2030.

The specific objectives of this study were to:

(1) Design and implement a contingent valuation survey that determines if individuals have a willingness-to-pay (WTP) for dam removal and river restoration. Using the survey results, estimate a total value/bid function with a set of explanatory variables.

(2) Design and implement a structured elicitation group (SEG) and compare the results to those obtained from the random mail surveys.

(3) Perform a cost-benefit analysis using the results obtained from both elicitation formats. Generalize the results of the cost-benefit analysis to define a list of policy requirements dam removal and explore the potential for benefit-transfer.

The main hypotheses of this study were:

(1) With respect to contingent valuation methodology, open-ended questions can be used to gain willingness-to-pay estimates that encourage respondents to answer truthfully, or in other words, are incentive compatible.

(2) As an alternative to the traditional philosophy of stated preferences, the philosophy of constructed preferences may more accurately describe the contingent valuation elicitation process in scenarios with complex and/or novel goods.

(3) The use of structured elicitation groups may provide an efficient alternative to randomly-selected mail surveys.

(4) Inclusion of non-market benefits and costs increases the probability of economic viability from a cost-benefit analysis perspective of dam removal.

8.2 Methodology

This study used contingent valuation (CV) methodology to estimate willingness-to-pay for dam removal in both real-world and hypothetical scenarios. The first part of the research developed and implemented a contingent valuation survey that focused on the possible removal of the Ballville Dam in Fremont, Ohio. The surveys used included

both open-ended (OE) and dichotomous-choice (DC) willingness to pay questions. The OE surveys were mailed to 275 Sandusky County residents, while the DC surveys were sent to 478 Sandusky County residents and 221 individuals that lived within a 30-mile radius of the dam but did not live in Sandusky County. All individuals receiving the survey were randomly selected. Each survey contained questions on personal knowledge, self-reported behavior, preferences and demographics, which were included in order to better explain how WTP is correlated with individual characteristics

Survey responses were first coded into a Microsoft Excel spreadsheet and then probit regressions were run using the statistical software program LIMDEP. The parameter estimates from the regression were then used to estimate mean WTP. A sensitivity analysis was run on both models and correlation matrices were examined in an effort to avoid problems such as multicollinearity. Aggregate estimates for Sandusky County and for the 30-mile radius were obtained by multiplying mean WTP by the number of households listed by the U.S.Census within those areas.

The second part of this research focused on the development and implementation of a new elicitation format, structured elicitation groups (SEG). The first SEG used a survey handout relating to the Ballville Dam and was administered in Fremont, Ohio. While this session proved to be a learning experience, it did not provide sufficient results for comparison with those from the mail survey. Originally the SEG results were to be compared to those of the mail survey, and in order to make this comparison a hypothetical scenario based largely on the actual facts relating to the Ballville Dam was created and incorporated into a lab experiment. Two "mail survey" sessions and two

SEG sessions were run using students enrolled in two AEDE courses at the Ohio State University.

Both the "mail surveys" and SEG handouts contained a series of demographic and preferences questions intended to help form a set of explanatory variables to explain variation in WTP values. The surveys and handouts also included pre- and post- survey questions in which the respondent was asked to rate such things as his/her knowledge and comfort levels before and after completing the questionnaire.

Results from both the handouts and the "mail surveys" were coded into a spreadsheet and OLS regressions were run on both data sets using LIMDEP. The parameter estimates were again used to estimate mean WTP. An analysis was also run on the pre- and post-survey data to examine assignment to either the "mail survey" or SEG session influence on how individuals rated themselves.

8.3 Conclusions and implications

The mean WTP for Sandusky County was $50.86 based on the returned DC mail surveys, and $48.42 for the OE mail surveys. The 30-mile radius mean WTP was $50.91. Aggregating these values across the respective populations resulted in estimated total social benefits of $1.2 million (DC) and $1.1 million (OE) for Sandusky County and $17.4 million (DC) for the total population living within a 30-mile radius of the dam. Lower bound estimates were also calculated using a Turnbull Estimation and the low-bound mean WTP was $36.38 for Sandusky County, and $38.95 for the 30-mile radius. The aggregated estimates of total social benefits based on these values were $863,000 and $12 million respectively.

In order to account for the possibility of negative WTP, respondents were asked whether or not they would be in favor of removing the dam if the cost of the project to them was zero. Only 70% of Sandusky DC respondents were in favor of this option, while 88% of individuals within a 30-mile radius preferred to see the dam removed under these circumstances. This result was consistent with expectations that individuals living closer to the dam would be more likely to see the dam as having positive assets (i.e. water supply, recreation in the reservoir) and would have to weigh the loss of these benefits against the perceived benefits of dam removal when choosing their WTP level. On the other hand, individuals living outside the county but within a 30-mile radius were less likely to currently receive any positive benefits from the dam, and therefore would not have to assess trade-offs between known benefits with the dam in place and expected benefits of removing the dam. Instead, they only had to decide what their WTP was for those expected benefits.

In cases such as this, a decision must be made as to who should pay for the removal. It appears that at least within a 30-mile radius, and perhaps even further, there is a population of individuals who would derive benefits from the dam being removed. On the other hand, the individuals most likely to bear the cost (Fremont) are also those individuals most likely to derive positive values from the existence of the dam. These findings suggest that there may be inequality in the distribution of the likely costs and benefits of dam removal, and this is a issue that should be examined when making any dam removal decision.

Implications can also be found based on the significant variables found in the regression analysis. In both the Sandusky and 30-mile regressions the variable BID was

significant and negative. This suggests to dam removal policymakers that the higher the cost of removal, the less likely individuals paying the cost will be in favor of the decision. Another variable (CONCREC) showed that the greater an individual's concern for improving recreation on the Sandusky River, the more likely they were to vote "yes" for the offered bid value. Membership in an environmental organization was also positively related to WTP. Several variables that typically are significant in a WTP analysis, such as age, education and/or income were not found to be significant. In fact, no key demographic variable, other than EORG, was found to be significant in either analysis.

The other focus of this study was the development of an elicitation format based more on the philosophy of constructive preferences. Results of the lab experiment showed that the knowledge and awareness levels of individuals participating in the SEG were significantly different pre- and post-survey. This same conclusion could not be made using the "mail survey" data. This suggests that individuals in the SEG are using the survey handout and question/answer session as learning tools to gain information not only on dam removal, but also about what issues matter most to them when making a decision about removing a dam.

Implications can also be made from the results of the WTP question. First, the ability of SEG participants to complete the question without apparent difficulty suggests that the process, and perhaps the valuation task included in the handout, facilitated the transition of preferences to dollar values. On the other hand, "mail survey" respondents, who like the SEG participants were all enrolled in an AEDE class, were not able to complete the valuation question with the same ease. Even with a limited sample size,

three distinct problems occurred; (1) leaving the WTP question blank, (2) not taking the WTP question seriously, and (3) using extreme values to complete the question. This suggests that the OE WTP question may be better handled by individuals participating in a SEG than by "mail survey" respondents.

Finally, the results of the econometric analysis showed that two highly significant variables in determining WTP by SEG participants were knowledge level after completing the handout (AAWARE) and level of comfort with writing a dollar value to describe personal preferences for dam removal (ACOMFORT). Both variables were both positively related to WTP, which supports the hypothesis that increasing a respondent's knowledge and comfort levels translates into their WTP values.

8.4 Limitations of the study

While the study provided results supportive of most of the hypotheses, there are several limitations that should be mentioned. First, the size of the research budget limited the sample size for both the mail surveys and the elicitation groups. A larger sample size in both cases would have allowed for increased degrees of freedom in the econometric models and greater explanatory power. In the case of the structured elicitation groups, increased sample size would have also allowed for the testing of the method on a more diverse group of participants. Even if another series of lab experiments had been used, as opposed to real world testing, it would have been useful to include students or individuals from disciplines or backgrounds other than AEDE. The inclusion of such individuals would allow for a test of the format on respondents who

most likely would have little or no knowledge of such issues as non-market valuation or willingness-to-pay.

Another limitation was inability of the survey to completely capture negative willingness-to-pay for dam removal. A question was included in the survey that asked respondents whether they would be in favor of or against the project if the cost to them was zero, with the assumption that respondents with a negative willingness-to-pay would be against the dam removal even at no cost to them. One-third of Sandusky County residents checked that even with zero cost they were still against removal of the dam which suggests that in the case of the Ballville Dam a good portion of the population felt they would be negatively affected by the project..

While this question provided insight into what proportion of the population had a negative willingness-to-pay, there was no way to determine either an individual or aggregate estimate. The option of asking individuals how much they were willing-to-pay to restore/repair the dam was considered, but the inclusion of WTP questions for two separate projects in one survey could lead to confusion and/or unnecessary tradeoffs on the part of the respondent. Splitting the sample and sending half the population a survey on dam removal and the other half a survey on dam repair/restoration was also considered but budget constraints prevented the use of this option.

Finally, the rewording and addition/deletion of several survey and handout questions may have led to a better understanding the variation of WTP among respondents. In particular, a question in the SEG handout asking respondents if they feel they are still missing any information they feel could better help inform their choice, and

if so, what. This question would be asked, individuals could be given a minute or two to reflect on what they learned, and they ask questions of the facilitator if necessary.

Several questions related to the quality and structure of the survey were found to be almost useless and highly correlated with the preferences of the individual. In particular, individuals who did not want to see the dam removed tended to rank the survey as "low quality" and "not useful at all". Eliminating these questions and adding more specific ones such as "what was missing" or "what other information did you need" might be more appropriate.

8.5 Future research

The results and findings of this study put forward at least two specific directions that future research could follow. The expected benefits of future study are two-fold. The first series of benefits relates to the development of a new elicitation format, structured elicitation groups, which was discussed previously in Section 6.14.

The second expected result is a set of standardized guidelines for dam removal studies and a classification scheme that serves both as a learning tool and a database for potential benefit transfer. This would not only allow for comparison between completed studies, but also allow for an assessment of the applicability of studies for benefit transfer.

Based largely on the contingent valuation protocols developed by the National Oceanic and Atmospheric Administration (NOAA) Blue Ribbon Panel (1993), the guidelines could include basic methods for completing a contingent valuation study on dam removal (e.g. sample frame, area to sample), examples of surveys and cover letters

that relate specifically to dam removal, and a sample format of how to correctly report data. Providing a detailed summary of a CV survey is important for two reasons; (1) it allows the research to be critiqued by others and (2) it provides an open example from which other researchers can learn. Every CV study should clearly report such items as the sample population, the sampling frame, the sample size, non-response rate and components, and item non-response for important questions. The actual survey handouts, as well as the results, would be made accessible to dam owners as well as restoration advocates and policy-makers. They would serve not only as reference material, but would also provide key indicator variables that affect WTP for dam removal in different scenarios, which are discussed in greater detail below as they relate to benefit transfer.

The comparison of dams in Appendix A provides convincing evidence that dam removal not only involves a large number of key variables, but also that these variables are likely to differ significantly between dams. One question still unanswered is whether this variation significantly affects WTP for dam removal, and if so, which attributes or indicators are most likely to cause the variation. Determining which variables are important will facilitate the assessment of applicability of benefit transfers under different dam removal scenarios, and will provide more insight as to where benefit transfer is most feasible.

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APPENDIX A

BENEFIT-TRANSFER METHOD

BENEFIT-TRANSFER METHOD

Introduction

It is generally agreed that primary research, or data collection, is a "first-best" strategy when performing a cost-benefit analysis because it facilitates the gathering of statistical information that is relevant and specific to the action or resource being evaluated. There are occasions though where primary research may not be a viable option either because of (1) budget constraints, (2) time limitations, or (3) because the resource impacts are expected to be low or insignificant. In all three cases, not accounting for the economic value of the resource at all, but giving it a zero value in the analysis, would be a "worst-best" scenario. When primary research is not an option, but an evaluation of the proposed change is necessary, then benefit transfer is a commonly proposed "second-best" strategy.

Benefit transfer is defined as the adaptation and use of economic information derived from a specific site(s) under certain resource and policy conditions to a site with similar resources and conditions (Rosenberger and Loomis, 2001). Typically, the site with the original data is called the "study" site, while the site to which the data is transferred is called the "policy" site. While this methodology tends to be less costly than primary research in terms of both money and time, it still may be valid and reliable

only under certain conditions, and even when these conditions are satisfied there may be several limitations associated with the application of benefit transfer.

The Great Lakes Protection Fund is interested in exploring the relevance of benefit-transfer for dam removal policy for a variety of reasons, including the growing national trend of dam removal and the high costs of primary data collection.

Conditions for performing benefit transfer

In order to perform an effective and efficient benefit transfer, there exist several necessary conditions that must be satisfied (Rosenberger and Loomis, 2001). First, the context of the policy site should be thoroughly defined. It is important to identify both the extent and magnitude of the expected resource change, as well as the extent and magnitude of the population that will be affected by the impacts. It is also necessary to identify the type of measurement to be used, the kinds of values to be measured as well as the degree of certainty the researcher has in the data to be transferred.

Secondly, the study site must meet certain conditions critical for benefit transfer. Without quality study site data, there is little or no chance for a successful benefit transfer. It is important that the original study, or studies, use sound economic methods and the correct empirical techniques. The study must also contain statistical information on the relationship between the benefits and the demographic and physical characteristics of the site.

Finally, correspondence between study and policy sites should exhibit a sufficient level of similarity in terms of the nature of the environmental change, the market for the environmental commodity and the demographic characteristics of the affected

population. It is also important that the quality and types of recreational activities between the two sites do not vary greatly in terms of such things as intensity, duration and skill requirements.

It is the case that most primary research was not done with the idea of future benefit transfer applications in mind. Because of that, the above conditions are not always met in the data obtained from primary research and it is important that the cost of performing benefit transfers with incomplete information should be accounted for by the researcher.

Potential limitations of benefit transfer

The first group of factors that potentially limits the reliability and validity of benefit transfers relates to the general quality of the original study. A key assumption in benefit transfer is that the data from the study site correctly estimate the true values for the environmental good in question. The benefit transfer estimates can be no more reliable than the study site estimates on which they were based. The quality of the benefit transfer process is directly related to the quality of the original study. As Rosenberger and Loomis (2001) note, this is the "garbage-in, garbage-out" factor.

A second limitation is the availability of original valuation studies. The availability of original studies that match the context of a specific policy site may be limited because of variation in site characteristics or available substitutes, and as noted previously, even if a sufficiently similar study site was found, most primary research was not designed for benefit transfer purposes.

A third group of potentially limiting factors is related to methodological issues. Differences across study sites in research methods and statistical analysis can affect the estimated values and lead to large differences in the values estimated. Related to research methods are things such as what questions were asked, how the questions were asked, and how environmental impacts were measured. On the other hand, model misspecification or the choice of functional form can affect the statistical analysis.

The availability of substitute goods is important when estimating the value of a proposed resource change. Failure to collect study site data on the availability of substitutes, and the prices of substitutes can limit the completeness of the original data. It is important for the researcher to also be aware of the types of values measured in the original study – use versus non-use, and apply the values appropriately in the benefit transfer application.

Fourth, the level of similarity between the study site and the policy site is an important factor when determining the efficiency and effectiveness of benefit transfer. Variation in the characteristics of the two sites, such as site location, site quality or difference in quality changes, can all affect the estimated values. It may also be the case that either the study site or policy site has a unique characteristic(s) not found in the other site.

Finally, there is the issue of data stability over time. Original studies were done at various points in time, and if relevant differences exist between then and now they may not measurable or identifiable. All of the factors listed above have the potential to lead to error or bias in the benefit transfer method. One of the main objectives of a benefit transfer is to minimize the mean square error between the "true" value and the

transferred value of impacts at the policy site. A potential problem is that the "true" values are only approximations derived from data at the study site, and are therefore subject to error themselves. A number of recent studies have tested the convergent validity and reliability of various benefit transfer methods [e.g. Loomis et al., 1995; Rosenberger and Loomis 2001]. The general indication of these studies has been that benefit transfer cannot replace original research, especially when the costs of being wrong are high, such as in court case evidence [Rosenberger and Loomis, 2001].

Types of benefit transfer methods

When conducting benefit transfer, there are three broadly defined approaches: (1) value transfer and (2) expert judgment and (3) function transfer (Bergstrom and De Civita, 1999). Value transfers involve the transfer of a single (point) estimate from the study site, or a measure of central tendency of the estimates from several study sites, such as mean or median value. An example of a value transfer would be estimating the total benefits of fishing at the policy site to be the product of the estimated value per fishing day at the study site and the total number of fishing days at the policy site (Vincent et al, 1986)

With expert judgment methods, total benefits at the policy site are estimated using an expert opinion or judgment process. For example, the policy site benefits would be estimated as the product of an expert judgment value of fishing value per day at the study site and the number of fishing days at the policy site. Finally, function transfers involve either the transfer of a benefit or demand function from the study site, or a meta-regression analysis which involves several study sites. The functions are then fitted to

the characteristics of the specific policy site and the adopted function is used to predict a benefit estimate for the policy site. Again using fishing as an example, the total benefits at the policy site might be estimated using a demand function derived from study site recreational data.

Procedure

The first step of the benefit transfer procedure is to identify the policy site context, or in the other words, define and quantify the resource(s) that will be affected by the proposed policy. This includes not only defining the various economic benefits associated with the change, but also the provisions and quality levels of those benefits (Fischhoff and Furby, 1988). Some examples include assessing the extent of the expected impacts on site or resource attributes, such as water quality, aquatic habitat, and fish spawning levels. Socio-economic characteristics of the affected population such as age, income and recreation participation levels also need to be determined. The last part of the initial analysis is to identify the resource commodity, the market for the resource, and the nature of the change. These characteristics must exhibit sufficient similarity between the study and policy site in order to perform an efficient benefit transfer (Rosenberger and Loomis, 2001).

The second step involves a thorough search of the literature for relevant study sites. This can be done using traditional search procedures such as reviewing journal articles, citations, books and government reports, or by using electronic research databases such as the Environmental Valuation Reference Inventory (EVRI) or the Social Science Citation Index. While the number and variety of valuation studies continues to

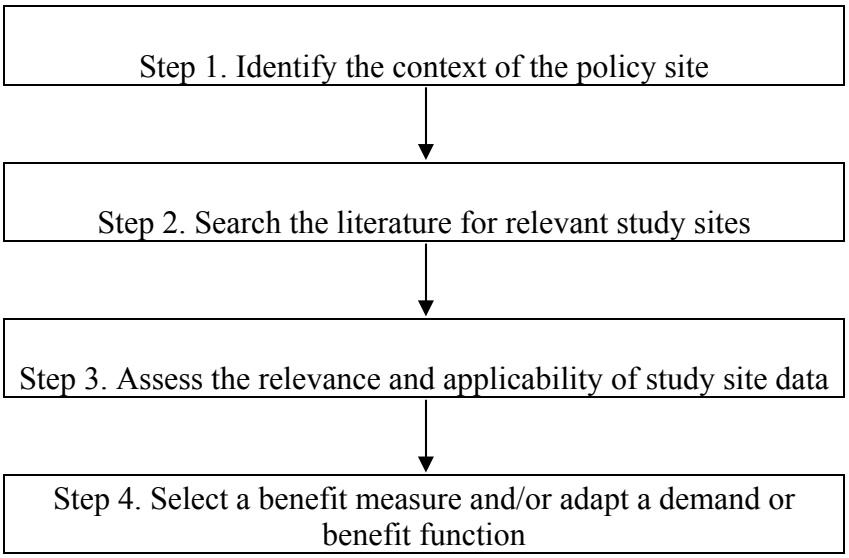
increase, it does not necessarily mean that finding a quality study site is easy. Boyle and Bergstrom (1992) note that "while a large number of valuation studies have been conducted, the number of study sites actually relevant to a particular issue may be limited." This may be due to a variety of reasons, such as the uniqueness of the site-specific characteristics of either the study site or policy site, or to differences in the methodology used for each study.

The third step is to assess the relevance and applicability of study site data selected for the benefit transfer. Values from potential study sites need to be examined to determine whether or not they are suitable for transfer. In order to objectively evaluate potential study site values, Boyle and Bergstrom (1992) suggest the following idealized technical criteria: (1) the non-market commodity valued at the study site must be identical to the non-market commodity to be valued at the policy site; (2) the populations affected by the non-market commodity at both sites have identical characteristics; and (3) the assignment of property rights at both sites must lead to the same theoretical appropriate welfare measure.

Independent of equivalence between study site and policy site characteristics, the quality of the original study must also be evaluated in terms of its theoretical construction, data collection procedures, statistical application and application of non-market values. In cases where site characteristics, socio-demographic characteristics and/or the nature of the proposed policy are not identical between study site and policy site it may be necessary to systematically adjust study site values and/or use supplemental data. Benefit transfer values may also be improved through the collection of primary data on the key site and socio-demographic characteristics at the policy site.

Such information may assist in determining the feasibility of a benefit transfer and improve and necessary adjustments of policy site values.

The final step in the process involves the selection of a benefit measure and/or demand or benefit function. As discussed previously, this could be a value transfer, such as a point estimate or average value, or a function transfer, such as a demand/benefit function or meta-analysis benefit function.



a. Taken from Rosenberger and Loomis ((2001)

Figure A.1: Procedure for performing a benefit transfer

Benefit transfer and dam removal

For several reasons the issue of dam removal is one that appears ideal for benefit transfer application. First, a growing number of dams are being considered for removal. There are now over 76,000 dams listed on the National Registry, and an estimated two million dams of smaller size. Over 50% of the dams officially accounted for in the

United States will be up for license renewal in the next decade (Liggett, 2002) and 80% will have exceeded their typical life expectancy by the year 2020. A shift in changing social values has also prompted owners of small dams and/or dams no longer used for economic purposes to reconsider the maintenance/removal issue.

In many cases, the issue of dam removal involves assessing the impacts dam removal would have on a variety of non-market goods and services (i.e. ecology of the watershed, local riparian species, public recreation). Collecting primary data for each specific dam would be expensive and time intensive, and budget and/or time constraints may mean that primary research is not always a viable option. Even with sufficient finances, primary data collection may not be justified because the expected resource impacts of removing the dam are low or insignificant, especially in the case of low-head dams or dams that have already been breached. All of these reasons suggest that the use of a method other than traditional primary data collection, such as benefit transfer, would be advantageous.

As discussed in the section on benefit transfer procedures, there are a number of key characteristics that need to be identified at both the study site and policy site. In order for the benefit transfer to be efficient there needs to be sufficient similarity between study site and policy site for each of these characteristics (See Table A.1).

Key Characteristics to Identify
(1) The resource affected by the proposed policy
(2) The extent of the expected site or resource impacts
(3) The population affected (extent and magnitude)
(4) Socio-demographic characteristics of the affected population
(5) Site characteristics
(6) The commodity, market, and nature of the change

Table A.1: Characteristics that require identification at both study and policy sites

In order to examine the level of similarity among proposed dam removal sites, key characteristics (as suggested above) for three different sites were identified and put into a matrix (See Table A.2). The three dams included in the matrix are all part of a study being done at the Ohio State University and funded by the Great Lakes Protection Fund and are all located in the Great Lakes Watershed. Each dam was initially chosen for the study (1) because it was being considered for removal, and (2) because an initial assessment of all three dams suggested that they were sufficiently similar for comparison. In other words, these dams were chosen with the expectation that they would be compared and used in a benefit transfer application.

All three dams were built in the early 1900s to be used as a source of hydropower and are of relatively similar dimensions (height and length). But the similarity stops there. Only one of the dams is still used to produce hydroelectricity while of the other two, the reservoir behind one serves as a city's water supply and the other is not being used at all. One dam is listed on the National Register of Historic Places, while another dam is located on a designated Scenic River, which would inevitably be improved by its removal. Recreation on all three rivers consists of mainly of boating, fishing and

swimming, but the levels of all three types of recreation vary greatly, as does the variety of fish available for sport fishing.

The demographics of communities near the dams are also something that needs to be considered. Education level, race and age distribution are all similar between the three communities located closest to the dams. Population density and per capita income vary significantly though, and the community with the lowest per capita income faces losing $220,000 annually in tax revenue from Consumer's Energy (owner of the dam) if the dam is removed.

Finally, a comparison of the advantages and disadvantages of removing each dam demonstrates the effects removal would have on the river, the environment, and the local community. Removing all three dams would improve natural fish movements by increasing the length of free-flowing river and improving water quality. However, the removal of the Croton Dam would mean the loss of a National Historic Place, the loss of hydropower, the loss of a reservoir for recreation and the loss of almost a quarter million dollars in tax revenue annually. On the other hand, the removal of the Sturgeon Dam led to economic savings for Wisconsin Electric, created a relatively rare seasonally flooded wetlands and deciduous floodplain forest, and gave public access to a previously submerged steep-walled rock canyon with waterfalls and rapids.

Assessing the quality and applicability of original dam removal studies

There are several ways to assess the quality of an original study. First, the internal validity of the study can be examined. In other words, the study should include sufficient information to assess both validity and reliability of the results. This refers to

such things as reporting the estimated WTP function, the statistical techniques used, the definition of variables included in the model, and any data manipulation (Brouwer, 2000).

Another way to assess the quality of an original study is by looking at the external validity of the study. According to Brouwer (2000), unlike the travel cost or hedonic pricing methods, contingent valuation allows for such an assessment through the survey format itself, i.e. via response rates, protest bids, and stated reasons for WTP by respondents. Reporting of these results is not always standard practice, but perhaps should be as they may be important in determining whether or not a particular study is suitable for benefit transfer.

The issues of availability of quality original studies, and the applicability of these studies to the policy site are closely related to the idea of site similarity. While the number of dams, especially low-head dams, being removed is increasing, there are still only a limited number of valuation studies that deal with willingness-to-pay for dam removal. Using four completed studies on dam removal, Table A.3 illustrates the differences not only in basic dam/site characteristics, but also in survey design, implementation and analysis.

In almost every category listed for comparison, dissimilarities were found. Basic geography and dam location varied as studies were conducted in the Pacific Northwest, and the Northeast. The heights of the dams being considered for removal ranged from 64 m to a mere 5.2 m. In most cases the major concern was assessing WTP to improve fish populations and spawning habitat, though some studies also looked at recreational

opportunities, improved water quality and river restoration. In each study though, the major species of fish affected was different.

Another major area of difference was the extent of impact dam removal would have. The Elwha and Glines Canyon Dams removal was expected to have a national impact due to the expected ecological improvements, the four species of fish involved (salmon and steelhead) and the proximity of the dams to Olympic National Park. On the other hand, the removal of the Edwards Dam is expected to only have a local and perhaps regional impact based on the size of the dam, the significance of the river, and the expected ecological improvements of dam removal.

Three of the four studies used CV methodology, but only two of the four chose to measure both use and non-use values. Of the two that chose to measure only use values, one measured all recreational values while the other only estimated the value of dam removal to recreational anglers. Survey samples varied from licensed anglers and boat ramp visitors, to a random stratified sample consisting of county, state and national strata.

Benefits were aggregated across different populations in each study as well. Two of the studies estimated the benefits of dam removal to recreational users and anglers, while the other two aggregated both use and non-use values across local and/or national populations. The stream of benefits for one study was estimated for a 100 year time frame, while another used a 10 year time frame.

Conclusion

Standardizing the methodology used in dam removal studies would not only allow for comparison between completed studies, but also allow for an assessment of the applicability of studies for benefit transfer. Guidelines should include such things as basic methods for completing a contingent valuation study on dam removal (e.g. sample frame, area to sample), examples of surveys and cover letters that relate specifically to dam removal, and a sample format of how to correctly report data. Providing a detailed summary of a CV survey is important for two reasons; (1) it allows the research to be critiqued by others and (2) it provides an open example from which other researchers can learn. Every CV study should clearly report such items as the sample population, the sampling frame, the sample size, non-response rate and components, and item non-response for important questions.

The comparison of the dams in the previous section provides convincing evidence that dam removal not only involves a large number of key variables, but also that these variables are likely to differ significantly between dams. One question still unanswered is whether this variation significantly affects WTP for dam removal, and if so, which attributes or indicators are most influential.

BT Conditions	Study Site	Policy Site 1	Policy Site 2
Resource	Ballville Dam	Sturgeon Dam	Croton Dam
Proposed Change	Dam removal	Dam removal	Dam removal
Advantages	1. Improve fish spawning habitat through increasing length of free-flowing river and improving water quality 2. Provide additional recreational land and recreational opportunities 3. Scenic river restoration/preservation 4. Increase potential for commerce during fish spawning runs	1. Improve natural fish movements through increasing length of free-flowing river and improved water quality 2. Renew habitat for smallmouth bass, cool-water forage fish and aquatic plant and insect communities 3. Creation of relatively rare seasonally flooded wetlands and deciduous floodplain forest 4. Public access to previously submerged steep-walled rock canyon with waterfalls and rapids 5. Increase recreational opportunities 6. Economic savings for Wis. Electric	1. Improve natural fish movements through increasing length of free-flowing river and improved water quality
Disadvantages	1. Loss of Fremont water supply 2.Lost "lake" atmosphere for property owners 3. Lost "lake" atmosphere for recreation 4. Increased soil erosion potential along river 5. Short term impacts relative to existing sediment removal and transport	1. 248 acres of lake habitat lost 2. Loss of portage and boat launches as well as lake based recreation 3. Loss of $25,000 in tax revenue annually 4. Short term impacts relative to existing sediment stabilization and transport downstream	1. Loss of hydropower 2. Loss of National Historic Place 3. Loss of lake area for recreation 4. Loss of $220,00 in tax revenue annually
Bearer of Cost	Unknown (public)	Wisconsin Electric (private)	Unknown (Consumer's Energy?)
Project Status	No decision to remove has been made.	First stage of removal is completed	No decision to remove has been made
Timeline	Cannot remove before 2014	In the process of being removed	Cannot remove before 2034

Table continued on the next page

Table A.2: Comparison of key characteristics for three dams

Table A.2 Continued

Cultural Norms	Mid-western United States	Mid-western United States	Mid-western United States
Site Characteristics	Built in 1911	Built in 1924	Built in 1907
Length	121.9m	66.1m	233m
Maximum height	10.5m	16.2m	12.2m
Classification	High hazard	High hazard	High hazard
Uses	City water supply	Hydroelectric power (no longer used)	Industry, processing, extraction and hydroelectric energy
Proximity to major population	2.4 km from Fremont, OH (pop.: 17,648)	2.8 km from Loretto, MI	14.48 km from Newaygo, MI (pop.: 1,670)
Sediment behind the dam	At least partially contaminated	Not contaminated	Not contaminated
River name	Sandusky River	Sturgeon River	Muskegon River
River/Dam Classification	Scenic river since 1970	-	National Register of Historic Places
Water quality	Poor in the spring	Meets MDEQ standards	Meets MDEQ standards
Endangered species	Bald Eagles	Bald eagles, Osprey	Karner blue butterfly
Current recreational uses	Fishing, Canoeing	Boating, canoeing	Fishing, boating, picnicking, swimming
After removal recreational uses	Fishing, Canoeing	Kayaking, canoeing, fishing, hiking	Unknown
Potential for soil erosion	None	None	Unknown
Demographics	Sandusky County, Ohio	Dickinson County, Michigan	Newaygo County, Michigan
Land Area	409 sq. miles	766 sq. miles	842 sq. miles
Population per square mile	151.0	35.8	56.8
Population	61,673 (2001)	27,291 (2001)	49,013 (2002)
Per capita income	$23,315 (1999)	$23,402 (1999)	$16,976 (1999)
Education	82.1% high school graduates, 11.9% with bachelor's degree or higher	88.8% high school graduates, 16.7% with bachelor's degree or higher	78.7% high school graduates, 11.4% with bachelor's degree or higher
Age distribution	26.2% are persons under 18, 14.5% are persons over 65 (2000)	25.1% are persons under 18, 18.1% are persons over 65 (2000)	29.1% are persons under 18, 12.8% are persons over 65 (2000)
Primary employment	Manufacturing, trade, services and government	Government, manufacturing, construction and retail	Manufacturing, retail trade, education, health, social services

	Edwards Dam (Boyle et al., 1991)	Newport No. 11 Dam (Gilbert et al., 1996)	Elwha and Glines Canyon Dams (Loomis, 1996)
Proposed Change	Dam Removal	Dam Removal	Dam Removal
Location	Maine	Vermont	Washington
Dam Height	7.3m	5.2m	33m and 64m
Species Affected	9 species of migratory fish	Salmon	Salmon/Steelhead
Extent of Impact	Local/Regional	Regional	National
Method	Contingent Valuation	Contingent Valuation	Contingent Valuation
Sample	Maine residents and non-residents with fishing licenses	County, and State	County, State and National
Sample size	n/a	n/a	600, 900, 1000
Response rate	n/a	n/a	77%, 68%, 55%
Survey Type	n/a	Telephone	Mail
Values Measured	Use (anglers only)	Use and non-use	Use and non-use
WTP Question	n/a	OE	DC
WTP Estimate	n/a	Mean: $67, $52	Mean: $59, $73, $68
Benefits Estimate	$36-48 million (recreational anglers only)	$390,000 (county residents only)	$94-138 million annual (local) $3.5-6.3 billion annual (Nat'l)
Time Frame	n/a	n/a	10 years

Table continued on the next page

Table A.3: Comparison of key elements in past dam removal studies

Table A.3 continued

	4 Snake River Dams (Loomis, 2002)	Ballville Dam (Kruse, 2004)	Fort Covington Dam (Warren, 2004)
Proposed Change	Dam Removal	Dam Removal	Dam Removal
Location	Washington	Ohio	New York
Dam Height	30m for all	10.5m	3m
Species Affected	Chinook Salmon	Walleye	Walleye and Eastern sand darter
Extent of Impact	Regional	Local/Regional	Local
Method	Travel Cost Method	Contingent Valuation	Contingent Valuation
Sample	Boat ramp visitors and Pacific NW/ California households	County and 30-mile radius	City and County
Sample size	10,000	724, 250	300, 300
Response rate	43.5%	35%, 21%	43%, 23.5%
Survey Type	Mail	Mail and SEG	Mail
Values Measured	Use (recreational)	Use and non-use	Use and non-use
WTP Question	-	DC and OE	DC
WTP Estimate	-	Mean: $43, $44	Mean: $30, $71
Benefits Estimate	$193-311 million annual (recreational values only)	$1,206,246 (county) $17,442,523 (30-mile)	$167,876 (city) $722,628 (county)
Time Frame	100 years	NPV	NPV

APPENDIX B

MAIL SURVEY

(The survey has been reformatted to fit the requirements of the dissertation)

December 20, 2004

Dear Sir or Madam:

As part of several ongoing river research projects at the Ohio State University, I am asking for your assistance in completing an important environmental impact survey. I need your opinions to complete a study of the Ballville Dam on the Sandusky River. This will also benefit you, because over the next few years, both individual citizens and elected and appointed officials will have to make informed decisions about the dam. It is possible that your responses may influence government decisions on dam removal, so please answer each question thoughtfully and with care. This study examines both the costs and benefits of dam removal and how removing a dam affects the local community, the environment, etc.

Your household is one of a small number of randomly selected households which are being asked to give their opinion on these matters. The following survey is easy to complete and should only take 15-20 minutes of your time. In order for the results to be representative, it is important that each questionnaire be completed and returned.

You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that I may check your name off of the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

The results of this research will be made available to the Ohio State University, state and local government officials, and all interested citizens. You may receive a summary of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself.

I would be more than happy to answer any questions you might have. Please write or call. My e-mail address is kruse.22@osu.edu and the telephone number is (614) 292.9519. Thank you for your assistance.

Sincerely,

Sarah Kruse

Graduate Research Associate
AEDEcon. Department

2120 FYFFE ROAD • COLUMBUS, OH • 43210
PHONE: 614.292.9519
KRUSE.22@OSU.EDU

Public Opinion Survey on the Ballville Dam

1. Before receiving this survey, were you aware of the Ballville Dam located on the Sandusky River just outside the city limits of Fremont:
   - ☐ YES
   - ☐ NO

2. Before receiving this survey, had you read or heard about projects to remove dams in order to address safety concerns:
   - ☐ YES
   - ☐ NO

3. Before receiving this survey, had you read or heard about projects to remove dams in order to improve water quality and habitat quality for fish and other species:
   - ☐ YES
   - ☐ NO

4. How would you rate the environmental quality of the Sandusky River:
   - ☐ EXTREMELY GOOD
   - ☐ VERY GOOD
   - ☐ GOOD
   - ☐ NOT VERY GOOD
   - ☐ NOT GOOD AT ALL

5. How would you rate the recreational quality of the Sandusky River:
   - ☐ EXTREMELY GOOD
   - ☐ VERY GOOD
   - ☐ GOOD
   - ☐ NOT VERY GOOD
   - ☐ NOT GOOD AT ALL

6. Over the past year, approximately how many times have you participated in each of these activities on the Sandusky River:

Activity	Number of times participating in activity (please check appropriate box)									
	0	1	2	3	4	5	6	7	8	9 +
Boating/ Canoeing										
Swimming										
Fishing from shore										
Fishing on a boat										
Picnicking/ Hiking										
Other										

7. Do you recreate (boat, fish, swim, etc.) on the Maumee River?
   - ☐ YES
   - ☐ NO

Public Opinion Survey on the Ballville Dam

You will now be provided with some information on the possible removal of the Ballville Dam. Please read the information carefully before answering the questions that follow.

History and condition of the Ballville Dam

The Ballville Dam was built in 1911 by the Ohio Power Company for power generation. In 1959, the dam was sold to the city of Fremont, Ohio and no longer generates power. It is currently rated as a high hazard dam by the State of Ohio, meaning there is probable loss of human life should the dam fail. The Ohio Department of Natural Resources (ODNR) has suggested approximately $500,000 of necessary repairs to fix and stabilize parts of the dam structure.

8. How concerned are you with the safety of the dam?
- ☐ EXTREMELY CONCERNED
- ☐ VERY CONCERNED
- ☐ CONCERNED
- ☐ NOT VERY CONCERNED
- ☐ NOT CONCERNED AT ALL

The reservoir behind the dam is the sole source of municipal water supply for the city of Fremont, Ohio. In 1999, Fremont hired an engineering firm to address concerns of the city relative to its ability to meet minimum safe drinking water standards. The study concluded that continued use of the existing reservoir would not resolve this problem.

The findings of the study suggest the building of a new up-ground reservoir that would serve as the city's primary water supply. Fremont is currently in the process of building the up-ground reservoir. The land has been purchased and the schedule for completion is 10 years (2014). **Dam removal would not take place until the upground reservoir is completed.**

9. Does your household use Fremont City water:
- ☐ YES
- ☐ NO

Possible Removal of the Ballville Dam

The Ohio Department of Natural Resources has expressed its desire to have the dam removed to improve river quality and increase the amount of fish spawning habitat on the Sandusky River. Dam removal would also improve stream habitat for many different species of fish including; walleyes, smallmouth bass, white bass, river red-horse, rock bass, darters and others.

The location of the dam, just 12 miles from the Sandusky Bay, splits the spawning habitat of Lake Erie walleye, and leaves less than one mile of spawning habitat below the dam. It has been estimated that above the dam there is nearly 20 additional miles of spawning habitat. According to Ohio Division of Wildlife, the walleye spawning population in the Sandusky River is one of the largest in the Lake Erie basin. Removal of the dam would eliminate the possibility of recreation on the dam reservoir, but would allow access to a longer length of river (approximately 32 miles) for fishing, canoeing, kayaking and other recreational activities.

11. How concerned are you about returning the Sandusky River to a more natural state (improving water quality, improving habit for aquatic species, increasing fish spawning habitat):
- ☐ EXTREMELY CONCERNED
- ☐ VERY CONCERNED
- ☐ SOMEWHAT CONCERNED
- ☐ NOT VERY CONCERNED
- ☐ NOT AT ALL CONCERNED

12. In your opinion, how important is a goal of improving the recreational quality the Sandusky River:
- ☐ EXTREMELY IMPORTANT
- ☐ VERY IMPORTANT
- ☐ SOMEWHAT IMPORTANT
- ☐ NOT VERY IMPORTANT
- ☐ NOT IMPORTANT AT ALL

Public Opinion Survey on the Ballville Dam

13. Using the information provided, as well as your own knowledge, what kind of effect do you think dam removal would have on the following categories?

Please only check one box for each category:

1= Extremely negative effect
2= Somewhat negative effect
3= No effect
4= Somewhat positive effect
5= Extremely positive effect

Category	Effect of Dam Removal				
	<More Neg.				More Pos.>
	1	2	3	4	5
Fish populations					
Fishing on the Sandusky					
Fishing on Lake Erie					
Recreational opportunities					
Safety					
Water quality					
Water supply					

After completing the table, please take a moment to think about each of the categories listed and how potential changes caused by dam removal may or may not affect you.

In order to help you, we have included the following list of potential advantages and disadvantages that may be associated with removing the Ballville Dam. They may be some of the reasons why individuals choose to vote for or against the dam removal project.

Advantages:

- Gain access to longer river length for canoeing, kayaking and fishing.
- Restore water quality and improve habitat for aquatic species
- Eliminate safety hazard and the need for long term repairs and maintenance to the dam
- Improve walleye fish spawning habitat.
- Increase potential for additional economic activity during fish spawning runs.

Disadvantages:

- One time cost of removal, which would include removal of the dam, dredging of a river channel, disposal of sediment and regrading of the remaining sediment.
- Loss of some recreational opportunities on the reservoir
- Loss of "lake" atmosphere for adjacent property owners created by existing reservoir.
- Temporary increases in soil erosion potential along river caused by lowering water level.

Your opinions on this project are very important in order to better estimate the economic benefits and costs of the proposed dam removal.

14. If funding was found for the dam removal project, would you like to see the dam removed? (The cost of the project for you is zero)

☐ I would be IN FAVOR of removing the dam

☐ I would be AGAINST removing the dam

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost we can determine whether enough people would vote for the proposition to justify putting it on the ballot. If the project does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for project.

Suppose your household would have to make a one-time payment of $10 to the trust fund to help cover the cost of the dam removal project. If an election were held today, would you vote for or against the project?

☐ I would vote FOR the dam removal project

☐ I would vote AGAINST the dam removal project

If you said that you would vote AGAINST the dam removal project, please let us know why you voted against it.

☐ Removing the dam, restoring the river and increasing fish populations is not worth this much to me.
☐ I cannot afford to pay this amount.
☐ I do not believe the dam should be removed.
☐ I want the dam removed, but don't want to pay for it.
☐ other, please describe: _____

The next few questions are about you and your household. The responses will be used for statistical purposes only, and they will not be associated with your name in any way. All responses will remain confidential.

1. Please check the area that best describes the location of your current residence:
   - ☐ THE CITY OF FREMONT
   - ☐ ANOTHER URBAN AREA
   - ☐ A SUBURBAN AREA
   - ☐ A RURAL AREA
   - ☐ OTHER, PLEASE DESCRIBE:_____

2. How long have you lived at your current address:
   - ☐ LESS THAN 5 YEARS
   - ☐ 5-10 YEARS
   - ☐ 11-15 YEARS
   - ☐ MORE THAN 15 YEARS

3. Do you rent or own your home: _____

4. How many miles do you live from the Sandusky River:
   - ☐ MY HOME BORDERS THE RIVER
   - ☐ LESS THAN 5
   - ☐ 5-10
   - ☐ 10-15
   - ☐ 15-20
   - ☐ 20-25
   - ☐ MORE THAN 25

5. What county do you live in: _____

6. Are you a member of any environmental organizations (Ducks Unlimited, Rivers Unlimited, Nature Conservancy, etc.)?

- ☐ YES
- ☐ NO

Please list: _____

7. If yes, how often do you participate in the activities or programs offered by these organizations?

- ☐ VERY OFTEN
- ☐ FREQUENTLY
- ☐ OCCASIONALLY
- ☐ RARELY
- ☐ NEVER

8. What is the highest level of schooling you have completed:

- ☐ 8TH GRADE OR LESS
- ☐ SOME HIGH SCHOOL
- ☐ HIGH SCHOOL DIPLOMA
- ☐ SOME COLLEGE
- ☐ ASSOCIATE DEGREE
- ☐ BACHELORS DEGREE
- ☐ MASTERS DEGREE
- ☐ PH. D.
- ☐ PROFESSIONAL DEGREE (JD, MD, ETC.)

9. What is your age?

- ☐ LESS THAN 20
- ☐ 20-29
- ☐ 30-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60-69
- ☐ 70+

10. What is your gender?

- ☐ MALE
- ☐ FEMALE

11. What is your race or ethnic background?

- ☐ WHITE, NON HISPANIC
- ☐ AFRICAN-AMERICAN
- ☐ LATIN-AMERICAN
- ☐ ASIAN-AMERICAN
- ☐ AMERICAN INDIAN
- ☐ OTHER

12. What is your current employment status, **please check one**:

- ☐ EMPLOYED FULL-TIME
- ☐ EMPLOYED PART-TIME
- ☐ SELF-EMPLOYED
- ☐ UNEMPLOYED
- ☐ RETIRED
- ☐ STUDENT
- ☐ OTHER, PLEASE DESCRIBE: _____

13. Including yourself, how many people reside in your household? _____

14. Of these people, how many earn money that contributes to your household income? _____

15. What was your approximate household income, **before tax deductions**, in 2003:
- ☐ LESS THAN $20,000
- ☐ $20,000-$39,999
- ☐ $40,000-$59,999
- ☐ $60,000-$79,999
- ☐ $80,000-$99,999
- ☐ MORE THAN $100,000

Please use the blank space on the next page to write any additional comments or suggestions you may have. Again, thank you for completing this survey.

To return it, please place it in the self-addressed stamped envelope that accompanied the survey and mail it back to us. If for some reason you do not have the envelope, please mail the survey to:

Sarah Kruse
Agricultural, Environmental and Developmental Economics
The Ohio State University
344 Agricultural Administration Building
2120 Fyffe Road
Columbus, Ohio 43210
kruse.22@osu.edu

Please Turn the Page…

Survey Evaluation
Please take just a few more minutes and help us understand how you felt about our survey. Your answers are VERY important in helping us provide reliable results. Thank you again.

1. How useful did you find the information presented in the survey to be for making your choices about dam removal?
- ☐ EXTREMELY USEFUL
- ☐ VERY USEFUL
- ☐ USEFUL
- ☐ NOT USEFUL
- ☐ NOT USEFUL AT ALL

2. In your view, how would you judge the quality of the technical/scientific information that was presented in this survey?
- ☐ LOW QUALITY
- ☐ MEDIUM QUALITY
- ☐ HIGH QUALITY

3. How well do you feel you understood the material presented in the survey?
- ☐ EXTREMELY WELL
- ☐ VERY WELL
- ☐ WELL
- ☐ NOT VERY WELL
- ☐ NOT WELL AT ALL

4. Did you feel the information provided in the survey was sufficient for you to feel confident in your responses?
- ☐ I FEEL EXTREMELY CONFIDENT
- ☐ I FEEL VERY CONFIDENT
- ☐ I FEEL CONFIDENT
- ☐ I FEEL NOT VERY CONFIDENT
- ☐ I FEEL NOT CONFIDENT AT ALL

5. How comfortable are you with the prospect that the choices you made today could have an influence on dam removal policy?

- ☐ EXTREMELY COMFORTABLE
- ☐ VERY COMFORTABLE
- ☐ COMFORTABLE
- ☐ NOT VERY COMFORTABLE
- ☐ NOT COMFORTABLE AT ALL

6. Do you feel that you might have answered survey questions differently if you had been provided with more detailed information on the issue?

- ☐ YES
- ☐ NO

Please tell us, _____

_____

_____

ADDITIONAL COMMENTS

December 20, 2004

Dear Madam or Sir:

Approximately three weeks ago you were mailed a public opinion survey on the Ballville Dam. I am writing again to emphasize how important your participation is to this project and ask you to please take a few minutes to fill out the survey. Whatever your level of knowledge and/or opinions about the dam, they are extremely important to the survey and the validity of the results. The best survey is one that accurately represents the population in question, but without your help this may not be possible..

This study will also benefit you, because over the next few years, both individual citizens and elected and appointed officials will have to make informed decisions about the dam. It is possible that your responses may influence government decisions on dam removal, so please answer each question thoughtfully and with care.

You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off of the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire or associated with any results of the survey.

I would be more than happy to answer any questions you might have. Please write or call. My e-mail address is kruse.22@osu.edu and the telephone number is (614) 292.9519.

Thank you for your assistance.

Sincerely,

Sarah Kruse

Graduate Research Associate
AEDEcon. Department

APPENDIX C

STRUCTURED ELICITATION GROUP HANDOUT

(The handout has been reformatted to fit the requirements of the dissertation)

The study in which you are about to participate is part of a research project sponsored by the Ohio State University and the Great Lakes Protection Fund. We need your opinions to complete a study of the Ballville Dam on the Sandusky River. This study will potentially benefit you as well, because over the next few years both individual citizens and elected and appointed officials will have to make informed decisions about the dam. It is possible that your responses may influence government decisions on dam removal, so please answer each question thoughtfully and with care.

In several cases we will first ask you a question relating to dam removal, then provide you with more information, and then ask you the same question again. You may find that your answers change or they may remain the same – the choice is entirely up to you and there is no single "right" answer. In all cases, the information we provide you with will be as accurate as possible, reflecting the current state of scientific knowledge.

INTRODUCTION

Over the past two centuries the installation of dams in the United States has transformed the nation's rivers. Dams were built mainly for economic reasons such as power generators, water supply, irrigation, or flood control. There are now over 76,000 dams (six feet or higher) and an estimated two million dams of smaller size.

In many cases the installation of dams has led to environmental changes in the both the river and the surrounding habitat. There has also been evidence of some dams directly influencing the decline of commercially important fish, as well as threatening the existence of endangered species. Recent attention has been given to the effects of dams for several reasons, including changing social values, safety issues related with aging structures, and an increase in scientific information on the long terms effects of dams on environment.

In many cases, the structural integrity of the dam is not only compromised or obsolete, but the dam is also no longer being used. Of the 76,000 dams officially accounted for in the United States, more than half will be up for license renewal in the next decade, and for many of these dams, structural obsolescence will require that a decision be made to either remove or restore the dam.

You have been asked to participate so that you can help in an ongoing study to decide on priorities when assessing the costs and benefits of dam removal. Funding for this study, which is being conducted by Ohio State University researchers, comes from the Great Lakes Protection Fund.

PLEASE ANSWER THE FOLLOWING QUESTIONS…

Please answer the following questions about dam removal. Use the five-point scale that is shown just under each question and circle the response number that best represents your views. There are no right or wrong answers, we want to know *your* views.

1. Do you think policy decisions about the removal of dams should be based just on public input or should they be made just by technical experts?

1	2	3	4	5
Just public input		Public and expert input		Just expert input

2. How would you characterize your level of knowledge about dams?

1	2	3	4	5
Very little knowledge		Moderate amount of knowledge		A lot of knowledge

3. How aware are you of the issues that matter most to you when thinking about dam removal?

1	2	3	4	5
Not at all aware		Aware		Extremely aware

4. How much have you thought about dams as a source of potential harm to humans or the environment?

1	2	3	4	5
Very little thought		Moderate amount of thought		A lot of thought

5. How comfortable are you with the prospect that your participation in this study could have an influence on government policies for dam removal?

1	2	3	4	5
Not at all comfortable		Moderately comfortable		Extremely comfortable

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

INFORMATION TO HELP INFORM YOU ON DAM REMOVAL

In order for informed decisions to be made about the Ballville Dam, it is important that people be given accurate information about dam removal. The starting place is to look at the issues that people in the community say matter most to them --- their values. In fact, this focus on values would be true for any tough decision you might need to make. For example, if you were shopping for a new car, you might look for features that make you, or your family, feel like you are doing your part for the environment while at the same time making you feel comfortable and safe.

In the case of the Ballville Dam, we have identified the following facets of the problem to be of importance when considering dam removal. We have done our best, but it is possible that we have not identified all the important issues associated with the possibility of removing the dam. Please feel free to write down any concerns or issues that may have been omitted and bring them up during the group discussion.

1. Environment

The Ohio Department of Natural Resources has expressed its desire to have the dam removed to improve river quality and increase the amount of fish spawning habitat on the Sandusky River. Removal of the dam would restore the continuity of the river, improve water quality and also improve the in-stream habitat for many different species of fish including; walleyes, smallmouth bass, white bass, river red-horse, rock bass, darters and others.

The location of the dam, just 12 miles from the Sandusky Bay, splits the spawning habitat of Lake Erie walleye, and leaves less than one mile of spawning habitat below the dam. It has been estimated that above the dam there is nearly 20 additional miles of spawning habitat. According to Ohio Division of Wildlife, the walleye spawning population in the Sandusky River is one of the largest in the Lake Erie basin.

Dam removal would also cause some short term impacts relative to existing sediment removal or natural transport downstream, including the potential for a temporary increase in soil erosion along the river caused by the lowering water levels.

2. Recreation

Removal of the dam would mean the loss of a “lake” atmosphere for adjacent property owners created by the existing reservoir, and the loss of some recreational activities on the reservoir. On the other hand, dam removal would allow access to a longer length of river (approximately 32 miles) for fishing, canoeing, kayaking and other recreational activities.

3. Safety
The dam is currently rated a high hazard dam by the State of Ohio, meaning there is probable loss of human life should the dam fail. Were the dam to be removed, safety issues with respect to the structure would be eliminated.

4. Cost
Removing the dam would involve a one-time cost, which would include removal of the dam, dredging to create a new stable river channel, disposal of sediment and re-grading of the remaining sediment.

If the dam were not removed, regular maintenance and upkeep costs would continue as long as the dam remained in place. The Ohio Department of Natural Resources (ODNR) has also suggested approximately $500,000 of necessary repairs to fix and stabilize parts of the dam structure in order to meet the dam safety laws of Ohio.

5. Water supply
The reservoir behind the dam is the sole source of municipal water supply for the city of Fremont, Ohio. In 1999, Fremont hired an engineering firm to address concerns of the city relative to its ability to meet minimum safe drinking water standards. The study concluded that continued use of the existing reservoir would not resolve this problem. Fremont is currently in the process of building the up-ground reservoir. The land has been purchased and the schedule for completion is 10 years (2014).

GROUP QUESTIONS

We would now like to take a few minutes to let you ask questions about the information you just received. As mentioned before, we attempted to make the information as accurate as possible, reflecting the current state of scientific knowledge. It is possible that you may disagree with what you have just read, or that you have heard information elsewhere differs with what you have heard here. This is a chance for you to ask questions and hopefully receive answers that address your concerns.

We only ask that you address all questions and comments to the facilitator, not to other members of the group and that you refrain from interrupting when someone else is speaking. This is not meant to be a group discussion, but rather a chance for everyone to listen to the questions, and answers, that others have. Please also remember that the facilitator does not know everything. He/she will try to answer all your questions but it may be possible that there are some questions he/she will be unable to answer. The purpose of this part of the session is to help you feel comfortable, knowledgeable and informed for the questions that will follow. If your question or comment is not addressed, please feel free to write it down and discuss it with the facilitator at the end of the session.

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

WHAT ARE THE EFFECTS OF DAM REMOVAL?

The previous discussion identified a number of changes that may occur if the Ballville Dam is removed. We have identified several categories that may be affected by dam removal and they are listed in the table below. Other information relating to dam removal may also influence your decisions about whether or not the Ballville Dam should be removed. A first task, however, is to think about the potential advantages and disadvantages as they relate to changes caused by dam removal.

Using the information provided before, as well as your own knowledge, what kind of effect do you think dam removal would have on the following categories?

Please only check one box for each category:

1= Extremely negative effect
2= Somewhat negative effect
3= No effect
4= Somewhat positive effect
5= Extremely positive effect

Category	Effect of Dam Removal				
	<More Negative		No Effect		More> Positive
	1	2	3	4	5
Fish populations					
Fishing on the Sandusky					
Fishing on Lake Erie					
Recreational opportunities					
Safety					
Water quality of river					
Water supply					

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

WHAT'S IMPORTANT TO YOU?

The purpose of this next task is to help you identify your preferences for removing the Ballville Dam. When making any decision, including one about dam removal, it is impossible to look at the big picture without considering all of sub-issues affected by the decision. In this exercise we would like you do identify which issues are most important to you when it comes to dam removal.

Do not initially worry about whether removing the dam would have a positive or negative effect on the following issues. Simply rank the "concerns" in order or importance to you. Please rank the issue that is most important to you by putting a "100" in the "Rank" column next to it. Then rank the rest of the issues by using any number from 1 to 100 to show how important the issue is relative to your top concern.

After ranking all the concerns, please go back and based on your personal knowledge and what you have learned today, decide whether dam removal would have a positive or negative effect on each issue. For each category, move the number you wrote in the rank column over to either the positive or negative effect column. Then add up the numbers that you have listed as positives and the numbers you have listed as negatives. If the sum of the positives is greater than the sum of the negatives, it suggests that you may have a positive value for dam removal. Similarly, if the sum of the negatives is greater than the sum of the positives, then you may perceive dam removal as having a negative value.

Take as much time as necessary to ensure that your ranking accurately reflects your preferences with respect to the advantages and disadvantages of removing the dam.

Concern	Rank	Effect of Dam Removal	
		+	-
Environment			
Aquatic species			
Recreation (fishing, boating etc.)			
Safety			
Water supply			
Other_____			
	TOTAL:	_____	_____

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

VALUATION QUESTIONS

On the basis of what you now know about dam removal, and the Ballville Dam in particular, we would like you to answer the following questions.

VALUATION QUESTION –TASK 1

If funding were found for the dam removal project, would you like to see the dam removed? (The cost of the project for you is zero)

Please feel free to refer back to the charts on the previous pages when answering this question.

- ☐ I would be IN FAVOR of removing the dam
- ☐ I would be AGAINST removing the dam

VALUATION QUESTION – TASK 2

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost of the dam removal project, we can determine whether enough people would vote for the proposition to justify our putting it on the ballot.

Once we have determined the actual cost, we will compare your response to it. If your response is greater than or equal to your share of the actual cost, then we will assume you would vote for the project. If your response is less than the cost we will assume you would vote against the project. If the proposition does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for the project.

Suppose your household would have to make a one-time payment to the trust fund in order to cover the cost of the project. What is the maximum amount you would be willing to pay for the dam removal project?

Again, please feel free to refer back to the charts on the previous pages when answering this question.

$_____

Please tell us why you chose that dollar amount: _____

_____

_____

HOW DO YOU FEEL ABOUT YOUR CHOICE?

Please answer the following questions that relate to the choice you made on the previous page. We know that you answered some of these same questions before, but we'd like you to answer them again. Some of your answers may have changed compared to your earlier responses and some may have stayed the same. Either is fine – we want to know *your* views at *this point in the session*. Again, there are no right or wrong answers. Please don't look back at your previous responses.

1. How would you NOW characterize your level of knowledge about dams and the Ballville Dam in particular?

1	2	3	4	5
Very little knowledge		Moderate amount of knowledge		A lot of knowledge

2. To what extent do you feel that you've identified the issues that matter most to you when thinking about removing dams?

1	2	3	4	5
Not at all well		Well		Extremely well

3. How difficult was it for you to complete this valuation task?

1	2	3	4	5
Not at all difficult		Difficult		Extremely difficult

4. How comfortable did you feel writing a dollar value for how much you value the possibility of dam removal?

1	2	3	4	5
Not at all comfortable		Comfortable		Extremely comfortable

5. How confident do you feel about the dollar value you chose in the second valuation task?

1	2	3	4	5
Not at all confident		Confident		Extremely confident

6. How useful did you find the information presented in the handout to be for making your choices about dam removal?

1	2	3	4	5
Not at all useful		Useful		Extremely useful

7. How well do you feel you understood the material presented in the survey?

1	2	3	4	5
Not at all well		Well		Extremely well

8. In your view, how would you judge the quality of the technical/scientific information that was presented in this survey?

☐	☐	☐
Low quality	Medium quality	High quality

9. How comfortable are you with the prospect that the choices you made today could have an influence on dam removal policy?

1	2	3	4	5
Not at all comfortable		Comfortable		Extremely comfortable

10. Do you feel that you might have answered survey questions differently if you had been provided with more information on the issue?

☐ Yes ☐ No

COMMENTS

Was there any particular part of the survey that MOST helped you? If so, please tell us:

SOME FINAL QUESTIONS…

The next few questions are about you and your household. The responses will be used for statistical purposes only, and they will not be associated with you in any way. All responses will remain confidential.

1. Please check the area that best describes the location of your current residence:
   - ☐ THE CITY OF FREMONT
   - ☐ ANOTHER URBAN AREA
   - ☐ A SUBURBAN AREA
   - ☐ A RURAL AREA
   - ☐ OTHER, PLEASE DESCRIBE:_____

2. How long have you lived at your current address:
   - ☐ LESS THAN 5 YEARS
   - ☐ 5-10 YEARS
   - ☐ 11-15 YEARS
   - ☐ MORE THAN 15 YEARS

3. Do you rent or own your home:
   - o RENT
   - o OWN

4. How many miles do you live from the Sandusky River?
   - ☐ MY HOME BORDERS THE RIVER
   - ☐ LESS THAN 5
   - ☐ 5-10
   - ☐ 10-15
   - ☐ 15-20
   - ☐ 20-25
   - ☐ More than 25

5. Are you a member of any environmental organizations (Ducks Unlimited, Rivers Unlimited, Nature Conservancy, etc.)?
   - ☐ YES
   - ☐ NO

   IF YES, PLEASE LIST _____

6. If yes, how often do you participate in the activities or programs offered by these organizations?
   - ☐ VERY OFTEN
   - ☐ FREQUENTLY
   - ☐ OCCASIONALLY
   - ☐ RARELY
   - ☐ NEVER

7. What is your gender?
   - ☐ MALE
   - ☐ FEMALE

8. What is the highest level of schooling you have completed:
- ☐ 8TH GRADE OR LESS
- ☐ SOME HIGH SCHOOL
- ☐ HIGH SCHOOL DIPLOMA
- ☐ SOME COLLEGE
- ☐ ASSOCIATE DEGREE
- ☐ BACHELORS DEGREE
- ☐ GRADUATE LEVEL DEGREE (PH.D, JD, MD, ETC.)

9. Please check the category that corresponds with your age.
- ☐ LESS THAN 20
- ☐ 20-29
- ☐ 30-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60-69
- ☐ 70+

10. What is your race or ethnic background?
- ☐ WHITE, NON HISPANIC
- ☐ AFRICAN-AMERICAN
- ☐ LATIN-AMERICAN
- ☐ ASIAN-AMERICAN
- ☐ AMERICAN INDIAN
- ☐ OTHER_____

11. What is your current employment status, **please check one**:
- ☐ EMPLOYED FULL-TIME
- ☐ EMPLOYED PART-TIME
- ☐ SELF-EMPLOYED
- ☐ UNEMPLOYED
- ☐ RETIRED
- ☐ STUDENT
- ☐ OTHER, PLEASE DESCRIBE: _____

12. Including yourself, how many people reside in your household:

_____

13. Of these people, how many earn money that contributes to your household income:

_____

14. What was your approximate household income, **before tax deductions**, in 2003:
- ☐ LESS THAN $20,000
- ☐ $20,000-$39,999
- ☐ $40,000-$59,999
- ☐ $60,000-$79,999
- ☐ $80,000-$99,999
- ☐ MORE THAN $100,000

Thank you! Please feel free to mention additional questions or comments to the facilitator or write them on the back of this page.

APPENDIX D

EXPERIMENTAL MAIL SURVEY

(The survey has been reformatted to fit the requirements of the dissertation)

December 20, 2004

Dear Sir or Madam:

Over the past two centuries the installation of dams in the United States has transformed the nation's rivers. Dams were built mainly for economic reasons such as power generators, water supply, irrigation, or flood control. There are now over 76,000 dams (six feet or higher) and an estimated two million dams of smaller size. Often, the installation of dams has led to environmental changes in the both the river and the surrounding habitat. There has also been evidence of some dams directly influencing the decline of commercially important fish, as well as threatening the existence of endangered species. Recent attention has been given to the effects of dams for several reasons, including changing social values, safety issues related with aging structures, and an increase in scientific information on the long terms effects of dams on environment.

As part of several ongoing river research projects at the Ohio State University, I am asking for your assistance in completing an important environmental impact survey. I need your opinions to complete a study of the Village Dam on the Sandy River. This will also benefit you, because over the next few years, both individual citizens and elected and appointed officials will have to make informed decisions about the dam. It is possible that your responses may influence government decisions on dam removal, so please answer each question thoughtfully and with care. This study examines both the costs and benefits of dam removal and how removing a dam affects the local community, the environment, etc.

For this survey we ask that you imagine yourself as a resident in the hypothetical town of Montey. You definitely see yourself staying in the community in the future. One focal point of Montey is the Sandy River, which runs though town. An issue that is currently being discussed by the town is the possible removal of the Village Dam, located on the river about two miles from the downtown. Your household is one of a small number of randomly selected households which are being asked to give their opinion on these matters. The following survey is easy to complete and should only take 15-20 minutes of your time. In order for the results to be representative, it is important that each questionnaire be completed and returned.

Thank you for your assistance.

Sincerely,

Sarah Kruse

G.R.A. AEDE Department

Public Opinion Survey on the Ballville Dam

Please answer the following questions:

1. Do you think policy decisions about the removal of dams should be based just on public input or should they be made just by technical experts?

1	2	3	4	5
Just public input		Public and expert input		Just expert input

2. How would you characterize your level of knowledge about dams?

1	2	3	4	5
Very little knowledge		Moderate amount of knowledge		A lot of knowledge

3. How aware are you of the issues that matter most to you when thinking about dam removal?

1	2	3	4	5
Not at all aware		Aware		Extremely aware

4. How much have you thought about dams as a source of potential harm to humans or the environment?

1	2	3	4	5
Very little thought		Moderate amount of thought		A lot of thought

5. How comfortable are you with the prospect that your participation in this study could have an influence on government policies for dam removal?

1	2	3	4	5
Not at all comfortable		Moderately Comfortable		Extremely comfortable

You will now be provided with some information on the possible removal of the Village Dam. Please read the information carefully before answering the questions that follow.

History and condition of the Village Dam

The Village Dam was built in 1911 for power generation. In 1959, the dam was sold to the city of Montey and no longer generates power. It is currently rated as a high hazard dam by the State Department of Natural Resources (DNR) and they have suggested that approximately $500,000 of repairs be done to stabilize parts of the dam structure.

The reservoir behind the dam is the sole source of municipal water supply for the city of Montey. In 1999, Montey hired an engineering firm to address concerns of the city relative to its ability to meet minimum safe drinking water standards. The study concluded that continued use of the existing reservoir would not resolve this problem.

The findings of the study suggest the building of a new up-ground reservoir that would serve as the city's primary water supply. Montey is currently in the process of building the up-ground reservoir. The land has been purchased and the schedule for completion is 10 years (2014). **Dam removal would not take place until the upground reservoir is completed.**

Possible Removal of the Village Dam

The State Department of Natural Resources has expressed its desire to have the dam removed to improve river quality and increase the amount of fish spawning habitat on the Sandy River. Dam removal would also improve stream habitat for many different species of fish including; walleyes, smallmouth bass, white bass, river red-horse, rock bass, darters and others.

The location of the dam, just 12 miles where the river enters Big Lake, splits the spawning habitat of Big Lake walleye, and leaves less than one mile of spawning habitat below the dam. It has been estimated that above the dam there is nearly 20 additional miles of spawning habitat. According to State Division of Wildlife, the walleye spawning population in the Sandy River is one of the largest in the Big Lake basin. Removal of the dam would eliminate the possibility of recreation on the dam reservoir, but would allow access to a longer length of continuous river (approximately 32 miles) for fishing, canoeing, kayaking and other recreational activities.

Public Opinion Survey on the Ballville Dam

6. Using the information provided, as well as your own knowledge, what kind of effect do you think dam removal would have on the following categories? Please only check one box for each category:
1= Extremely negative effect
2= Somewhat negative effect
3= No effect
4= Somewhat positive effect
5= Extremely positive effect

Category	Effect of Dam Removal				
	<More Negative				More Positive>
	1	2	3	4	5
Fish populations					
Fishing on the Sandy					
Fishing on Big Lake					
Recreational opportunities					
Safety					
Water quality of river					

After completing the table, please take a moment to think about each of the categories listed and how potential changes caused by dam removal may or may not affect you.

In order to help you, we have included the following list of potential advantages and disadvantages that may be associated with removing the Village Dam. They may be some of the reasons why individuals choose to vote for or against the dam removal project.

Advantages:
- Gain access to longer river length for canoeing, kayaking and fishing.
- Restore water quality and improve habitat for aquatic species
- Eliminate safety hazard and the need for long term repairs and maintenance to the dam
- Improve walleye fish spawning habitat.
- Increase potential for additional economic activity during fish spawning runs.

Disadvantages:
- One time cost of removal, which would include removal of the dam, dredging of a river channel, disposal of sediment and regrading of the remaining sediment.
- Loss of some recreational opportunities on the reservoir
- Loss of "lake" atmosphere for adjacent property owners created by existing reservoir.
- Temporary increases in soil erosion potential along river caused by lowering water level.

Your opinions on this project are very important in order to better estimate the economic benefits and costs of the proposed dam removal.

7. If funding was found for the dam removal project, would you like to see the dam removed? (The cost of the project for you is zero)

☐ I would be IN FAVOR of removing the dam

☐ I would be AGAINST removing the dam

Public Opinion Survey on the Ballville Dam

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost of the dam removal project, we can determine whether enough people would vote for the proposition to justify our putting it on the ballot.

Once we have determined the actual cost, we will compare your response to it. If your response is greater than or equal to the actual cost, then we will assume you would vote for the project. If your response is less than the cost we will assume you would vote against the project. If the proposition does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for project. Suppose your household would have to make a one-time payment to the trust fund in order to cover the cost of the project. What is the maximum amount you would be willing to pay for the dam removal project?

$_____

Please tell us why you chose that dollar amount: _____

The next few questions are about you. Please answer them as YOURSELF, not as a hypothetical citizen in the town of Montey. The responses will be used for statistical purposes only, and they will not be associated with your name in any way. All responses will remain confidential.

1. Are you a member of any environmental organizations (Ducks Unlimited, Rivers Unlimited, Nature Conservancy, etc.)?
   - ☐ YES
   - ☐ NO

Please list: _____

2. If yes, how often do you participate in the activities or programs offered by these organizations?
   - ☐ VERY OFTEN
   - ☐ FREQUENTLY
   - ☐ OCCASIONALLY
   - ☐ RARELY
   - ☐ NEVER

3. What is the highest level of schooling you have completed:
   - ☐ HIGH SCHOOL DIPLOMA
   - ☐ SOME COLLEGE
   - ☐ ASSOCIATE DEGREE
   - ☐ BACHELORS DEGREE
   - ☐ GRADUATE LEVEL DEGREE

4. What is your age?
   - ☐ LESS THAN 20
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70+

5. What is your gender?
   - ☐ MALE
   - ☐ FEMALE

6. What is your race or ethnic background?
   - ☐ WHITE, NON HISPANIC
   - ☐ AFRICAN-AMERICAN
   - ☐ LATIN-AMERICAN
   - ☐ ASIAN-AMERICAN
   - ☐ AMERICAN INDIAN
   - ☐ OTHER

7. What is your nationality? _____

Public Opinion Survey on the Ballville Dam

Survey Evaluation

Please take just a few more minutes and help us understand how you felt about our survey. Your answers are VERY important in helping us provide reliable results. Thank you again.

1. How would you NOW characterize your level of knowledge about dams and the Village Dam in particular?
   - ☐ VERY LITTLE KNOWLEDGE
   - ☐ LITTLE KNOWLEDGE
   - ☐ MODERATE AMOUNT OF KNOWLEDGE
   - ☐ A GOOD AMOUNT OF KNOWLEDGE
   - ☐ A LOT OF KNOWLEDGE

2. To what extend do you feel that you've identified the issues that matter most to you when thinking about removing dams?
   - ☐ NOT AT ALL WELL
   - ☐ NOT WELL
   - ☐ WELL
   - ☐ VERY WELL
   - ☐ EXTREMELY WELL

3. How useful did you find the information presented in the survey to be for making your choices about dam removal?
   - ☐ EXTREMELY USEFUL
   - ☐ VERY USEFUL
   - ☐ USEFUL
   - ☐ NOT USEFUL
   - ☐ NOT USEFUL AT ALL

4. In your view, how would you judge the quality of the technical/scientific information that was presented in this survey?
   - ☐ LOW QUALITY
   - ☐ MEDIUM QUALITY
   - ☐ HIGH QUALITY

5. How well do you feel you understood the material presented in the survey?
   - ☐ EXTREMELY WELL
   - ☐ VERY WELL
   - ☐ WELL
   - ☐ NOT VERY WELL
   - ☐ NOT WELL AT ALL

6. Do you feel the information provided in the survey was sufficient for you to feel confident in your responses?
   - ☐ EXTREMELY CONFIDENT
   - ☐ VERY CONFIDENT
   - ☐ CONFIDENT
   - ☐ NOT VERY CONFIDENT
   - ☐ NOT CONFIDENT AT ALL

7. How comfortable are you with the prospect that the choices you made today could have an influence on dam removal policy?
   - ☐ EXTREMELY COMFORTABLE
   - ☐ VERY COMFORTABLE
   - ☐ COMFORTABLE
   - ☐ NOT VERY COMFORTABLE
   - ☐ NOT COMFORTABLE AT ALL

8. Do you feel that you might have answered survey questions differently if you had been provided with more detailed information on the issue?

- ☐ YES
- ☐ NO

Please tell us, _____

9. How difficult was it for you to complete this valuation task?

- ☐ NOT AT ALL DIFFICULT
- ☐ NOT DIFFICULT
- ☐ DIFFICULT
- ☐ VERY DIFFICULT
- ☐ EXTREMELY DIFFICULT

10. How comfortable did you feel writing a dollar value for how much you value the possibility of dam removal?

- ☐ EXTREMELY COMFORTABLE
- ☐ VERY COMFORTABLE
- ☐ COMFORTABLE
- ☐ NOT VERY COMFORTABLE
- ☐ NOT COMFORTABLE AT ALL

11. How confident do you feel about the dollar value you chose in the second valuation task?

- ☐ EXTREMELY CONFIDENT
- ☐ VERY CONFIDENT
- ☐ CONFIDENT
- ☐ NOT VERY CONFIDENT
- ☐ NOT CONFIDENT AT ALL

THANK YOU AGAIN FOR TAKING TIME TO FILL OUT THE SURVEY!

ADDITIONAL COMMENTS

APPENDIX E

EXPERIMENTAL SEG HANDOUT

(The handout has been reformatted to fit the requirements of the dissertation)

The study in which you are about to participate is part of a research project sponsored by the Ohio State University and the Big Lake Protection Fund. We need your opinions to complete a study of the Village Dam on the Sandy River. This study will potentially benefit you as well, because over the next few years both individual citizens and elected and appointed officials will have to make informed decisions about the dam. It is possible that your responses may influence government decisions on dam removal, so please answer each question thoughtfully and with care.

For this session we ask that you imagine yourself as a resident in the hypothetical town of Montey. You definitely see yourself staying in the community in the future. One focal point of Montey is the Sandy River, which runs though town. An issue that is currently being discussed by the town is the possible removal of the Village Dam, located on the river about two miles from the downtown.

In several cases we will first ask you a question relating to dam removal, then provide you with more information, and then ask you the same question again. You may find that your answers change or they may remain the same – the choice is entirely up to you and there is no single "right" answer. In all cases, the information we provide you with will be as accurate as possible, reflecting the current state of scientific knowledge.

INTRODUCTION

Over the past two centuries the installation of dams in the United States has transformed the nation's rivers. Dams were built mainly for economic reasons such as power generators, water supply, irrigation, or flood control. There are now over 76,000 dams (six feet or higher) and an estimated two million dams of smaller size.

Often, the installation of dams has led to environmental changes in both the river and the surrounding habitat. There has also been evidence of some dams directly influencing the decline of commercially important fish, as well as threatening the existence of endangered species. Recent attention has been given to the effects of dams for several reasons, including changing social values, safety issues related with aging structures, and an increase in scientific information on the long terms effects of dams on environment.

In many cases, the structural integrity of the dam is not only compromised or obsolete, but the dam is also no longer being used. Of the 76,000 dams officially accounted for in the United States, more than half will be up for license renewal in the next decade, and for many of these dams, structural obsolescence will require that a decision be made to either remove or restore the dam.

You have been asked to participate so that you can help in an ongoing study to decide on priorities when assessing the costs and benefits of dam removal. Funding for this study, which is being conducted by Ohio State University researchers, comes from the Big Lake Protection Fund.

PLEASE ANSWER THE FOLLOWING QUESTIONS…

Please answer the following questions about dam removal. Use the five-point scale that is shown just under each question and circle the response number that best represents your views. There are no right or wrong answers; we want to know *your* views.

1. Do you think policy decisions about the removal of dams should be based just on public input or should they be made just by technical experts?

1	2	3	4	5
Just public input		Public and expert input		Just expert input

2. How would you characterize your level of knowledge about dams?

1	2	3	4	5
Very little knowledge		Moderate amount of knowledge		A lot of knowledge

3. How aware are you of the issues that matter most to you when thinking about dam removal?

1	2	3	4	5
Not at all aware		Aware		Extremely aware

4. How much have you thought about dams as a source of potential harm to humans or the environment?

1	2	3	4	5
Very little thought		Moderate amount of thought		A lot of thought

5. How comfortable are you with the prospect that your participation in this study could have an influence on government policies for dam removal?

1	2	3	4	5
Not at all comfortable		Moderately comfortable		Extremely comfortable

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

INFORMATION TO HELP INFORM YOU ON DAM REMOVAL

In order for informed decisions to be made about the Village Dam, it is important that people be given accurate information about dam removal. The starting place is to look at the issues that people in the community say matter most to them --- their values. In fact, this focus on values would be true for any tough decision you might need to make. For example, if you were shopping for a new car, you might look for features that make you, or your family, feel like you are doing your part for the environment while at the same time making you feel comfortable and safe.

In the case of the Village Dam, we have identified the following facets of the problem to be of importance when considering dam removal. We have done our best, but it is possible that we have not identified all the important issues associated with the possibility of removing the dam. Please feel free to write down any concerns or issues that may have been omitted and bring them up during the group discussion.

1. Environment

The State Department of Natural Resources has expressed its desire to have the dam removed to improve river quality and increase the amount of fish spawning habitat on the Sandy River. Removal of the dam would restore the continuity of the river, improve water quality and also improve the in-stream habitat for many different species of fish including; walleyes, smallmouth bass, white bass, river red-horse, rock bass, darters and others.

The location of the dam, just 12 miles from where the river enters Big Lake, splits the spawning habitat of Big Lake walleye, and leaves less than one mile of spawning habitat below the dam. It has been estimated that above the dam there is nearly 20 additional miles of spawning habitat. According to the State Division of Wildlife, the walleye spawning population in the Sandy River is one of the largest in the Big Lake basin.

Dam removal would also cause some short term impacts relative to existing sediment removal or natural transport downstream, including the potential for a temporary increase in soil erosion along the river caused by the lowering water levels.

2. Recreation

Removal of the dam would mean the loss of a “lake” atmosphere for adjacent property owners created by the existing reservoir, and the loss of some recreational activities on the reservoir. On the other hand, dam removal would allow access to a longer length of river (approximately 32 miles) for fishing, canoeing, kayaking and other recreational activities.

3. Safety

The dam is currently rated a high hazard dam by the State, meaning there is probable loss of human life should the dam fail. Were the dam to be removed, safety issues with respect to the structure would be eliminated.

4. Cost

Removing the dam would involve a one-time cost, which would include removal of the dam, dredging to create a new stable river channel, disposal of sediment and re-grading of the remaining sediment.

If the dam were not removed, regular maintenance and upkeep costs would continue as long as the dam remained in place. The State Department of Natural Resources (DNR) has also suggested approximately $500,000 of necessary repairs to fix and stabilize parts of the dam structure in order to meet the dam safety laws of the State.

5. Water supply

The reservoir behind the dam is the sole source of municipal water supply for the city of Montey. In 1999, Montey hired an engineering firm to address concerns of the city relative to its ability to meet minimum safe drinking water standards. The study concluded that continued use of the existing reservoir would not resolve this problem. Montey is currently in the process of building the up-ground reservoir. The land has been purchased and the schedule for completion is 10 years (2014). **Dam removal would not take place until the reservoir has been completed.**

GROUP QUESTIONS

We would now like to take a few minutes to let you ask questions about the information you just received. As mentioned before, we attempted to make the information as accurate as possible, reflecting the current state of scientific knowledge. It is possible that you may disagree with what you have just read, or that you have heard information elsewhere that differs with what you have heard here. This is a chance for you to ask questions and hopefully receive answers that address your concerns.

We only ask that you address all questions and comments to the facilitator, not to other members of the group and that you refrain from interrupting when someone else is speaking. This is not meant to be a group discussion, but rather a chance for everyone to listen to the questions, and answers, that others have. Please also remember that the facilitator does not know everything. He/she will try to answer all your questions but it may be possible that there are some questions he/she will be unable to answer. The purpose of this part of the session is to help you feel comfortable, knowledgeable and informed for the questions that will follow. If your question or comment is not addressed, please feel free to write it down and discuss it with the facilitator at the end of the session.

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

WHAT ARE THE EFFECTS OF DAM REMOVAL?

The previous discussion identified a number of changes that may occur if the Village Dam is removed. We have identified several categories that may be affected by dam removal and they are listed in the table below. Other information relating to dam removal may also influence your decisions about whether or not the Village Dam should be removed. A first task, however, is to think about the potential advantages and disadvantages as they relate to changes caused by dam removal.

Using the information provided before, as well as your own knowledge, what kind of effect do you think dam removal would have on the following categories?

Please only check one box for each category:

1= Extremely negative effect
2= Somewhat negative effect
3= No effect
4= Somewhat positive effect
5= Extremely positive effect

Category	Effect of Dam Removal				
	<More Negative		No Effect		More> Positive
	1	2	3	4	5
Fish populations					
Fishing on the Sandy River					
Fishing on Big Lake					
Recreational opportunities					
Safety					
Water quality of river					
Water supply					

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

WHAT'S IMPORTANT TO YOU?

The purpose of this next task is to help you identify your preferences for removing the Village Dam. When making any decision, including one about dam removal, it is impossible to look at the big picture without considering all the sub-issues affected by the decision. In this exercise we would like you do identify which issues are most important to you when it comes to dam removal.

Do not initially worry about whether removing the dam would have a positive or negative effect on the following issues. Simply rank the "concerns" in order or importance to you. Please rank the issue that is most important to you by putting a "100" in the "Rank" column next to it. Then rank the rest of the issues by using any number from 1 to 100 to show how important the issue is relative to your top concern.

After ranking all the concerns, please go back and based on your personal knowledge and what you have learned today, decide whether dam removal would have a positive or negative effect on each issue. For each category, move the number you wrote in the rank column over to either the positive or negative effect column. Then add up the numbers that you have listed as positives and the numbers you have listed as negatives. If the sum of the positives is greater than the sum of the negatives, it suggests that you may have a positive value for dam removal. Similarly, if the sum of the negatives is greater than the sum of the positives, then you may perceive dam removal as having a negative value.

Take as much time as necessary to ensure that your ranking accurately reflects your preferences with respect to the advantages and disadvantages of removing the dam.

Concern	Rank	Effect of Dam Removal	
		+	-
Environment			
Aquatic species			
Recreation (fishing, boating etc.)			
Safety			
Water supply			
Other_____			

TOTAL: _____ _____

PLEASE STOP AND CHECK WITH FACILITATOR BEFORE PROCEEDING

VALUATION QUESTIONS

On the basis of what you now know about dam removal and the Village Dam in particular, we would like you to answer the following questions.

VALUATION QUESTION –TASK 1

If funding were found for the dam removal project, would you like to see the dam removed? (The cost of the project for you is zero)

Please feel free to refer back to the charts on the previous pages when answering this question.

- ☐ I would be IN FAVOR of removing the dam
- ☐ I would be AGAINST removing the dam

VALUATION QUESTION – TASK 2

We would now like to know what the dam removal project is worth to you. We are doing this survey so that when we know the exact cost of the dam removal project, we can determine whether enough people would vote for the proposition to justify our putting it on the ballot.

Once we have determined the actual cost, we will compare your response to it. If your response is greater than or equal to your share of the actual cost, then we will assume you would vote for the project. If your response is less than the cost we will assume you would vote against the project. If the proposition does go on the ballot, and passes, then everyone will contribute an equal amount to a trust fund set up specifically for the project.

Suppose your household would have to make a one-time payment to the trust fund in order to cover the cost of the project. What is the maximum amount you would be willing to pay for the dam removal project?

Again, please feel free to refer back to the charts on the previous pages when answering this question.

$_____

Please tell us why you chose that dollar amount: _____

_____

_____

_____

HOW DO YOU FEEL ABOUT YOUR CHOICE?

Please answer the following questions that relate to the choice you made on the previous page. We know that you answered some of these same questions before, but we'd like you to answer them again. Some of your answers may have changed compared to your earlier responses and some may have stayed the same. Either is fine – we want to know *your* views at *this point in the session*. Again, there are no right or wrong answers. Please don't look back at your previous responses.

1. How would you NOW characterize your level of knowledge about dams and the Village Dam in particular?

1	2	3	4	5
Very little knowledge		Moderate amount of knowledge		A lot of knowledge

2. To what extent do you feel that you've identified the issues that matter most to you when thinking about removing dams?

1	2	3	4	5
Not at all well		Well		Extremely well

3. How difficult was it for you to complete this valuation task?

1	2	3	4	5
Not at all difficult		Difficult		Extremely difficult

4. How comfortable did you feel writing a dollar value for how much you value the possibility of dam removal?

1	2	3	4	5
Not at all comfortable		Comfortable		Extremely comfortable

5. How confident do you feel about the dollar value you chose in the second valuation task?

1	2	3	4	5
Not at all confident		Confident		Extremely confident

6. How useful did you find the information presented in the handout to be for making your choices about dam removal?

1	2	3	4	5
Not at all useful		Useful		Extremely useful

7. How well do you feel you understood the material presented in the survey?

1	2	3	4	5
Not at all well		Well		Extremely well

8. In your view, how would you judge the quality of the technical/scientific information that was presented in this survey?

☐	☐	☐
Low quality	Medium quality	High quality

9. How comfortable are you with the prospect that the choices you made today could have an influence on dam removal policy?

1	2	3	4	5
Not at all comfortable		Comfortable		Extremely comfortable

10. Do you feel that you might have answered survey questions differently if you had been provided with more information on the issue?

☐ Yes ☐ No

COMMENTS

Was there any particular part of the survey that MOST helped you? If so, please tell us:

SOME FINAL QUESTIONS…

The next few questions are about you. Please answer them as YOURSELF, not as a hypothetical citizen in the town of Montey. The responses will be used for statistical purposes only, and they will not be associated with you in any way. All responses will remain confidential.

1. Are you a member of any environmental organizations (Ducks Unlimited, Rivers Unlimited, Nature Conservancy, etc.)?
   - ☐ YES, PLEASE LIST _____
   - ☐ NO

2. If yes, how often do you participate in the activities or programs offered by these organizations?
   - ☐ VERY OFTEN
   - ☐ FREQUENTLY
   - ☐ OCCASIONALLY
   - ☐ RARELY
   - ☐ NEVER

3. What is your gender?
   - ☐ MALE
   - ☐ FEMALE

4. What is the highest level of schooling you have completed?
   - ☐ HIGH SCHOOL DIPLOMA
   - ☐ SOME COLLEGE
   - ☐ ASSOCIATE DEGREE
   - ☐ BACHELORS DEGREE
   - ☐ GRADUATE LEVEL DEGREE (PH.D, JD, MD, ETC.)

5. Please check the category that corresponds with your age.
   - ☐ LESS THAN 20
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70+

6. What is your race or ethnic background?
   - ☐ WHITE, NON HISPANIC
   - ☐ AFRICAN-AMERICAN
   - ☐ LATIN-AMERICAN
   - ☐ ASIAN-AMERICAN
   - ☐ AMERICAN INDIAN
   - ☐ OTHER_____

7. What is your nationality? _____

Thank you! Please feel free to mention additional questions or comments to the facilitator or write them on the back of this page.