RESTORATION SCALING BASED ON TOTAL VALUE EQUIVALENCY: GREEN BAY NATURAL RESOURCE DAMAGE ASSESSMENT

Final Report

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Acronyms

CERCLA	Comprehensive Environmental Reponses, Compensation, and Liability Act
CVM	contingent valuation method
EPA	U.S. Environmental Protection Agency
FCAs	fish consumption advisories
FRGS	Fox River Global Meeting Goal Statement
iRCDP	Initial Restoration and Compensation Determination Plan
NRDA	natural resource damage assessment
PCBs	polychlorinated biphenyls
RAP	Remedial Action Plan
RCDP	Restoration and Compensation Determination Plan
RI/FS	Remedial Investigation and Feasibility Study
RV	revealed preference
SP	stated preference
TVE	total value equivalency
WTP	willingness to pay

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1. Introduction

1.1 Purpose of the Study

This study was prepared as part of the Lower Fox River/Green Bay natural resource damage assessment (NRDA) by the U.S. Fish and Wildlife Service (the Service), the National Oceanic and Atmospheric Administration, the Oneida Tribe of Indians of Wisconsin, the Menominee Tribe of Indians of Wisconsin, the Michigan Attorney-General, and the Little Traverse Bay Board of Odawa Indians (collectively referred to as the Co-trustees) in accordance with the regulations at 43 CFR §§ 11.81-11.84, the Assessment Plan: Lower Fox River/Green Bay NRDA at 61 FR 43,558 (August 2, 1996), and the Lower Fox River/Green Bay NRDA: Initial Restoration and Compensation Determination Plan (iRCDP) at 63 FR 50,254 (September 21, 1998).

Releases of polychlorinated biphenyls (PCBs) into the Lower Fox River and Green Bay have resulted in, and continue to result in, injuries to natural resources and related ecologic and human use service flow losses at these sites. The objective of this total value equivalency (TVE) study is to support the restoration planning portion of the Co-trustees' damage determination by (1) obtaining public preferences for the types and mix of restoration alternatives, and (2) providing value-based methods to scale resource restoration projects to provide services of *equivalent* societal value to the *total value* of all PCB-caused service flow losses from 2000 until service flows are returned to baseline (*PCB-caused service flow losses* are also referred to as *PCB-caused losses*, or as *losses*).

This study considers PCB-caused losses based on remedial scenarios proposed in the draft remedial investigation/feasibility study (ThermoRetec Consulting, 2000a,b). The results herein may be revised and the revisions incorporated into the Co-trustees restoration determination after the U.S. Environmental Protection Agency (EPA) issues a Record of Decision.

The remainder of this introduction provides background on the case, explains how this study supports the Co-trustees damage determination, and provides a summary of key results. This study uses a survey to obtain preferences and to scale restoration. Chapters 2 and 3 provide a summary of the survey instrument design and implementation. Chapter 4 provides a summary of survey results, focusing on the public's preferences across different types of restoration alternatives. Chapter 5 provides the economic model used, and Chapter 6 reports the results for the scaling of alternative restoration actions to provide services equivalent in value to the ongoing PCB-caused losses. Chapter 6 also addresses the comparability and overlap between this study and the Co-trustees' recreational fishing damage determination (Breffle et al., 1999), and provides additional study conclusions. The appendices provide copies of survey materials, supporting economic model details, and a summary of related literature concerning area residents' preferences and values regarding natural resource injuries and restoration programs.

While not the focus of this study, the study survey design also provides information that can be used to compute willingness-to-pay (WTP) monetary measures for interim losses from 2000 until a return to baseline, which can be used as a measure of compensable values. The methods to compute these values are presented in Chapter 5 and the results are presented in Chapter 6.

1.2 Background

PCBs are hazardous substances that were released into the Lower Fox River of Wisconsin, primarily by paper company facilities as part of the manufacturing, deinking, and repulping of carbonless copy paper that contained PCBs (Sullivan et al., 1983; WDNR, 1998; Stratus Consulting, 1999c), primarily between the late 1950s and mid-1970s.[1] Through time, PCBs have been and continue to be redistributed into the sediments and natural resources of the Lower Fox River and Green Bay (Stratus Consulting, 1999c).

Fish and wildlife throughout the Lower Fox River and the waters of Green Bay are exposed to PCBs, primarily through the food chain process (Stratus Consulting, 1999c). As a result of elevated PCB concentrations in fish, in 1976 the Wisconsin Department of Health and Human Services issued fish consumption advisories (FCAs) for sport-caught fish in the Wisconsin waters of Green Bay (including the Lower Fox River), and in 1977 Michigan issued FCAs for the Michigan waters of Green Bay (Stratus Consulting, 1999b). These FCAs continue today and are expected to continue for decades into the future, depending on the level of remediation and restoration at the site (Thermoretec Consulting, 2000a,b). Past and future recreational fishing active use losses from PCB-caused FCAs in these waters were addressed by the Co-trustees in Breffle et al. (1999). Similar to FCAs, waterfowl consumption advisories have been issued since 1987 in the Lower Fox River area because of elevated concentrations of PCBs (WDNR, 1987).

PCBs have caused injuries to fish and wildlife in the area, causing ecologic and human use service flow losses. Walleye have higher rates of tumors and pre-tumors than do walleye from comparable reference areas, and the difference has been attributed to PCBs (Stratus Consulting, 1999b; Barron et al., 2000). PCB injuries to bald eagles, double-crested cormorants, and common and forster's terns (both identified as endangered species by the State of Wisconsin) in the area include decreased egg hatching success. Forster's terns are also injured as a result of

1. PCBs are a hazardous substance under 40 CFR § 301.4 pursuant to Section 102(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Section 311 of the Federal Water Pollution Control Act.

increased deformity rates (Stratus Consulting, 1999a). In addition, PCB concentrations pose risks of adverse effects on piscivorous mammals in the area, such as mink (ThermoRetec Consulting, 2000c).

The assessment area includes the *waters of Green Bay*[2] and the surrounding land and wildlife resources directly or indirectly impacted by the PCB contamination in the waters of Green Bay, plus a part of northeast Lake Michigan (Figure 1.1).

1.3 Objectives

The purpose of the Co-trustee's damage determination is to "establish the amount of money to be sought in compensation for injuries to natural resources resulting from a release of a hazardous substance" [43 CFR §11.80(b)]. The measure of damages is defined as *restoration costs* plus, at the discretion of the Co-trustees, *compensable values for interim losses* [43 CFR §11.80(b)]. In addition, damages include the Co-trustees' reasonable assessment costs [42 USC § 9607(a)(4)(C)]. The term *interim losses* refers to losses from the time of release to when resources and services are returned to baseline and encompasses *past losses* up to the present, and *ongoing losses* during and after remediation and restoration actions until services flows are returned to baseline [43 CFR §11.80(b)]. The primary focus of this study is to support restoration planning.

Restoration refers to actions undertaken to return an injured resource to its baseline condition as measured by the services provided by that resource [43 CFR § 11.14(ll)]. *Baseline* refers to the conditions that would have existed in the assessment area had the release of hazardous substances not occurred [43 CFR § 11.14(e)] and *services* are defined as the "physical and biological functions performed by the resource, including the human use of those functions" [43 CFR § 11.14 (nn)]. Restoration can be accomplished by restoring or rehabilitating resources or by replacing or acquiring the *equivalent* of the injured natural resources, as measured by the services those resources provide [43 CFR § 11.82(a)]. In restoration planning, Trustees evaluate restoration alternatives and select and determine the scale of the preferred alternative based on the magnitude of service flow losses the releases cause over time.[3] The costs to perform the preferred alternative become the restoration cost component of the damage determination.

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2. The waters of Green Bay are defined to include the Bay of Green Bay, all bays within Green Bay (e.g., Little and Big Bay de Noc, Sturgeon Bay), and all rivers feeding into Green Bay up to the first dam or obstruction, including the Lower Fox River starting at Little Lake Buttes des Morts to the Bay of Green Bay.

3. An alternative can consist of single actions or combinations of actions [43 CFR § 11.82(b)(1)].

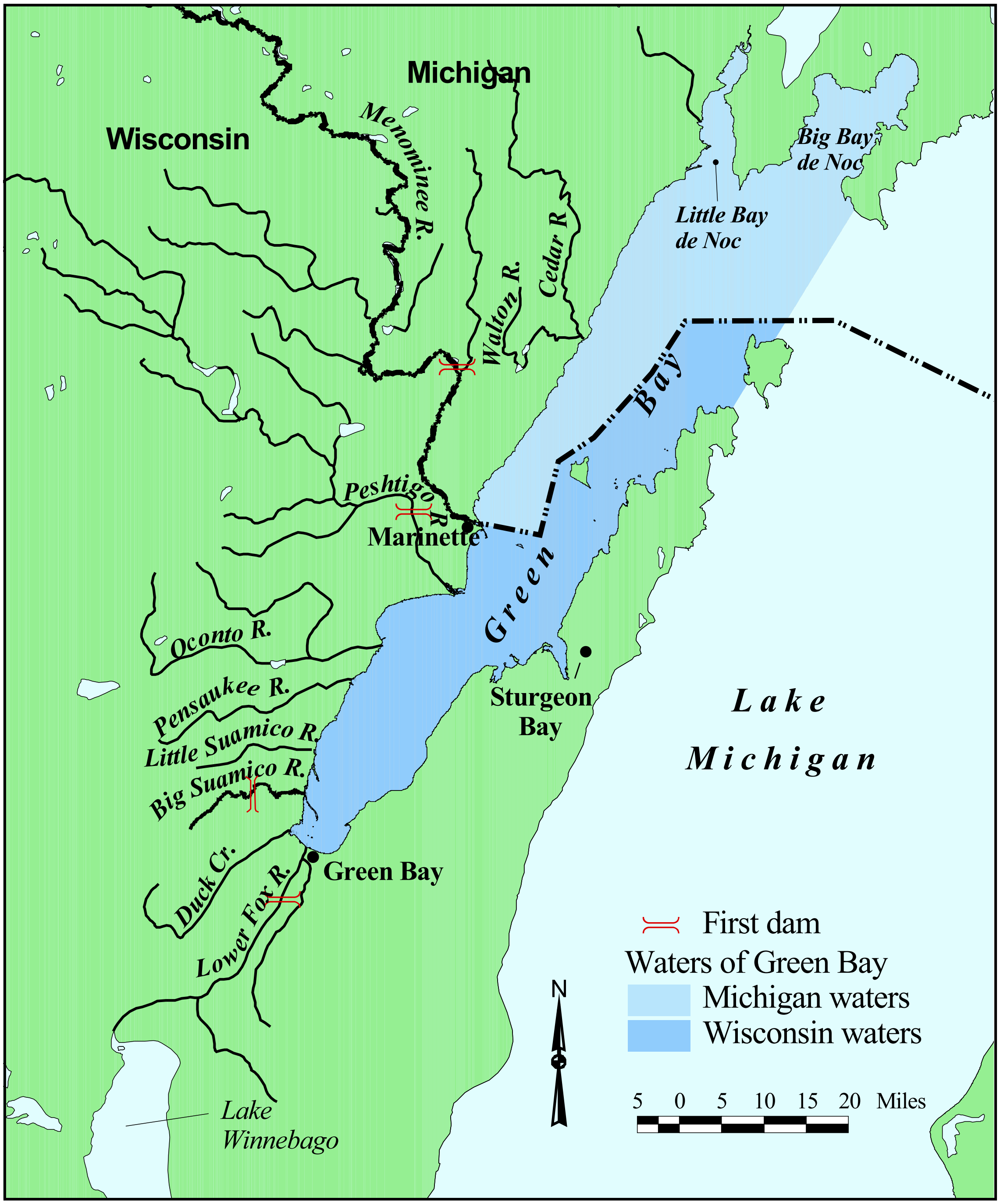

Figure 1.1. Wisconsin and Michigan waters of Green Bay.

This TVE study supports restoration planning in two ways. First, the study explicitly obtains public input regarding the preferences and values for alternative types of restoration projects, which aids the Co-trustees in evaluating the benefits of alternatives [43 CFR § 11.82(d)(2)], and ensures that the public has input on the selection of alternatives [43 CFR § 11.90].

Second, the study provides value-based methods to determine the appropriate scale of potential restoration actions. In some cases, restoration can be obtained by actions that restore, rehabilitate, or acquire the same amount of the same services at the same or very similar locations as those that were lost. For example, if an oil spill causes a boat launch to be closed, opening access to a comparable new boat launch nearby may provide the same services of the same scale as the losses, and thus the replacement services are equivalent (in type, level, and value) to the service flow losses. The amounts of services to be restored depend on the injuries through time, which may vary with the contamination and with the remediation efforts through time. For example, if contamination reduces mink populations, restoration might include habitat enhancements to support the population, combined with periodic mink stocking at varying levels to return the stocks to baseline levels through time. Scaling restoration programs that provide the same or very similar services is sometimes referred to as *service-to-service* scaling, where the amount of restored services are scaled to be equal to the amount of lost services now and through time.

For a large share of the PCB-caused service flow losses in the assessment area, particularly within Green Bay, where most of the PCBs have come to be located, providing restoration with the same or very similar services may not be technically feasible (i.e., the Co-trustees may be unable to find or develop resources that are sufficiently extensive to be developed in sufficient quantities), may be undesirable (e.g., increasing the population of fish or birds that may continue to experience injuries from PCB exposure), or may be too expensive. For this and other reasons, it may be preferable to select restoration actions that provide resources and services of a similar but different type or quality than those injured. Because such restoration may not provide the same services, it may not be possible to apply *service-to-service scaling*. In these cases, value-based scaling methods provide a basis for selecting and scaling restoration activities.

Value-to-value scaling is used in this study to scale restoration projects that provide services similar to, but not the same as, those lost.[4] Scaling is computed such that the societal value of the services gained through restoration equals the societal value of PCB-caused losses. Value is measured by the utility (benefits or satisfaction) that people derive from all active and passive uses of the resources. Dollar measures of value are not required for value-to-value scaling.

4. See also 15 CFR § 990.53(d) for additional discussion of value-based scaling concepts and methods.

In this study we focus on restoring all human use losses, including *active use losses* related to well-identified active, and often on-site, resource uses such as recreational fishing, and *passive use losses* arising from services individuals receive from resources apart from their own readily identified and measured active uses. [5]

Certain active use losses may be cost-effectively and readily individually measured and valued, as the Co-trustees have done for recreational fishing active use losses (see Breffle et al., 1999). However, focusing solely on these losses omits consideration of other potentially significant losses, thus understating the services to be restored. This TVE study is a total value assessment because it addresses most or all PCB-caused service flow losses, including but not limited to recreational fishing and other recreational losses such as waterfowl hunting and wildlife viewing; casual or indirect losses such as reduced enjoyment while driving or walking by or working near a site, and when hearing about, reading about, or seeing photographs of a site; and option and bequest losses tied to preserving resource services for future use for oneself or for others.

Value-to-cost scaling can be used to select the type and scale of restoration projects such that their cost equals the value of the lost services. This is the same as computing compensable values [CFR 43 § 11.83-11.84] and applying the recovered damages to selected restoration projects [43 CFR § 11.93 (b)]. This study supports the selection of the mix and scale of restoration projects once damages are recovered by identifying project preferences and the relative value of alternative mixes of projects. While not the primary focus of this study, the study can provide a measures of *compensable values* for interim losses from 2000 until services are returned to baseline using a WTP measure [43 CFR §11.83(c)(2)].[6,7]

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5. Some authors use different terms to refer to these concepts, or define the terms slightly differently. These differences generally have little substantive impact when the focus is on restoring all human use losses. These terms are consistent with the DOI regulations, where passive use losses include nonuse losses such as bequest and existence losses.

6. *Compensable values* include "the value of lost public use of the services provided by the injured resources, plus lost nonuse values such as existence and bequest values" [43 CFR § 11.83(c)(1)].

7. The values provided in this study could also be used to support value-to-value scaling of the compensable values for the total interim recreational fishing losses (Breffle et al., 1999) to the value of the restoration programs addressed here.

1.4 Approach

Survey of preferences and values

To obtain public preferences and values, a survey was conducted with residents of 10 Wisconsin counties surrounding the Wisconsin waters of Green Bay. The survey focuses on four groups of natural resource restoration programs for the Green Bay area. Over 600 restoration projects for the assessment area were compiled and analyzed, with a large majority of the proposed projects falling into one of these groups (see Chapter 2). The levels of restoration considered for each of the four program groups were selected reflecting relevant technical options and responses from respondents in survey focus groups and pretests.

1. *Restore wetlands* near the waters of Green Bay. Wetlands restoration will provide increased spawning and nursery habitat and increased food for a wide variety of fish, birds, and other wildlife. This provides wildlife services similar to, but not the same as, those injured by PCBs. Preferences and values for restoration of wetlands can also be applied as an indicator of the preferences and values for preventing further wetland loss and for other habitat enhancement projects. Restoration levels range from taking no action up to a 20% increase in wetlands within five miles of Green Bay within Wisconsin (although selected wetlands for restoration could also be located in Michigan).

2. *Remove PCBs* in the sediments of the assessment area. Removal of PCBs will reduce the number of years until FCAs and the injuries to wildlife are eliminated. The levels of removal considered result in the number of years until PCBs are at safe levels (i.e., a return to baseline conditions) ranging from 100 years (no additional removal) to 20 years with intensive remediation.

3. *Enhance outdoor recreation* in 10 counties surrounding Green Bay. Enhanced recreation includes increasing facilities at existing parks such as adding picnic grounds, boat ramps, and biking and hiking trails, and developing new parks. These facilities provide recreation services, although not the same services as those affected by the PCB-caused losses. The levels of recreation enhancements considered range from no improvements up to a 10% increase in facilities at existing parks and a 10% increase in new park acreage.

4. *Reduce runoff* that contributes to pollution of the waters of Green Bay. Controlling runoff improves water quality by lessening algae growth and improving water clarity, especially in the lower bay. This improves aquatic vegetation and habitat for fish and some birds and improves recreation. Runoff control in this case provides similar, but not the same, services as those injured by PCBs. The runoff control levels considered range from no change in the amount of runoff up to a 50% reduction, reflected by changes in water quality measures.

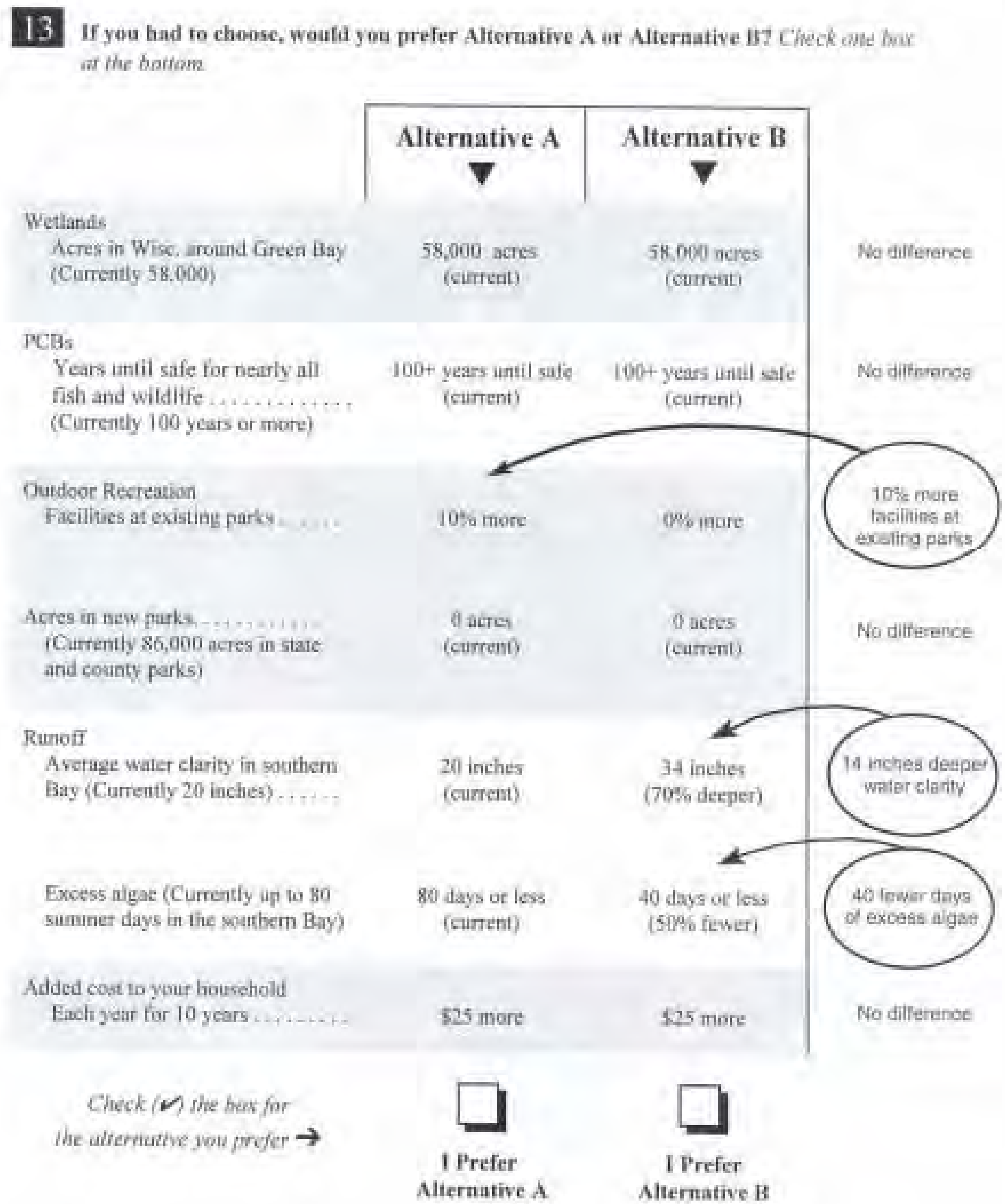
This TVE study is designed to support restoration planning by providing a large-scale perspective of public preferences across alternative types of restoration programs, and providing a method to scale programs that provide equivalent value to the service flow losses. The study is not intended to provide a selection of individual projects such as specific wetland acres or specific recreational facilities. That task is left to Co-trustees and regional planners who have a detailed knowledge of needs, technical effectiveness, and cost-effectiveness.

The survey describes each of the four natural resource restoration programs and asks a variety of questions to elicit preferences about the programs and the program levels. Next, the survey includes six stated preference choice questions, where respondents state their preferences by choosing which of two alternatives (A or B) they prefer, where each alternative has a specified level for each of the four restoration programs.

Figure 1.2 provides an illustration of the choice questions presented to respondents. In this question respondents are making a choice between enhanced outdoor recreational facilities at existing parks and increased levels of runoff control. By varying the program mixes and levels across questions and examining the choices made, mathematical methods (knows as random utility models) are used to determine how much of one kind of restoration has equivalent value to different amounts of other kinds of restoration.

The alternatives, and the choice between alternatives, are designed to reflect realistic and meaningful options for natural resource management in the study area. To present realistic choices, each of the alternatives includes a dollar cost to the household associated with the alternative. The dollar values presented differ across choice pair, and across survey versions, which allows for calculation of the public's WTP for the value of PCB-caused losses, or compensable values (see Chapter 5), and for the natural resource enhancements considered.

The TVE survey was implemented through a mail survey of a stratified random sample of households in 10 counties near Green Bay. Of the 650 eligible respondent households, 470 responded, resulting in a 72% response rate. An evaluation of the sampling plan and responses indicates that any potential sampling and response biases are likely to be small and thus have a minimal impact on the results (see Chapter 3 for further discussion of potential sampling and response biases).



13 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	Alternative B ▼	
Wetlands Acres in Wisc. around Green Bay (Currently 58,000)	58,000 acres (current)	58,000 acres (current)	No difference
PCBs Years until safe for nearly all fish and wildlife . . . . (Currently 100 years or more)	100+ years until safe (current)	100+ years until safe (current)	No difference
Outdoor Recreation Facilities at existing parks	10% more	0% more	10% more facilities at existing parks
Acres in new parks. . . . . (Currently 86,000 acres in state and county parks)	0 acres (current)	0 acres (current)	No difference
Runoff Average water clarity in southern Bay (Currently 20 inches)	20 inches (current)	34 inches (70% deeper)	14 inches deeper water clarity
Excess algae (Currently up to 80 summer days in the southern Bay)	80 days or less (current)	40 days or less (50% fewer)	40 fewer days of excess algae
Added cost to your household Each year for 10 years	$25 more	$25 more	No difference
Check (✔) the box for the alternative you prefer →	☐ **I Prefer Alternative A**	☐ **I Prefer Alternative B**	

Figure 1.2. Sample choice question.

Remediation scenarios

This TVE study determines what level of enhancements in the selected natural resource programs has a value that is equivalent to the value of PCB-caused losses over various time periods for alternative remediation scenarios. Figure 1.3 illustrates how ongoing PCB-caused losses depend on the rate of remediation f services. In the figure, Area A represents past losses experienced before remediation begins at the site (assumed to be 2000); these losses are not addressed in this TVE study. Area B reflects an assumption of a 10 year period (2000-2009) for remediation actions during which time limited, if any, recovery may occur. Areas C-F are ongoing losses after remediation (if any), depending on the level of remediation. We consider several scenarios:

1. *Intensive remediation.* This scenario assumes that losses continue largely unabated during the remediation period (Area B), then linearly decline to baseline over another 10 years (Area C) for a total of 20 years of ongoing losses. This scenario reflects the Fox River Global Meeting Goal Statement (FRGS-97) by the Fox River Global Meeting Participants (1997), and is similar to the more intensive remedial actions being considered in the Remediation Investigation and Feasibility Study (RI/FS, ThermoRetec Consulting, 2000a,b).

2. *Intermediate remediation*. This scenario assumes that losses continue largely unabated during a 10 year remediation period (Area B), then linearly decline to baseline over another 30 years (Areas C + D) for a total of 40 years on ongoing losses (10 + 30). This scenario is similar to the intermediate remediation scenarios in the RI/FS.

3. *Little or no additional remediation*. These scenarios consider limited remediation over 10 years (Area B), resulting in declining losses over either (a) an additional 60 years (Areas C + D + E) for a 70 year total (10 + 60), or (b) an additional 90 years (Areas C + D + E + F) for a 100 year total (10 + 90).

The TVE study design allows the calculation of the scale of restoration to provide services of equal value to the value of PCB-caused losses through time, or to a portion of the losses through time, such as between a 20 year intensive remediation and a 40 year intermediate remediation (Area D in Figure 1.3).

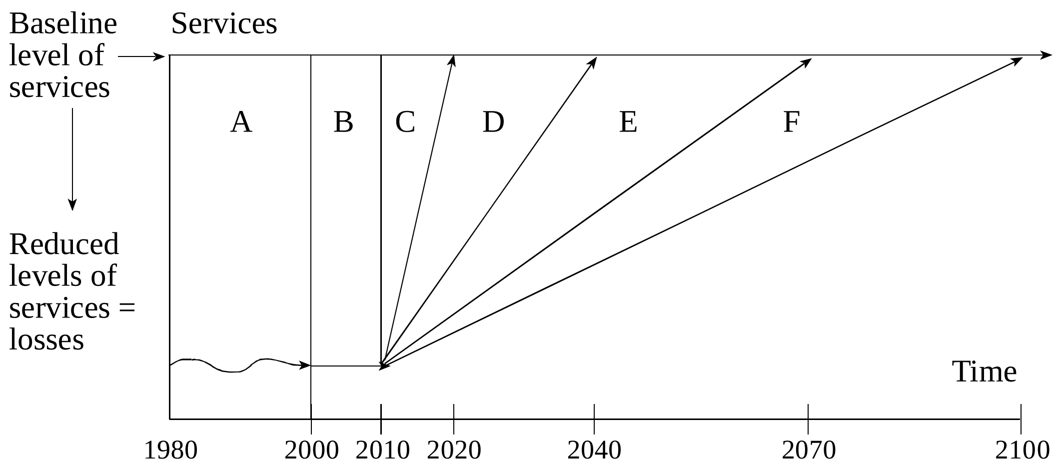


Figure 1.3. PCB-caused service flow losses under alternative time paths for a return to baseline.

1.5 Summary of Results

Awareness and preferences

Respondents were asked how aware they were of each of the four natural resource topics presented (wetlands, PCBs, outdoor recreation, and runoff control) before receiving the survey. Respondents reported being moderately to highly aware of the topics, with over 80% reporting they were somewhat to very aware of each topic. The literature identifies that higher awareness can be expected to enhance the reliability of responses and to reduce the burden of communication in survey design. High levels of awareness of a topic most likely reflect personal interest in the topics and increased preference for, and values for, natural resource restoration.

Various questions address respondent concerns and preferences for the four programs and the service flow benefits they provide. There is a strong and statistically significant preference for PCB removal over other natural resource enhancement programs, even though efforts were taken to ensure that PCB removal was treated in the survey on an equal basis with the other natural resource restoration programs (see Chapter 2). Relative to PCB removal, runoff control and wetland enhancements have modest interest and values. Limited interest is expressed in enhancing 120 regional parks, and almost no interest is expressed in adding new regional parks. Table 1.1 summarizes the importance ratings for the benefits from each program. Table 1.2 summarizes preferences in terms of doing and spending less, the same, or more, compared to current levels, for each program in the future.

Table 1.1. Importance of natural resource action benefits (1 = not at all important to 5 = very important).

Benefits[a]	**Mean importance ranking (SE of mean)**
Remove PCBs to reduce risks to birds, fish, and other wildlife	4.3 (0.05)
Remove PCBs so that it is safe to eat fish, and waterfowl	4.3 (0.05)
Reduce runoff to improve water clarity	4.0 (0.05)
Increase wetland acreage to support birds, fish, and other wildlife	3.9 (0.05)
Reduce runoff to reduce algae blooms	3.8 (0.05)
Add facilities at existing parks	3.6 (0.05)
Add new parks	3.3 (0.06)

a. Listed in order of mean importance score, not in the order they appear in the survey.

Table 1.2. Preferred actions for natural resource programs.

Natural resource programs[a]	**Do less and spend less**[b]	**Do and spend the same**	**Do more and spend more**
PCB investigations and removal	NA[c]	17%	83%
Runoff reduction	2%	34%	65%
Wetlands maintenance and/or restoration	3%	42%	56%
New facilities at existing parks and/or opening new parks	2%	51%	47%

a. Listed in order of mean importance score, not in the order they appear in the survey.
b. Percentages are adjusted to remove missing responses, which amount to less than 2.4% for all questions and may not sum to 100% due to rounding.
c. Not applicable: "Do less and spend less" was not offered as an option for PCBs.

The reported preferences vary by household characteristics. For example, households report higher importance for the benefits of a program, and interest in doing more and spending more, if they have anglers active in fishing the waters of Green Bay, if they live very near Green Bay, and if they were previously very aware of the natural resource topic.

Scaling restoration

The results of the choice questions, which trade off enhancements in natural resource programs, demonstrate that respondents predominately answer in a manner consistent with our expectations: more enhancements are preferred to fewer enhancements, and lower costs are preferred to higher costs. These results support the reliability of the results.

The resource trade-off questions are used to scale combinations of resource restoration programs that would provide services that the public considers to be equivalent in value (measured in utility) to eliminating the continuing PCB-caused losses. While the final mix and scale of restoration programs will be determined later, the model presented here provides a basis upon which to scale alternative restoration programs. The costs for the selected restoration programs are addressed in the Co-trustees' Restoration Compensation Determination Plan (RCDP).

Table 1.3 provides examples of the scale of sample mixes of restoration projects that provide services with value equal to the ongoing PCB-caused losses for selected scenarios. Each line represents one possible mix of restoration projects. The listed examples are but a few of the infinite number of possible combinations that the Co-trustee Council and potentially responsible parties could develop to provide services of equal value to the PCB-caused losses. The first three lines provide example combinations for the scale of restoration providing services of value equal to the PCB-caused losses from 2000 until a return to baseline if an intensive level of remediation returns services to baseline by 2020:

- A combination of 3,100 acres of wetlands restoration, plus a 10% enhancement in existing park facilities, plus a 50% runoff control program
- A combination of 5,500 acres of wetlands restoration, plus an 8% increase in existing park facilities, plus a 45% runoff control program
- 11,000 acres of wetlands restoration, plus a 45% runoff control program.

The second block provides examples for the 40 year intermediate level of remediation. The third and fourth blocks provide examples of the scale of restoration that provides services of value equal to a portion of the PCB-caused losses corresponding to the differences between a 20 and 40 year remediation and between a 20 and 70 year remediation.

Table 1.3. Illustration of restoration scaling.

	Example mixes of restoration programs		
Scenario	**Wetland restoration acres**[a]	**Existing park enhancement**	**Runoff control**[b]
PCB remediation scenarios[c]			
Intensive: (0 to 20 years)	3,100	10%	14”/50%
	5,500	8%	12”/45%
	11,000	0%	12”/45%
Intermediate: (0 to 40 years)[d]	24,100	10%	16”/55%
	16,000	20%	16”/55%
Partial restoration			
Intensive vs. 40 year Intermediate (20 to 40 years)	2,900	2%	4”/25%
	5,000	3%	2”/13%
	2,400	0%	7”/33%
Intensive vs. 70 year Intermediate (20 to 70 years)	5,700	0%	14”/50%
	13,000	10%	10”/40%

a. Rounded to nearest 100 acres.

b. Additional inches of water clarity/percentage decrease in number of excess algae days.

c. Restoration is for PCB-caused losses during the period indicated.

d. Requires extrapolating beyond the range of actions considered for some or all programs.

These illustrations do not include additional acres of new parks as a restoration approach because acres of new parks in the 10 county area was found to have a near-zero value. A few key findings emerge as applicable to the ultimate selection and scaling of restoration alternatives within the identified three project types (wetlands, outdoor recreational facilities, and runoff control):

- Wetland (and likely other wildlife habitat) restoration programs and runoff control programs are preferred to, and more highly valued than, programs to enhance outdoor recreation in the assessment area. While specific outdoor recreation enhancements would benefit some residents, the majority of residents indicated limited interest in additional facilities and parks.

- Continued increases in the levels of wetland restoration programs increase benefits, but at a declining rate. That is to say, there are diminishing marginal utility gains as more wetlands are restored. As a result, increased restoration well beyond the levels addressed in the study will most likely result in limited additional benefits to the public.

- The value of PCB-caused losses is so substantially larger than the value of service flow benefits from the restoration programs that it is difficult to generate benefits equivalent in value to the PCB-caused losses with just improvements in one program. For instance, a widespread improvement in regional parks provides services that are equal in value to value of the first few years of PCB-caused losses, a 20% increase in wetland acres provides services with value equal to about the first seven years of PCB-caused losses, and a 50% additional runoff control provides services with value equal to about the first 15 years of PCB-caused losses. Therefore, to provide sufficient restoration with value equal to the value of ongoing PCB-caused losses until a return to baseline will likely require a combination of several programs.

- The restoration combinations presented in Table 1.3 consider up to a 40 year time horizon for eliminating PCB injuries because even the maximum combination of the wetlands, outdoor recreation, and runoff control programs considered do not provide enough service flow benefits to be equivalent to eliminating PCB losses more than 40 years more quickly. To provide services flow benefits for PCB-caused losses beyond 40 years would required additional natural resource programs, or variations on the programs addressed herein.

Double counting and comparison to other studies

The WTP value measures for interim losses estimated in this TVE study can be used to eliminate double counting in the final damage determination and to compare the results here with other existing literature.

This TVE study differs from, but necessarily partially overlaps, the Co-trustees' recreational damage determination (Breffle et al., 1999) because both include a portion of the recreational fishing losses due to PCB-caused fish consumption advisories. The WTP results of the TVE and recreational fishing studies can be compared for those households with Green Bay anglers in the 10 nearby Wisconsin counties. For this comparison population, the WTP values in this TVE study are comparable to or slightly larger than the WTP values in the recreational fishing study. This is as expected because this study values a larger set of losses than does the recreational fishing study, although for households with Green Bay anglers, fishing losses may well be the dominant component of PCB-caused losses. The comparability of the results supports the estimated magnitude of damages in each study, and allows double counting between the studies to be readily addressed (see Section 6.3.3).

The results of this study are also consistent with other existing literature specifically addressing social preferences and values for PCBs and other natural resource management programs in northeastern Wisconsin (see Appendix D). Existing literature consistently identifies that regional residents are aware of and concerned about water pollution issues, and place a high priority and value on cleaning up contaminated water resources. While the existing literature does not address the same scenarios as in this TVE study, allowing for differences in the scenarios, the preferences and WTP values calculated in this TVE study are of a consistent magnitude with those found in the literature.

2. Survey Design

Section 2.1 provides an overview of the survey instrument, key survey design considerations influencing why we selected the stated preference choice-question approach, and how we designed the survey. Section 2.2 provided a detailed discussion of the individual elements of the survey.

2.1 Survey Design Overview

2.1.1 Background

To support the restoration planning objectives of this study, the survey needed to address the range of the most relevant restoration alternatives. Therefore, we first developed a database of potential restoration projects, drawing on work completed by many groups in the Green Bay area (Hagler Bailly Services, 1998). The database merged the specific project recommendations made in the 1988 Lower Green Bay Remedial Action Plan for the Lower Fox River and Lower Green Bay Area of Concern (WDNR, 1988), projects from the 1994 Green Bay Habitat Restoration Workshop Summary (WDNR, 1994), and projects that in various documents were developed, gathered by, and presented to the WDNR Habitat Restoration Workgroup (the Boronow Group), which worked during 1997 and 1998. The Potential Restoration Projects Database contains over 600 individual projects or ideas.

Most of the identified restoration projects could be placed into one of four broad natural resource topic areas. Working with scientists, for each topic area we next developed technical information about current conditions, and about the types of benefits that could be obtained from restoration projects. The levels of restoration to be considered in the survey for each topic area were selected reflecting technical options and responses from respondents in survey focus groups and pretests (see Section 2.2.2). The four natural resource restoration topics, along with their related service flows and range of restoration levels are as follows:

1. *Restoration of wetlands* near the waters of Green Bay. Wetlands restoration will provide increased spawning and nursery habitat and increased food for a wide variety of fish, birds, and other wildlife. This provides wildlife services similar to, but not the same as, those injured by PCBs. Preferences and values for restoration of wetlands can also be applied as an indicator of the preferences and values for preventing further wetland loss and for other nonwetland habitat enhancement projects. Restoration levels range from taking no action up to a 20% increase in wetlands within five miles of Green Bay in Wisconsin (although selected wetlands could also be located in Michigan).

2. *Removal of PCBs* in the sediments of the assessment area. Removal of PCBs will reduce the number of years until FCAs and the injuries to wildlife are eliminated. The levels of removal considered result in the number of years until PCBs are at safe levels (i.e., a return to baseline conditions), ranging from 100 years (no additional removal) to 20 years.

3. *Enhance outdoor recreation* in 10 counties surrounding Green Bay. Enhanced recreation includes increasing facilities at existing parks such as adding picnic grounds, boat ramps, and biking and hiking trails, and developing new parks. These facilities provide recreation services, although not the same services as those affected by the PCB-caused losses. The levels of recreation enhancements considered range from no improvements up to a 10% increase in facilities at existing parks and a 10% increase in new park acreage.

4. *Reduce runoff* that contributes to pollution of the waters of Green Bay. Controlling runoff improves water quality by lessening algae growth and improving water clarity, especially in the lower bay. This improves aquatic vegetation and habitat for fish and some birds and improves recreation. Runoff control in this case provides similar, but not the same, services as those injured by PCBs. The runoff control levels considered range from no change in runoff up to a 50% reduction, reflected by changes in water quality measures.

After describing the topics and restoration program levels, the survey included six stated preference choice questions, where respondents stated their preferences across restoration types and levels. Figures 1.2 and 2.1 provide illustrations of two examples of choice questions.

- In Figure 1.2, respondents were asked to make a choice between two restoration alternatives: enhanced outdoor recreational facilities at existing parks in Alternative A or increased levels of runoff control in Alternative B. In both alternatives, household costs increase by $25 per year for 10 years.

- In Figure 2.1, respondents were asked to make a choice between a restoration alternative or remaining with the status quo: PCB removal resulting in a reduction to 40 years until PCBs are safe, at a per household cost increase of $200, in Alternative A, or no additional resource enhancements and no additional household costs in Alternative B.

The restoration levels for the four programs and the associated household costs are varied across the alternatives in each question and across the questions. By examining the choices made, mathematical methods (knows as random utility models) are used to determine how much of one kind of restoration has equivalent value to different amounts of other kinds of restoration, and to compute the WTP value of ongoing PCB-caused losses and of the restoration alternatives.

14 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands Acres	58,000 acres (current)	58,000 acres (current)
PCBs Years until safe for nearly all fish and wildlife	40 years until safe (60% faster)	100+ years until safe (current)
Outdoor Recreation Facilities at existing parks.	0% more	0% more
Acres in new parks	0 acres (current)	0 acres (current)
Runoff Average water clarity in the southern Bay	20 inches (current)	20 inches (current)
Excess algae days in lower Bay . .	80 days or less (current)	80 days or less (current)
Added cost to your household Each year for 10 years	$200 more	$0 more
Check (✔) the box for the alternative you prefer ➔	❑	❑

Figure 2.1. Typical choice question.

2.1.2 Selection of the stated preference choice-question survey approach

Generally, two broad classes of approaches are often used to evaluate preferences and values for natural resource changes: stated preference (SP) approaches and revealed preference (RP) approaches.[1] SP approaches use survey questions to have respondents explicitly or implicitly state their preferences and value. In a very simple SP approach, respondents could be asked, "When fishing in this area do you prefer fishing for perch, or fishing for catfish?" or "Would you pay $5 to launch your boat in these waters?" In contrast, an RP approach examines behavioral choices that have been made, and which are observed in markets or reported by respondents in surveys, to infer preferences and values. In our simple example, RP data might find that most anglers in the area fish for perch and few fish for catfish, and thus we reveal that for the current conditions there is a preference for perch fishing; and RP data might find that most boat anglers will pay $5 to launch their boat at the site rather than fish elsewhere, or would fish elsewhere.

We selected the SP approach because it would cost-effectively provide the most comprehensive, valid, and accurate information to support the restoration planning objectives of the study.[2] A stated preference survey can be more comprehensive because it can measure preferences and values (in utility or dollars) for more PCB-caused service flow losses, and for most or all of the service flow gains from a restoration alternative. Another strength of the SP approach is that the researcher can measure public preferences and values directly relevant to all levels of all four restoration alternatives being considered for the site of interest, including restoration providing service levels that do not currently exist, thus obtaining valid and accurate information (Morikawa et al., 1990; Louviere, 1996).

We judged that using RP approaches would not sufficiently serve the study objectives. RP approaches could be cost-effectively applied, or applied at all, for only a limited number of PCB-caused losses, such as for recreational fishing (such as in Chen and Cosslett, 1998; Herriges et al., 1999; and Breffle and Morey, 2000), and for only a limited number of the service flow benefits for a few of the restoration alternatives of interest (such as for selected recreational activities). RP approaches would not be cost-effective for many types of active uses related to enjoying a site and generally could not be used to reveal values for some service flows, including passive uses and cultural uses.

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1. See, for example, Kopp and Smith (1993), Freeman (1993), Adamowicz et al. (1994), Breffle et al. (1999), and the U.S. DOI NRDA regulations at 43 CFR § 11.83(c). Some authors use different terms to refer to these methods.

2. *Comprehensive* refers to covering all or a large set of the service flow losses and gains, for all or a large set of the restoration options of interest. *Valid* refers to measuring the specific variable of interest, without bias, rather than measuring a close but different variable or measuring the variable with bias. A*ccuracy* refers to measuring the variable with reasonable precision.

Even for the service flows that RP approaches could cost-effectively measure, RP approaches would not be able to reliably and accurately measure values for many of the restoration alternatives of interest because some alternatives enhance natural resources in ways that do not currently exist in the assessment area. Therefore, relevant behavioral data for the assessment area to measure preferences and values does not exist. In some cases, RP information can be used from other comparable sites, or the same site in prior years, to learn about preferences and values for some of the service flows of interest, but generally the ability to comprehensively, reliably, and accurately measure current preferences and values relevant to the unique assessment area is limited.

Using RP data as the primary approach would have the undesirable effect of understating PCB-caused losses and limiting the evaluation to the types and levels of restoration alternatives to those that may not be of the most interest and value. Thus, for a comprehensive assessment, SP studies would be required. Conducting additional RP studies, beyond the recreational fishing damage determination and in addition to the required SP study, would not be cost-effective because of the limited coverage of restoration alternatives and service flows that RP studies could provide.

2.1.3 Choice-question method as an established method

We selected a choice-question method because the method is established in the literature, and can be designed to cost-effectively and directly assess the study objectives for the specific types and levels of PCB-caused losses and restoration alternatives of relevance.

Choice questions evolved from conjoint analysis, which has been extensively used in marketing and transportation research.[3] Choice questions have come into widespread use in environmental economics. For example, Magat et al. (1988) and Viscusi et al. (1991) applied SP data to estimate the value of reducing health risks; Adamowicz et al. (1994, 1997) and Morey et al. (1999a) applied it to estimate recreational site choice models for fishing, moose hunting, and mountain biking, respectively; Breffle et al. (1999) used it to value changes in recreational fishing; Adamowicz et al. (1998) used it to estimate the value of enhancing the population of a threatened species; Layton and Brown (1998) used it to estimate the value of mitigating forest loss resulting from global climate change; Morey et al. (1999b) applied SP data to estimate WTP for monument preservation in Washington, DC; Swait et al. (1998) compared prevention versus compensation programs for oil spills; and Mathews et al. (1997) and Ruby et al. (1998) asked anglers to choose between two saltwater fishing sites as a function of their characteristics. Breffle et al. and Mathews et al. were NRDA applications.

3. For survey articles and reviews related to use in marketing, see Louviere (1988, 1992, 1994), Green and Srinivasan (1990) Batsell and Louviere (1991); and for use in transportation planning, see Hensher (1994).

A number of additional applications to environmental topics have used a rating variation of choice questions, in which survey respondents rate the degree to which they prefer one alternative over the other. For example, Opaluch et al. (1993) and Kline and Wichelns (1996) develop a utility index of the characteristics associated with potential noxious facility sites and farm land preservation. Johnson and Desvousges (1997) estimate preferences and WTP for various electricity generation scenarios and related environmental and social impacts.[4]

We chose to use choice questions rather than the rating variation of choice questions and to limit the choice to two alternatives. Choice questions mimic the real choices individuals continuously make, whereas individuals rank and rate much less often.[5] And choice questions among two options are easier, thus reducing the burden on our respondents while still providing information sufficient for the study objectives.

The use of the choice-question method in this natural resource damage assessment is consistent with U.S. DOI NRDA regulations [43 CFR § 11.83(c)(3)]. The choice-question methods used here combine elements of random utility models used in recreation assessment and stated preference methods, which are identified as acceptable methods in the U.S. DOI regulations [43 CFR § 11.83(c)(3)]. Choice-question methods are explicitly identified (under the name "conjoint methods") in the NOAA NRDA regulations for use in value-to-value scaling of restoration alternatives (15 CFR Part 990, preamble Appendix B, part G), which is supported in Mathews et al. (1995, 1997).

2.1.4 Key design considerations

Once we had chosen a survey based choice-question approach, our attention turned to strategies to design and implement a state-of-the-art application. To provide valid and accurate preferences and values, our SP survey incorporates general survey design considerations as described in several standard works, including Dillman (1978, 2000), Shuman and Presser (1996), and Tourangeau et al. (2000). In addition, we addressed survey design considerations that are specific to all SP surveys (Mitchell and Carson, 1989; Kopp et al., 1997) and to choice-question application of SP surveys. In this section we discuss selected key survey design considerations.

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4. Other examples include Rae (1983), Lareau and Rae (1998), Krupnick and Cropper (1992), Gan and Luzar (1993), and Mackenzie (1993). Adamowicz et al. (1997) provide an overview of environmental valuation choice and ranking studies up to 1996. Dozens of new environmental economic applications are now occurring each year.

5. See, for example, Louviere and Woodward (1983), Louviere (1988), and Elrod et al. (1992).

Accurate, neutral, and accessible information

An important consideration to our design was to present accurate information in a neutral and accessible manner. Throughout the survey design we consulted with scientists and public officials to assure and document that all of the information presented in the survey provided accurate and balanced perspectives of the natural resource topics of interest.

Beyond accuracy in the scientific information, several actions were taken to assure the survey made a neutral presentation. These included not identifying the sponsor, but rather noting the usefulness of the results to government, industry, and citizen groups; assuring there was a consistent and equal presentation of each of the four natural resource topics addressed; and repeatedly recognizing that respondents may not place importance on the identified resource enhancements (e.g., "how important, if at all, . . ." and rather than assuming restoration would be preferred, including options such as "do less and spend less" and "do and spend the same").

In pretests, when respondents were asked for whom and why they thought the survey was being conducted, the most frequent answer was they did not know, second was that it involved the State of Wisconsin in its efforts to help evaluate what to do in the Green Bay area, and some respondents indicated that they thought the paper companies were sponsoring the research. While our focus was on restoration preferences and scaling for PCB-caused losses, focus group and pretest respondents indicated they thought that the survey had to do with all four resource topics and was not motivated by, or oriented to, consideration of PCBs or any of the other topics. When asked if they felt that the survey contained any bias for or against any particular issue, focus group and pretest respondents overwhelmingly indicated that they did not feel the survey was biased.

An important design consideration is to present the required information in a manner that is accessible to, and not a burden to, respondents; otherwise respondents may not complete any or all of the survey, and may be confused by information and provide unreliable and/or inaccurate information. In this survey, wherever possible, we present information at a basic level, and to facilitate reading the survey we carefully structured the information in consistent formats for each resource topic and in the choice questions. While considerable information is presented, simple questions and maps, graphs, and tables are interspersed among the text to break up the information, to be visually interesting, and to help the respondent think about the information as he or she progresses through the survey. The simple questions also provide useful attitudinal and demographic information. Again, focus groups and pretests were used to work on survey language and respondent ability to understand the survey and provide valid and accurate answers.

Context

A standard tenet of SP design is that if the SP context of the presentation and questions simulates real choices, and if the responses could have a real impact on the respondents, there is incentive for the respondents to provide answers that are a valid and accurate reflection of their preferences. In this survey, we present a realistic context that government, industry, and citizen group planners are examining options for natural resources in northeast Wisconsin. These issues have long and frequently received a high level of attention in the news in the assessment area. In fact, a large portion of respondents in the focus groups, pretests, and final instrument expressed awareness of, and concern about, the various natural resource topics being addressed. A large share of the residents in the area enjoy the natural resources of interest in one way or another, and thus changes in the resources would affect them. Often there are public meetings on these natural resource topics, and it is reasonable for citizens to accept that decision makers seek public input through a survey of this type, and that results will influence the selection of the types and levels of actions to be taken.

In most SP studies, the context of who will pay, and how, is a key design feature. While our study focused on restoration priorities and scaling of restoration, which did not require that we specify the costs, participants in focus groups quickly identified that consideration of who will pay and how was important to set a realistic context for the choices they were presented with: "Who is going to pay," or "I know we will have to pay some for these natural resource improvements, but industry, users, and farmers should pay their share" typify the types of comments received. These types of concerns also identify that respondents took the survey seriously.

Reflecting the concern about who pays and how, we included dollar costs to the household associated with each alternative. Dollar costs would be paid through a combination of federal, state, and local taxes, as most often occurs for these types of major natural resource programs. Dollar costs would be paid over a 10 year period, matching the implementation period identified for the projects. With these aspects added to the context, most respondents in focus groups and the pretest identified the choice questions as reasonable and meaningful. While the inclusion of dollar costs adds realism to the context of the presentation, by varying the costs across choice pairs and across survey versions, it also allows for calculation of the public's WTP for the value of PCB-caused losses (see Chapter 5), and for the natural resource enhancements considered.

Information presentation

Another consideration in any SP survey is that respondents have the information necessary for them to make informed choices (Fischoff and Furby, 1988). Choices that are poorly informed may result in inaccurate and potentially biased reflections of preferences. We addressed this consideration in two ways: by carefully selecting the information to be presented (and making sure it is accurate), and by limiting the population surveyed to those households near the site (see the section below on the choice of population to be surveyed).

One of the most important peculiarities of SP surveys, compared to surveys used for other purposes, is the amount of information that must be conveyed to, and understood by, respondents. Ideally, to make the best choices, people should be fully informed, but a goal of full information is impractical, would create an unnecessary respondent burden, and may even worsen the response rates and the quality of response. As identified by Fischoff and Furby (1988):

> Simply telling people everything provides no guarantee that they have understood everything. Such a strategy might even impede understanding if attention to critical features of the contingent market is diverted by a deluge of details about features that could have gone without saying because they have little practical effect on decisions.

What we strive for in designing SP surveys (and often in life) is information that is fundamental to the choice process; that is accurate, neutral, and realistic; and that is simple and straightforward to understand. In this specific SP instrument, we specifically identify the natural resource topics of interest and identify characteristics of current conditions, and changes in current conditions if natural resource programs are undertaken. Thus, we have specified the goods to be compared in the choice questions and, as discussed above, the context under which changes would occur.

A related informational consideration is the number of restoration alternatives, and their characteristics, to present. Clearly, as the number of details about restoration alternatives increase, it becomes more challenging for the respondent to understand, track, and trade off many characteristics, which increases the chance of confusion or focusing on only one or a few of the attributes (reducing accuracy), or dropping out (resulting in low response rates).

We chose to present four types of restoration program characteristics by seven index variables, as illustrated in Figures 1.2 and 2.1. Generally, a small number of characteristics is included so as not to overwhelm the respondent.[6] The respondent must understand each of the characteristics (in our case, programs and their benefits) and keep track of changes in each of the characteristics in both alternatives of a choice question.

6. For example, Opaluch et al. (1993) characterize noxious facilities in terms of seven characteristics; Adamowicz et al. (1997) use six characteristics to describe recreational hunting sites; Johnson and Desvousges (1997) use nine characteristics to describe social and environmental impacts of electricity-generation scenarios; and Mathews et al. (1997) use seven characteristics to describe fishing sites.

Our design asks respondents meaningful questions that support restoration planning by providing a large-scale perspective of public preferences across alternative types of restoration programs, and by providing information to scale programs that provide equivalent value to the PCB-caused losses. The study is not intended to provide a selection of individual projects such as which specific wetland acres to restore or specific recreational facilities to build. That task is left to Co-trustees and regional planners who have a detailed knowledge of needs, technical effectiveness, and cost-effectiveness.

The choice of the population to be surveyed

We limited the study to a "target population" of residents from a 10-county area near Green Bay and the Lower Fox River (Figure 2.2) and sampled from this population. Each county is located nearly entirely within 60 miles of Green Bay. Because of their proximity to the bay, individuals from these counties could be expected to be more active users of, and more familiar with, the natural resources in the Green Bay area than individuals from outside of the target population. For example, approximately 90% of all recreational fishing days in the waters of Green Bay (including the Lower Fox River and other tributaries up to the first obstruction) by Wisconsin residents are by anglers who reside in the 10 counties (Breffle et al., 1999). Respondent familiarity with the resources increases saliency and thus response rates and reduces the amount of information that must be presented in the survey. In addition, Shuman and Presser (1996) have argued that the more crystallized respondent attitudes and values are (which familiarity should support), the less important small context changes are likely to be in survey design.

Of course, people farther from Green Bay may have suffered damages from PCBs. Restricting our study to the 10 counties represented a compromise. Some losses would probably remain uncounted for the sake of greater accuracy of the losses that would be addressed (see Section 6.4 for additional discussion).

Choice of survey mode

The survey was designed to be conducted by mail, with a telephone survey of nonrespondents (see Chapter 3). On a general level there are three major modes for administering surveys: personal interview, telephone interview, and mail (Dillman, 2000; Tourangeau et al., 2000). Telephone interviews were rejected as the main survey mode because we concluded that we needed to present too much information to effectively convey over the phone without also mailing information to respondents, and thus increasing costs with limited demonstrated gain in the response rates and quality over a mail survey. Personal interviews with visual aids can be effective in communicating information for these types of surveys (Carson et al., 1992), but are very labor intensive to obtain the desired response rates and generally cost hundreds of dollars per completed interview. Both telephone and personal interview surveys can be beneficial when there is a need for interaction between an interviewer and respondent, such as to explain complex

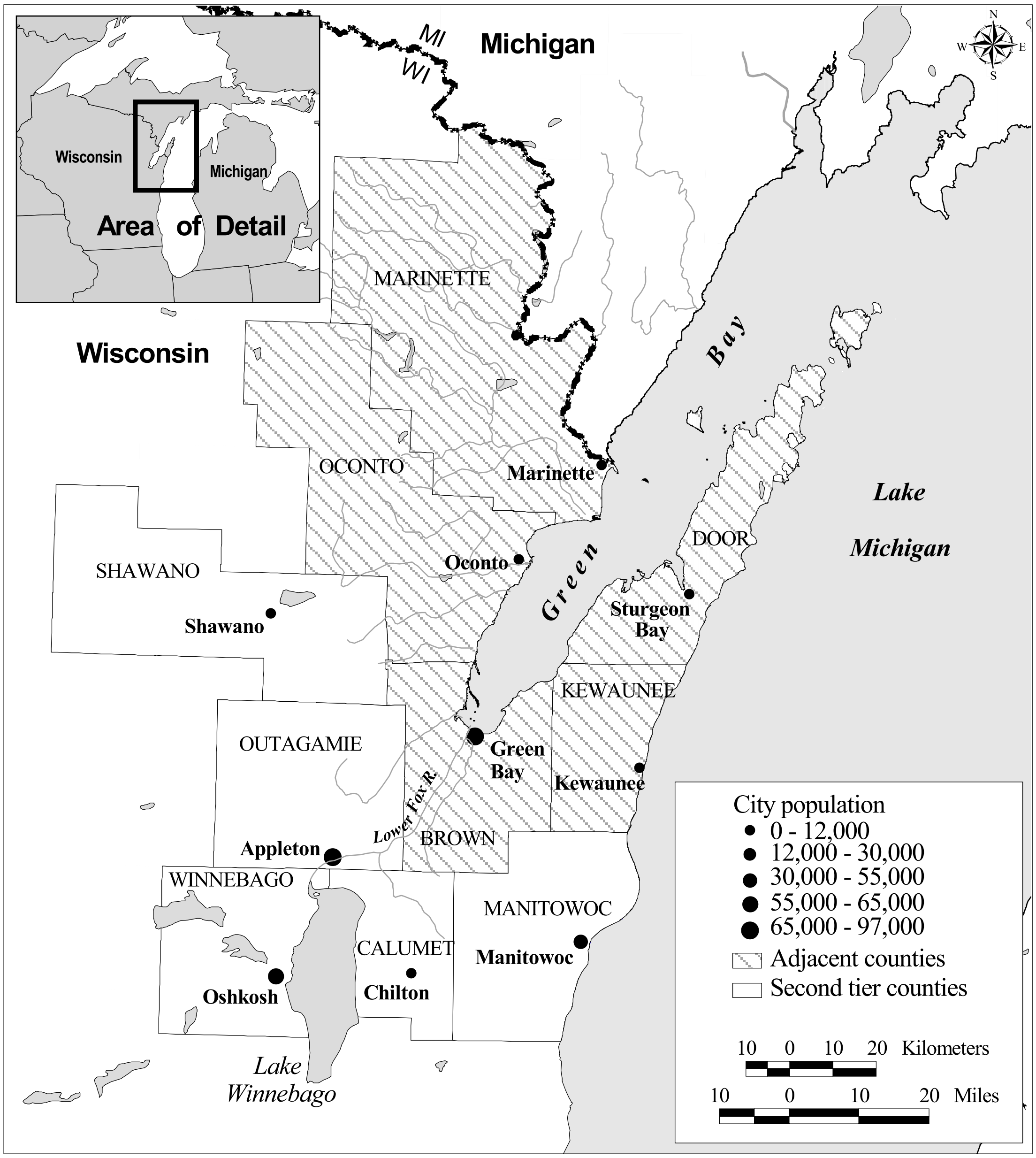

Figure 2.2. Target population counties.

information, or when the series of questions to be asked varies depending on the answers received as the survey progresses. However, the interpersonal communication in telephone and personal interviews is more likely to result in potential *social desirability biases,* wherein the respondents are more likely to provide what they consider to be socially desirable responses (Dillman and Tarnai, 1991; Whittaker et al., 1998; Ethier et al., 2000).

By limiting the sample to people in the 10-county area, and by careful design and pretesting, we reduced the burden of information communication substantially. Our statistical design for the key questions did not require the questions to be asked to vary depending on the responses to prior questions. Based on experience, and on repeated pretesting, we concluded that the required information could be successfully presented in a mail survey approach with high quality responses and high response rates, so long as respondents were provided a modest completion incentive of $15. As such, the mail survey approach was the most cost-effective approach to obtain high quality data.

Focus groups, pretesting, and peer review

An important aspect of survey design is to use focus groups and pretests to ensure that all material in the survey was clear and readable by members of the general public, that the information was presented so the context was meaningful and realistic to ensure neutrality of the survey, and that respondents are providing the information that researchers seek (e.g., the survey obtains valid information for the study objectives). The TVE survey instrument was developed and pretested through a series of eight focus groups and three rounds of in-person pretest interviews conducted in northeast Wisconsin with 182 subjects. The focus groups generally included 8 to 12 people in semi-structured discussions. In the pretests, the respondents completed draft survey instruments, and a research team member debriefed the respondent on the survey instrument and their answers. Table 2.1 indicates the date, site, activity, number of participants, and focus of the various survey development and pretesting steps.

To further assure that the survey reflected professional standards, the survey instrument was peer reviewed at various stages by Vic Adamowicz, Professor, Department of Rural Economics, University of Alberta; Don A. Dillman, Professor of Sociology and Rural Sociology and Deputy Director for Research of the Social and Economic Sciences Research Center at Washington State University in Pullman; and Roger Tourangeau, Senior Research Scientist at the Survey Research Center at the University of Michigan and Research Professor at the Joint Program in Survey Methodology at the University of Maryland.

Table 2.1. Green Bay total value equivalency survey focus groups and pretests.

Date	Site	Activity	Number of participants	Type of respondents	Focus	Investigators
4/29/98 and 4/20/98	Green Bay, Wisconsin	Four focus groups	34	General public	Assess familiarity with and terminology used to describe natural resource issues in NE Wisconsin	Jeff Lazo, Mike Welsh
9/22/98 and 9/23/98	Green Bay, Wisconsin	Four focus groups	42	General public	Explore strategies for using stated preference questions and to better understand the amount and type of information that was needed and could be provided	Jeff Lazo, Mike Welsh
6/9/99 and 6/10/99	Green Bay, Wisconsin	Self-administered w/debriefing	56	General public	Explore stated preference strategies and ways of describing the resource management options	Rich Bishop, Jeff Lazo, Sonya Wytinck
8/4/99	Green Bay, Wisconsin	Self-administered w/debriefing	36	General public	Pretest final survey instrument	Rich Bishop, Jeff Lazo
8/5/99	Oshkosh, Wisconsin	Self-administered w/debriefing	14	General public	Pretest final survey instrument	Rich Bishop, Jeff Lazo

2.2 Detailed Design

In this section we discuss the details of the four major sections of the survey:

1. introductory materials
2. introduction of the four natural resource management topics and programs
3. choice questions
4. follow-up questions including sociodemographic questions.

Table 2.2 outlines the final survey instrument and the general purposes of the questions. A copy of one version of the survey instrument is provided in Appendix A (the versions vary only by the levels of programs and costs in the choice questions, which is discussed below).

2.2.1 Introductory materials

Along with the survey instrument, respondents received a personalized cover letter. The sponsor(s) of the survey and the intended use of the results for restoration planning and damage assessment were not identified. The cover letter stated that the survey would help "representatives from government, industry, and citizen groups" determine "what should the priorities be for natural resource programs in Northeast Wisconsin?" This approach was adopted as part of our strategy to make the survey neutral with respect to the natural resource alternatives.

The introductory material identified the study area as northeast Wisconsin. This was reemphasized on the cover page with the title, "What Are Your Opinions About the Future of Natural Resources in Northeast Wisconsin," and a color map of the study area on the front page. When respondents opened the survey booklet, they found an introductory sentence stating that "Decision makers are examining options for natural resources in northeast Wisconsin." The inside front cover provided the definition of the "Bay of Green Bay" as "the waters of the Bay of Green Bay and all tributaries up to the first dam or obstruction" to focus respondents on resources issues related to the Bay.

Question 1 asked respondents how often they personally participate in activities related to the use of the resources on the waters and shorelines of the Bay of Green Bay. This question served as a simple beginning question, reinforced the location of interest, and elicited information on the respondents' natural resource uses to begin the cognitive process of thinking about how the resources relate to the respondent through their activities.

Table 2.2. Outline of Green Bay total value equivalency survey.

Section	Item or question	Purpose
Introductory materials	Cover letter	Provide information on the purpose and importance of the study.
	Cover page — map	Show the location of Green Bay, major cities and towns, tributaries, and first dam or obstruction. Identify the study area and indicate the general purpose of the survey to seek their opinions about the future of natural resources in the area.
	Inside cover	Define the term “Bay of Green Bay.”
	Question 1	Elicit information on participation in outdoor activities. Have individuals consider their uses of the natural resources around the Bay. Introduce the four natural resource topics addressed in the remainder of the survey.
Introduction to natural resource programs	Questions 2-3	Provide information on wetlands and the benefits from increased wetlands. Elicit the importance on increased wetlands benefits. Introduce levels of program options in terms of restoring wetlands.
	Questions 4-6	Provide information on PCBs and the benefits from PCB removal. Elicit the importance of PCB removal benefits. Introduce levels of removal, safe levels, and years of injury.
	Questions 7-9	Provide information on state and county parks and their facilities. Identify levels of enhancements and elicit importance of improved facilities and new park benefits. Introduce concepts and levels of programs for enhancing and enlarging state and county parks.
	Questions 10-12	Provide information on runoff (nonpoint source pollution) and the benefits from increased runoff control. Elicit importance of the benefits of runoff control. Introduce levels of programs to reduce runoff and its impacts in terms of water quality variables.
Choice questions	What alternatives do you prefer	Introduce the choice questions. Introduce and define the payment vehicle. Reiterate key information about each of the four resource topics.
	Questions 13-18	Implement the choice questions.
Follow-up and socio-demographics	Questions 19-22	Obtain information to assist in analyzing individuals’ responses to the choice questions.
	Questions 23-35	Obtain sociodemographic information.
	Question 36	Elicit additional open-ended comments on the survey.

2.2.2 Natural resource topics

The next section of the survey introduced each of the four natural resource topics in four separate two-page sections. Each natural resource topic was given consistent treatment so that none of the four topics stood out as being presented as more or less important than the others. The four sections followed a similar presentation, as outlined in Table 2.3 and discussed below.

Table 2.3. Format of the natural resource topic sections.

Natural resource topic	Define topic and related benefits	Describe historical trends and current status of resources for the topic, and elicit respondents' opinions on importance of enhancement benefits	Introduce possible levels of enhancement and respondents' attitudes on action	Provide supporting table or diagram on the natural resource topic and service flows
Wetlands	Introduction	Question 2	Question 3	Map of WI wetlands within 5 miles of the Bay of Green Bay
PCBs	Introduction	Questions 4 & 5	Question 6	Table of GB/LFR FCAs
Outdoor recreation	Introduction	Questions 7 & 8	Question 9	Map of state and county recreation areas
Runoff	Introduction	Questions 10 & 11	Question 12	Figure of water pollution from runoff

For each natural resource topic, the presentation began with information defining the resources in the topic area and other information found to be useful to respondents, such as historical trends and current status. The next questions identified the benefits associated with resource enhancements (or correspondingly the impacts of current conditions) and asked how important it was to the respondent, if at all, to undertake resource programs that would obtain these benefits. These questions again have respondents consider how the benefits relate, if at all, to their own interests. Each presentation was accompanied by diagrams or tables, which provided supporting information, and helped to sustain respondent interest and attention.

The last section for each topic gave more information about potential enhancement programs and program levels, identified a 10 year implementation period (which matches the subsequent 10 year payment period), and provided other program information. The questions then asked respondents if they felt that less, the same, or more should be done and spent on the resource enhancement programs. These questions continue the process of considering program benefits, especially relative to the added costs to undertake the programs.

In addition to providing useful information on their own, the responses to the importance and action questions in these sections also provide consistency checks against the results of the choice questions. We expected when we designed these questions that the relative importance of benefits from the natural resource programs, and desire to do or spend less, the same, or more on these types of programs, would be highly correlated with the results to the choice questions for all respondents as a whole and generally for each individual respondent.

Wetlands

The resource description focused on wetlands within 5 miles of the Bay of Green Bay and historical trends in wetland losses and related policies (Harris et al., 1977; Bosley, 1978; WDNR, 1988; Shideler, 1992). A distance of five miles was used to include the primary feeding range of bald eagles and other species living near the bay, and as an approximation of the distance up the tributaries where Green Bay fish spawn most often, thus making a strong connection to the injured natural resources and services. These wetlands were identified using GIS techniques (ESRI, 1998; WDNR, 1999a). It was stated that regulations now in place will effectively prevent further reductions in wetland acres (NRCS, 1990; USGS, 1996; WDNR, 1999c) to focus on the benefits of wetland restoration.

Question 2 identified wetland services such as habitats for fish, birds, and mammals and described the expected changes in wetland-dependent species if the quantity of wetlands increased (WDNR, 1979; Christie and Meyers, 1987; Brazner, 1997; Stratus Consulting, 1999a). Respondents were asked to indicate how important they felt it was to increase wetland acreage to support birds, fish, and other wildlife (e.g., to obtain program benefits).

Question 3 asked respondents whether they would prefer that less or the same be done and spent to maintain wetlands, or more be done and spent to restore wetlands. The “do more” option introduces information on options to restore wetlands and indicates that up to 11,600 acres could be restored. Based on a review of proposed restoration options, it seemed unlikely that significantly more than a 20% to 30% increase in wetland acreage would be likely. In addition, in focus groups and survey pretests, there was significantly diminishing interest in more than a 20% increase in wetlands.

PCBs

The industrial sources of PCBs in the Lower Fox River were identified (U.S. EPA, 1997) and it was pointed out that PCBs were banned from industrial use in the mid-1970s, which makes it clear that the issue is not one of stopping continued industrial releases (U.S. EPA, 1998). To identify how PCBs affect the environment and people, the survey identifies that PCBs have accumulated in the sediments of the Lower Fox River and the Bay of Green Bay and that birds, fish, and wildlife ingest PCBs through the food chain (WDNR, 1999b). Injuries were then described in terms of (1) FCAs, including an FCA summary table (U.S. EPA, 1996, 1999; WDNR, 1999b), and (2) harm to wildlife in and around Green Bay. The indicated magnitudes of risks to birds, fish, and other wildlife were based on several sources (Christie and Meyers, 1987; Matteson, 1988; Mossman, 1988; Matteson and Erdman, 1992; U.S. EPA, 1998; Stratus Consulting, 1999a, 1999b; ThermoRetec Consulting, 1999).

Questions 4 and 5 discussed the impact of PCBs on wildlife and potential human health impacts and asked respondents to tell us how important they felt PCB removal was, if at all, to them so that it is safe to eat fish and waterfowl, and to reduce harm to birds, fish, and other wildlife. Question 6 then asked them whether they would prefer that no further efforts go into PCB investigations and removal, or that more should be done to remove PCBs. To provide a single index of PCB injuries (or benefits from removal), the concept of years until PCBs are at safe levels was identified and defined: "By safe levels we mean there are no consumption advisories for, and no harm to, nearly all fish and wildlife." The question introduction and responses identified how long it will be until safe levels under alternative options, ranging from 100 years under the do-no-more options to between 20 and 70 years with some PCB removal (Stratus Consulting, 1999a). Also introduced are the 10 year removal implementation period and that damages would decline through time thereafter. " No "do less" option was offered since doing less removal (other than completing the demonstration projects) is not feasible.

Outdoor recreation

The quantity and distribution of state parks and natural areas and county parks (there are no national parks) in the 10 county region were described in the introduction and on the accompanying map in this section of the survey (ESRI, 1998; WDNR/GEO, 1998). Recreational sites throughout the 10 counties are widely accessible to residents, and many of these sites provide services similar to the types of recreational services affected by PCB contamination. We included all 10 counties to increase the likelihood that a respondent (from any of the 10 counties) would expect to experience benefits from the proposed enhancements (e.g., focus groups suggested that if only parks within two miles of the bay were included, many respondents from greater distances would have a lower likelihood of using the enhancements, and would most likely report lower importance and values for such a recreation program). We excluded city parks as many of these provide services (e.g., ball parks, playgrounds) dissimilar to the affected recreational services. Facilities offered at outdoor recreation sites were described (WLRB, 1997) as was the potential need for more facilities to meet future needs.

Questions 7 and 8 introduced the possibility of adding facilities at existing parks and opening new parks throughout the 10 county area, with the 10% enhancement level illustrated. Respondents were asked how important it was to them to improve existing parks and to add new parks. In Question 9, the 10 year implementation period was defined, and respondents were asked if they prefer less or the same be done and spent to maintain existing facilities, or more be done to add facilities and new parks. Note that only a 10% enhancement was considered because, in focus groups and pretests, most respondents expressed significantly diminishing and even zero interest in more than a 10% increase in recreational facilities.

Runoff

Sources of runoff to the Green Bay watershed, and the impacts of runoff on bay resources, were explained next (WDNR, 1988, 1993a, 1993b, 1996a, 1996b, 1997a, 1997b, 1997c; Harris, 1993). In response to what we heard in focus groups and pretest interviews, we identified how runoff can be reduced; pointed out that invasion of zebra mussels was leading to some improvements in water clarity, but that the future effects of the zebra mussel invasion were uncertain (Harris, 1993); and identified that runoff is not a source of PCBs and does not affect drinking water quality (Bierman et al., 1992). To improve respondents' understanding of runoff, an illustration provided a stylized river cross-section showing sources, transport, and impacts.

Question 10 discussed how, how much, and where nutrients in runoff lead to excess algae in Green Bay (Harris and Christie, 1987; Harris, 1993; Sachs, 1999), and asked respondents how important it is to them to reduce the number of days with excess algae in Green Bay. Question 11 discussed the impacts of sediments and algae on water quality, and the resulting impacts on aquatic habitat, fish, and birds (Sager et al., 1996). Because not all these effects could be quantified, water clarity was used as an index for these effects when asking how important it would be to reduce runoff to improve water clarity (and used in subsequent survey questions).

Question 12 stated that runoff control options would take 10 years to reach their goals and asked individuals if they prefer less, the same, or more be done and spent to control runoff. The "do the same" option reminded respondents that current water clarity averages about 20 inches in the summer and that there are currently about 80 days a year of excess algae in the southern Bay of Green Bay. The "do more" option specifies that potential control programs could lead to up to a 50% reduction in runoff, resulting in water clarity of 34 inches and 40 days a year of excess algae. The days of excess algae and inches of water clarity were estimated based on regression models of phosphorus and water quality in lower Green Bay using data provided by Dr. Paul Sager, University of Wisconsin-Green Bay, and summarized in Harris (1993).

2.2.3 Choice questions

Introduction

The choice questions were preceded by an introductory page "What Alternatives Do You Prefer?" which set the context for the choices to be made. The context included making choices among alternatives that enhance natural resources and that will cost more for the respondents' households beyond what they are now paying. To provide a credible scenario and to reduce scenario rejection since respondents often indicated that the responsible parties (industry, farmers) and specific/interest user groups should pay for these improvements, the survey indicated that "some costs will be paid by industry, farmers, and conservation organizations. But taxpayers may have to pay something as well." Household payments would be made through increases in local, state, and federal taxes. Consistent with the 10 year time period for each of the natural resource options to be implemented, a 10 year payment period was specified. Based on the focus groups and pretest interviews, we judged that this represented an acceptable and realistic payment vehicle and time frame to respondents.

To ensure that key features of the trade-off scenarios were clear, the choice section introduction reiterated key items of the natural resource programs, and the choice questions further identified how the proposed program levels compared to existing conditions. The first choice question also provided extended information, including describing the baseline conditions and identifying the specific differences between the two alternatives to aid in successfully working through the first question.

Choice question design

Each choice question includes a pair of alternatives, or a choice pair. Each alternative contains a specific combination of the levels of the four natural resource programs and costs to the respondent's household. The levels considered for each natural resource program, and household costs, are summarized in Table 2.4. The levels considered ranged from the current conditions to varying levels of improvement to current conditions (discussed above for each program). This reflects the objective of determining the level of restoration program enhancements that will provide services of equivalent value to the value of an enhanced PCB removal program. Further, we found in pretesting, as well as in the final results, that very few respondents preferred to do less and spend less on any one of the natural resource programs (typically less than 3%). If fact, except for increased recreational facilities and parks, the majority of respondents supported doing more and spending more on each of the programs (between 55% and 81%). However, for some or all programs, some respondents may prefer the status quo level of effort, spending, and benefits as compared to program improvements that cost them money. This potential is accommodated in the design of the questions (see "referendum pairs" below). The annual household costs ranged from $0 to $200. This range reflected focus group and pretest results and a desire to have a range that covered a substantial share of the likely range of values that households may have so as to reduce potential truncation bias that could bias downward the valuation results (Rowe et al., 1996).

Table 2.4. Green Bay equivalency value survey — attribute levels.

Attribute	Level 1	Level 2	Level 3	Level 4	Level 5
Wetlands					
Acres in Wisc. around Green Bay (currently 58,000)	58,000 acres (current)	60,900 acres (5% more)	63,800 acres (10% more)	69,600 acres (20% more)	n.a.
PCBs					
Years until safe (currently more than 100 years)	100 or more years (current)	70 years (30% faster)	40 years (60% faster)	20 years (80% faster)	n.a.
Outdoor recreation					
Facilities at existing parks	0% more (current)	10% more	n.a.	n.a.	n.a.
Outdoor recreation					
Acres in new parks (currently about 86,000 acres in state and county parks)	0 (current)	4,300 (5% more)	8,600 (10% more)	n.a.	n.a.
Runoff					
Average water clarity in southern Bay (currently 20 inches)	20 inches (current)	24 inches (20% deeper)	34 inches (70% deeper)	n.a.	n.a.
Excess algae (currently up to 80 summer days in the southern Bay)	80 days or less (current)	60 days or less (25% fewer)	40 days or less (50% fewer)	n.a.	n.a.
Added cost to your household					
Each year for 10 years	$0	$25	$50	$100	$200

The alternatives were designed and combined into choice pairs to obtain sufficient independent variation in the attributes to statistically identify the separate influence of each attribute on the choice of Alternative A or Alternative B. The survey was designed to include six choice pairs to limit potential respondent fatigue associated with answering repetitive questions. Ten sets of choice pairs (i.e., 10 survey versions) were designed to obtain sufficient variation in choice pairs for statistical analysis. Thus, a total of 60 alternatives were designed (10 sets with 6 pairs each).

Given the number of characteristics and the levels they can take, there were over 1,400 possible alternatives and an extremely large number of possible pairs of alternatives. Several software packages are available to select choice pairs to meet statistical design objectives, and in many packages constraints may be imposed to eliminate certain types of inappropriate pairs. We used SAS Proc Factex and Proc Optex to help design the pairs. However, one quickly finds that, even with multiple constraints imposed on the selected pairs, the software package results are not entirely satisfactory. Therefore, we further designed the selected choice pairs to reflect additional considerations related to the complexity of the pairs and to ensure realism and consistency in the pairs presented to any one respondent, as discussed below. The final survey pairs are summarized in Appendix A, Table A.1.

Using randomly generated pairs results in many, or even most, pairs involving varying levels of many attributes in each alternative. Thus, respondents are presented with the task of comprehending and selecting between mixes of multiple programs changes in each alternative in most or all of the questions. This may be a complex task for some respondents, especially if there are limited practice questions, and may result in respondents choosing to focus only on a subset of attributes as the basis for decision making, thus increasing the variance in the estimation of preferences. One way to try to partially address this would be to provide simplified practice questions to make respondents accustomed to the format. However, a lot of space and respondent time would go into practice questions that would not generate useful data.

Instead of practice questions, we selected a design to graduate respondents from simple to more complex choice pairs as they progressed through the survey instrument, thus reducing the cognitive burden at the outset. This would have the additional benefit of allowing us to do selected statistical comparisons of the responses across different types of choice pairs and, early in the question sequence, to address potential preferences for the status quo (see Section 4.7 and Chapter 5). Three types of choice questions were used:

- **Simple resource-to-resource pairs.** The first paired comparison question in each version of the survey (see Figure 1.2 and Question 13 in all of the survey versions) presented a choice between an improvement in one attribute in Alternative A and an improvement in a second attribute in Alternative B.[7] Other program levels (attributes) were held at current levels in both alternatives, and the same dollar cost was presented in both alternatives (see Question 13 in the sample survey in Appendix A). The programs and levels of changes were varied across the survey versions, and across Alternatives A and B, to cover all the resources, with slightly more cases with PCBs as one of the alternatives. This design provided several benefits. First, respondents began the paired comparisons with a relatively simple question that was expected to be more easily answered, leading them to continue the survey. Second, the results provided simple tradeoff results between program levels that did not require a complex statistical model to begin to evaluate the results.

7. A few simple resource-to-resource questions were added or randomly occur in subsequent questions.

- **Referendum pairs.** The second question in each survey version (Question 14) presented a choice between an improvement in one attribute and the associated increased costs versus no change in the attributes from current levels and costs (e.g., the status quo, see Figure 2.1 from survey version 1 where Alternative A reduces the years until PCBs are at safe levels from 100 years to 40 years at a cost of $200, and no other changes occurring, compared to Alternative B of the status quo and no increase in household costs). For the referendum questions, the attribute levels and dollar costs were varied across the survey versions, and across Alternatives A and B, to cover a broad range of the resources, with slightly more cases with PCB as one of the alternatives. These questions provided a relatively simple trade-off early in the question sequence to aid respondents' progress through the choice questions, and provided an early question in which respondents may demonstrate a preference for the status quo as opposed to program enhancements at added costs to their household. This type of question is similar to a traditional contingent valuation referendum question and provided evidence on the relative merits of resource-to-resource trade-offs versus resource-to-money trade-off questions.

- **Complex choice pairs.** The third type of questions are ones in which either or both Alternative A and Alternative B may have changes in more than one resource program and costs as compared to current conditions, generally resulting in complex comparisons that we expect may result in increased noise in the estimation of preferences.

The pairs in Questions 15 through 18 were allowed to be of any of the above question types, and generally are complex choice pairs. The starting point for selecting these pairs was obtained by applying the pair-design software programs to generate more pairs than needed. To retain realism, dominant choice pairs were eliminated. These were cases where one alternative was clearly an improvement over the second alternative. For example, Alternative A would have the same or increased levels of each natural resource program at the same or reduced cost compared to Alternative B. Respondents reported such questions as unrealistic choices (e.g., "How can you get more environmental benefits at the same or lower costs?"). Furthermore, such choices provide little statistical benefit.

Next, the selection and assignment of pairs to survey versions was considered. Sequencing conflicts within a survey version were evaluated and limited. For example, assume Question 14 proposed a small change in wetlands (e.g., 5,800 acres) at a high cost (e.g., $100 per year per household). If a subsequent question traded off a much larger change in wetlands (or the same small change in wetlands plus enhancements in other resource programs) at a much lower cost (e.g., $25 per year per household), participants in focus groups and pretests questioned the realism of the question set and its policy relevance. Sequencing was also evaluated in terms of avoiding a string of questions in any survey version focusing on one of the four resource programs, to avoid emphasizing any one topic in any survey version. The assignment of pairs to survey versions also considered the ability to compare results across survey versions, as well as within survey versions.

These steps increased the realism of the choices for respondents. There are some nonzero correlations between the various attribute levels across the alternatives (see Table 2.5), but this is not uncommon and the correlations here are sufficiently orthogonal to support the accurate estimation of parameters.

2.2.4 Follow-up questions and demographics

The remaining survey questions help us analyze responses to the choice questions and other survey questions. Question 19 asked how important each attribute in the choice questions (i.e., acres of wetland, years until safe levels of PCBs) was in the choices made by the respondent. We expect a strong correlation between the choice question results and the ratings in this question, reflecting that respondent answers to the choice questions are consistent with their intended rating of importance of the various factors to be considered, and we further expect both of these results to be correlated with the importance assigned to the benefits of the natural resource programs, and desired actions for less, the same, or more of these programs as reported in Questions 2 through 12.

Question 20 asked how confident respondents were in their answers to the choice questions, and Question 21 asked whether their responses to the choice questions should be considered by decision makers. Recognizing that the choice questions may be difficult for some respondents, these questions are intended to give an indication of the quality that respondents assign to their responses. Question 22 asked about pre-survey awareness of natural resource issues. We expected that awareness of the issues would be related to increased interest in and value for these programs, and that increased awareness would result in improved response quality (Cameron and Englin, 1997).

Because we expected that whether or not individuals from a household fish in Green Bay may be a significant explanatory variable, and to address potential double counting between the recreational damage determination (Breffle et al., 1999), Question 23 asked whether the respondent or anyone else in the household had fished in Green Bay or its tributaries up to the first dam in the last 12 months. This question is more specific than Question 1, which asks about the typical activity levels. We treat this question as an improved measure of interest in Green Bay fishing compared to Question 1, rather than as a specific estimate of such activity because the survey does not focus on fishing and asks for a full year recall (see Breffle et al., for

Table 2.5. Correlation between choice set attribute levels.

	Wetlands A	PCBs A	Recreation A	New parks A	Runoff A	Cost A	Wetlands B	PCBs B	Recreation B	New parks B	Runoff B	Cost B
Wetlands A	1.000											
PCBs A	-0.104	1.000										
Recreation A	0.205	0.078	1.000									
New Parks A	0.386	0.121	0.080	1.000								
Runoff A	0.313	-0.167	0.097	0.186	1.000							
Cost A	0.337	-0.298	0.101	0.330	0.206	1.000						
Wetlands B	0.163	-0.071	0.008	0.140	0.115	0.094	1.000					
PCBs B	-0.474	0.107	-0.361	-0.142	-0.123	-0.042	0.076	1.000				
Recreation B	0.304	-0.149	-0.045	0.116	0.178	0.102	0.122	-0.114	1.000			
New Parks B	0.294	-0.319	-0.053	0.170	0.191	0.077	0.126	-0.122	0.141	1.000		
Runoff B	0.194	-0.141	0.026	0.150	0.013	0.144	0.162	0.003	0.156	0.105	1.000	
Cost B	0.388	0.053	0.263	0.262	0.194	0.030	0.171	-0.412	0.191	0.309	0.257	1.000

estimates of Green Bay fishing activities and for discussions of recall bias in reported fishing activity levels).

Questions 24 through 35 asked background sociodemographic questions. Question 36 allowed respondents to provide additional comments about the survey and topics addressed.

3. Survey Implementation

3.1 Sample Selection

Our goal was to obtain 400 to 450 completed surveys, which would provide sufficient sample size to evaluate preferences with statistical confidence based on experience with similar studies (Breffle et al., 1999). With 6 choice questions per respondent, such a sample size would provide a minimum of 2,400 choice question responses (6 × 400). Based on experience with rates of ineligible addresses from mailing lists (10% to 20%) and expected response rates from eligible households (60% to 75%), a total starting sample of 750 was selected.

A stratified random sample was drawn from the 10-county area based on two sampling strata, as identified in Figure 2.1 and Table 3.1. The two strata radiate out from the Bay of Green Bay, reflecting the focus on the natural resource programs presented:

1. The "adjacent" stratum of five counties with shoreline on the Bay of Green Bay, the population of which is predominately located within about 20 miles of the bay.

2. The "second tier" stratum of five counties that border the "adjacent" counties.[1] These counties are located 10 to 60 miles from the bay, with the largest cities in these counties generally 30 or more miles from the bay.

The sample was weighted to emphasize households in the first stratum, since these households were likely to be the most familiar with the resources in question, and have the highest PCB-caused service flow losses and the highest potential benefits from natural resource restoration projects. However, we judged that people in the second tier counties were close enough to the assessment area to be familiar with the resources in question and potentially to have PCB-caused service flow losses. Furthermore, including the second tier would allow us to investigate how the scaling of restoration and WTP vary with distance within 60 miles of the site. The strata were weighted to achieve a minimum of 300 responses from the adjacent stratum and a minimum of 125 responses from the second tier stratum. Within each stratum, the sample was divided among counties based on the estimated 1998 population in the county, assuming the number of individuals per household was consistent across counties.

1. Three potential second tier counties (Forest, Menominee, and Langlade) were excluded because all or nearly all of Forest and Langlade are more than 60 miles from the site, and Menominee has a small population.

Table 3.1. Green Bay total value equivalency survey sample plan.

County	City	County touches bay	Approx. county distance to bay	Approx. largest city distance to bay	1998[a] population	% of total	Sample[b]	Target number of completed surveys
Adjacent strata					**Strata weight**	**1.600**		
Brown	Green Bay	Yes	<20	<10	218,149	26.87%	320	
Door	Sturgeon Bay	Yes	<20	<10	26,537	3.27%	40	
Kewaunee	Kewaunee	Yes	<25	<20	19,904	2.45%	30	
Marinette	Marinette	Yes	<60	<10	42,523	5.24%	65	
Oconto	Oconto	Yes	<60	<10	33,089	4.07%	50	
Adjacent strata subtotal					340,202	41.90%	505	300
Second tier strata					**Strata weight**	**0.570**		
Calumet	Chilton	No	25-40	35	38,760	4.77%	20	
Manitowoc	Manitowoc	No	15-50	35	84,434	10.40%	45	
Outagamie	Appleton	No	10-40	30	155,953	19.21%	80	
Shawano	Shawano	No	10-60	30	38,730	4.77%	20	
Winnebago	Oshkosh	No	30-60	45	153,937	18.96%	80	
Second tier subtotal					471,814	58.10%	245	125
Totals					812,016	100%	750	425

a. Wisconsin Official Population Estimates, County Estimates (1998).

b. Sample by county = 750 × % of total × strata weight, rounded to nearest 5. Ten survey versions randomized across each county.

Households within a county were randomly selected by Genesys Sampling Systems from households with listed telephone numbers and available addresses. In northeast Wisconsin this provided coverage of more than 77% of all households in the target population, as measured by the ratio of households with listed telephone numbers to total households (Table 3.2). The percentage of listed households varies by county, but is consistent across the aggregate of all counties in the two sampling strata (76.9% and 78.4%).

Table 3.2. Households with listed telephone numbers.[a]

Strata/county	Households	Number listed	Listed %
Adjacent strata			
- Brown	88,228	71,350	81%
- Door	17,593	14,050	80%
- Kewaunee	7,453	6,074	81%
- Marinette	26,455	19,125	73%
- Oconto	17,896	10,555	59%
Subtotal	157,625	121,244	76.9%
Second tier strata			
- Calumet	14,140	6,745	48%
- Manitowoc	31,570	25,179	80%
- Outagamie	68,238	57,155	84%
- Shawano	16,227	12,077	74%
- Winnebago	58,971	47,081	80%
Subtotal	189,146	148,237	78.4%
Total			
- Unweighted			77.8%
- Weighted[b]			77.3%

a. Source — Genesys Sampling Systems.

b. Weighted by sample size for each strata; see Table 3.1.

Because the survey was designed to obtain head of household attitudes and values, the design allowed for either a male or a female head of household to complete the survey.

3.2 Implementation

The survey was implemented by the Hagler Bailly Survey Center in Madison, Wisconsin. As noted above, ten versions of the mail survey were prepared. Sampled households were randomly assigned a version number before implementation. Standard procedures for repeat-contact mail surveys (Dillman, 2000) were followed, except that we added an attempt to contact nonrespondents by telephone.

1. **Initial mail survey package.** This package consisted of a cover letter from the Hagler Bailly Survey Research Center explaining the study, a 21-page mail survey booklet, and a postage-paid return envelope. The cover letter stated that a $15 check would be sent to respondents if they completed the survey by September 30. The surveys were mailed on September 10.

2. **Thank you/reminder postcard.** All sampled individuals were mailed a postcard 5 days after the initial mailing (September 15). The postcard thanked those who had responded to the survey and reminded those who had not yet responded to please do so.

3. **Combination telephone and mail follow-up.** Between October 5 and October 12, 1999, we tried follow-up telephone calls with all sample households that had remained potentially eligible and that had not returned the survey up to that point. Those we reached were told that the study deadline had been extended. They were asked whether they had received the survey and whether they had returned it. Those who had not returned the survey were asked to please complete it by October 18 and return it. If they needed another copy of the survey, it was mailed the day after the telephone call. Respondents reached by telephone who recalled receiving the mail survey, and who indicated they would not be returning it, were asked to complete a short telephone survey. Households that were not reached by phone by October 13 were sent another mail survey.

The cutoff date for accepting completed mail surveys was November 5, 1999.

Table 3.3 shows the response rates for the mail survey, by county, stratum, and in total. Overall, we received completed mail surveys from 72% of the eligible (adjusted) sample. The eligible sample did not include those who were known to be deceased, those for whom the mailings were undeliverable, those who had disconnected telephone numbers, those where the telephone was no longer a residential phone, and one individual identified as a U.S. Fish and Wildlife Service employee.[2] Four surveys were returned less than half completed and were treated as nonresponses.

2. Of the starting sample, 87% remained in the eligible sample (13% were removed from the sample based on the above criteria). While this varied somewhat by county, the eligible sample proportion of the starting sample was quite consistent across the aggregate of all counties in each of the two sampling strata (86.5% and 87.1%). The completion rate varied by county, but was consistent across the aggregate of all counties in each sampling strata (72.3% and 71.3%).

Table 3.3. Mail survey response rates.

	Total	Brown	Calumet	Door	Kewaunee	Manitowoc	Marinette	Oconto	Outagamie	Shawano	Winnebago
Starting sample size	750	320	20	40	30	45	65	50	80	20	80
Undeliverable	53	15	1	9	3	1	8	5	2	2	7
Deceased	4	2	0	0	0	0	1	1	0	0	0
Out of sample	43	19	1	2	2	5	3	0	5	0	6
Service employee	1	0	0	0	1	0	0	0	0	0	0
Disconnected phone number	39	19	1	1	1	4	3	0	5	0	5
Non-household	3	0	0	1	0	1	0	0	0	0	1
Adjusted sample size	650	284	18	29	25	39	53	44	73	18	67
Refused	51	22	1	1	3	4	7	1	6	1	5
Mail refusals	5	0	0	0	1	1	0	0	2	0	1
Phone refusals	39	19	1	1	2	2	4	1	4	1	4
Elderly/unable to comprehend	7	3	0	0	0	1	3	0	0	0	0
Partially completed survey (less than half completed)	4	1	0	0	0	0	2	0	0	1	0
Number of completed surveys	470	214	13	20	17	25	33	32	52	13	51
Response rate to mail survey[a]	72%	75%	72%	69%	68%	64%	62%	73%	71%	72%	76%

a. Computed as the number of completed surveys/adjusted sample size.

We tried to call 327 members of the sample, reached 217 and 136 said that they intended to return the survey. Of these 136, 83 (61%) did return the survey by the cutoff date. The remaining 81 respondents reached by telephone either refused to complete the mail survey or were incapable of returning the survey (e.g., language barrier or age), including 13 who completed the brief telephone survey (these 81 nonrespondents remained in the sample for response rate calculations).

We could not reach 110 members of the sample. Of these, 42 were deleted from the sample because of bad or disconnected telephone numbers (the sample was of households with listed phone numbers). Of the remaining 68 subjects, 60 were sent a second mail survey and cover letter extending the response deadline (a few respondents were deleted from this mailing reflecting households where an individual was reached but where there was a potential language barrier). All 68 respondents with potentially valid phone numbers, but where contact could not be made, were left in the sample for the response rate calculations.

Of the 60 people who were sent a second survey after we could not reach them by telephone, 24 (40%) returned it before the cutoff date. The lower response rate for these households most likely reflected a combination of factors: more resistant sample members, additional bad addresses in the sample, and seasonal residences where respondents may not have received any of the mail or phone contacts. The 1990 Census (Census of Population and Housing, STF1A) for Door and Marinette counties (two counties with lower response rates) indicated that about one-third of the housing units were for "seasonal, recreational or occasional use," compared to an average of about 7% for the other eight counties.

The response rate to individual survey questions was high. For all questions other than the 11 parts of Question 1 and Question 35, item nonresponse was less than 2.5%. Item nonresponse for Question 35, the income question, was 4.7%. The rate of "don't know" responses was also very low, less than 3.0% for every question in the survey.

3.3 Evaluation of Potential Sample and Nonresponse Biases

3.3.1 Introduction

To summarize the results at the outset, while we find some differences in the characteristics of the survey respondents compared to the target population, statistical analyses in Chapters 4 and 5 indicate that these differences are not likely to result in any significant biases to the results.

Sampling bias refers to possible differences between the sample selected and the target population. The target population was all households in the 10 counties neighboring the Bay of Green Bay and the Lower Fox River, with responses sought from a head of the selected household. Given the sample was selected from households with listed telephone numbers, the most likely source of sampling bias, if any, would be differences between those households with and without telephone numbers. Given that about 77% of the households in both sampling strata of the target population have listed phone numbers (Table 3.2), households without listed telephones would need to be dramatically different from those with listed phones for there to be a substantial sampling bias in the results of this study.

Research by Piekarski (1989) indicates that households with unlisted telephone numbers are more likely to be multifamily housing units and renter occupied than are listed households (which are more likely to own their residences). Younger persons (both female and male) and single, divorced, and separated householders (with and without children) are more likely to be unlisted than are other types of households. Finally, retired householders are more likely to be listed than employed householders. We examine the impact of these potential differences later in this section.

Nonresponse biases potentially result from the differences between the respondents and the nonrespondents in the sample. In some valuation assessments, analysts are concerned that individuals who are less interested in (and have lower awareness of) the topics addressed in the survey are less likely to respond. Such individuals would be likely to have lower benefits from natural resource improvements. This difference could lead to an upward bias in the estimated WTP values. However, for restoration scaling this potential bias would be minimal if nonrespondents have proportionately lower values for both PCB injuries and for the benefits from other restoration projects. In any case, the mail survey had a high response rate of 72%, which can be expected to significantly limit the magnitude of any potential nonresponse bias on the overall assessment.

3.3.2 Comparison of phone survey and mail survey respondents

In the phone survey, we completed comparison questions with 13 individuals who said they would not return the mail survey. While the telephone follow-up sample size of 13 for this comparison is very small, the results are suggestive. The telephone survey covered demographic characteristics, participation rates in fishing and other outdoor activities, and streamlined versions of the importance ratings for increased wetlands, PCB removal, and increasing facilities at existing parks in questions that closely parallel the mail survey questions 2, 4, 5, and 7. (To streamline the telephone survey, a runoff question was omitted.) The 13 nonrespondents were much less likely to report that they or household members are Green Bay anglers than the mail survey respondents (1 of 13 versus 30% in the mail survey**)**. As described in Chapter 5, Green Bay anglers have PCB values approximately 20% larger than for those who were not Green Bay anglers, and similar relative values for the other natural resource programs. Thus, nonrespondents may require slightly less restoration to provide services of equal value to PCB injuries than do respondents, but we would not expect the effects to be large. In addition, we found the following:

- The 13 nonrespondents reported lower participation rates than did mail survey respondents for each of the outdoor recreational activities asked.

- The importance ratings for each of the natural resource benefits are not statistically different between the 13 nonrespondents and mail survey respondents (Table 3.4). As in the mail survey, the rating for outdoor recreation facilities is much lower than for the other programs, and the ratio of importance for PCBs and wetlands to outdoor recreation is larger for the 13 nonrespondents than in the mail survey. The relative significance of wetlands to PCBs is slightly higher in the phone follow-up than in the mail survey, but the sample size is insufficient to place much emphasis on this.

- The 13 nonrespondents are slightly, but not statistically significantly, older (58.6 years versus 50.8 years), have smaller household sizes (1.7 versus 2.7), and are more likely to be female (46% versus 29%). The sample size in the telephone survey is insufficient to conclude that these are meaningful differences, and thus any differences are expected to have at most a negligible impact on the assessment.

Table 3.4. Comparison of importance ratings from phone and mail surveys.

	Telephone survey		Mail survey		Z value for difference
	Net of don't knows		Net of missing/don't knows		
Importance to . . .	Mean	SE	Mean	SE	
Increase wetland to support increased populations of wildlife	4.16	0.37	3.9	0.05	0.70
Remove PCBs so it is safe to eat fish and waterfowl	4.08	0.38	4.3	0.05	0.58
Remove PCBs to reduce risks to wildlife	4.16	0.37	4.3	0.05	0.38
Add new facilities at existing state and county parks	3.00	0.51	3.6	0.05	1.18

In summary, the results for the 13 nonrespondents who completed the phone comparison questions suggest that while modest differences in restoration scaling might occur because of differences between respondents and nonrespondents, the evidence from within the study does not support concluding that any resulting biases would be substantial.

3.3.3 Comparison of Census information and mail survey respondents

Another way to consider sampling and nonresponse bias is to look outside the study by comparing the characteristics of the sample and the target population based on Census data, and then consider how these differences may affect the assessment based on the analyses in Chapters 4 and 5. However, the mail survey sample is of heads of households, and for most socioeconomic characteristics the most similar readily available Census data are for all adults age 18 and older. This provides a somewhat misleading comparison because many younger adults are less likely to be heads of households.

The analyses in Chapters 4 and 5 show that higher levels of participation in outdoor recreation (especially whether respondents are Green Bay anglers) and higher levels of awareness of the four resource issues are key variables in explaining how much restoration is of equal value to the value of PCB-caused losses, and the magnitude of WTP values, per household. Therefore, we consider here how demographic characteristics of the survey respondents might be different from the population and how the differences might, if at all, affect the assessment.

Table 3.5 shows that more survey respondents own their residences than do members of the 1990 adult population (84% versus 71%). In part, this most likely reflects that some young adults in the Census data are not heads of households and are less likely to own their residence than are heads of households. This is also consistent with the Piekarski (1989) evidence that samples based on listed telephones may over-represent households that own their residences. Simple Pearson correlations suggest that residence ownership is positively and significantly correlated with awareness for three of the four natural resource topics (with outdoor recreation being the exception) and with increased levels of recreation, but not with increased participation in Green Bay fishing. However, the strength of the relationships between residence ownership and these variables, or on choices made in Questions 13 through 18, is either small or insignificant.

Table 3.5. Ownership of residence (Question 24).

Tenure	Number of observations	Percent of respondents	Percent of occupied housing units in 10 county area[a]
Own	395	84.0%	71.2%
Rent	73	15.5%	28.8%
Missing	2	0.4%	NA

a. Source: U.S. Census Bureau (1990).

About 71% of the mail survey respondents were males, which exceeds the population proportion among adults (Table 3.6). The fact that listed telephones are more likely to be in the male head of household name than the female head of household name explains this result. Further, any adult head of household could complete the survey to reflect the household attitudes and values, so it

Table 3.6. Gender of respondents (Question 26).

	Number of observations	Percent of respondents	Percent of population in 10 county area[a]
Male	335	71.3%	49.2%
Female	135	28.7%	50.8%
Missing	0	0.0%	NA

a. Source: U.S. Census Bureau (1990).

is valid for female heads of household to have their male counterparts complete the survey. While we do not consider the sample gender ratio to be a source of bias, we note that males reported higher rates of outdoor participation (including Green Bay fishing) and were more aware of all four resource issues than females. This also may be part of the reason why the male head of household chose to complete the survey.

The average age of survey respondents is about 51 years (ranging from 21 to 96 with a standard error of 0.73). The Census population average is 44.3 years old for adults over 18 years of age. That retired individuals are more likely to have listed telephones may be part of the reason. However, the Census population average includes young adults who are living with others (e.g., parents, older relatives), and who are not a head of the household. Thus, heads of households are expected to be older than the average adult age 18 and older. Further, male heads of household, who more frequently completed the survey, on average are older than female heads of household. Finally, while recreational participation (other than fishing) increased with age, the rate of participation in Green Bay fishing decreased. Overall, we do not anticipate that difference between the age distribution of our respondents and the age distribution of all adults in the population had a biasing effect on the analysis in the next chapters.

Table 3.7 shows that the sample mean family size of 2.7 individuals is comparable to the population mean family size (also 2.7 people per household). Table 3.8 shows that the racial and ethnic compositions of the sample and the population also are very comparable. For these two characteristics, the Census variable is directly comparable to its counterpart sample variable, and the results are very similar.

Table 3.9 shows that the sample tends to have a higher level of educational attainment than the population of all adults. Here again, the Census statistics may not be strictly comparable to our population of heads of households. Many adults 18 and older in the Census figures are younger adults who may not have completed their schooling. There may also be some effect due to households with unlisted telephone numbers being more likely to be renters rather than homeowners. Presumably homeowners tend to have higher levels of educational attainment and income.

Table 3.7. Household and family size (Questions 28, 29, 30, 31).

Question	Net of missing: Number of observations	Net of missing: Mean	Net of missing: SE	Missing
How many people are there in your household, including yourself?	468	2.7	0.06	0.4%
How many children do you have, whether living with you or not?	467	2.3	0.08	0.6%
How many grandchildren do you have, whether living with you or not?	464	2.0	0.18	1.3%
How many listed telephone numbers does your household have?	465	1.1	0.02	1.1%
Census estimate of average household size for 10 counties [a]	NA	2.7	NA	NA

a. Source: U.S. Census Bureau (1990).

Table 3.8. Racial or ethnic background (Question 34).

Racial or ethnic background	Percent of respondents	Percent of population in 10 county area[a]
White or Caucasian	97.9%	97.3%
Black or African American	0.2%	0.3%
Hispanic or Mexican American	0.2%	0.7%
Asian or Pacific Islander	0.4%	1.0%
Native American Indian	0.9%	1.2%
Other	0.0%	0.2%
Missing	0.4%	NA

a. Source: U.S. Census Bureau (1990).

Table 3.9. Highest level of schooling attained (Question 32).

Level of schooling	Percent of respondents	Percent of population age 18 and older in 10 county area[a]
Did not complete high school	5.1%	21.0%
High school diploma or equivalent	38.1%	40.0%
Some college, two year college degree (AS) or technical school	31.7%	17.3%
Four year college graduate (BA, BS)	12.3%	10.6%
Some graduate work but did not receive a graduate degree	4.3%	NA
Graduate degree (MA, MS, MBA, PhD, JD, MD, etc.)	7.7%	3.7%
Missing	0.9%	

a. Source: U.S. Census Bureau (1990).

Table 3.10 shows that the sample has fewer employed individuals and more retired individuals than the population. Education levels and employment status were found to have little influence on the key assessment variables.

Table 3.10. Employment status (Question 33).

Employment category	Percent of respondents	Percent of 10 county population[a]
Employed full time	64.7%	77.4%
Employed part time	5.5%	(employed full or part time)
Retired	25.7%	
Homemaker	2.1%	19.8% (not in labor force)
Student	0.6%	
Unemployed	1.1%	2.8%
Missing	0.2%	NA

a. Percent of labor force aged population (i.e., 16 years and older) for 1997.

Source: Wisconsin Department of Workforce Development (2000).

Table 3.11 summarizes the 1998 household income levels reported by the mail survey respondents. The median household income is in the $40,000 to $49,999 bracket. We compute the population median income as approximately $43,000 based on Census data.[3] These figures are for the same variable and the results are very comparable and do not suggest any source for substantive sampling and nonresponse bias.

3. Specifically, we computed the median household income for each county based on 1995 Census data (U.S. Census Bureau, 1998), escalated by the CPI from 1995 to 1998 dollars (1.0696), and weighed the county estimates by county population to compute a 10 county median.

Table 3.11. Household income.

Mail survey income categories	% of survey respondents (omitting missing)[a]
Less than $10,000	4.5%
$10,000 to $19,999	11.8%
$20,000 to $29,999	12.9%
$30,000 to $39,999	15.6%
$40,000 to $49,999	14.5%
$50,000 to $59,999	10.7%
$60,000 to $79,999	16.5%
$80,000 to $99,999	6.3%
$100,000 to $149,999	3.8%
$150,000 or more	3.3%
10 county sample median	$40,000 to $49,999
10 county Census median[b]	about $43,000

a. 4.7% missing. Percents may not total 100% due to rounding.

b. Based on 1995 median household income by county (U.S. Census Bureau, 1998), inflated to 1998 with the CPI, and weighted by county population.

3.4 Summary

The above evaluation indicates that any sampling and nonresponse biases will have limited impact on the assessment. First, the differences between the measurable sample and population characteristics are generally small, and these differences are not associated with strong influences on the assessment. Second, the high sample coverage rates and response rates reduce the potential for these biases and reduce the influence of these biases, if any, on the overall assessment. Finally, the influence of any potential sampling and nonresponse bias is further minimized in the scaling of restoration because the potential biases typically would be in the same direction for all of the resource programs. Thus some of the potential bias may largely cancel out when computing the scale of restoration of equivalent value to PCB losses.

4. Survey Results

4.1 Introduction

This chapter provides results on respondent activities, attitudes, awareness, and evaluations of the four natural resource topics and programs. Responses to choice Questions 13 through 18 are addressed in Section 4.6 and in Chapter 5. Responses to sociodemographic questions were summarized in Section 3.3 (see also Appendix C).

A respondent's awareness of the four natural resource topics before receiving the survey (from Question 22) is found to be an important indicator of responses to opinion and attitude questions (reported in this chapter), and to preferences and values for natural resource restoration options (as reported in the next chapter). We begin by reporting on respondent awareness of the four topics, and note throughout the presentation how the results are related to respondent awareness. Then, we report the results on respondent activity levels in potentially related recreation, and respondents' ratings of the importance of natural resource topics. We conclude by simple evaluations of the choice pair results that do not require models such as used in Chapter 5.

4.2 Topic Awareness

Question 22 asked respondents, "Prior to receiving this survey, how aware were you of each of the four natural resource topics we addressed?" Each topic was rated from 1 = "I was not aware of this topic" to 5 = "I was very aware of this topic." Respondents with more awareness, or familiarity, generally have more crystallized attitudes and values regarding the natural resource, and thus responses may have greater validity and accuracy. Increased awareness probably reflects respondents' interests, and in general increased awareness may be associated with increased preferences for natural resource enhancements.

Results for the awareness question are presented in Table 4.1. These results indicate that respondents have a moderate to high level of awareness of the topics, especially of PCBs: approximately 70% of respondents report awareness scores of 4 or 5 for PCBs, and over 90% reporting scores of 3 or greater. For the other three topics, about 45% to 50% report scores of 4 or 5, and over 80% report scores of 3 or greater. Topic awareness is correlated with participation in recreational activities, especially fishing in the waters of Green Bay, and with several sociodemographic variables (Table 4.2). Awareness is also highly correlated with several policy variables and with responses to questions in which respondents evaluate their own responses to the program choice questions (discussed below).

Table 4.1. Awareness of natural resource topics before receiving the survey[a] (Question 22: 1 = was not aware of this topic to 5 = very aware of this topic).

							Net of missing		
Natural resource topic	**Not at all aware 1**	**2**	**Somewhat aware 3**	**4**	**Very aware 5**	**Missing**	**Number of observations**	**Mean awareness rating**	**SE**
Wetlands	8.7%	9.8%	36.6%	24.7%	20.0%	0.2%	469	3.4	0.05
PCBs	4.3%	2.6%	21.7%	29.2%	40.6%	1.7%	462	4.0	0.05
Outdoor recreation	6.4%	12.6%	35.1%	25.3%	19.4%	1.3%	464	3.4	0.05
Runoff	7.9%	10.9%	30.0%	27.5%	22.6%	1.3%	464	3.5	0.06

a. Totals may not sum to 100% because of rounding.

4.3 Outdoor Recreational Activity in and around the Waters of Green Bay Area

Question 1 examines the level of outdoor recreation participation for many activities on the waters and shoreline of the Bay of Green Bay. It reiterates the geographic focus of the survey, motivates respondents to think about if and how the natural resource enhancements might affect them, and provides potentially useful explanatory variables for evaluation of subsequent responses, such as the types and levels of recreational activity. Question 1 is not intended to provide precise estimates, but indicators of relative activity levels across respondents.

The most popular outdoor activities are ones that do not require a lot of equipment or time, such as enjoying outdoor scenery, viewing wildlife, camping or picnicking, and hiking, walking, or jogging. More than 50% of respondents report participating in those activities at least once a year. Other activities have smaller groups of avid participants, but more than 50% of respondents never participate or participate less than once a year. Fishing, biking, swimming, and boating attract about 40% of the respondents at least once a year. The least popular activities are waterskiing or jetskiing, and canoeing or kayaking; only about 12% indicated they do these activities at least once a year. Hunting is also a less common activity, with only 26% participating at least once a year.

Proximity to the Bay of Green Bay influences participation. As would be expected, respondents who live closer to the bay participate more frequently in many of the activities on the bay (Table 4.3). The only activities that did not show a significant difference in participation by those who live near Green Bay (about 50% live within 8.8 miles) and those who live farther away (more than 8.8 miles, but still within the 10 neighboring counties) were camping or picnicking, fishing, hunting, and canoeing or kayaking.

Table 4.2. Correlations between topic awareness (Question 22) and other variables.

Correlation variables	**Natural resource topic awareness**[a]			
	Wetlands	**PCBs**	**Outdoor recreation**	**Runoff**
Recreation variables	Question 1 none[b] **Question 23 fish Green Bay**	Question 1 *fishing, boating, skiing, canoeing, swimming, hunting, hiking/walking*, hunting, wildlife viewing, enjoying scenery **Question 23 fish Green Bay**	Question 1 **enjoying scenery**, *boating, skiing, swimming, wildlife viewing, hiking/walking*, canoeing, hunting, biking **Question 23 fish Green Bay**	Question 1 none **Question 23 fish Green Bay**
Policy variables	**Question 2 wetland acres** Question 6 PCB spending	**Question 2 wetland acres** *Question 4 PCBs FCAs*	*Question 2 wetland acres* Question 6 PCB spending **Question 7 enhance facilities** **Question 8 add facilities**	**Question 2 wetland acres** Question 10 excess algae Question 11 water clarity
Evaluation variables	Question 19 **wetlands**, *algae, costs* **Question 20 confidence** **Question 21 use of results** **Question 22 awareness — all issues** **Made a comment**	Question 19 **wetlands, PCBs** **Question 20 confidence** **Question 21 use of results** **Question 22 awareness — all issues** **Made a comment**	Question 19 *wetlands,* **enhance facilities, new parks,** *excess algae* **Question 20 confidence** **Question 21 use of results** **Question 22 awareness — all issues** Made a comment	Question 19 **wetlands,** PCBs, new parks, **water clarity, excess algae** **Question 20 confidence** **Question 21 use of results** **Question 22 awareness — all issues** **Made a comment**
Socio-demographic variables	**Question 24 own residence** **Question 26 male** *Question 34 ethnic background*	**Question 24 own residence** *Question 26 male* Question 28 # in household	Question 26 male	*Question 24 own residence* **Question 26 male** *Question 29 # children*

a. **Bold** = correlation at 99% confidence or higher, *italics* = correlation at 95% to 99% confidence, regular = correlation at 90% to 95% confidence.
b. Correlated with "enjoying outdoor scenery" at 10.4% level.

Table 4.3. Average participation level[a] in outdoor activities on the waters and shorelines of the Bay of Green Bay by distance of residence to Green Bay (Question 1).

Location of residence		Enjoying outdoor scenery	Wildlife viewing	Hiking, walking, or jogging	Camping or picnicking	Fishing	Biking	Swimming	Boating (nonfishing)	Hunting	Canoeing or kayaking	Waterskiing or jetskiing
Near Green Bay[b]	Mean	3.04[d]	2.49[d]	2.41[d]	1.92	1.81	1.83[d]	1.79[d]	1.70[d]	1.50	1.22	1.21[d]
	SE	0.065	0.072	0.077	0.063	0.065	0.074	0.067	0.058	0.062	0.038	0.038
	Nobs	232	229	229	222	229	225	223	222	221	217	218
Farther from Green Bay[c]	Mean	2.73[d]	2.22[d]	2.23[d]	1.87	1.76	1.55[d]	1.54[d]	1.45[d]	1.51	1.17	1.13[d]
	SE	0.077	0.076	0.082	0.066	0.073	0.063	0.058	0.051	0.066	0.036	0.033
	Nobs	212	213	209	209	217	207	210	209	210	206	205
All respondents	Mean	2.89	2.36	2.32	1.90	1.78	1.69	1.67	1.58	1.50	1.20	1.17
	SE	0.051	0.053	0.056	0.046	0.048	0.049	0.045	0.039	0.045	0.026	0.025
	Nobs	444	442	438	431	446	432	433	431	431	423	423

Nobs = Number of observations.

a. Where 1 = less than once a year or never, 2 = 1 to 5 times a year, 3 = 6 to 10 times a year, and 4 = more than 10 times a year.

b. Respondents are near Green Bay if their residence is less than 8.8 miles from Green Bay (about half the respondents).

c. Respondents are farther from Green Bay if their residence is 8.8 miles or more from Green Bay (about half the respondents).

d. Indicates activity level of those who live near Green Bay is significantly different from those who live farther from Green Bay at the 95% level.

Those who were very aware of the natural resource topics addressed in the survey tended to be more avid participants in recreational activities in the Green Bay area than those who were only somewhat or not at all aware. Table 4.4 shows the mean activity levels for respondents who indicated that they were more aware of all the natural resource programs presented (i.e., a rating of 4 or 5 in Question 22 for all four issues) and for those respondents who indicated they were less aware of the natural resource programs presented (i.e., a rating of 1, 2, or 3 in Question 22 for all four issues). The only activity that did not have a statistically significant difference in participation levels between more aware and less aware respondents was waterskiing or jetskiing. For all other activities named in Question 1, the respondents who were more aware of

Table 4.4. Participation level by awareness of issue (Question 1 by Question 22).

Activity	Awareness level	Number of observations	Mean frequency of activity[c]	SE
Fishing	less aware[a]	86	1.52[d]	0.093
	more aware[b]	112	1.93[d]	0.101
Boating (nonfishing)	less aware[a]	83	1.45[d]	0.084
	more aware[b]	106	1.76[d]	0.086
Waterskiing or jetskiing	less aware[a]	83	1.12	0.049
	more aware[b]	100	1.21	0.052
Canoeing or kayaking	less aware[a]	82	1.09[d]	0.036
	more aware[b]	104	1.38[d]	0.070
Swimming	less aware[a]	83	1.49[d]	0.079
	more aware[b]	107	1.80[d]	0.105
Hunting	less aware[a]	84	1.31[d]	0.079
	more aware[b]	104	1.66[d]	0.101
Wildlife viewing	less aware[a]	84	1.96[d]	0.104
	more aware[b]	111	2.77[d]	0.108
Enjoying outdoor scenery	less aware[a]	85	2.49[d]	0.111
	more aware[b]	110	3.21[d]	0.096
Camping or picnicking	less aware[a]	81	1.73[d]	0.102
	more aware[b]	107	1.99[d]	0.092
Biking	less aware[a]	82	1.54[d]	0.095
	more aware[b]	108	1.86[d]	0.104
Hiking, walking, or jogging	less aware[a]	85	2.11[d]	0.125
	more aware[b]	109	2.53[d]	0.115

a. In Question 22 for each of the four natural resource topics, respondent indicated a 1, 2, 3 for how aware they were of the topic before receiving the survey (1 = not at all aware, 3 = somewhat aware, 5 = very aware).
b. In Question 22 for each of the four natural resource topics, respondent indicated a 4 or 5 for how aware they were of the topic before receiving the survey (1 = not at all aware, 3 = somewhat aware, 5 = very aware).
c. 1 = less than once a year or never, 2 = 1 to 5 times a year, 3 = 6 to 10 times a year, 4 = more than 10 times a year.
d. Indicates activity level of those who are more aware is significantly different from those who are less aware at the 95% level.

the natural resource programs in the region were also more avid participants. This result is intuitive: people who use the resource are more aware of topics related to the resource.

Question 23 asks how many days the respondent fished in the last 12 months. The intent of this question was to obtain an indication of interest in Green Bay fishing for respondent households rather than a precise estimate of participation in the sample counties, which is available elsewhere (Breffle et al., 1999). The Green Bay fishing participation rate reported in Question 23 is about 30.4%, and just over double the participation rates determined in Breffle et al. (1999). Two reasons explain this result. First, the sample is weighted to more heavily sample respondents in counties adjacent to Green Bay, who would fish these waters more often (Stratum 1, see Section 3.1). Reweighting the results to the population in the 10 study counties results in an estimate of about 26.5%. Second, because this question asks for one year recall, we can expect some telescoping in the response, e.g., respondents who fished in the prior year, but not the last 12 months, may report the event in the past 12 months because of telescoping and/or to indicate they generally fish the site (Westat, 1989; Tourangeau et al., 2000).

Question 23 also asked for the number of days fished in the waters of Green Bay by those who had fished on Green Bay. These anglers reported fishing Green Bay an average of 10.5 days (SE = 1.14) in the prior 12 months. This level is similar to that found in Breffle et al. (1999), where anglers who fished Green Bay reported fishing 9.95 days (SE = 0.55) per year. In both instances the anglers were asked to recall their fishing activities over a 12 month period, which may be subject to recall bias. A discussion of potential biases and adjustments for bias can be found in Breffle et al. (1999, pp. 3-29 to 3-32). With adjustments for recall bias, it was estimated that anglers in the 1999 study had spent an average of 6.19 days of open water plus ice fishing the Bay of Green Bay in that 12 month period.

4.4 Importance and Action Scores

Questions 2 through 12 are part of the presentation of the four natural resource topics considered in this survey. Each presentation has a description of the current state of the resource followed by one or two importance questions and then one action question. The importance questions ask how important the benefits from potential programs are to the respondent. The action questions ask whether the respondent feels that less, the same, or more should be done and spent on each of these topics.

4.4.1 Benefits importance scores

Respondents were asked to rate the importance of the environmental and human use service flow benefits for each of the four general programs (Question 2 for wetlands, Questions 4, 5 for PCBs, Questions 7, 8 for outdoor recreation, Questions 10, 11 for runoff). Table 4.5 shows the ratings of the importance questions. From the responses we see that residents of this area are concerned about natural resource issues in and around Green Bay. Of the four programs considered, removing PCBs is rated most important (with statistical significance), reducing runoff and increasing wetlands are next (their ratings are not significantly different from each other at the 95% level), and improving outdoor recreation is rated least important (with statistical significance).

Table 4.5. Importance of all natural resource action benefits (Questions 2, 4, 5, 7, 8, 10, 11: 1 = not at all important to 5 = very important).

	Net of missing/don't know				
Benefits[a]	**Number of observations**	**Mean importance rating**	**SE**	**Don't know**	**Missing**
Remove PCBs so that it is safe to eat fish and waterfowl (Question 4)	458	4.3	0.05	1.7%	0.9%
Remove PCBs to reduce risks to birds, fish and other wildlife (Question 5)	462	4.3	0.05	1.3%	0.4%
Reduce runoff to improve water clarity (Question 11)	461	4.0	0.05	1.9%	0.0%
Increase wetland acreage to support birds, fish and other wildlife (Question 2)	460	3.9	0.05	1.7%	0.4%
Reduce runoff to reduce algae blooms (Question 10)	457	3.8	0.05	2.8%	0.0%
Add facilities at existing parks (Question 7)	467	3.6	0.05	0.6%	0.0%
Add new parks (Question 8)	466	3.3	0.06	0.9%	0.0%

a. Listed in order of mean importance, not in the order they appeared in the survey.

Respondents' levels of awareness of the different resource topics before receiving the survey often affects their benefits importance scores. Those who are more aware had higher benefits importance scores for each of the natural resource topics than those who are less aware (Table 4.6). Benefits from removing PCBs are rated on average as 4.3 on the 5 point scale by all those who are more aware of any individual topic, and 4.1 to 4.2 by those who were less aware of individual topics. Outdoor recreation parks and facilities receive the highest scores from those who are more aware of outdoor recreation in the area, but they still have the lowest action score even by this group.

While scores change with awareness, the rankings of the different benefits from natural resource actions remain nearly the same. Removing PCBs always rank first, and enhancing outdoor recreation (adding facilities or new parks) always rank last. The only difference is that the rankings of wetlands programs and runoff programs sometimes switch, although the difference in scores generally are not large.

Thus, while awareness is correlated with benefit importance scores (higher awareness scores generally resulting in somewhat higher benefit importance scores), awareness has a relatively limited impact on the average rankings across the four programs (e.g., PCBs always ranked first and outdoor recreation always ranked last).

Table 4.6. Mean (SE) importance of all natural resource action benefits by awareness of issues (Questions 2, 4, 5, 7, 8, 10, 11: 1 = not at all important to 5 = very important).

Natural resource action benefits[a]	More aware all[a]	Less aware all[a]	More aware wetlands[b]	Less aware wetlands[b]	More aware PCBs[b]	Less aware PCBs[b]	More aware recreation[b]	Less aware recreation[b]	More aware runoff[b]	Less aware runoff[b]
Number of observations	117	92	210	258	327	140	209	259	234	234
Remove PCBs so that it is safe to eat fish and waterfowl (Question 4)	4.4 (0.10)	4.0 (0.13)	4.3 (0.07)	4.2 (0.07)	4.3 (0.06)	4.1 (0.10)	4.3 (0.07)	4.2 (0.07)	4.3 (0.07)	4.2 (0.07)
Remove PCBs to reduce risks to birds, fish, and other wildlife (Question 5)	4.4 (0.10)	4.0 (0.13)	4.3 (0.07)	4.2 (0.07)	4.3 (0.06)	4.2 (0.09)	4.3 (0.07)	4.2 (0.07)	4.4 (0.07)	4.2 (0.07)
Reduce runoff to improve water clarity (Question 11)	4.1 (0.10)	3.8 (0.11)	4.1 (0.07)	3.9 (0.06)	4.0 (0.06)	3.9 (0.09)	4.0 (0.07)	3.9 (0.06)	4.1 (0.07)	3.8 (0.07)
Increase wetland acreage to support birds, fish, and other wildlife (Question 2)	4.3 (0.11)	3.5 (0.13)	4.3 (0.08)	3.6 (0.07)	4.1 (0.06)	3.7 (0.10)	4.1 (0.08)	3.8 (0.08)	4.2 (0.07)	3.7 (0.08)
Reduce runoff to reduce algae blooms (Question 10)	4.0 (0.10)	3.6 (0.12)	3.9 (0.08)	3.7 (0.07)	3.8 (0.06)	3.7 (0.09)	3.9 (0.07)	3.7 (0.07)	4.0 (0.07)	3.6 (0.07)
Add facilities at existing parks (Question 7)	3.7 (0.12)	3.5 (0.12)	3.6 (0.08)	3.6 (0.07)	3.6 (0.06)	3.7 (0.09)	3.8 (0.08)	3.4 (0.07)	3.6 (0.08)	3.6 (0.07)
Add new parks (Question 8)	3.5 (0.12)	3.2 (0.14)	3.3 (0.09)	3.3 (0.07)	3.3 (0.07)	3.3 (0.11)	3.6 (0.09)	3.1 (0.07)	3.3 (0.08)	3.3 (0.08)

a. If respondents chose 4 or 5 for awareness of all four topics in Question 22, they fall in the "more aware all" category. If respondent chose 1, 2 or 3 for all four topics in Question 22, they fall in the "less aware all" category.

b. If respondents chose 4 or 5 for awareness of the *topic* in Question 22, they fall in the "more aware *topic*" category, otherwise they are in the "less aware *topic*" category.

4.4.2 Action scores

Action scores refers to the questions about whether respondents prefer doing and spending less, the same, or more than currently occurs for each resource topic (Question 3, Question 6, Question 9, Question 12). Table 4.7 shows the level of action respondents would like to see implemented to improve these resources. The greatest support is for actions to remove PCBs, there is moderate support for wetlands and runoff programs, and the lowest support is for actions to improve outdoor recreation. Respondents who are more aware tend to want more done and spent than respondents who are less aware of the resource topic, except for PCBs, where even respondents who indicated they were less aware also feel it is important to do more and spend more.

Table 4.7. Preferred level of action for natural resource programs (Questions 3, 6, 9, 12).

Natural resource program[a]		Do less and spend less	Do the same	Do more and spend more	Missing[d]
PCB investigations and removal (Question 6)	All	NA[c]	16.4%	81.3%	2.3%
	More aware of PCBs[b]	NA	16.2%	81.7%	2.1%
	Less aware of PCBs[b]	NA	16.9%	80.3%	2.8%
Runoff reduction (Question 12)	All	1.5%	33.4%	63.6%	1.5%
	More aware of runoff[b]	0.9%	23.8%	74.5%	0.8%
	Less aware of runoff[b]	2.1%	43.0%	52.8%	2.1%
Wetlands maintenance and/or restoration (Question 3)	All	2.6%	40.9%	54.7%	1.9%
	More aware of wetlands[b]	1.9%	26.7%	70.0%	1.4%
	Less aware of wetlands[b]	3.1%	52.3%	42.3%	2.3%
New facilities at existing parks and/or opening new parks (Question 9)	All	1.9%	50.9%	46.8%	0.4%
	More aware of recreation[b]	1.9%	40.0%	58.1%	0.0%
	Less aware of recreation[b]	1.9%	59.6%	37.7%	0.8%

a. Listed in order of preference for more action, not in the order they appeared in the survey.
b. If respondents chose 4 or 5 for awareness of the *topic* in Question 22, they fall in the "more aware of *topic*" category, otherwise they are in the "less aware of *topic*" category.
c. Not applicable: "Do less and spend less" was not offered an option for PCBs, as discussed in Section 2.2.2.
d. Percentage may not total to 100% because of rounding.

These measures are correlated with the benefits importance scores. For instance, in Table 4.5 we see that removing PCBs receives the highest importance rating of all the issues, and in Table 4.7 we see that most respondents would like to see more done and more spent to remove the PCBs.

4.5 Evaluation Scores

This section provides results for Questions 19 through 21, to which respondents provide follow-up evaluation of their own responses to the choice questions, Question 13 through Question 18.

Question 19 is again asking about the importance of various natural resource program benefits, but the context is slightly different. Here the question relates to the tradeoffs that respondents made in the set of choice questions. In these tradeoffs the respondent is constrained by the cost of the sets of programs. The cost is an important factor for respondents (rated second to PCB removal) and as such has an effect on the ratings of all the programs. Comparing results reported in Table 4.5 to those in Table 4.8, we see that adding a monetary dimension reduces the average rating of each of the issues, but does not change their relative ranking.

Table 4.8. Importance of program attributes in making choices between alternatives (Question 19: 1 = not at all important to 5 = very important).

	Net of missing			
Program attribute[a]	**Number of observations**	**Mean importance rating**	**SE**	**Missing**
Years until safe levels of PCBs	468	3.9	0.05	0.4%
Annual cost to your household	466	3.8	0.05	0.9%
Inches of water clarity	465	3.5	0.05	1.1%
Days of excess algae each summer	467	3.3	0.05	0.6%
Acres of wetlands	468	3.3	0.05	0.4%
Facilities at existing parks	464	3.1	0.05	1.3%
Acres of new parks	466	2.9	0.06	0.9%

a. Listed in order of mean importance, not in the order they appeared in the survey.

For example, PCB removal remains the most important action, but while the benefits of PCB removal are rated an average of 4.3 on a scale of 5 (1 = not at all important, 5 = very important) with no consideration of cost, they are rated an average of 3.9 on the same scale when a monetary constraint is introduced. Cost is the next most important consideration. Recreation remains the lowest ranked resource topic. In the benefits importance questions, adding facilities was rated 3.6 and new parks 3.3, but with the addition of a monetary constraint in Question 19, they are rated 3.1 and 2.9 on a scale of 1 to 5.

In their responses to Question 19, the more aware and less aware groups have the same relative rankings for the benefits of natural resource programs that we saw in the benefits importance scores (Table 4.6). When the benefits of the resource programs are ranked along with cost in

Question 19, cost is ranked the most important factor for those who are less aware of all of the topics and the second most important factor (after PCBs) for those who are more aware of all the topics, suggesting that values will be lower for those who are less aware than for those who are more aware.

Questions 20 and 21 provide two perspectives on respondents' evaluations of their responses to the choice questions, and these are summarized in Tables 4.9 and 4.10. Question 20 asks respondents to consider their confidence in their choices between the alternatives in Questions 13 through 18. Question 21 takes a pragmatic perspective and tells the respondent to consider that "Questions 13 to 18 were asked to provide citizen input for decisions makers to consider along with scientists and planners," and then asks, "With this in mind how much should public officials consider your responses to Questions 13 through 18?"

Table 4.9. Confidence in choices between alternatives (Question 20: 1 = not at all confident to 5 = very confident).

							Net of missing		
Category[a]	**Not at all confident 1**	**2**	**Somewhat confident 3**	**4**	**Very confident 5**	**Missing**	**Nobs**	**Mean confidence rating**	**SE**
All	1.3%	4.9%	40.0%	37.9%	15.5%	0.4%	468	3.6	0.04
More aware	0.9%	3.4%	23.9%	46.2%	24.8%	0.9%	116	3.9	0.08
Less aware	2.2%	12.9%	49.5%	29.0%	6.5%	0%	93	3.2	0.09

Nobs = Number of observations.

a. If respondents chose 4 or 5 for awareness of all four topics in Question 22, they fall in the "more aware" category. If respondents chose 1, 2 or 3 for all four topics in Question 22, they fall in the "less aware" category.

Respondents were generally confident about the choices in the paired comparison questions: 93% indicated they were somewhat to very confident in the choices they made. And 95% felt that their responses should be somewhat or completely considered (along with other information from scientists and planners) in decisions made by public officials concerning these natural resource issues. Respondents who were more aware of the natural resource issues before receiving the survey tended to be more confident in their answers and more certain that their responses to the choice questions should be considered by public officials. Most all of those who are least confident in their responses (value = 1 or 2 in both Question 20 and Question 21) are individuals with lower awareness for several or all of the response topics and who report lower preference for, and values for, the restoration programs.

Table 4.10. Extent to which public officials should consider your responses to choice questions (Question 21: 1 = should not consider my responses at all to 5 = should completely consider my responses).

	Should not consider my responses at all		Should somewhat consider my responses		Should completely consider my responses		Net of missing		
Category[a]	**1**	**2**	**3**	**4**	**5**	**Missing**	**Nobs**	**Mean confidence rating**	**SE**
All	0.6%	3.4%	27.2%	39.4%	28.9%	0.4%	468	3.9	0.04
More aware	0.0%	0.9%	11.1%	42.7%	44.4%	0.0%	116	4.3	0.07
Less aware	1.1%	12.9%	40.9%	29.0%	16.1%	0%	93	3.5	0.10

Nobs = Number of observations.

a. If respondent chose 4 or 5 for awareness of all four topics in Question 22, they fall in the “more aware” category. If respondent chose 1, 2 or 3 for all four topics in Question 22, they fall in the “less aware” category.

4.6 Comments

In response to Question 36, 125 (27%) of the respondents provided written comments on the survey. Table 4.11 provides a summary of their 181 comments. A total of 37 respondents (7.9% of all respondents) made one or more comments that might indicate scenario rejection.[1]

When considering the impact of potential scenario rejection on the scaling of restoration to be of equivalent value to PCB-caused service flow losses, what would matter is if there were a disproportionate level of rejection tied to PCBs versus the other topics. This is in fact the case. A total of 29 respondents made comments suggesting potential rejection of paying for PCB removal, 4 respondents made comments suggesting potential rejection of paying for runoff programs, 3 respondents made comments suggesting potential rejection of paying for outdoor recreation programs, and 6 respondents made comments suggesting potential rejection of implementing it through the government bureaucracy. Thus, this suggests that a bias, if any, would be toward understating the required level of restoration to be of equivalent value to PCB-caused service flow losses.

1. Scenario rejection occurs when an individual’s preference statement does not reflect his value for a commodity but rather is in response to some component of the choice pair scenario, such as the payment vehicle or the timing of commodity provision.

Table 4.11. General comments made at end of survey, coded into categories.

Comment number[a]	Comment category	Number making comment[b]	Percent of those with comments	Percent of all respondents
11	Industry should pay / is liable for PCBs	21	16.8%	4.5%
12	Farmers should pay for runoff	4	3.2%	0.9%
13	User should pay	3	2.4%	0.6%
14	Use other funding source / taxes already too high	5	4.0%	1.1%
15	Bureaucracy / government wastes money	6	4.8%	1.3%
16	Amount must be reasonable / don't raise it too much	4	3.2%	0.9%
23	PCB removal is very important	11	8.8%	2.3%
24	Concerns about PCB removal — process, efficiency, effectiveness	11	8.8%	2.3%
25	Quit fishing because of PCBs / want safer fish	7	5.6%	1.5%
30	Parks — general	1	0.8%	0.2%
31	Need more info about parks	1	0.8%	0.2%
33	Improve current parks / stop decline / current conditions poor	6	4.8%	1.3%
34	Don't expand / add facilities / add more parks	2	1.6%	0.4%
35	I don't use parks	1	0.8%	0.2%
36	I do use, or have used parks	2	1.6%	0.4%
40	Wetlands — general	2	1.6%	0.4%
41	Need more info about wetlands	2	1.6%	0.4%
42	Wetlands are important for future generations	1	0.8%	0.2%
43	Wetlands are a very important resource	8	6.4%	1.7%
44	Don't spend more on wetlands	1	0.8%	0.2%
50	Runoff — general	1	0.8%	0.2%
51	Need more info about runoff	1	0.8%	0.2%
53	Runoff is an important issue	1	0.8%	0.2%
60	Survey issues — general	3	2.4%	0.6%
61	Support for survey (compliment, thanks)	19	15.2%	4.0%
62	Survey biased	6	4.8%	1.3%
63	Didn't like tradeoffs (wanted a spend no more option, didn't want to trade recreation for environment)	3	2.4%	0.6%
70	Other — general	11	8.8%	2.3%
71	Mention other environmental issues	22	17.6%	4.7%
72	Enforce current regulations	6	4.8%	1.3%
73	Environment is important / general support for environment	9	7.2%	1.9%

a. Comment number as coded.

b. Sum is greater than 125 because some respondents brought up several topics in their comments.

4.7 Choice Pair Evaluation Using Simple Comparisons

In Chapter 5 we apply a sophisticated statistical model to evaluate the responses to the choice questions accounting for characteristics of the respondents. However, simple evaluations of a subset of the choice pairs provide straightforward insight into respondent preferences and into whether respondents are responsive to the natural resource changes being presented. These simple comparisons are based on the percentage of respondents to a choice pair that selects one or the other of the two alternatives in the choice pair. They do not consider respondent characteristics and are based on small sample sizes.

Table 4.12 summarizes the eight simple resource-to-resource pairs (i.e., costs are held constant across the two alternatives) involving PCB removal, measured as years until safe levels of PCBs are reached, versus other enhancements in one of the other three resource programs. The table lists the version and question number (e.g., the pair of alternatives) and sample size, the change in years until PCBs are safe and the changes in the other resource topics that are compared in the two alternatives, the dollar amount that was held constant in both alternatives, and the percent choosing the alternative with fewer years until PCBs are at safe levels.

Table 4.12. Pairs with PCB removal versus other single resource programs.

V#/Q#[a]	Number of observations	Years until PCB levels are safe	Versus	Fixed $ value	Percent choosing reduced PCBs
9/13	48	100 to 70 years	Runoff: 0% to 25% control	$25	57%
9/17	49	100 to 70 years	Wetlands: 0% to 10% increase in acres	$25	76%[b]
10/13	40	100 to 40 years	Runoff: 0% to 50% control	$50	58%
8/13	44	100 to 40 years	Wetlands: 0% to 20% increase in acres	$50	69%[b]
6/13	32	100 to 20 years	Wetlands: 0% to 20% increase in acres	$50	82%[b]
3/16	42	70 to 40 years	Parks: 0% to 5% increase in new acres and 0% to 10% enhancements at existing parks	$100	69%[b]
10/17	48	70 to 20 years	Recreation: 0% to 10% enhancements at existing parks	$50	92%[b]
5/15	50	40 to 20 years	Recreation: 0% to 10% enhancements at existing parks	$50	60%

a. V# =Version number, Q# = question.
b. Statistically significant at 10% or higher levels.

The results in Table 4.12 highlight a consistent preference for PCB removal when directly compared to enhancements in other programs. In each such direct comparison, PCB removal is preferred. Even with the small sample sizes in the individual choice questions, the preference is statistically significant at a 10% level for most of the comparisons (falling just short of statistical significance in the other cases, which involve either smaller PCB changes and/or runoff control). For other simple resource-to-resource comparisons, we find certain runoff control programs are preferred to outdoor recreational enhancements and to certain wetland programs, and statistically significantly so in three of four such comparisons. These simple comparisons identify that PCB removal and runoff control are, respectively, the first and second most preferred restoration actions. These results are consistent with the attitude scores provided earlier in this chapter and with the model presented in Chapter 5 that incorporate all of the choice pairs and important respondent attributes (and thus has more statistical power).

Comparing results for choice pairs from different survey versions can be used as "between-sample" tests of if and how respondents respond to changes in the level of resource changes and costs presented. One would expect that a program providing more benefits (e.g., more acres of wetlands or less years of PCB contamination) would be valued the same as or more than a program providing a lesser level of benefits. Such "scope tests" have sometimes been suggested as a validity test for contingent valuation studies (Carson, 1997). The choices respondents make indicate that respondents are responding to different levels of natural resource attributes presented to them — the support for programs varies with the level of change in the program results.

Table 4.13 compares the results of resource-to-resource choice pairs that provide scope test type comparisons. Using the first row as an example, pair 5/15 (Version 5, Question 15, which has 50 observations) asks for a choice between a 10% increase in existing recreational facilities (resource change 1) and reducing the years until PCBs are at safe levels from 40 years to 20 years. In this choice, the dollar cost presented to respondents for both alternatives is the same at $50. Pair 10/17 calls for a choice between the same change in existing recreational facilities (10% increase) and reducing the years until PCBs are at safe levels from 70 years to 20 years (in this question, the cost of both programs was $50). In both choice pairs (5/15 and 10/17), one resource change was a 10% increase in existing recreational facilities. In the second choice pair listed, this change in recreation was compared to a larger change in PCBs than in the first choice pair (70 to 20 years versus 40 to 20 years). One would expect that the preference for the recreational enhancement in the second pair (10/17) would be less than in the first pair because the PCB change is even larger, and this is what is found. In this case, the preference for the recreational enhancement program drops from 40% to 8%, which is a statistically significant change. The dollar levels are not expected to influence the choices because, except in the seventh

Table 4.13. Simple comparison of choice pairs: Resource comparisons.

Comparison	V#/Q#	Number of observations	Resource change 1	Resource change 2	$	% select change 1	Expected result
1	5/15	50	Rec: 0% to 10% ↑	PCBs: 40 to 20 yrs	50	40%	Yes[a]
	10/17	48	Rec: 0% to 10% ↑	PCBs: 70 to 20 yrs	50	8%	
2	8/13	44	Wetland: 0% to 20% ↑	PCBs: 100 to 40 yrs.	50	32%	Yes[a]
	6/13	44	Wetland: 0% to 20% ↑	PCBs: 100 to 20 yrs	50	18%	
3	10/17	48	PCBs: 70 to 20 years	Rec: 0% to 10% ↑	50	92%	Yes[a]
	5/18	49	PCBs: 70 to 20 years	Rec: 0% to 10% ↑ and Wetlands: 0% to 10% ↑	50	67%	
4	10/13	48	PCBs: 100 to 40 yrs	Rec: 0% to 10% ↑	50	58%	Yes
	1/16	38	PCBs: 100 to 40 yrs	Rec: 0% to 10% ↑ and Runoff control: 0% to 50% ↑	50	53%	
5	5/15	50	PCBs: 40 to 20 yrs	Rec: 0% to 10% ↑	50	60%	(vs 5/15)
	8/15	45	PCBs: 40 to 20 yrs	Rec: 0% to 10% ↑ and Wetlands: 0% to 5% ↑	50	51%	Yes
6	9/16	49	PCBs: 40 to 20 yrs	Rec: 0% to 10% ↑ and Runoff control: 0% to 25% ↑	50	41%	(vs 5/15) Yes[a]
7	2/13	48	Wetlands: 0% to 5% ↑	Parks: 0% to 5% ↑	25	44%	Yes[a]
	4/15	47	Wetlands: 0% to 5% ↑	Parks: 0% to 10% plus other improvements and cost decreases	NA	9%	
8	5/15	50	Rec: 0% to 10% ↑	PCBs: 40 to 20 years	50	40%	Yes
	2/17	48	Rec: 0% to 10% ↑	PCBs: 40 to 20 years and Wetlands: 10% to 20% ↑	100	31%	

Notes: V# = version number, Q# = question number. $ = fixed dollar amount in both alternatives of a pair. Pairs are ordered in each block such that the probability of choosing resource change 1 would be expected to decrease with the second pair compared to the first pair. ↑ = enhancements/increases.

a. Statically significant difference a 10% one-tailed test level.

comparison in this table, they are the same for both alternatives in a choice pair, but are presented for perspective on the questions.[2]

The remainder of Table 4.13 lists seven additional comparisons (note that 5/15 is compared to both 8/15 and 9/16). The table is presented so that the expected probability of selecting the enhancements listed as "resource change 1" as compared to "resource change 2" decreases with the second pair because the improvements in resource change 2 are larger in the second pair than in the first pair.[3] Limited pairs can be compared in this manner because in many pairs not listed here some resources or costs increase while other decrease, or the pairs compare increases in one or many programs with increases in one or many programs. The pairs listed provide comparisons where the expected change in preferences is clear so long as one assumes zero or increasing utility with increasing program levels and with decreasing costs.

In all cases in Table 4.13, the results are as expected, and in many cases the differences are statistically significant. This is important because the sample sizes are small for such between-sample comparisons that do not control for other variables (resident location, awareness, angler). Given these considerations, the results provide strong evidence for between-sample scope responsiveness for the accuracy of the resource-to-resource comparison question responses.

Table 4.14 makes similar comparisons using the referendum style questions (Question 14 in all 10 survey versions). Again, in each comparison the data are presented so that the probability of selecting resource change 1 is expected to be less for the second choice pair than for the first choice pair. The results here also support that respondents are responding to scope, but in two comparisons the results do not support expectations. Both cases involve responses to Version 2, Question 14. The reasons why the results to Version 2, Question 14 provide contradictory results are unclear, and may be the small sample size and varying sample characteristics. For example, respondents to Version 2 rated the importance of costs, in Question 19, higher than did respondents in any other survey version, which is consistent with the results reported in Table 4.14. Given the sample sizes, respondent characteristics, and other potential influences, are not controlled in these simple comparisons, it is not surprising or unreasonable that one of the pairs, and 2 of 14 comparisons in Tables 4.13 and 4.14, would result in unexpected results from simple comparisons.

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2. The dollar values are also the same for both choice pairs in most of the comparisons in Table 4.13. In many utility function specification (e.g., utility linear in program levels and income, utility linear in program levels and program levels all consistently interacting with income), the dollar level would not affect the choice between alternatives. Other utility specifications may exist where the dollar value could affect the choice between alternatives, but the results in Tables 4.12 and 4.13, and in Chapter 5, do not suggest cause for concern that the dollar levels are substantially, if at all, influencing the preference and scope test conclusions reported here.

3. The pairs are presented in this manner to facilitate comparisons. Resource change 1 and resource change 2 may be either Alternative A or Alternative B in the actual question.

Table 4.14. Simple comparison of choice pairs: Referendum comparisons.

Comparison	V#/Q#	Number of observations	Resource change 1	Resource change 2 (or $ cost change)	$	% select change 1	Expected result
1	4/14	47	PCBs: 100 to 20 yrs	$0 to $200	NA	57%	Yes[a]
	1/14	38	PCBs: 100 to 40 yrs	$0 to $200	NA	39%	
2	5/14	51	PCBs: 100 to 40 yrs	$0 to $50	NA	67%	Yes[a]
	1/14	38	PCBs: 100 to 40 yrs	$0 to $200	NA	39%	
3	2/14	48	PCBs: 100 to 20 yrs	$0 to $50	NA	44%	Yes
	1/14	38	PCBs: 100 to 40 yrs	$0 to $200	NA	39%	
4	2/14	48	PCBs: 100 to 20 yrs	$0 to $50	NA	44%	No
	4/14	47	PCBs: 100 to 20 yrs	$0 to $200	NA	57%	
5	2/14	48	PCBs: 100 to 20 yrs	$0 to $50	NA	44%	No[a]
	5/14	51	PCBs: 100 to 40 yrs	$0 to $50	NA	67%	
6	9/14	49	Parks: 0% to 10% ↑	$0 to $50	NA	43%	Yes[a]
	8/14	45	Parks: 0% to 5% ↑	$0 to $100	NA	22%	

Notes: V# = version number, Q# = question number. $ = fixed dollar amount in both alternatives of a pair. Pairs are ordered in each block such that the probability of choosing resource change 1 would be expected to decrease with the second pair compared to the first pair. ↑ = enhancements/increases.

a = Statically significant difference a 10% one-tailed test level.

5. A Model of Preferences for Resource Alternatives

5.1 Introduction

In this chapter we present the choice-question model used to estimate preferences for resource enhancement projects in and around the Bay of Green Bay. This model can be used to examine how individuals trade off different levels of the four programs, such as wetlands acres and years until PCBs are at safe levels. It can also show how individuals value changes in program levels in monetary terms, such as the WTP for program enhancements.

The choice-question model seeks to explain statistically each respondent's six choices from the choice pairs as a function of a number of program and individual characteristics. The model parameters represent a quantitative measure of the relative importance of the program characteristics in determining the benefits individuals receive from their availability. For example, the parameter on a variable for the number of years until no PCB-caused losses remain indicates the decrease in benefits if the number of years increases by that much.

We assume in the model that survey respondents chose the alternative (Alternative A or Alternative B) in each pair that would provide them with the largest net benefit. The technical logic of pairwise choice-question models is presented in Appendix B.

Sections 5.2 and 5.3 present variables affecting utility and discuss model features. Section 5.4 constructs the utility function for the natural resource program benefits and discusses the parameters. Section 5.5 discusses the computation of WTP for environmental changes; Section 5.6 describes the estimation method; and Section 5.7 presents the estimated parameters and assesses model performance.

5.2 Factors Affecting Utility from Green Bay Resources

Our choice questions are "binary" choices (i.e., they are choices between two alternatives). Economists assume respondents choose one of the alternatives over the other because the respondents believe that they would receive more satisfaction, or "utility," from the chosen alternative than from the rejected one. To analyze the survey responses, it is necessary to assume that the "utility function" takes on a specific mathematical form. Utility is assumed to be a function of the characteristics of the alternatives. Here we followed the common practice of assuming that utility is a linear function of the utility parameters as shown in Equation B-1 of Appendix B.

In our choice pairs, the levels of the characteristics take on a limited number of discrete values (see Table 2.4). For example, the number of years until no PCB-caused losses remain takes on a value of 100, 70, 40, or 20; wetlands variables also take on four values. Rather than assume that these variables are continuous variables, and then impose a functional form on the data, we have chosen to treat each of the resource levels as separate "dummy variables," which take on a value of one if a particular resource level occurs in the choice alternative, and zero otherwise. This method allows the greatest degree of flexibility in the model because the utility from each level of a characteristic is estimated independently from other levels. Therefore, the model is not linear in the characteristics; that is, marginal utilities (benefits) for increasing amounts of a type of resource action are not constant. There are 11 different dummy variables for the five resource groups (not counting the base case in each group that does not have a dummy variable, for identification of the model). The cost of the alternative is also a determinant of utility.[1]

The model also incorporates preference heterogeneity; that is, marginal utilities for changes in characteristics are allowed to vary over different types of people. Preferences typically vary across individuals, although assuming preferences are the same across individuals is a common assumption in models of this kind. The classic way of including heterogeneity is to let effects on utility from changes in site characteristics vary as a function of individual socioeconomic and demographic characteristics. This traditional method, which we use in this study, has been employed for many years, and a summary discussion can be found in Pollack and Wales (1992).

To reduce greatly the number of parameters introduced into the model by incorporating preference heterogeneity, a restriction was imposed to add structure within each resource group. As noted above, for example, the model contains three dummy variables for four PCB characteristics.[2] It is assumed that the set of PCB parameters, or parameters for any of the other resource groups, varies across different types of respondents proportionately. For example, the PCB parameters for anglers (based on Question 23) are all higher than for non-anglers by the same percentage.

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1. Because our model is linear in income, it does not have income effects, and the income variable does not affect estimation. When computing the utility difference between the alternatives, income drops out when utility from one alternative is subtracted from utility in the other alternative, because income is the same in both.

2. The fourth level serves as the current level and thus does not require a dummy variable. Its utility is simply the level of utility when the other three dummy variables are set at zero.

Recreational anglers and those living close to Green Bay are allowed to have different preferences for reductions in PCB years. Further, those who have a high self-reported level of awareness for a given resource group are allowed to have different preferences for that particular resource group than those less aware.[3] Prior respondent experience with environmental commodities tends to increase values, which should be addressed in the econometric model, and awareness is an effective means to proxy that experience (see Cameron and Englin, 1997). The awareness variable is an index or conglomeration reflecting past experience and behavior as well as exogenous characteristics of the individual, as discussed in Chapter 4. Including awareness also captures respondent confidence in their reported results (Section 4.5).

In preliminary analyses, other individual-specific variables including gender and involvement in other types of recreation, were found not to be statistically significant. Any variables found not to be significant were omitted from the final specification of the model to: 1) increase the accuracy (efficiency) of the estimates by reducing unnecessary noise, and 2) make the estimated model parameters more straightforward to interpret by removing needless complications.

5.3 Other Model Features

5.3.1 Positioning effects

Positioning effects occur when respondents have a tendency to choose one of the alternatives (usually the first one, Alternative A in this case) more frequently than the other after controlling for all other relevant variables (here, the six attributes). Positioning may occur because the survey process may be difficult or tiring for some individuals, or their preferences for the resource program may not be well defined. In such cases, respondents may tend to select the first alternative repeatedly to reduce their cognitive burden. In the final sample of 470 respondents, 32 chose Alternative A in all six choices and 8 chose Alternative B in all choices. To evaluate the impact of positioning effects on our results, if any, a dummy variable equal to one was included for A alternatives.

5.3.2 Varying difficulty of choice

Using randomly generated levels of changes in natural resource programs will result in many, or even most, pairs involving varying levels for multiple programs in each choice pair. Thus, respondents would be presented with the challenging task of comprehending multiple changes

3. Awareness interactions were included for all resource groups except new parks, because that resource action was not found to yield significantly positive benefits in preliminary specifications.

each time they compare a pair of alternatives. The choice task may be daunting for some respondents and, if so, they may tend to focus only on a subset of the characteristics as the basis for decision-making, thus increasing the variance in the parameter estimates.

The choice pairs throughout the 10 different versions of the survey were designed to be of distinctly different types, some which may be more difficult for respondents to rank than others. These are described in detail in Section 2.2.3:

- *Simple resource-to-resource pairs:* These choice questions present a simple one resource versus one resource tradeoff: for example, an improvement in wetlands in one alternative versus an improvement in recreational facilities in the second alternative, with the levels of other programs and taxes paid the same in both alternatives.

- *Referendum pairs:* These choice questions mimic standard referendum questions developed in the contingent valuation literature: for example, an improvement in wetlands with an increase in taxes in one alternative versus the status quo in the other alternative.

- *Complex pairs:* These choice questions present complex mixes of multiple changes in natural resource levels and taxes paid in either or both alternatives of a choice pair.

The ability of respondents to reveal preferences may vary across these different types of questions, which exhibits itself in varying degrees of randomness in decision-making. The magnitude of this randomness can be examined using scale parameters, that differ by type of choice question, that make all of the model parameters larger or smaller relative to the variance of the random component of preferences. Therefore, we model not only heterogeneity of preferences across individuals but also heterogeneity in the variance of the stochastic component across pair types for a given individual. Two dummy variables were added to scale the parameters to account for the fact that results may be statistically "noisier" across the three different types of questions.[4]

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4. Estimating separate scale factors for different choice questions in the estimation of environmental preferences has been done to test for learning and fatigue effects (see, for example, Breffle et al., 1999 and Adamowicz et al., 1998). With learning, randomness may decrease; and with fatigue, randomness may increase. Swait and Adamowicz (2000) allowed for the level of unexplained noise in choices to vary over choices and individuals using stated preference choices, and combining stated preference and revealed preference data. Scale parameters were allowed to vary with complexity, where complexity was represented by an endogenously-determined overall measure of uncertainty called entropy (which increases in the number of alternatives and correlations between attributes), rather than using prespecified complexity categories as we have done. Mazzotta and Opaluch (1995) present results supporting the hypothesis that increasing complexity in the choice task increases the associated noise in the choice.

5.4 The Utility Function

The following equation presents the utility function for individual *i*; all of the variables in this function are defined in Table 5.1:

$$
\begin{aligned}
U_i &= \beta_y (y_i - COST_i) \\
&+ \sum_{l=1}^{3} (1 + \beta_{weta} D_{weta_i})(\beta_{wet_l} D_{wet_l}) \\
&+ \sum_{m=1}^{3} [(1 + \beta_{pa} D_{pa_i} + \beta_n D_{n_i} + \beta_f D_{f_i}) \beta_{p_m} D_{p_m}] \\
&+ (1 + \beta_{pea} D_{pea_i}) \beta_{pe} D_{pe} + \sum_{q=1}^{2} \beta_{pn_q} D_{pn_q} \\
&+ \sum_{r=1}^{2} (1 + \beta_{roa} D_{roa_i}) \beta_{ro_r} D_{ro\,r} + \beta_A D_A + \varepsilon_i \,,
\end{aligned}
\tag{5-1}
$$

where $\varepsilon_i \sim N(0, \frac{\sigma_\varepsilon^2}{(1 + s_s D_s + s_r D_r)^2})$, and σ_ε is not identified and so is set to $\sqrt{1/2}$.

Parameter β_y indicates the increase in utility if the cost decreases by $1 and is typically referred to as the marginal utility of money. It is assumed to be a constant. This parameter is expected to have a positive sign, which also implies that the individual prefers to pay a lower cost. Downward sloping demand (i.e., demand is a decreasing function of price) is a standard tenet of consumer economic theory and is very often observed in practice.

The other site-characteristic parameters, $\beta_{wet_l}, \beta_{p_m}, \beta_{pe}, \beta_{pm_q}$, and β_{ro_r} represent the change in utility from a change in each of the respective resource characteristics. The expected signs of the elements of β_{ro} are positive for all levels and increasing for better runoff quality; individuals are expected to prefer better water clarity and fewer excess algae days. The expected signs of the elements of β_p are expected to be negative for all levels and getting larger in absolute values as the number of years increases; individuals prefer PCB-caused losses to last a shorter period. Finally, we expect wetlands and parks to provide increasing benefits as more of the resources are provided.

Individual characteristic dummies are defined such that the base parameter (where the dummy equals zero) is for the type of individual with the largest expected parameter. For example, anglers may have larger marginal utilities (in absolute value) than non-anglers, and anglers are given a value of zero for the dummy. The parameters on the dummy variables are then used to scale (down) the base parameters multiplicatively (see Equation 5-1) for the types of individuals

Table 5.1. Model variables.

Variable	Definition
Green Bay characteristics	
COST	Cost per year for 10 years
$D_{wet_l}, l \in [1,3]$	= 1 if acres of preserved wetlands increased to amount in level *l* = 0 otherwise baseline level: 58,000 acres; increased levels: 60,900 acres, 63,800 acres, 69,600 acres
$D_{p_m}, m \in [1,3]$	= 1 if years until safe from PCBs is decreased to time in level *m* = 0 otherwise baseline level: 100 years; decreased levels: 70 years, 40 years, 20 years
D_{pe}	= 1 if facilities at existing parks are increased by 10% = 0 otherwise
$D_{pn_q}, q \in [1,2]$	= 1 if acres of new parks increased by the amount in level *q* = 0 otherwise increased levels: 5%, 10%
$D_{ro_r}, r \in [1,2]$	= 1 if runoff improves water quality level to level *r* = 0 otherwise baseline level: 20" of water clarity and 80 excess algae days or less; improved levels: 24" (20% improvement) and 60 days or fewer (25% reduction), 34" (70% improvement) and 40 days or fewer (50% reduction)[a]
Individual characteristics[b]	
y_i	Income of respondent *i*
D_{weta_i}, D_{pa_i}, D_{pea_i}, D_{roa_i}	= 0 if respondent *i* is highly aware of issues related to wetlands, PCBs, existing parks, and runoff, respectively (Question 22 = 4 or 5) = 1 otherwise
D_{n_i}	= 0 if respondent *i* lives near Green Bay (within two miles based on zip code) = 1 otherwise
D_{f_i}	= 0 if respondent *i* is a Green Bay recreational angler (Question 23) = 1 otherwise
Pair- and alternative-specific variables	
D_A	= 1 if alternative is A alternative = 0 otherwise
D_s	= 1 if pair compares two alternatives in which only one resource characteristic varies in each alternative (*single v. single*) = 0 otherwise
D_r	= 1 if pair contains resource improvement(s) with positive cost compared to baseline conditions with no cost (*referendum*) = 0 otherwise

a. Note that changes in water clarity and excess algae days are perfectly correlated in the choice pairs.
b. Note that the dummy variable definitions for individual characteristics are opposite the usual convention: those *with* a characteristic get a value of zero instead of one. The base case with all dummies equal to zero is the type expected to have the highest value for PCBs and other resources (i.e., angler, lives near, higher awareness). Given the form of the utility function, estimation was easier by scaling *down* the marginal utilities of other, lower-value types of individuals with dummies set to one.

with dummies equal to one (e.g., non-anglers). It is easier for the estimation program to scale down larger parameters than to scale up smaller parameters (the latter of which may effectively equal zero). To clarify, suppose that some type of individual has a marginal utility that is effectively zero. For example, those less aware of wetland resources may have no value for more wetlands, and an associated zero marginal utility. It would be impossible for the estimation program to scale up the zero parameter for the less aware group to anything positive for another type of individual (e.g., more aware). Conversely, it is easy for the program to scale down a positive marginal utility, even to zero.

The awareness parameters, $\beta_{weta}, \beta_{pa}, \beta_{pea},$ and β_{roa}, are expected to be negative, because those with a higher awareness are expected to have a higher value for resource quality than those with a lower awareness. Likewise, those living near Green Bay, and those who fish Green Bay recreationally, are expected to value PCB cleanup more than those who live far and those who do not fish; β_n and β_f are expected to be negative for those who do not fish and live at a distance.

5.5 Willingness to Pay per Household

For a model with no income effects and only one alternative in each state, such as this model, the computation of WTP for a resource program (such as to avoid years of PCB-caused losses) per household, measured as the compensating variation (CV_i), is straightforward. It can be computed as the difference between utility in the two states divided by the marginal utility of money. Because utility is linear in the vector of marginal utilities β_i, the formula for CV_i is:

$$CV_i = \frac{1}{\beta_y}[\beta_i^{\prime}(x_i^1 - x_i^0)], \qquad (5\text{-}2)$$

where x is the vector of the resource characteristics and β_i varies across individuals as a function of individual characteristics.

Because all of the resource (and respondent) characteristics are incorporated as dummy variables with values of zero or one, the formula for CV_i for a given resource characteristic is simply the marginal utility for that characteristic as represented by a model parameter(s) divided by the marginal utility of money. Also note that the stochastic component cancels out of Equation 5-2, so $E(CV_i) = CV_i \; \forall \; i$. Estimated values are reported in Chapter 6.

5.6 Model Estimation

In the empirical model, parameters are estimated using a mathematical search algorithm that makes the individuals' observed choices most likely. In other words, the estimated parameters maximize the likelihood of collectively observing the chosen alternatives from the choice pairs. The parameter estimates are called *maximum likelihood* estimates because they are estimates of the population parameters that maximize the likelihood of drawing the sample of the observed choices.

The Gauss application module "Maxlik" was used to maximize the likelihood function (Equation B-4 in Appendix B). Convergence was achieved for a variety of starting values, and always at the same point. The model was estimated using a personal computer with a 400 MHz Pentium II chip and 128 MB of RAM and took approximately 12 minutes to converge.

The *likelihood function* that is maximized is derived and presented in detail in Appendix B. In short, it is a joint probability over all of the individuals in the data set. For a single individual it is computed as the product of the probabilities of the chosen Green Bay alternatives over the six choice-occasion pairs. Maximizing the likelihood function is equivalent to maximizing the joint probability of observing the collective angler choices. Parameters estimated by maximum likelihood have desirable statistical properties. For example, the estimates get closer to their actual values as the sample size grows larger. Under some additional assumptions, these are also the most precise estimates.

5.7 The Estimated Model

This section presents an overview of the estimation of the model described above. The estimated parameters of the utility function in Equation 5-1 are discussed qualitatively here, and the specific parameter estimates are reported in Table 5.2. In the next chapter, these parameters are used to compute the rates at which individuals trade off PCB-caused losses with other site characteristics, and to value in WTP the changes in site characteristics. Major conclusions that can be drawn from this section are that model parameters are estimated with accuracy, and that the model accurately predicts the choices.

5.7.1 Signs and significance of the parameter estimates

An important result from this estimation is that all of the estimated parameters with expected signs do in fact have the expected signs, and within resource groups, parameters have reasonable relative magnitudes. As expected, the cost of an alternative has a highly significant negative effect on utility.

Table 5.2. Parameter estimates.

Parameter	Estimate[a] (asymptotic *t* statistic)
β_y (marginal utility of money)	0.0060 (13.286)
β_{wet_l} (wetlands)	
l = 60,900 acres	0.1873 (2.264)
l = 63,800 acres	0.3420 (3.780)
l = 69,600 acres	0.4187 (5.000)
β_{p_m} (PCBs)	
m = 20 years	1.2172 (7.253)
m = 40 years	0.8477 (6.735)
m = 70 years	0.3273 (3.871)
β_{pe} (existing parks)	0.1077 (1.918)
β_{pn_q} (new parks)	
q = 5%	0.0236 (0.438)
q = 10%	-0.1030 (-1.856)
β_{ro_r} (runoff/water quality)	
r = 24" clarity and < 60 excess algae days	0.1838 (2.856)
r = 34" clarity and < 80 excess algae days	0.4817 (7.465)
β_{weta} (wetlands awareness)[b]	-1.0879 (-5.527)
β_{pa} (PCBs awareness)[b]	-0.3387 (-3.729)
β_{pea} (existing parks awareness)[b]	-1.0780 (-2.234)
β_{roa} (runoff/water quality awareness)[b]	-0.4599 (-3.202)
β_n (PCBs for group not living near)	-0.1618 (-1.708)
β_f (PCBs for non-angler group)	-0.1958 (-2.498)
β_A (position dummy)	0.1244 (4.456)
s_s (scale for resource-to-resource pairs)	0.5897 (2.363)
s_r (scale for referendum pairs)	-0.4422 (-3.932)

a. Parameters can be interpreted as the change in utility for the specified change in the characteristics, as compared to current levels.
b. Awareness = 1 if less aware of this specific resource topic.

The signs on the wetlands improvements parameters are significant at a 5% level, and positive and increasing at a decreasing rate with greater numbers of acres restored, suggesting diminishing marginal utility. The second 5,800 additional acres is only valued about one-fifth as much as the first 5,800 acres. Utility from improvements in runoff is also increasing and significant at a 5% level; inches of water clarity also exhibit diminishing marginal utility. The first 4 additional inches of water clarity are valued about 54% more per inch compared to subsequent inches.

Increasing facilities at existing parks is significant at a 10% (and almost 5%) level using a two-tailed test. A 5% increase in new parks has a positive parameter, and a 10% increase has a negative parameter, indicating that respondents do not value more parks. Individuals may think land designation for a significant increase in parks is a waste of government funds, or that better uses of land exist.

Parameters on the PCB variables are highly significant, show sensitivity to scope (i.e., a greater number of years until PCB-caused losses no longer remain reduces utility more), and indicate that individuals discount the future. For example, a change in the number of years until PCBs are at safe levels from 100 years to 70 years increases utility 41% less per year of change than a change from 40 to 20 years.

Awareness was found to be a highly significant variable. Those who are less aware of recreational parks and wetlands essentially derive no utility from changes in the levels of these resources. Those less aware of PCBs have benefits that would be about 34% less for their removal, and those less aware of runoff and water quality issues get about one-half the utility.

Anglers and those living in close proximity also would get more utility from the reduction in the years until PCBs are at safe levels: the parameter for non-anglers is approximately 20% lower, and the parameter for those living beyond two miles is approximately 16% lower.[5] Distance and angler status were found not to be significant for other resource groups. This result makes sense because the other programs have a wider geographic impact than just the waters of Green Bay.

The parameter for positioning is significant and positive, meaning that A is selected more frequently than B, controlling for other variables. This parameter is retained in the model to eliminate positioning bias in the assessment; the utility from a program alternative (and subsequently tradeoffs and WTP) is then computed using the estimated parameters but excluding the positioning parameter, because the positioning parameter is used to calibrate for survey

5. Two miles from the Bay of Green Bay, where the large majority of recreational fishing occurs in the “waters of Green Bay” (Breffle et al., 1999), was chosen to define the distance variable in the econometric analysis because that is the farthest distance for which we found a statistically significant difference between the two distance groups.

design effects but is not a demand parameter. The significance of the positioning parameter is caused largely by a small number of respondents (28) who chose Alternative A in all six pairs, which may happen for some respondents because of the complexity of the choices. Furthermore, some choices of A are expected for these individuals, and their choices are generally consistent with other survey responses. For example, in the group who chose Alternative A in every case, PCBs and cost were generally ranked as most important, and alternatives with better PCB and cost characteristics were generally chosen. Theory cannot predict what effect the omission of the positioning parameter would have on the estimated relative importance of PCBs and other parameters; it was included as a precautionary measure, and its inclusion is econometrically preferred.

The simple resource-to-resource comparisons have the smallest variance in the random component. [6] The variance for simple resource-to-resource pairs is about 0.4 times the variance of the complex pairs (60% smaller). It is not surprising that these pairs have less noise than the complex pairs because the comparison of alternatives is more straightforward. The referendum-style questions have the greatest variance, suggesting that individuals can make tradeoffs between different resource improvements more easily than they can trade off site characteristics for money; the variance for referendum pairs is about 3.21 times the variance for complex pairs (221% larger), and about 8.11 times the variance for simple resource-to-resource pairs (or the variance for simple resource-to-resource pairs is about 12% as large as the variance for referendum pairs). The greater noise with referendum pairs may also suggest some degree of scenario rejection when the respondent is essentially asked for a WTP in money. This referendum result is supported by the data in Tables 4.13 and 4.14 which also suggest that sensitivity to scope is manifested less in the referendum pairs.

By allowing only the variances to differ across question types (and not the means of the parameters), we are imposing *parameter proportionality* across question types, where the relative magnitude of different demand parameters remains the same. With parameter proportionality, expected choices across the types of choice questions will be the same; only the level of randomness varies.[7] Louviere (1996) notes that parameter proportionality is often not

6. It is important here not to confuse estimated variances of the random components (which are maximum likelihood parameter estimates that are not expected to change in any particular direction as sample size grows) with the estimated variances for those parameter estimates (which do shrink with sample size). The statistical significance of the estimated variance parameters is notable, given the smaller sample sizes for the referendum and single versus single type choice pairs (about one-quarter the sample size each as compared to the number of observations with complex pairs).

7. The reader should be clear that smaller estimated scales for certain types of choice questions mean that responses to those types receive less weight in estimation of the model parameters (i.e., less weight in the likelihood function discussed in Appendix B) than other types with higher scales. The demand parameter estimates would be different if the scale were the same for every pair.

rejected across different types of data sets in numerous studies. However, even in cases where parameter proportionality is statistically rejected, Louviere suggests that modeling only error variability will account for most of the heterogeneity. Estimating separate models by choice type to test for parameter proportionality was not possible. Sample sizes were not large enough and the variation in attribute levels too limited for some choice types and variables. Several parameters were not identified in the models separated by choice type.

5.7.2 Measures of model fit

Statistical procedures were implemented to show how well the model explains the data. First, an intuitively appealing test of fit is to examine the proportion of choices from choice pairs that are accurately predicted by the model. To determine which alternative the model predicts would be chosen from a pair, the estimated parameter values are put into Equation 5-1, along with the resource characteristics and costs from the two alternatives. Whichever alternative gives the highest value for estimated expected utility is the alternative the model predicts will be chosen. The model correctly predicts about 66% of the 2,784 choices in the data.

A pseudo-R^2 for the choice pairs is approximately 0.12. It is akin to a measure of fit for a simple linear regression model where the value ranges from zero to one and indicates the percentage of variation in the data that is explained by the model. A value of 0.12 is typical for cross-sectional data.

6. Restoration Scaling and Valuation Results

6.1 Introduction

Section 6.2 addresses the scale of restoration of equal value to the ongoing PCB-caused losses in terms of the three types of programs evaluated: wetlands enhancements, recreational enhancement, and runoff control. The selection and cost of preferred restoration is addressed in the RCDP. WTP measures for ongoing PCB-caused losses from 2000 until a return to baseline, as well as WTP measures for the restoration alternatives, are presented in Section 6.3. The WTP results provide additional perspective on the values used to scale restoration, as the underlying utility measures and WTP measures are linearly related. The WTP results for PCB-caused losses are also compared with those in the recreational fishing damage determination (Breffle et al., 1999) to avoid double counting [43 CFR § 11.84 (c)]. Section 6.4 provides conclusions, including a summary of study design features that indicates the estimates are likely to understate the required amounts of restoration and understate the WTP value measures (or ongoing PCB-caused losses).

For this assessment we assume that the regional population remains constant over the scenario time period. This assumption has limited impact on the scaling of restoration so long as the relative preferences between PCB removal and other restoration programs considered remain relatively stable in the future. However, this assumption will likely understate the WTP value measures if there will be population growth in the future because this growth is not factored into the computations.

6.2 Restoration Scaling

We use the model results in Chapter 5 to scale the wetlands, runoff, and recreation enhancement restoration programs to provide services of equal value to the PCB-caused service flow losses, and to compute WTP values. Because there are many possible combinations of the mix and levels of restoration programs, we illustrate the scale of restoration for a sample of program combinations for selected scenarios.

The scale of restoration for PCB-caused losses is computed such that the marginal disutility from continued PCB-caused losses is just offset by the marginal utility gained from enhancements in other natural resource restoration programs. For example, if the estimated marginal disutility for 10 more (or utility from 10 fewer) years of PCB-caused losses is estimated to be 4, and the marginal utility for a 25% increase in runoff control in Green Bay is estimated to be 4, then a 25% increase in runoff control would provide restoration of equal value to 10 more years of

PCB-caused losses. As a further example, if preserving an additional 5,000 acres of wetlands (above the current amounts) generates a marginal utility of 4 and an additional 10,000 acres has a marginal utility of 6, and the marginal utility for a 20-year reduction in PCB-caused losses is 5, we use linear interpolation. We infer that a 7,500-acre increase in wetlands would provide restoration of equivalent value to 20 more years of PCB-caused losses.

To scale restoration (and subsequently to compute WTP value measures), we first need to weight the sample results to reflect the differences between the sample and the population in the 10 sample counties. The sample was made comparable to the population using weights for distance (counties closer to Green Bay were sampled more heavily than counties farther away, and some living near Green Bay have higher PCB-caused losses) and recreational angler status (the sample has a disproportionately high number of anglers, who value PCB removal more).[1]

Weighting did not have a large impact on results. For example, average WTP values for PCB removal (and therefore for PCB-caused losses) per household fell by about 9% when the weights were used. For restoration scaling the effect was even smaller. Those who value a reduction in the number of years until PCBs are at safe levels less also tend to have lower values for other resource programs, so the effects of sample adjustments on the computation of the scale of restoration are largely offsetting.

Individuals differ in terms of how they trade off different resource programs for reductions in PCB-caused losses. We determine the level of restoration that is necessary for the population as a whole. For each scenario, for each individual in the weighted sample we use the model parameters to compute the utils associated with the PCB-caused losses and to compute the utils associated with the varying levels of the restoration programs. The individual utils are added up across all individuals in the weighted sample and the appropriate scale of restoration is determined so it yields the same total utils as the PCB-caused losses.

We consider the scale of restoration, and the WTP measures of ongoing PCB-caused losses, for a range of remediation scenarios (see Section 1.4). Estimates of the scale of restoration of equivalent value to PCB losses, and WTP measures for PCB-caused losses, between now (2000) and 20 years from now are computed by annualizing the utility and WTP for changes in losses

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1. The proportion of angler households in the population was determined using data from the recreational damage determination (Breffle et al., 1999). Green Bay angler households were identified in the current study using Question 23 about fishing Green Bay in the last 12 months. However, this question may simply reflect interest in fishing, and weighting on the basis of this response compared to population data about anglers who actually did fish the waters of Green Bay may result in an overcorrection. Because households with interest in Green Bay angling have higher WTP and value the reduction of PCB years more relative to other resource actions, this overcorrection will lead to an understatement of the scale of restoration and of WTP values for the public as a whole.

between remediation lasting 20 years and remediation lasting 40 years, and using a discount rate of 3% to compute the present value of losses from period 2000 to 2020 based on Figure 1.3. A 3% discount rate is selected to be consistent with regulatory guidance (Section 6.3.2) and consistent with all other present value calculations in the Co-trustee damage determination.

Potential natural recovery during the assumed 10 year period of remediation is not considered. After remediation is selected, the damage estimates can be revised to account for natural recovery. However, unless the rate of natural recovery is rapid, such revisions would be minimal.

Table 6.1 provides examples of the scale of sample mixes of restoration projects that provide services with value equal to the ongoing PCB-caused losses over specified time periods. For instance, the first three lines provides three examples of restoration providing services of value equal to the PCB-caused losses from 2000 until a return to baseline if an intensive level of remediation returns services to baseline in 2020. The second block provides examples for the 40 year intermediate level of remediation and the third block provides examples of the scale of restoration that provides services of value equal to a portion of the PCB-caused losses corresponding to differences between a 20 year and 40 year remediation, and between a 20 year and 70 year remediation. The examples include a combination of wetland acreage, park enhancements, and runoff control to provide sufficient restoration. Additional acreage of new parks was not found to be valued, so this program is not included in constructing restoration combinations.

For some scenarios, single resource programs using wetlands only or runoff control only, or combinations of these two actions, provide a sufficient scale of restoration. However, even a substantial recreation program of enhancements at 120 regional parks, for example, provides restoration benefits equivalent to only a few years of PCB-caused losses. In some cases, more of a program is required than considered in the survey. In these cases we extrapolate at the same marginal utility as for the last program units added, which likely understates the scale of restoration due to diminishing marginal utility of increasing program units (wetland acres, % control of runoff, % improvement in existing parks).

For two reasons, it may be economically more efficient to pursue combinations of programs rather than a single-resource program to provide properly scaled restoration. First, diminishing marginal utility at increasingly high levels for wetlands and runoff control means that the benefits do not increase at the same rate as the size of these programs are increased. Second, very high quantities of a given program may result in increasing marginal costs, to the point where some large programs may be technically infeasible.

Table 6.1. Illustration of restoration scaling.

Scenario	Example mixes of restoration programs		
	Wetland restoration acres[a]	Existing park enhancement	Runoff control[b]
PCB remediation scenarios[c]			
Intensive: (0 to 20 years)	3,100	10%	14"/50%
	5,500	8%	12"/45%
	11,000	0%	12"/45%
Intermediate: (0 to 40 years)[d]	24,100	10%	16"/55%
	16,000	20%	16"/55%
Partial restoration			
Intensive vs. 40 year Intermediate (20 to 40 years)	2,900	2%	4"/25%
	5,000	3%	2"/13%
	2,400	0%	7"/33%
Intensive vs. 70 year Intermediate (20 to 70 years)	5,700	0%	14"/50%
	13,000	10%	10"/40%

a. Rounded to nearest 100 acres.

b. Additional inches of water clarity/percentage decrease in number of excess algae days.

c. Restoration is for PCB-caused losses during the period indicated.

d. Requires extrapolating beyond the range of actions considered for some or all programs.

The scenarios in Table 6.1 do not include ongoing damages from 2000 that continue beyond 2040. This is because the levels considered for increased wetlands acres plus runoff control plus recreational enhancements do not provide benefits sufficient for ongoing PCB-caused losses starting in 2000 and continuing beyond 2040 without extrapolating well beyond the levels considered, and because the diminishing marginal utility reflected in the results suggests that the incremental value may be close to zero for additional enhancements well beyond the range considered. Therefore, for remediation that takes longer than 40 years, additional restoration actions beyond (or variations to) the three programs considered here may also be required.

Table 6.1 also provides scales of restoration for a portion of ongoing losses. These measures may be combined with other damage measures as an alternative approach to assess damages for all losses through time, such as using a combination of recreational fishing damages, total compensable damages, or habitat restoration programs for past damages and interim damages up to 2020, and then using Table 6.1 to scale restoration for ongoing losses after 2020.

6.3 WTP Measures of Values

6.3.1 Population-weighted annual measures of WTP per household

By asking respondents to consider tradeoffs between resource programs and monetary costs their household pays, we are also able to derive WTP for the programs, which for PCBs is a measure of total compensable values for ongoing PCB-caused losses. To obtain population based WTP measures, as for restoration scaling, the sample WTP values are weighted to reflect the population in the 10 county assessment area. To obtain present value measures, the stream of 10 year payments is discounted to 2000.

Table 6.2 presents the annual WTP estimates over 10 years based on CV_i from Equation 5-2. The values reported in Table 6.2 are population means, obtained by weighting the sample results to the population as described in Section 6.2. The 95% confidence intervals are approximated using the Krinsky-Robb procedure using 500 draws.

Figure 6.1 graphically presents the mean WTP results for each level of the four programs. Table 6.2 and Figure 6.1[2] demonstrate that PCB removal is generally much more highly valued than any other resource program, reflecting the results in the previous section that large quantities of multiple programs would be necessary to compensate for some injury scenarios. Diminishing marginal utility for a single program is reflected in the values for wetlands and runoff control (i.e., total values for these resource programs increase at a decreasing rate as more of the action is undertaken). The values for PCB removal increase as the years decrease until safe levels are reached. This reflects that near-term losses (e.g., between 0 and 20 years from now) are valued more highly by respondents than losses in the more distant future (e.g., between 100 and 70 years). Note that the mean WTP values for all resource changes and scenarios is less than 1% of the typical household's budget.

The mean WTP values per household for PCB-caused losses in the intensive remediation scenario (constant losses between 2000 and 2009, then linearly declining losses to zero at the end of 2019) averages to about $36 per year (the present value of 10 payments of $83.42 = $733, divided by 20 years of losses). The present value of annual losses ranges from about $52 per year in the first 10 years prior to remediation reducing losses, then declining to zero at the end of the 20th year. These values are of a similar size as those reported in the literature for other significant natural resource programs in the assessment area and Great Lakes area (Appendix D).

2. Figure 6.1 omits values for outdoor recreation enhancements through additional acres of park, which are not statistically different from zero for all respondents or for the more aware respondents.

Table 6.2. Mean population-weighted household willingness to pay for resource programs (dollars per year for 10 years, in 1999 dollars).

Resource program	**Mean E(*CV*)**[a]
PCB remediation scenarios	
Intensive: (0 to 20 years)	$83.42 [$47.04, $116.99]
Intermediate: (0 to 40 years)	$118.92 [$67.06, $166.77]
No additional remediation: (0 to 100 years)	$200.37 [$146.10, $251.59]
Other PCB scenarios[b]	
20 to 100 years	$116.95 [$91.09, $139.97]
40 to 100 years	$81.45 [$61.52, $102.27]
70 to 100	$31.44 [$17.17, $47.26]
0 to 70 years	$168.93 [$114.61, $217.11]
20 to 70 years	$85.50 [$64.95, $106.63]
40 to 70 years	$50.00 [$33.76, $68.21]
20 to 40 years	$35.50 [$20.02, $49.78]
Other resource programs	
Wetlands	
58,000 → 60,900 acres	$13.48 [$2.60, $24.76]
58,000 → 63,800 acres	$24.61 [$10.76, $38.30]
58,000 → 69,600 acres	$30.12 [$18.58, $42.89]
Existing parks (10% increase)	$7.73 [-$0.15, $15.83]
New parks	
5% increase	$0[c]
10% increase	$0[c]
Runoff control	
Clarity: 20” → 24”; reduction in algae days: 25%	$23.50 [$7.54, $42.24]
Clarity: 20” → 34”; reduction in algae days: 50%	$61.60 [$46.92, $78.65]

a. Simulated 95% confidence interval in brackets.
b. WTP is for avoidance of PCB-caused losses during the period indicated.
c. Not significantly different from $0 for all respondents or even for the more aware respondents (Table 6.3).

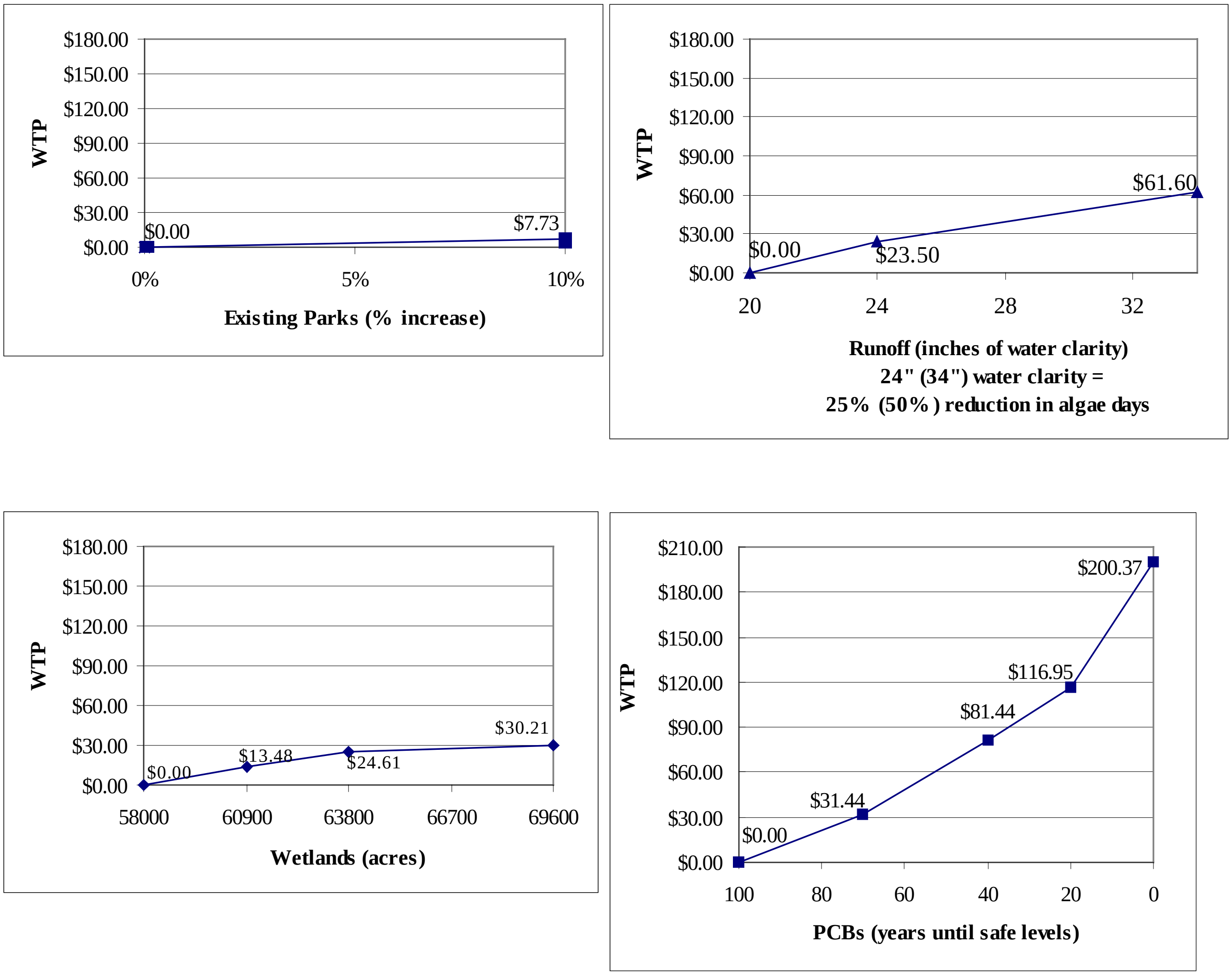

Figure 6.1. Population-weighted willingness to pay estimates for resource programs (household WTP per year for 10 years, $1999).

Heterogeneity of preferences was incorporated into the model to allow different types of respondents to report different household WTP values. As illustrated in Table 6.3, values vary in plausible ways; e.g., households closer to the site and with recreational anglers have higher PCB values. For each natural resource program and scenario, the values are reported by households that are more aware of the natural resource topic (topic awareness = 4 or 5) and by households that are less aware of the natural resource topic (topic awareness = 1, 2, or 3). Note that the WTP values decrease with awareness for each of the topics except the addition of new parks, for which the values are not statistically different from zero for either the more aware or less aware group. For PCB removal, the values are lower for the less aware group, compared to the more aware group (by 34% to 53% depending on household location and angler status), but are still statistically significantly larger than zero. Similarly, the runoff control values decrease by nearly half for the less aware group as compared to the more aware group. The wetlands and existing parks values decrease to $0 for the less aware group.

6.3.2 Aggregate present values of PCB-caused losses

In this section, the present values of interim WTP for PCB-caused losses between 2000 and a return to baseline are presented for alternative scenarios based on the population-weighted estimates of WTP. The aggregate values represent losses to the 346,700 households in the 10 county area; we assume the population remains constant into the future. The aggregate values are computed using a 3% discount rate (with no discounting in the first year of payment and then discounting the subsequent nine years of payment). A 3% discount rate is consistent with the average real three-month Treasury bill rates over the last 15 years (Bureau of Economic Analysis, 1998; Federal Reserve, 1998) and is consistent with the U.S. DOI implementation guidelines (U.S. DOI, 1995) for NRDAs under 43 CFR § 11.84 (e)(2). Using a 3% discount rate, the present value multiplier for 10 years of payments is 8.786. Using a 2% discount rate on the 10 years of payments would result in a 4.3% increase in the aggregate present value, and using a 6% discount rate would result in an 11.2% decrease in the aggregate present value. The total values for key remediation scenarios, and differences between remediation scenarios, are reported in Table 6.4 and range from $254 million for ongoing losses with a 20 year return to baseline, to $610 million for ongoing losses if there is little or no PCB removal.

Aggregate WTP values for interim PCB-caused losses from 2000 until a return to baseline may be larger than, similar to, or smaller than the costs of the appropriately scaled restoration programs to provide services of equal value to PCB-caused losses. Differences can be attributed to the degree of cost and technical feasibility of restoration programs, and the degree to which resource enhancement programs provide multiple benefits, including both active and passive use benefits, such that the values of these programs exceed the costs of these programs.

Table 6.3. Household WTP estimates by respondent type (dollars per year for 10 years, in 1999 dollars).

Resource change	Mean WTP	
	More aware[a]	Less aware
PCB remediation scenarios[b]		
Intensive: (0-20 years)		
all respondents	$118.96	$65.90
angler, near (within two miles)	$145.32	$96.09
angler, not near	$121.80	$72.57
non-angler, near (within two miles)	$116.86	$67.64
non-angler, non near	$93.34	$44.12
Intermediate: (0-40 years)		
all respondents	$169.58	$93.94
angler, near (within two miles)	$207.16	$136.98
angler, not near	$173.63	$103.45
non-angler, near (within two miles)	$166.59	$96.42
non-angler, non near	$133.06	$62.89
No additional remediation: (0-100 years)		
all respondents	$285.72	$158.28
angler, near (within two miles)	$349.03	$230.80
angler, not near	$292.52	$174.31
non-angler, near (within two miles)	$280.68	$162.46
non-angler, non near	$224.19	$105.97
Other resource programs		
Wetlands		
58,000 → 60,900 acres	$31.34	$0[c]
58,000 → 63,800 acres	$57.24	$0[c]
58,000 → 69,600 acres	$70.07	$0[c]
Existing parks (10% increase)	$18.02	$0[c]
New parks		
5% increase	$0[c]	$0[c]
10% increase	$0[c]	$0[c]
Runoff control		
Clarity: 20” → 24”; reduction in algae days: 25%	$30.75	$16.61
Clarity: 20” → 34”; reduction in algae days: 50%	$80.61	$43.54

a. If respondents chose 4 or 5 for awareness of the relevant topic in Question 22, they fall in the “more aware” category, otherwise they are in the “less aware” category.
b. WTP is for avoidance of PCB-caused losses during the period indicated.
c. Estimated values were not statistically different from zero. To estimate population-weighted means, individual values were set to $0.

Table 6.4. Present value of total WTP for ongoing PCB-caused losses: Residents of 10 Wisconsin counties (millions of 1999 dollars).

Scenario	Mean (range[a])
PCB remediation scenarios	
Intensive (20 years)	$254 ($143-$356)
Intermediate (40 years)	$362 ($204-$508)
Intermediate (70 years)	$515 ($349-$661)
Limited or none (100 years)	$610 ($445-$766)
Changes in remediation scenarios	
20 rather than 40 years	$108 ($ 61-$75)
20 rather than 70 years	$260 ($198-$325)
20 rather than 100 years	$356 ($276-$426)
40 rather than 70 years	$152 ($103-$208)
40 rather than 100 years	$248 ($187-$312)
70 rather than 100 years	$96 ($52-$144)

a. 95% confidence interval.

6.3.3 Comparison to recreational fishing damage determination

Introduction

The PCB-caused losses considered in this TVE assessment differ from, and only partially overlap, the PCB-caused losses considered in the Co-trustee's recreational fishing damage determination (Breffle et al., 1999).

- *Time periods*. The recreational fishing assessment considers losses from 1980 until a return to baseline. This TVE assessment considers losses from 2000 until a return to baseline, or a subset of the time period in the recreational fishing assessment.

- *Affected populations*. The recreational fishing assessment considers losses to Wisconsin resident and non-resident anglers who purchased licenses in an 8 county area of Wisconsin surrounding the Bay of Green Bay to fish the Wisconsin waters of Green Bay, plus losses experienced by anglers who fished the Michigan waters of Green Bay. This TVE assessment considers losses to all residents of a 10 county area of Wisconsin. This population includes the anglers from these counties, but does not include other anglers from outside of these counties (e.g., from anglers from other Wisconsin counties, or from out-of-state).

- *Losses considered*. The recreational fishing assessment considers only active use losses resulting from fish consumption advisories. This TVE assessment considers these losses and all other PCB-caused losses.

The results of this TVE assessment and the recreational fishing assessment can be compared for a comparison population of households with Green Bay anglers in the 10 Wisconsin counties near the Bay of Green Bay. For this comparison population, and for ongoing damages from 2000 until a return to baseline, the WTP measures of compensable values in this TVE assessment are slightly larger than the WTP measure of compensable values in the recreational fishing assessment. This is as expected as this assessment values a larger set of losses than in the recreational fishing assessment, although for households with Green Bay anglers, the active use fishing losses may well be the dominant component of PCB-caused losses. While the two assessments take different approaches to measure compensable values, the comparability of the results for a comparison population supports the estimated magnitude of damages in each assessment, and allows double counting between the assessments to be readily addressed.

Comparison

The recreational fishing assessment computed annual WTP per angler for losses in 2000. The present value of all losses was then computed reflecting an assumed 10-year remediation period with minimal recovery, followed by a recovery period of varying lengths (10, 20, and 90 years for a total time period for return to baseline of 20, 40, and 100 years), and discounted to a present value using a 3% discount rate (which is used in all subsequent comparisons). In contrast, the estimation of WTP damages in this TVE assessment is based on the respondent WTP per year for 10 years to obtain changes in future PCB-caused losses, including recreational fishing and other losses. For comparison purposes, for each remediation scenario we assume that the time stream of losses corresponding to the TVE values is the same as in the recreational fishing study. We also use a 3% discount rate for all present value calculations.

We make the following adjustments to the total values from each assessment to make them comparable for households in the 10 counties who have Green Bay anglers. For the TVE assessment, we multiply the total values reported in Table 6.4 by 11.46% (the percent of households with Green Bay anglers)[3] and by 1.1703 (the ratio of WTP per household for households with Green Bay anglers to the WTP per household for all households in the sample). These numbers are reported in the first data column of Table 6.5. For the recreation assessment we take the total damages for Wisconsin waters of Green Bay, which were computed for anglers who purchase licenses in 8 neighboring counties. These values are reduced reflecting that only 76% of the anglers resided in these counties (Breffle et al., 1999; Table 3.18), and escalated by

3. In 1998 there were about 48,600 Green Bay anglers who purchased their Wisconsin fishing license in 8 nearby counties (Breffle et al., 1999; page 8-6). Approximately 76% of these anglers resided in these 8 counties. Allowing for 5% of households to have more than one Green Bay angler results in 35,117 households with Green Bay anglers, or 11.12%). We assume the same percent for Shawano and Calumet counties, which are also included in the TVE assessment, resulting in 38,553 households and 40,480 Green Bay anglers.

Table 6.5. Comparison of total future damages in the recreational fishing and total value equivalency assessments.

Scenario	Total values for comparison population of households in 10 county region with Green Bay anglers (millions, 1999$)		Ratio of total values to recreational fishing values
	Total value equivalency study	**Recreational fishing study**	
Intensive restoration (0-20 years)	$33.1	$30.7	1.08
Intermediate restoration (0-40 years)	$47.1	$43.1	1.09
No restoration (100+ years)	$79.4	$61.9	1.28
Intensive — intermediate restoration (20-40 years)	$14.1	$12.6	1.12

1.02 for inflation and by 1.096 to reflect the number of households in the 10 counties in the TVE assessment as compared to households in the 8 counties in the recreational fishing assessment (see Table 3.2). These values are reported in the second data column of Table 6.5.

The ratios of the TVE total values to the recreational fishing compensable values (for the comparison population) are reported in the last column of Table 6.4 and range from 1.07 to 1.28, with the variation in the ratio most likely reflecting differences in the assumptions and actual values for discount rates and other computation variables, and normal imprecision in the underlying estimates.

A similar comparison can be made based on individual angler household damages. For simplicity, consider the WTP for reducing the period of recovery from 40 years to 20 years (from intermediate to intensive remediation), a value directly reported in this TVE study (reducing required assumptions for comparison) and estimated to be $364 ($41.4 per year for Green Bay angling households) for 10 years discounted at 3%, where the first payment is not discounted. The recreation study reports average angler values of approximately $51 per angler per year for current damages for open water fishing ($1998 from Table 1.1 in Breffle et al., 1999). Adding ice fishing (+18%), updating to 1999 dollars (+2%), and allowing for multiple Green Bay anglers per Green Bay household results in values of $65 per year per household with Green Bay anglers. Computing these damages for the period 20 to 40 years hence, with damages declining from baseline levels to zero over this period (2020 to 2040), and discounting to a present value at 3% discount rate, results in a present value of $335 per household with Green Bay anglers, or about 9% less than the comparable $364 from this assessment.

Double counting

If both the Co-trustees' recreational fishing damage assessment and this TVE assessment are to be used to assess damages, double counting should be eliminated. The overlap between the studies is for future losses from 2000 until injuries and losses are eliminated, limited to Wisconsin households in the 10 neighboring counties with Green Bay anglers. There is no double counting for past damages, for Wisconsin resident anglers from outside of the 10 counties, for nonresident anglers, or for any damages associated with fishing in Michigan waters of Green Bay.

Double counting can be addressed in several ways. First, in this TVE assessment we compute the WTP values for ongoing PCB-caused losses to households with Green Bay anglers (anglers who fish the waters of Green Bay) in the 10-county area to be about 13% of the total value of losses to all households in the study. Thus, one could add the recreational fishing study damages (in total) to 87% of the values from this study and remove double counting. Alternatively, one could add the total damages from this study to the non-overlapping portions of the recreational fishing assessment (past damages, damages in Michigan waters of Green Bay), and to 17% of the future losses in Wisconsin waters of Green Bay (from non-residents and from residents from outside of the 10 county area).[4]

6.4 Conclusions

This TVE assessment identifies that the scale of restoration of equivalent value to, and the WTP values for, PCB-caused losses in the Lower Fox River and Green Bay area are substantial. It is possible for combinations of natural resource restoration programs, including wetlands restoration, improvements to outdoor recreational facilities, and runoff control, to provide sufficient benefits with value equal to PCB-caused losses during a limited time frame (less than 40 years) if the programs are sufficiently comprehensive and extensive.

The overall assessment results are consistent with the literature identified in Appendix D, and the estimated values for anglers in the population are consistent with the more specific recreational fishing damages assessment — the damages are larger here because this assessment considers all injuries rather than just reduced enjoyment of fishing because of fish consumption advisories considered in the recreational fishing assessment (Breffle et al., 1999).

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4. 48,600 individuals purchasing licenses in the 8 counties minus 40,480 Green Bay anglers from the 10 counties accounting for in the TVE study leaves 8,180, or 17%.

The key biases and omissions in the assessment are summarized below and in Table 6.6. Overall, the estimated scale of restoration and WTP values are expected to be conservative (i.e., the level or restoration, and the WTP estimates, are understated).

Table 6.6. Omissions, biases, and uncertainties resulting in conservative estimates.

Method or assumption	Effect on scale of restoration	Effect on WTP values for PCB losses
Past damages were omitted	-	-
Only about 15% of the Wisconsin households were considered (10 counties)	unknown, small	-
Michigan household losses are not considered	unknown, small	-
Tribal resource losses are not considered	-	-
Unknown period for return to baseline	unknown	unknown
Sampling and non-response bias	unknown, small	+, small
Population growth not incorporated	no effect	-
Increasing environmental preferences not considered	unknown	-

A "-" ("+") indicates that the effect of the omission, bias, or uncertainty on the scale of restoration or WTP value measures is to understate (overstate) the true level or value.

1. *Omission of past damages*. Past damages are omitted and potentially substantial. In the recreational fishing report past damages accounted for between 44% and 60% of total damages, depending on the remediation scenario. The significance of the omission in this study is unknown but could be expected to be important compared to ongoing losses.

2. *Omission of Wisconsin residents outside of the neighboring 10 counties and of Michigan residents*. This TVE assessment focused on residents in 10 Wisconsin counties. Distance was found to have little effect on values except for the existence of higher values for PCB-caused losses for a minority of respondents living very close to Green Bay.

   The effect of omitting more distant residents on the scale of restoration is unknown; however, the effect may be small because study results do not show distance as having a great effect on tradeoffs. The effect on WTP values for PCB losses is to have a clear downward bias that results in understated aggregate values. For example, because there are over five times as many Wisconsin households outside of the 10 county region, even if the average value for PCB losses by residents from outside the 10 county region were 10% of the values for households within the 10 county region, the omitted values would be as much as 50% of the measured aggregate values.

3. *Omitted losses to Michigan households*. Also omitted are preferences and values for Michigan residents in the region. In 1990 there were about 24,000 households in two Michigan counties adjacent to the upper portion of the waters of Green Bay (Delta and Menominee), and another 44,000 in the next four adjacent counties (Alger, Dickinson, Marquette, and Schoolcraft). All totaled this amounts to slightly less than 20% as many households as in the 10 Wisconsin counties considered. Because of their proximity to the injured natural resources, one might also expect these households to experience losses, although potentially less than for Wisconsin households because the degree of some (but not all) injuries is less in the upper bay. As above, the scale of restoration (largely located in Wisconsin) may not be substantially altered, but the WTP value measures of PCB-caused losses are understated.

4. *Omitted losses associated with Tribal resources*. Estimates of PCB losses focused on the Lower Fox River and Green Bay and did not include detail on injuries to Tribal lands and waters, and to the associated Tribal, cultural, and other losses. Neither the scale of restoration nor the WTP value measures account for Tribal resources, and thus are understated.

5. *Unknown period for a return to baseline*. The time period for remediation, and the resulting time period until a return to baseline, is uncertain until the Record of Decision is completed. Therefore, the assessment scales restoration, and computes WTP value measures of ongoing losses, for a range of scenarios.

6. *Sampling and nonresponse biases.* As identified in Sections 3.3 and 3.4, any such biases are expected to be small due to the comparability of the sample and the population, and the high response rates. Any such bias would likely similarly influence the value of all natural resource enhancement programs and thus largely cancel out for the restoration scaling resulting in minimal impact. The impact of sampling and nonresponse biases on the WTP values would likely be to increase the computed values, although the analysis suggests any such biases would be small, if they existed at all.

7. *Constant population*. The population is expected grow over time. This is not expected to have any effect on the scale of restoration so long as relative preferences and values remain constant for PCB removal and for other restoration programs, but aggregate WTP will be understated by the amount the population grows.

8. *Constant preferences.* Preferences for environmental commodities may change over time. How PCB losses vis-à-vis benefits from other resource enhancement programs will change is not clear, so the effect on the scale of restoration is unknown. However, increased environmental preferences would have a tendency to increase WTP, and therefore WTP value measures for PCB-caused losses.

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Appendix A — Survey Materials

A.1 Introduction

This appendix includes survey materials, including:

- Initial letter with first mailing
- Mail survey instrument. Note: Only Version 1 is included. All other versions are the same except that the choice pairs vary across versions.
- Table of choice pairs by survey version
- Follow-up postcard
- Follow-up phone survey script
- Follow-up letters for those reached by phone
- Follow-up letters for those not reached by phone
- Thank you letter

The letters included here do not show the letterhead. For the final hard copy report the letters with letterhead will be copied and included.

The mail survey included here does not have all the pictures. For the final hard copy report the mail survey with the pictures will be copied and included.

Initial letter with first mailing

CASEID

<Address>

Dear <Address>:

What should the priorities be for natural resource programs in Northeast Wisconsin? Representatives from government, industry, and citizen groups are addressing this question right now in order to develop regional action plans. Informed decisions can <u>only</u> be made if these decision makers know how citizens like you think about natural resource issues in your area.

The questionnaire included with this letter asks for your household's opinions on natural resource issues in Northeast Wisconsin. It should be answered by either the male or female head of household. **Your opinion matters!** Your household is part of a small sample of households in Northeast Wisconsin that were scientifically selected to provide citizen opinions. Because the sample size is small, it is important that we hear from you. The survey does not require any special knowledge--we just ask that you consider each question and respond with your own opinion.

We realize this questionnaire takes time to answer and that your time is valuable. **If you return the survey by September 30 <u>and</u> complete all the questions, we will send you a $15 "Thank You" check.** A postage-paid envelope has been provided. As a further thank you for returning a completed survey, we will also send you a summary of the results later this year.

All of your answers are confidential; your name will never be revealed to anyone. A code number has been put on the questionnaire so we can send you the $15 check for completing and returning it. If you have any questions, please call me toll-free at 1-800-935-4277. Thank you for your help, and please remember to complete all questions.

Sincerely,

Pam Rathbun, Manager
Survey Research Center

WHAT ARE YOUR OPINIONS ABOUT THE FUTURE OF NATURAL RESOURCES IN NORTHEAST WISCONSIN?

Important Definition

In this survey "the Bay of Green Bay" means the waters of the Bay of Green Bay and all tributaries up to the first dam or obstruction.

Introduction

Decision makers are examining options for natural resources in northeast Wisconsin. Your responses to this survey will help in making decisions about which options are best.

1 How often do <u>you</u> personally participate in each of the following activities in Wisconsin on the waters and shorelines of the <u>Bay of Green Bay</u>? *Circle the letter of your answer for each activity.*

	Less than once a year or never	1 to 5 times a year	6 to 10 times a year	More than 10 times a year
Fishing	A	B	C	D
Boating (non-fishing)	A	B	C	D
Waterskiing or jetskiing . . .	A	B	C	D
Canoeing or kayaking	A	B	C	D
Swimming	A	B	C	D
Hunting	A	B	C	D
Wildlife viewing	A	B	C	D
Enjoying outdoor scenery . .	A	B	C	D
Camping or picnicking	A	B	C	D
Biking	A	B	C	D
Hiking, walking, or jogging	A	B	C	D

This survey addresses four natural resource topics. The information provided reflects the most recent scientific reports about these topics.

- **Wetlands**
- **PCBs**
- **Outdoor recreation**
- **Runoff**

Wetlands

Within 5 miles of the Bay of Green Bay there are about 58,000 acres of wetlands in Wisconsin (see map on the facing page), and another 86,000 acres in Michigan. These nearby wetlands are very important to the fish and wildlife of the Bay of Green Bay.

- **Farming, cutting forests, and developing residential and urban areas have reduced wetlands in this area by more than half in the past 100 years.**
- **Current regulations are designed to prevent further loss of wetlands in this area.**
- **Programs have been proposed to restore wetlands in this area. Any wetlands restoration would take about 10 years.**

2 **Wetlands around the Bay of Green Bay provide spawning and nursery habitats for a majority of the fish species in the Bay, including yellow perch, bluegill, largemouth bass, northern pike, and over 35 other species. These wetlands also provide necessary habitat and food for many bird species in the Bay area, including terns, many species of ducks and geese, shorebirds, bald eagles, several species of hawks, coots, and others. Other wildlife such as deer, muskrat, and mink also use wetlands for habitat.**

Increases in wetlands would support nearly proportional increases in the populations of those bird and fish species that depend on wetlands. For example, increasing wetland acres by 10% would increase the numbers of those birds and fish that rely on wetlands by about 10%.

How important to you, if at all, is it to increase wetland acreage near to the Bay of Green Bay to support birds, fish, and other wildlife? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

3 **Which of the following options do you prefer for Wisconsin wetlands near to the Bay of Green Bay?** *Circle the number of your answer***.**

1 Do less and spend less to maintain wetlands, resulting in a loss of wetlands.
2 Do and spend about the same to maintain the current wetland acreage (about 58,000 acres).
3 Do more and spend more to restore wetlands. Options to restore wetlands range from restoring 2,900 acres (5% more than now) to restoring 11,600 acres (20% more than now).

V1

Wisconsin Wetlands Within 5 Miles of the Bay of Green Bay

PCBs

PCBs are substances that were used by industry until the mid-1970s, when they were banned.

- **PCBs released into the Lower Fox River have accumulated in the sediments at the bottom of the Lower Fox River and Green Bay.**
- **PCBs get into fish, birds, and other wildlife through the food chain.**

4 **Because of PCBs, consumption advisories have been issued for all sport-caught fish in Green Bay (including all tributaries up to the first dam) and for some waterfowl in the area. The fish consumption advisories tell how often a meal of fish may be safely eaten (see table on the facing page). Eating more fish than is recommended may increase a woman's risk of bearing children with learning disabilities and slow development, and for everyone may increase the risk of cancer.**

Programs have been proposed to remove PCBs in this area. How important to you, if at all, is it to remove PCBs so that it will be safe to eat fish and waterfowl? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

5 **PCBs cause harm to wildlife in and near the Bay of Green Bay.**

Birds **Forester's terns and common terns in the area reproduce at rates that are about half of the rate elsewhere in Wisconsin. Both are listed as Wisconsin endangered species.**
Bald eagles in the area also reproduce at about half the normal rate for Wisconsin. PCBs contribute to this problem. Bald eagles are no longer listed as endangered.
A small percentage of cormorants experience deformities such as crossed bills.

Fish **About 25% of walleye have abnormalities that can become cancerous liver tumors.**

Other Wildlife **Some sensitive fish-eating wildlife, like mink, may be harmed.**

Even though PCBs harm wildlife, it is unclear whether the total numbers of terns, eagles, cormorants, walleye, mink and other species in the area are less than if there were no PCBs. This is because wildlife migrates into and out of the area, because there is limited habitat in the area for some species, and because other factors influence wildlife populations.

How important to you, if at all, is it to remove PCBs in the Bay of Green Bay area to reduce harm to birds, fish, and other wildlife? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

V1

6 **PCB removal would take about 10 years. Any PCB removal would use the best available technology to minimize stirring up PCBs, and the PCBs that are removed would be disposed of in a manner that would prevent future risks to humans and wildlife.**

Not all PCBs can be removed. The PCBs that are not removed may continue to harm some fish and wildlife. For example, with extensive PCB removal, fish consumption advisories for yellow perch and some impacts to wildlife would be eliminated shortly after PCB removal, but it would be 20 years total (10 years for removal plus 10 more years for nature to recover)

before PCBs are at safe levels. By safe levels we mean there are no consumption advisories for, and no harm to, nearly all fish and wildlife.

Which of the following options do you prefer for PCBs in the Green Bay area of Wisconsin?
Circle the number of your answer.

1 No further PCB investigations or removal. With no further removal it will be 100 years or more until PCBs are at safe levels.

2 Do more and spend more to remove PCBs. Depending on how many PCBs are removed, the time until PCBs are at safe levels would range from 20 years up to 70 years.

Wisconsin Department of Natural Resources

Fish Consumption Advisories for PCBs

V1

Outdoor Recreation

In 10 Wisconsin counties around the Bay of Green Bay, there are over 120 state parks, natural areas, and county parks covering more than 86,000 acres (see map on the facing page).

- **These parks include a variety of facilities such as picnic grounds, beaches, scenic sites, piers, boat ramps, biking and hiking trails, and interpretive centers.**
- **To meet the current and future needs of area residents, programs have been proposed to add facilities at existing parks and to open new parks.**

7 **Adding facilities at existing parks can improve recreational opportunities in these parks. For example, 10% more facilities would mean that most parks would see improvements. Some parks would add hiking or biking trails, some parks would add picnic areas, some parks would add a boat ramp, some parks would add adjacent land, and so forth.**

How important to you, if at all, is adding facilities at existing parks throughout the area to enhance recreational opportunities? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

8 **New parks can be opened throughout the area to increase recreational opportunities. How important to you, if at all, is opening new parks to enhance outdoor recreational opportunities?** *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

9 **Any new facilities at existing parks, and any new parks, would be located throughout the area to best meet the needs of residents and would take up to 10 years to accomplish. Which of the following options do you prefer for state and county parks in northeast Wisconsin?** *Circle the number of your answer.*

1 Do less and spend less to maintain existing outdoor recreation parks.
2 Do and spend about the same to maintain existing park conditions and facilities.
3 Do more and spend more to add facilities at existing parks and/or to open new parks.

V1

State and County Recreation Areas

Runoff

Runoff from farms, highways, construction sites, and residential and urban neighborhoods carries plant nutrients and sediments into the Bay of Green Bay and its tributaries, causing algae growth, muddy water, and changes in aquatic habitat (see figure on the facing page).

- **Runoff pollution can be reduced by decreasing erosion; controlling farm, urban, and residential wastes; fencing livestock away from streams; and other measures.**
- **Zebra mussels (small shellfish) have invaded Green Bay. They filter the water, making it clearer. However, scientists say we <u>cannot</u> count on zebra mussels to improve water clarity in the future.**
- **Runoff is <u>not</u> a significant source of the PCBs in the Lower Fox River and Green Bay and does not affect the quality of your drinking water.**

10 **When too many plant nutrients are present, excess algae coats the surface of the water with decaying plants and causes a foul odor. The frequency of excess algae varies by location in the Bay of Green Bay from seldom in the central and northern Bay to up to 80 days a summer in the southern Bay. Most excess algae occurs from mid-June to mid-September.**

How important to you, if at all, is it to control runoff to reduce the number of days with excess algae in Green Bay? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

11 **Because of sediments and algae, you can only see down into the water about 20 inches on average in southern Green Bay, with clearer water to the north. This not only makes the water look less appealing but also reduces the light that reaches underwater plants and thus reduces aquatic habitat. Populations of desirable fish and birds are smaller and carp populations are larger than they would be otherwise, but scientists cannot yet put numbers on the vegetation and wildlife effects.**

How important to you, if at all, is it to control runoff to improve water clarity? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know
1	2	3	4	5	8

12 **Any actions to reduce runoff would take up to 10 years to reach their goals. Which of the following options do you prefer for controlling runoff around the Bay of Green Bay?**
Circle the number of your answer.

1 Do less and spend less, resulting in reduced water clarity, increased days of excess algae, and less aquatic habitat in Green Bay and its tributaries.

2 Do and spend about the same. In the southern parts of Green Bay, average summer water clarity would remain about 20 inches, excess algae would occur up to 80 days a summer, and aquatic habitat would remain the same.

3 Do more and spend more to control runoff. Options range up to a 50% reduction in runoff. In the southern parts of Green Bay, this would result in about 34 inches of water clarity, excess algae up to 40 days per year, and increased aquatic habitat.

Water Pollution from Runoff

What Alternatives Do You Prefer?

In each of the next questions there are two alternatives, labeled A and B (see Question 13).

- **Each alternative describes a possible combination of options for natural resources in and around the Bay of Green Bay and the additional costs to your household beyond what you are now paying.**
- **Depending on the options, some costs will be paid by industry, farmers, and conservation organizations. But taxpayers may have to pay something as well. Assume <u>your household pays</u> its share of any added costs through a combination of federal, state, and local taxes <u>each year for the next 10 years.</u>**
- **Since we do not yet know how much each alternative will actually cost you or others, we are asking about a range of costs.**
- **For each question, even if you do not view either Alternative A or B as ideal, still tell us which of the two alternatives you would prefer.**
- **To help you get started, for Question 13 we have provided information on the right-hand side indicating the differences, if any, between Alternatives A and B.**

REMEMBER

1. **The goal of wetlands restoration is to provide additional habitat for fish and wildlife.**

2. **For PCBs, the "years until safe" is the number of years until there are no consumption advisories for, and no harm to, nearly all fish and wildlife. Many advisories and effects will end sooner, but a few advisories and effects may last longer.**

3. **New recreation facilities at existing parks could include rest rooms, trails, boat ramps, and picnicking and camping facilities. Any new facilities at existing parks and any new parks would be located to best meet the needs of area residents.**

4. **Pollution from runoff creates excess algae, reduces water clarity, and causes the loss of aquatic habitat, all of which occur most often in the southern Bay.**

13 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	Alternative B ▼	
Wetlands			
Acres in Wisc. around Green Bay. (Currently 58,000)	58,000 acres (current)	69,600 acres (20% more)	11,600 more acres in wetlands
PCBs			
Years until safe for nearly all fish and wildlife . . . . (Currently 100 years or more)	100+ years until safe (current)	100+ years until safe (current)	No difference
Outdoor Recreation			
Facilities at existing parks	10% more	0% more	10% more facilities at existing parks
Acres in new parks. . . . . (Currently 86,000 acres in state and county parks)	0 acres (current)	0 acres (current)	No difference
Runoff			
Average water clarity in southern Bay (Currently 20 inches)	20 inches (current)	20 inches (current)	No difference
Excess algae (Currently up to 80 summer days in the southern Bay)	80 days or less (current)	80 days or less (current)	No difference
Added cost to your household			
Each year for 10 years.	$25 more	$25 more	No difference
Check (✔) the box for the alternative you prefer ➔	☐ **I Prefer Alternative A**	☐ **I Prefer Alternative B**	

V1

14 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands Acres	58,000 acres (current)	58,000 acres (current)
PCBs Years until safe for nearly all fish and wildlife	40 years until safe (60% faster)	100+ years until safe (current)
Outdoor Recreation Facilities at existing parks.	0% more	0% more
Acres in new parks	0 acres (current)	0 acres (current)
Runoff Average water clarity in the southern Bay	20 inches (current)	20 inches (current)
Excess algae days in lower Bay . .	80 days or less (current)	80 days or less (current)
Added cost to your household Each year for 10 years	$200 more	$0 more
Check (✔) the box for the alternative you prefer ➔	☐	☐

15 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands		
Acres	60,900 acres	63,800 acres
	(5% more)	(10% more)
PCBs		
Years until safe for nearly all fish and wildlife	100+ years until safe (current)	20 years until safe (80% faster)
Outdoor Recreation		
Facilities at existing parks	0% more	10% more
Acres in new parks	0 acres	8,600 acres
	(current)	(10% more)
Runoff		
Average water clarity in the southern Bay	20 inches (current)	24 inches (20% deeper)
Excess algae days in lower Bay. .	80 days or less (current)	60 days or less (25% fewer)
Added cost to your household		
Each year for 10 years	$50 more	$200 more
Check (✔) the box for the alternative you prefer ➔	☐	☐

16 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands		
Acres	58,000 acres (current)	58,000 acres (current)
PCBs		
Years until safe for nearly all fish and wildlife	100+ years until safe (current)	40 years until safe (60% faster)
Outdoor Recreation		
Facilities at existing parks	10% more	0% more
Acres in new parks	0 acres (current)	0 acres (current)
Runoff		
Average water clarity in the southern Bay	34 inches (70% deeper)	20 inches (current)
Excess algae days in lower Bay .	40 days or less (50% fewer)	80 days or less (current)
Added cost to your household		
Each year for 10 years	$50 more	$50 more
Check (✔) the box for the alternative you prefer ➔	☐	☐

17 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands		
Acres	69,600 acres (20% more)	69,600 acres (20% more)
PCBs		
Years until safe for nearly all fish and wildlife	40 years until safe (60% faster)	100+ years until safe (current)
Outdoor Recreation		
Facilities at existing parks	0% more	10% more
Acres in new parks	4,300 acres (5% more)	4,300 acres (5% more)
Runoff		
Average water clarity in the southern Bay	34 inches (70% deeper)	24 inches (20% deeper)
Excess algae days in lower Bay .	40 days or less (50% fewer)	60 days or less (25% fewer)
Added cost to your household		
Each year for 10 years	$100 more	$50 more
Check (✔) the box for the alternative you prefer ➔	☐	☐

18 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	**Alternative B** ▼
Wetlands		
Acres	63,800 acres	60,900 acres
	(10% more)	(5% more)
PCBs		
Years until safe for nearly all fish and wildlife	20 years until safe (80% faster)	70 years until safe (30% faster)
Outdoor Recreation		
Facilities at existing parks	0% more	0% more
Acres in new parks	4,300 acres	8,600 acres
	(5% more)	(10% more)
Runoff		
Average water clarity in the southern Bay	20 inches (current)	34 inches (70% deeper)
Excess algae days in lower Bay. .	80 days or less (current)	40 days or less (50% fewer)
Added cost to your household		
Each year for 10 years	$50 more	$25 more
Check (✔) the box for the alternative you prefer ➔	☐	☐

19 **When you were making your choices between alternatives A and B in Questions 13 through 18, how important were each of the following?** *Circle the number of your answer for each item.*

	Not at all important		Average importance		Very important
Acres of wetland	1	2	3	4	5
Years until safe levels of PCBs	1	2	3	4	5
Facilities at existing parks	1	2	3	4	5
Acres of new parks	1	2	3	4	5
Inches of water clarity	1	2	3	4	5
Days of excess algae each summer. . .	1	2	3	4	5
Annual cost to your household	1	2	3	4	5

20 **Overall, how confident do you feel about your choices between the alternatives in Questions 13 through 18?** *Circle the number of your answer.*

Not at all confident		Somewhat confident		Very confident
1	2	3	4	5

21 **Questions 13 through 18 were asked to provide citizen input for decision makers to consider along with other information from scientists and planners. With this in mind, how much should public officials consider <u>your responses</u> to Questions 13 through 18?** *Circle the number of your answer.*

Should not consider my responses at all		Should somewhat consider my responses		Should completely consider my responses
1	2	3	4	5

22 **Prior to receiving this survey, how aware were you of each of the four natural resource topics we addressed?** *Circle the number of your answer for each topic.*

	I was not aware of this topic		I was somewhat aware of this topic		I was very aware of this topic
Wetlands	1	2	3	4	5
PCBs	1	2	3	4	5
Outdoor recreation	1	2	3	4	5
Runoff	1	2	3	4	5

About You and Your Household

This information is used to help group your responses with responses of other households. Your individual responses and your name will not be released.

23 **In the last 12 months, have you fished in Green Bay or its tributaries up to the first dam (see map on the cover)?** *Circle the number of your answer.*

1 No

(If no) in the last 12 months, have *other* household members fished in Green Bay or its tributaries up to the first dam? *Circle the number of your answer.*

1 No

2 Yes

3 Don't know/Uncertain

2 Yes

(If yes) in the last 12 months, on about how many days have you fished in Green Bay or its tributaries up to the first dam?

________ Days

24 **Do you own or rent your residence?** *Circle the number of your answer.*

1 Own

2 Rent

25 **Do you have a vacation home or cabin in northeast Wisconsin?** *Circle the number of your answer.*

1 Yes

(If yes) about how many miles is it from your vacation home or cabin to the Bay of Green Bay?

_______ Miles to Green Bay

2 No

26 **Your gender:**

1 Female
2 Male

27 **Your age:** ______ Years old

28 **How many people are there in your household, including yourself?**

number

29 **How many children do you have, whether living with you or not?**

number

30 **How many grandchildren do you have, whether living with you or not?**

_____ number

31 **How many listed telephone numbers does your household have?**

_____ listed telephone numbers

32 **What is the highest level of schooling you have completed?** *Circle the number of your answer.*

1 Did not complete high school
2 High school diploma or equivalent
3 Some college, two year college degree (AS) or technical school
4 Four year college graduate (BA, BS)
5 Some graduate work but did not receive a graduate degree
6 Graduate degree (MA, MS, MBA, PhD, JD, MD, etc.)

33 **What is you present employment status?** *Circle the number of your answer.*

1 Employed full time
2 Employed part time
3 Retired
4 Homemaker
5 Student
6 Unemployed

34 **Which of the following categories best describes your racial or ethnic background?** *Circle the number of your answer.*

1 White or Caucasian
2 Black or African American
3 Hispanic or Mexican American
4 Asian or Pacific Islander
5 Native American Indian
6 Other: _______

35 **What was your household income (before taxes) in 1998?** *Circle the number of your answer.*

1 less than $10,000
2 $10,000 to $19,999
3 $20,000 to $29,999
4 $30,000 to $39,999
5 $40,000 to $49,999
6 $50,000 to $59,999
7 $60,000 to $79,999
8 $80,000 to $99,999
9 $100,000 to $149,999
10 $150,000 or more

36 **Is there anything we have overlooked? Please use this space for any additional comments you would like to make.**

Your Participation Is Greatly Appreciated!

Please return the survey in the enclosed envelope to:

Hagler Bailly Services
University Research Park
455 Science Drive
Madison, Wisconsin 53711

Table of choice pairs by survey version

Table A-1 Version 1 Choice Sets				
	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	69600	58000	58000
Change in Wetlands	current	20 % more	current	current
PCBs - Years Until Safe	100+	100+	40	100+
Percent Increase in Facilities at Existing Parks	10	0	0	0
Acres in New Parks	0	0	0	0
Change in Acres in Parks	current	current	current	current
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	25	25	200	0
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	63800	58000	58000
Change in Wetlands	5% more	10% more	current	current
PCBs - Years Until Safe	100+	20	100+	40
Percent Increase in Facilities at Existing Parks	0	10	10	0
Acres in New Parks	0	8600	0	0
Change in Acres in Parks	current	10% more	current	current
Inches of Average Water Clarity	20	24	34	20
Change in Water Clarity	current	20% deeper	70% deeper	current
Excess Algae Days in Lower bay	80	60	40	80
Change in Excess Algae Days	current	25% fewer	50% fewer	current
Added Cost to Household for 10 Years	50	200	50	50
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	69600	69600	63800	60900
Change in Wetlands	20 % more	20 % more	10% more	5% more
PCBs - Years Until Safe	40	100+	20	70
Percent Increase in Facilities at Existing Parks	0	10	0	0
Acres in New Parks	4300	4300	4300	8600
Change in Acres in Parks	5% more	5% more	5% more	10% more
Inches of Average Water Clarity	34	24	20	34
Change in Water Clarity	70% deeper	20% deeper	current	70% deeper
Excess Algae Days in Lower bay	40	60	80	40
Change in Excess Algae Days	50% fewer	25% fewer	current	50% fewer
Added Cost to Household for 10 Years	100	50	50	25

Table A-2
Version 2 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	60900	58000	58000
Change in Wetlands	current	5% more	current	current
PCBs - Years Until Safe	100+	100+	100+	20
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	4300	0	0	0
Change in Acres in Parks	5% more	current	current	current
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	25	25	0	50

	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	63800	63800	63800
Change in Wetlands	current	10% more	10% more	10% more
PCBs - Years Until Safe	70	70	100+	70
Percent Increase in Facilities at Existing Parks	10	0	10	0
Acres in New Parks	4300	8600	8600	4300
Change in Acres in Parks	5% more	10% more	10% more	5% more
Inches of Average Water Clarity	24	20	20	24
Change in Water Clarity	20% deeper	current	current	20% deeper
Excess Algae Days in Lower bay	60	80	80	60
Change in Excess Algae Days	25% fewer	current	current	25% fewer
Added Cost to Household for 10 Years	25	200	200	50

	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	69600	63800	63800	60900
Change in Wetlands	20 % more	10% more	10% more	5% more
PCBs - Years Until Safe	20	40	40	20
Percent Increase in Facilities at Existing Parks	0	10	10	10
Acres in New Parks	4300	4300	0	0
Change in Acres in Parks	5% more	5% more	current	current
Inches of Average Water Clarity	34	34	34	34
Change in Water Clarity	70% deeper	70% deeper	70% deeper	70% deeper
Excess Algae Days in Lower bay	40	40	40	40
Change in Excess Algae Days	50% fewer	50% fewer	50% fewer	50% fewer
Added Cost to Household for 10 Years	100	100	100	200

Table A-3
Version 3 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	69600
Change in Wetlands	current	current	current	20 % more
PCBs - Years Until Safe	100+	100+	100+	100+
Percent Increase in Facilities at Existing Parks	0	10	0	0
Acres in New Parks	8600	0	0	0
Change in Acres in Parks	10% more	current	current	current
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	25	25	0	50

	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	69600	69600	63800	63800
Change in Wetlands	20 % more	20 % more	10% more	10% more
PCBs - Years Until Safe	100+	20	70	40
Percent Increase in Facilities at Existing Parks	10	0	10	10
Acres in New Parks	8600	8600	4300	0
Change in Acres in Parks	10% more	10% more	5% more	current
Inches of Average Water Clarity	24	34	20	20
Change in Water Clarity	20% deeper	70% deeper	current	current
Excess Algae Days in Lower bay	60	40	80	80
Change in Excess Algae Days	25% fewer	50% fewer	current	current
Added Cost to Household for 10 Years	50	200	100	100

	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	60900	58000	69600
Change in Wetlands	5% more	5% more	current	20 % more
PCBs - Years Until Safe	20	40	40	70
Percent Increase in Facilities at Existing Parks	0	0	0	10
Acres in New Parks	0	8600	8600	0
Change in Acres in Parks	current	10% more	10% more	current
Inches of Average Water Clarity	34	24	24	34
Change in Water Clarity	70% deeper	20% deeper	20% deeper	70% deeper
Excess Algae Days in Lower bay	40	60	60	40
Change in Excess Algae Days	50% fewer	25% fewer	25% fewer	50% fewer
Added Cost to Household for 10 Years	25	100	200	100

Table A-4
Version 4 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	58000
Change in Wetlands	current	current	current	current
PCBs - Years Until Safe	100+	100+	20	100+
Percent Increase in Facilities at Existing Parks	10	0	0	0
Acres in New Parks	0	0	0	0
Change in Acres in Parks	current	current	current	current
Inches of Average Water Clarity	20	34	20	20
Change in Water Clarity	current	70% deeper	current	current
Excess Algae Days in Lower bay	80	40	80	80
Change in Excess Algae Days	current	50% fewer	current	current
Added Cost to Household for 10 Years	25	25	200	0
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	60900	63800	69600
Change in Wetlands	current	5% more	10% more	20 % more
PCBs - Years Until Safe	70	100+	20	70
Percent Increase in Facilities at Existing Parks	10	0	0	0
Acres in New Parks	8600	4300	4300	8600
Change in Acres in Parks	10% more	5% more	5% more	10% more
Inches of Average Water Clarity	34	24	34	24
Change in Water Clarity	70% deeper	20% deeper	70% deeper	20% deeper
Excess Algae Days in Lower bay	40	60	40	60
Change in Excess Algae Days	50% fewer	25% fewer	50% fewer	25% fewer
Added Cost to Household for 10 Years	50	200	200	25
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	69600	60900	60900	69600
Change in Wetlands	20 % more	5% more	5% more	20 % more
PCBs - Years Until Safe	70	40	70	70
Percent Increase in Facilities at Existing Parks	0	10	10	10
Acres in New Parks	8600	8600	0	0
Change in Acres in Parks	10% more	10% more	current	current
Inches of Average Water Clarity	20	20	34	24
Change in Water Clarity	current	current	70% deeper	20% deeper
Excess Algae Days in Lower bay	80	80	40	60
Change in Excess Algae Days	current	current	50% fewer	25% fewer
Added Cost to Household for 10 Years	200	50	50	50

Table A-5
Version 5 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	58000
Change in Wetlands	current	current	current	current
PCBs - Years Until Safe	100+	100+	40	100+
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	8600	0	0	0
Change in Acres in Parks	10% more	current	current	current
Inches of Average Water Clarity	20	24	20	20
Change in Water Clarity	current	20% deeper	current	current
Excess Algae Days in Lower bay	80	60	80	80
Change in Excess Algae Days	current	25% fewer	current	current
Added Cost to Household for 10 Years	25	25	50	0
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	60900	58000
Change in Wetlands	current	current	5% more	current
PCBs - Years Until Safe	40	20	70	40
Percent Increase in Facilities at Existing Parks	10	0	0	0
Acres in New Parks	0	0	8600	0
Change in Acres in Parks	current	current	10% more	current
Inches of Average Water Clarity	20	20	24	24
Change in Water Clarity	current	current	20% deeper	20% deeper
Excess Algae Days in Lower bay	80	80	60	60
Change in Excess Algae Days	current	current	25% fewer	25% fewer
Added Cost to Household for 10 Years	50	50	100	25
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	63800	60900	63800	58000
Change in Wetlands	10% more	5% more	10% more	current
PCBs - Years Until Safe	70	70	70	20
Percent Increase in Facilities at Existing Parks	0	10	10	0
Acres in New Parks	0	4300	0	0
Change in Acres in Parks	current	5% more	current	current
Inches of Average Water Clarity	34	20	20	20
Change in Water Clarity	70% deeper	current	current	current
Excess Algae Days in Lower bay	40	80	80	80
Change in Excess Algae Days	50% fewer	current	current	current
Added Cost to Household for 10 Years	50	25	50	50

Table A-6
Version 6 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	69600	58000	63800
Change in Wetlands	current	20 % more	current	10% more
PCBs - Years Until Safe	20	100+	100+	100+
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	0	0	0	0
Change in Acres in Parks	current	current	current	current
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	50	50	0	25

	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	69600	69600	69600	60900
Change in Wetlands	20 % more	20 % more	20 % more	5% more
PCBs - Years Until Safe	20	40	40	70
Percent Increase in Facilities at Existing Parks	10	0	10	10
Acres in New Parks	0	4300	0	8600
Change in Acres in Parks	current	5% more	current	10% more
Inches of Average Water Clarity	20	34	24	24
Change in Water Clarity	current	70% deeper	20% deeper	20% deeper
Excess Algae Days in Lower bay	80	40	60	60
Change in Excess Algae Days	current	50% fewer	25% fewer	25% fewer
Added Cost to Household for 10 Years	100	100	50	100

	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	63800	69600	58000
Change in Wetlands	5% more	10% more	20 % more	current
PCBs - Years Until Safe	70	100+	100+	20
Percent Increase in Facilities at Existing Parks	10	0	10	0
Acres in New Parks	4300	0	8600	0
Change in Acres in Parks	5% more	current	10% more	current
Inches of Average Water Clarity	24	34	34	20
Change in Water Clarity	20% deeper	70% deeper	70% deeper	current
Excess Algae Days in Lower bay	60	40	40	80
Change in Excess Algae Days	25% fewer	50% fewer	50% fewer	current
Added Cost to Household for 10 Years	200	50	200	200

Table A-7 Version 7 Choice Sets				
	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	69600	58000	58000
Change in Wetlands	current	20 % more	current	current
PCBs - Years Until Safe	100+	100+	100+	100+
Percent Increase in Facilities at Existing Parks	0	0	0	10
Acres in New Parks	0	0	0	0
Change in Acres in Parks	current	current	current	current
Inches of Average Water Clarity	34	20	20	20
Change in Water Clarity	70% deeper	current	current	current
Excess Algae Days in Lower bay	40	80	80	80
Change in Excess Algae Days	50% fewer	current	current	current
Added Cost to Household for 10 Years	50	50	0	50
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	69600	58000	58000
Change in Wetlands	5% more	20 % more	current	current
PCBs - Years Until Safe	40	20	70	40
Percent Increase in Facilities at Existing Parks	10	0	10	0
Acres in New Parks	4300	8600	4300	0
Change in Acres in Parks	5% more	10% more	5% more	current
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	50	100	25	25
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	63800	63800	69600	63800
Change in Wetlands	10% more	10% more	20 % more	10% more
PCBs - Years Until Safe	40	20	100+	20
Percent Increase in Facilities at Existing Parks	0	10	10	10
Acres in New Parks	0	4300	8600	0
Change in Acres in Parks	current	5% more	10% more	current
Inches of Average Water Clarity	24	24	20	24
Change in Water Clarity	20% deeper	20% deeper	current	20% deeper
Excess Algae Days in Lower bay	60	60	80	60
Change in Excess Algae Days	25% fewer	25% fewer	current	25% fewer
Added Cost to Household for 10 Years	25	50	50	100

Table A-8
Version 8 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	69600	58000	58000
Change in Wetlands	current	20 % more	current	current
PCBs - Years Until Safe	40	100+	100+	100+
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	0	0	0	4300
Change in Acres in Parks	current	current	current	5% more
Inches of Average Water Clarity	20	20	20	20
Change in Water Clarity	current	current	current	current
Excess Algae Days in Lower bay	80	80	80	80
Change in Excess Algae Days	current	current	current	current
Added Cost to Household for 10 Years	50	50	0	100

	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	58000	69600	60900
Change in Wetlands	5% more	current	20 % more	5% more
PCBs - Years Until Safe	40	20	100+	70
Percent Increase in Facilities at Existing Parks	10	0	0	0
Acres in New Parks	0	0	4300	0
Change in Acres in Parks	current	current	5% more	current
Inches of Average Water Clarity	20	20	20	24
Change in Water Clarity	current	current	current	20% deeper
Excess Algae Days in Lower bay	80	80	80	60
Change in Excess Algae Days	current	current	current	25% fewer
Added Cost to Household for 10 Years	50	50	100	200

	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	60900	69600	63800	58000
Change in Wetlands	5% more	20 % more	10% more	current
PCBs - Years Until Safe	40	40	20	100+
Percent Increase in Facilities at Existing Parks	0	10	10	10
Acres in New Parks	8600	4300	8600	8600
Change in Acres in Parks	10% more	5% more	10% more	10% more
Inches of Average Water Clarity	20	34	34	20
Change in Water Clarity	current	70% deeper	70% deeper	current
Excess Algae Days in Lower bay	80	40	40	80
Change in Excess Algae Days	current	50% fewer	50% fewer	current
Added Cost to Household for 10 Years	25	200	100	50

Table A-9 Version 9 Choice Sets				
	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	58000
Change in Wetlands	current	current	current	current
PCBs - Years Until Safe	100+	70	100+	100+
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	0	0	0	8600
Change in Acres in Parks	current	current	current	10% more
Inches of Average Water Clarity	24	20	20	20
Change in Water Clarity	20% deeper	current	current	current
Excess Algae Days in Lower bay	60	80	80	80
Change in Excess Algae Days	25% fewer	current	current	current
Added Cost to Household for 10 Years	25	25	0	50
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	58000
Change in Wetlands	current	current	current	current
PCBs - Years Until Safe	20	70	40	20
Percent Increase in Facilities at Existing Parks	0	0	10	0
Acres in New Parks	0	8600	0	0
Change in Acres in Parks	current	10% more	current	current
Inches of Average Water Clarity	20	20	24	20
Change in Water Clarity	current	current	20% deeper	current
Excess Algae Days in Lower bay	80	80	60	80
Change in Excess Algae Days	current	current	25% fewer	current
Added Cost to Household for 10 Years	50	100	50	50
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	63800	60900	63800
Change in Wetlands	current	10% more	5% more	10% more
PCBs - Years Until Safe	70	current	40	70
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	0	0	8600	8600
Change in Acres in Parks	current	current	10% more	10% more
Inches of Average Water Clarity	20	20	34	20
Change in Water Clarity	current	current	70% deeper	current
Excess Algae Days in Lower bay	80	80	40	80
Change in Excess Algae Days	current	current	50% fewer	current
Added Cost to Household for 10 Years	25	25	100	25

Table A-10
Version 10 Choice Sets

	Question 13		Question 14	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	58000	58000
Change in Wetlands	current	current	current	current
PCBs - Years Until Safe	40	100+	100+	100+
Percent Increase in Facilities at Existing Parks	0	0	0	0
Acres in New Parks	0	0	0	0
Change in Acres in Parks	current	current	current	current
Inches of Average Water Clarity	20	34	20	24
Change in Water Clarity	current	70% deeper	current	20% deeper
Excess Algae Days in Lower bay	80	40	80	60
Change in Excess Algae Days	current	50% fewer	current	25% fewer
Added Cost to Household for 10 Years	50	50	0	25
	Question 15		Question 16	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	63800	63800	58000
Change in Wetlands	current	10% more	10% more	current
PCBs - Years Until Safe	40	100+	40	40
Percent Increase in Facilities at Existing Parks	0	10	0	0
Acres in New Parks	0	8600	4300	8600
Change in Acres in Parks	current	10% more	5% more	10% more
Inches of Average Water Clarity	24	34	24	24
Change in Water Clarity	20% deeper	70% deeper	20% deeper	20% deeper
Excess Algae Days in Lower bay	60	40	60	60
Change in Excess Algae Days	25% fewer	50% fewer	25% fewer	25% fewer
Added Cost to Household for 10 Years	100	100	50	100
	Question 17		Question 18	
	Alternative A	Alternative B	Alternative A	Alternative B
Wetlands - Acres	58000	58000	69600	60900
Change in Wetlands	current	current	20 % more	5% more
PCBs - Years Until Safe	20	70	70	20
Percent Increase in Facilities at Existing Parks	0	10	0	0
Acres in New Parks	0	0	8600	0
Change in Acres in Parks	current	current	10% more	current
Inches of Average Water Clarity	20	20	34	20
Change in Water Clarity	current	current	70% deeper	current
Excess Algae Days in Lower bay	80	80	40	80
Change in Excess Algae Days	current	current	50% fewer	current
Added Cost to Household for 10 Years	50	50	25	100

Follow-up postcard

Hello,

A few days ago you should have received a questionnaire asking for your opinions about natural resources in Northeast Wisconsin. If you have already completed and returned the questionnaire, accept our sincere thanks. You will soon receive your $15 “Thank You” check. If you have not completed and returned the questionnaire, we ask that you do so today.

It is very important that we hear from you. Your response will help shape decisions being made on natural resource priorities. We cannot survey all households in Northeast Wisconsin, so your responses will represent other households like yours that were not selected for the study. If you need another copy of the questionnaire, please call us at 1-800-935-4277 and we will mail another one. As a thank you for returning the questionnaire with all questions completed, we will send you a $15 “Thank You” check and a summary of the study results. Please return the survey by September 30.

Thank you for your help with this important study.

Pam Rathbun, Manager
Survey Research Center

Follow-up phone survey script

Hello, my name is **________________** and I am calling from the Hagler Bailly Survey Research Center in Madison, Wisconsin. I am trying to reach **[respondent name]**.

[IF RESPONDENT IS NOT AVAILABLE:]
Is there another adult head of household that I could speak to?

[If concerned about purpose of the call] This is not a marketing or sales call. We are collecting citizen input for government, industry, and citizen groups to consider when developing action plans for natural resources in Northeast Wisconsin. I want to assure you that your answers will be kept confidential and your name will not be revealed to anyone.

[If asking about the study sponsor] In order not to bias the responses to the survey, the sponsor is confidential until the results are released to government, industry and the general public later this fall. You will be mailed a summary of the results at that time.

[Response to: "*The response date passed*".] Because receiving responses from every household in our sample is important, we have extended the response date to October 16 (NOTE: this will change if calling goes into next week). If we mail the survey again tomorrow, can you complete it and return it in a week?

[Response to: "*Why are you paying $15?*"]
The survey is very important and we find we can get more citizen input for less money this way. More people return the survey faster, so we don't have to contact as many households, and contact you as often, to get an accurate sample of the public's input.

[If correct respondent is on the phone]

QA Recently, we mailed you a questionnaire asking your opinions about the future of natural resources in Northeast Wisconsin and offered to pay $15 for an adult head of your household to complete the survey. The survey had a map of northeast Wisconsin on the cover and some color graphics inside. Do you remember receiving that questionnaire?

1 YES
2 NO *[SKIP TO QA2]*

QA1 As of today, we have not received your completed questionnaire. Your household is part of a small group of people we are asking for opinions, so your response is very important. We are extending the deadline for completing the survey, and receiving $15 as a thank you for your time and effort. If we send you another survey, could you find the time to complete the survey and return it to us within a week of receiving it?

1 YES – SEND NEW SURVEY *[SKIP TO VERIFY]*
2 YES – DO NOT NEED ANOTHER SURVEY *[THANK AND TERMINATE]*
3 SURVEY HAS ALREADY BEEN RETURNED *[THANK AND TERMINATE]*
4 NO *[SKIP TO QB]*

QA2 We are collecting citizen input for government, industry, and citizen groups to consider when developing actions plans for natural resources in Northeast Wisconsin. Your household is part of a small group of people we are asking for opinions, so your response is very important. If we send you another survey, could you return the survey to us within a week after you receive it? We will send you $15 as a thank you for your time and effort.

1 YES – SEND NEW SURVEY *[SKIP TO VERIFY]*
2 YES – DO NOT NEED ANOTHER SURVEY *[THANK AND TERMINATE]*
3 SURVEY HAS ALREADY BEEN RETURNED *[THANK AND TERMINATE]*
4 NO *[SKIP TO QA2A]*

QA2A Since we only sampled a small number of households, it is very important that we hear from your household. Your opinions will represent those of other households similar to you. Is there another adult head of household that would be interested in completing the survey for $15?

1 YES, GETTING THEM TO THE PHONE *[REPEAT QA2]*
2 YES, BUT NOT AVAILABLE AT THIS TIME *[SET CALLBACK]*
3 NO *[SKIP TO QB]*

QB It is very important for our preliminary analysis that we understand how those who haven't returned the survey compare to those who did. This way we will not misinterpret the results. Could I take about 5 minutes to ask you a few questions? I'd like to remind you that all of your answers are confidential and your name will not be revealed to anyone.

1 YES *[SKIP TO Q1]*
2 NO *[ASK FOR A MORE CONVENIENT TIME, OTHERWISE, THANK AND TERMINATE]*

VERIFY (If new survey needs to be sent) I would like to verify some information that I have.

I have your name as…

NAME____
STREET ADDRESS______________________________________
CITY____________________________STATE ________ ZIP____________
PHONE____

Q1 In the last 12 months, have you fished in Green Bay or in rivers or streams near where they enter Green Bay?

1 YES *[SKIP TO Q1A]*
2 NO *[SKIP TO Q1B]*

8 DON'T KNOW *[SKIP TO Q1B]*
9 REFUSED *[SKIP TO Q1B]*

Q1A In the last 12 months, how often did you fish in the Bay of Green Bay or rivers or streams that enter into the Bay of Green Bay? Would it be…

1 LESS THAN 5 DAYS,
2 5 TO 10 DAYS, OR
3 MORE THAN 10 DAYS?

8 DON'T KNOW
9 REFUSED

Q1B In the last 12 months, have OTHER household members fished Green Bay or rivers or streams near where they enter Green Bay?

1 YES
2 NO

8 DON'T KNOW
9 REFUSED

Q2 How often do you participate in each of the following 3 activities in the waters or on the shorelines of the Bay of Green Bay and the rivers or streams near to where they feed into Green Bay. For each activity, tell me if you participate in the activity just around the Bay of Green Bay once a year or less often, about 1 to 5 times a year, or more than 5 times a year.

Q2a Wildlife viewing or enjoying the scenery
Q2b Camping or picnicking
Q2c Biking, hiking, walking, or jogging

1 ONCE A YEAR OR LESS
2 1 TO 5 TIMES A YEAR
3 MORE THAN 5 TIMES A YEAR

8 DON'T KNOW
9 REFUSED

Q3 Next, I am going to read you a list of 4 actions that may be taken to enhance natural resources in Northeast Wisconsin. After I read the list, we will go back through them one by one and I will want you to rate the importance to you of the action on a 1 to 5 scale, where 1 equals not at all important, 3 is somewhat important, and 5 is very important.

1. increase wetland and other habitat around the Bay of Green Bay to support increased populations of birds, fish and other wildlife.

2. remove PCBs in the Lower Fox River and the Bay of Green Bay so that consumption advisories on fish and waterfowl can be removed.

3. remove PCBs in the Lower Fox River and the Bay of Green Bay to reduce risks to birds, fish and other wildlife.

4. add new facilities at existing state and county parks throughout a 10 county Northeast Wisconsin area (new facilities may include boat launches, picnic areas, hiking and biking trails, and the like.)

Q3a OK, let's take them one at a time. On a 1 to 5 scale, where 1 is not at all important, 3 is somewhat important, and 5 is very important, how important is it to you to…

Increase wetland and other habitats around the Bay of Green Bay to support increased populations of birds, fishing and other wildlife?

1 NOT AT ALL IMPORTANT
2
3 SOMEWHAT IMPORTANT
4
5 VERY IMPORTANT

8 DON'T KNOW
9 REFUSED

Q3b How important is it to you to remove PCBs in the Lower Fox River and the Bay of Green Bay so that consumption advisories on fish and waterfowl can be removed?

1 NOT AT ALL IMPORTANT
2
3 SOMEWHAT IMPORTANT
4
5 VERY IMPORTANT

8 DON'T KNOW
9 REFUSED

Q3c How important is it to you to remove PCBs in the Lower Fox River and the Bay of Green Bay to reduce risks to birds, fish and other wildlife?

1 NOT AT ALL IMPORTANT
2
3 SOMEWHAT IMPORTANT
4
5 VERY IMPORTANT

8 DON'T KNOW
9 REFUSED

Q3d How important is it to add new facilities at existing state and county parks throughout a 10 county Northeast Wisconsin area? (new facilities may include boat launches, picnic areas, hiking and biking trails, and the like.)

1 NOT AT ALL IMPORTANT
2
3 SOMEWHAT IMPORTANT
4
5 VERY IMPORTANT

8 DON'T KNOW
9 REFUSED

(For recreation, if asked: the 10 county area is around the Bay of Green Bay from Winnebago, Calumet and Manitowoc counties on the south to Marinette and Door counties on the north. Your county is in this area).

I have just 3 more quick questions about you and your household to help us group your responses with others.

Q5 What is your age?

____ YEARS OLD
999 REFUSED

Q6 How many people are there in your household, including yourself?

____ PEOPLE
99 REFUSED

Q7 What was your total household income before taxes in 1998? I'll read off the categories, so just stop me when I reach the category that includes your household's total 1998 income.

1 LESS THAN $20,000
2 $20,000 TO $40,000
3 $40,000 TO $60,000
4 $60,000 TO $80,000
5 $80,000 TO $150,000
6 MORE THAN $150,000

8 DON'T KNOW
9 REFUSED

That's all the questions I have for you. Do you have any comments that you would like to add?

Thank you for your time. We really appreciate your participation in this brief survey.
Thanks again, and have a good evening.

[TERMINATE INTERVIEW]

GENDER
Respondent gender:

1 MALE
2 FEMALE

8 DON'T KNOW

LANG Language or other barrier:

1 YES, POSSIBLE LANGUAGE BARRIER
2 YES, DEFINITE LANGUAGE BARRIER
3 NO LANGUAGE, BUT OTHER TYPE OF BARRIER *[SPECIFY]*
4 NO BARRIERS

Follow-up letters for those reached by phone

«CASEID»

Dear «FIRSTNAM» «LASTNAM»:

Enclosed is another copy of the questionnaire we discussed on the phone this week. Thank you for your willingness to complete and return this questionnaire.

Since we were only able to survey a small number of households in Northeast Wisconsin, your response is very important. Informed decisions about natural resource issues can only be made if decision-makers know how citizens like you think about natural resource issues in your area. We want to remind you that the questionnaire does not require any special knowledge--we just ask that you consider each question and respond with your own opinion.

You will be sent a summary of the results of this study later this year. **In addition, if you postmark the questionnaire by October 18 and complete all the questions, we will send you a $15 "Thank You" check.**

All of your answers are confidential; your name will never be revealed to anyone. A code number has been put on the questionnaire so we can send you the $15 check for completing and returning it. If you have any questions, please call me toll-free at 1-800-935-4277.

Thank you for your help, and please remember to complete all questions.

Sincerely,

Pam Rathbun
Hagler Bailly Survey Manager

Follow-up letters for those not reached by phone

«ID»

Dear «FIRST_NAME» «LAST_NAME»,

A couple weeks ago, we sent you a questionnaire asking for your household's opinions on natural resource issues in Northeast Wisconsin. We are pleased that many households have returned their questionnaire, but we still would like to hear from you. If you recently mailed our questionnaire back to us, please accept our thanks and disregard this letter.

Since we were only able to survey a small number of households in Northeast Wisconsin, your response is very important. Regardless of whether you are a full-time resident of Northeast Wisconsin or a seasonal resident, **your opinion counts**. Informed decisions about natural resource issues can only be made if decision-makers know how citizens like you think about natural resource issues in your area. We want to remind you that the questionnaire does not require any special knowledge--we just ask that you consider each question and respond with your own opinion.

In the event that your questionnaire has been misplaced, a replacement questionnaire and a postage paid, self-addressed envelope are enclosed for your convenience. This questionnaire should be answered by either the male or female head of your household.

You will be sent a summary of the results of this study later this year. Because receiving responses from every household in our sample is important, we have extended the response date to October 25--**if you postmark the questionnaire by Monday, October 25 and complete all the questions, we will send you a $15 "Thank You" check.**

If there is anything we can do to help you complete this questionnaire, please feel free to call me toll-free at 1-800-935-4277.

Your cooperation in this study is greatly appreciated!

Sincerely,

Pam Rathbun

Hagler Bailly Survey Manager

Thank you letter

Dear Northeast Wisconsin Resident:

Thank you for responding to the survey about "Your Opinions about the Future of Natural Resources in Northeast Wisconsin". Enclosed is a $15 check to thank you for your assistance with this important study. Around the end of this year, you will also be receiving a summary of the study results.

Please call me at 608-232-2800 if you have any other questions.

Pam Rathbun, Manager
Survey Research Center

Appendix B — Modeling Consumer Preferences for Green Bay Resource Characteristics Using Stated Preference Data

B.1 Introduction

The purpose of this model is to estimate the parameters in a conditional indirect utility function for natural resource program characteristics using stated preference (SP) data, which consist of the answers to choice questions. Each sampled individual indicated his or her choice between a pair of Green Bay alternatives (Green Bay under different conditions). For each sampled individual, this comparison is repeated *J* times, where the characteristics of the Green Bay alternatives in the pairs are varied over the *J* pairs.

Section B.2 develops the choice probabilities for the two Green Bay alternatives using the SP data that indicate which Green Bay alternative is chosen. Section B.3 presents the likelihood function for the model.

B.2 Choice Probabilities for SP Green Bay Pairs

Let utility for the Green Bay alternatives be given by:

$$U_{ij}^{k_{ij}} = \beta_i' x_{ij}^{k_{ij}} + \varepsilon_{ij}^{k_{ij}}, i = 1,\ldots,m;\ j = 1,\ldots,J;\ k_{ij} \in [1,2]\,, \qquad \text{(B-1)}$$

where $U_{ij}^{k_{ij}}$ is the utility of the *k*-th alternative of pair *j* to individual *i*. That is, *i* indexes the *m* respondents, *j* indexes the *J* pairs, and k_{ij} indicates which of the two alternatives within each pair is chosen. The $L \times 1$ vector $x_{ij}^{k_{ij}}$ contains the characteristics of the alternatives, and hence the elements of the unknown $L \times 1$ vector β_i can be interpreted as marginal utilities.[1] The first element of $x_{ij}^{k_{ij}}$ is the difference between income for individual *i* and the cost of alternative k_{ij}, and the model is restricted to one with a constant marginal utility of money, which is the first element of β_i. This specification implies no income effects; that is, the probability of choosing any alternative is independent of income. The term $\beta_i' x_{ij}^{k_{ij}}$ is the nonstochastic part of utility, while $\varepsilon_{ij}^{k_{ij}}$ represents a stochastic component. It is assumed the $\varepsilon_{ij}^{k_{ij}}$ are independent (across *i*) and identically distributed mean zero normal random variables, uncorrelated with $x_{ij}^{k_{ij}}$, with constant unknown variance σ_ε^2. For SP data, it is assumed that the individual does not know his stochastic component before actually deciding on the particular alternative. That is, $\varepsilon_{ij}^{k_{ij}}$ is assumed to be the sum of factors unknown to *both* the individual and the investigator, although its distribution

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1. The parameter vector β is subscripted by *i* to indicate the marginal utilities may vary over individuals as a function of individual characteristics.

is assumed to be known.[2,3] That an individual does not know his preferences completely results from the fact that preferences have a component that varies randomly over time. When the individual answers stated-choice questions he does not know exactly what his preferences would be if he were presented with these alternatives as an actual choice at some point in the future. We assume the survey questions are answered probabilistically and reflect what he is likely to do if he were repeatedly presented with the actual choice.

Let $K_{ij} \in [1,2]$ be the Bernoulli random variable that is the choice for individual *i* on occasion *j*. The individual is assumed to choose alternative k_{ij} with the probability[4]:

$$P(K_{ij} = k_{ij}) = P_{ij}^{k_{ij}} = P(U_{ij}^{k_{ij}} > U_{ij}^{3-k_{ij}}) , \qquad \text{(B-2)}$$

where k_{ij} is the observed value of K_{ij}. That is, we may think of the individual's choice as a drawing from a Bernoulli distribution with the probability given by Equation B-2.

From Equations B-1 and B-2 and assumptions regarding the stochastic component, the probability of choosing alternative k_{ij} is:

---

2. For revealed preference data, the usual discrete-choice model specification is that the disturbances are known to the individual, and the behavioral assumption is utility maximization. The assumption is also sometimes made for SP data, although the rationale is less clear. However, even under the assumption that each unique pair of disturbances for each choice occasion is known to the individual a priori (and that the individual would evaluate utility for the two scenarios under the assumption of utility maximization), the identical likelihood function would be produced.

3. Manski (1999) assumes that stated choices made when it may be impractical for scenarios to contain all information relevant to making some actual choice in the future (which is represented by the stochastic component in equation B-1) do represent respondents' "intentions." According to Manski (p. 62), under this assumption the individual "applies his or her subjective distribution of [the stochastic term] to form a subjective choice probability," and subsequently chooses between alternatives. This theory is adopted in our specification. He provides a formal, theoretical proof that under standard economic and econometric assumptions, the researcher can obtain consistent estimates of choice probabilities (that is, as the sample gets large, the estimated sample probability approaches the true population probability; see p. 59). Choice questions can be used not only to predict choice behavior for the scenarios presented, but also can be used to extrapolate to other feasible scenarios using familiar statistical methods, including the binary probit model (Section 3 in Manski).

4. In this notation, if the individual chooses alternative $K_{ij} = 1 [\text{or } 2]$, then the alternative that was not chosen is $3 - K_{ij} = 2 [\text{or } 1]$.

$$\begin{aligned} P_{ij}^{k_{ij}} &= \mathrm{P}(\beta_i' x_{ij}^{k_{ij}} + \varepsilon_{ij}^{k_{ij}} > \beta_i' x_{ij}^{3-k_{ij}} + \varepsilon_{ij}^{3-k_{ij}} \\ &= \mathrm{P}[\varepsilon_{ij}^{3\text{-}k_{ij}} - \varepsilon_{ij}^{k_{ij}} < -\beta_i' (x_{ij}^{3-k_{ij}} - x_{ij}^{k_{ij}})] \\ &= \Phi[-\beta_i' (x_{ij}^{3-k_{ij}} - x_{ij}^{k_{ij}}) / \sqrt{2}\sigma_\varepsilon], \end{aligned} \tag{B-3}$$

where $\sqrt{2}\sigma_\varepsilon$ is the standard deviation of $\varepsilon_{ij}^{3-k_{ij}} - \varepsilon_{ij}^{k_{ij}}$ and $\Phi(\cdot)$ is the univariate standard normal cumulative distribution function. This probability will enter into the likelihood function in Section B.3. The parameter vector β_i is identified only up to the scale factor $\sqrt{2}\sigma_\varepsilon$, and σ_ε is not identified, since only the sign and not the scale of the dependent variable (the utility difference) is observed.[5] Nevertheless, we have chosen to list the parameters of the likelihood function $(\beta, \sigma_\varepsilon)$ separately. Notice also the *J* observations for each respondent have simply been stacked to produce a data set with *Jm* observations.

B.3 The Likelihood Function

The maximum likelihood parameter estimates are consistent. They are also asymptotically efficient under the additional assumption that the $\varepsilon_{ij}^{k_{ij}}$ are uncorrelated across *j*. The likelihood function is a function of the probabilities of the preferred alternatives from the Green Bay pairs (Section B.2). The likelihood function is:

$$L(k_{ij}, i = 1,\ldots,m; j = 1,\ldots,J \mid x_{ij}^1, x_{ij}^2; \beta_i, \sigma_\varepsilon) = \prod_{i=1}^{m} \prod_{j=1}^{J} \mathrm{P}(K_{ij} = k_{ij}). \tag{B-4}$$

5. However, the scale factor can be allowed to vary across individuals or choice occasions as long as one scale is fixed for identification. Individuals or choice questions with smaller scales will receive less weight in the likelihood function in Section B-3, and will therefore have less influence on the estimation of parameters.

Appendix C — Survey with Means and Frequencies

WHAT ARE YOUR OPINIONS ABOUT THE FUTURE OF NATURAL RESOURCES IN NORTHEAST WISCONSIN?

Important Definition

In this survey "the Bay of Green Bay" means the waters of the Bay of Green Bay and all tributaries up to the first dam or obstruction.

Introduction

Decision makers are examining options for natural resources in northeast Wisconsin. Your responses to this survey will help in making decisions about which options are best.

1 **How often do <u>you</u> personally participate in each of the following activities in Wisconsin on the waters and shorelines of the <u>Bay of Green Bay</u>?** *Circle the letter of your answer for each activity.*

	N	Less than once a year or never	1 to 5 times a year	6 to 10 times a year	More than 10 times a year	Missing
Fishing	446	238	119	36	53	24
Boating (non-fishing)	431	250	132	29	20	39
Waterskiing or jetskiing . .	423	372	36	9	6	47
Canoeing or kayaking	423	363	42	13	5	47
Swimming	433	249	113	36	35	37
Hunting	432	312	59	22	39	39
Wildlife viewing	442	117	150	73	102	28
Enjoying outdoor scenery .	444	53	121	91	179	26
Camping or picnicking . . .	431	178	161	51	41	39
Biking	420	264	87	31	38	38
Hiking, walking, or jogging	438	145	116	66	111	32

This survey addresses four natural resource topics. The information provided reflects the most recent scientific reports about these topics.

- **Wetlands**
- **PCBs**
- **Outdoor recreation**
- **Runoff**

Wetlands

Within 5 miles of the Bay of Green Bay there are about 58,000 acres of wetlands in Wisconsin (see map on the facing page), and another 86,000 acres in Michigan. These nearby wetlands are very important to the fish and wildlife of the Bay of Green Bay.

- **Farming, cutting forests, and developing residential and urban areas have reduced wetlands in this area by more than half in the past 100 years.**
- **Current regulations are designed to prevent further loss of wetlands in this area.**
- **Programs have been proposed to restore wetlands in this area. Any wetlands restoration would take about 10 years.**

2 **Wetlands around the Bay of Green Bay provide spawning and nursery habitats for a majority of the fish species in the Bay, including yellow perch, bluegill, largemouth bass, northern pike, and over 35 other species. These wetlands also provide necessary habitat and food for many bird species in the Bay area, including terns, many species of ducks and geese, shorebirds, bald eagles, several species of hawks, coots, and others. Other wildlife such as deer, muskrat, and mink also use wetlands for habitat.**

Increases in wetlands would support nearly proportional increases in the populations of those bird and fish species that depend on wetlands. For example, increasing wetland acres by 10% would increase the numbers of those birds and fish that rely on wetlands by about 10%.

How important to you, if at all, is it to increase wetland acreage near to the Bay of Green Bay to support birds, fish, and other wildlife? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
25	26	101	110	198	8	2	460	3.93	1.67

3 **Which of the following options do you prefer for Wisconsin wetlands near to the Bay of Green Bay?** *Circle the number of your answer***.**

Category	Freq.
1 Do less and spend less to maintain wetlands, resulting in a loss of wetlands.	12
2 Do and spend about the same to maintain the current wetland acreage (about 58,000 acres).	192
3 Do more and spend more to restore wetlands. Options to restore wetlands range from restoring 2,900 acres (5% more than now) to restoring 11,600 acres (20% more than now).	257
Missing	9
Total	470

Wisconsin Wetlands Within 5 Miles of the Bay of Green Bay

PCBs

PCBs are substances that were used by industry until the mid-1970s, when they were banned.

- **PCBs released into the Lower Fox River have accumulated in the sediments at the bottom of the Lower Fox River and Green Bay.**
- **PCBs get into fish, birds, and other wildlife through the food chain.**

4 **Because of PCBs, consumption advisories have been issued for all sport-caught fish in Green Bay (including all tributaries up to the first dam) and for some waterfowl in the area. The fish consumption advisories tell how often a meal of fish may be safely eaten (see table on the facing page). Eating more fish than is recommended may increase a woman's risk of bearing children with learning disabilities and slow development, and for everyone may increase the risk of cancer.**

Programs have been proposed to remove PCBs in this area. How important to you, if at all, is it to remove PCBs so that it will be safe to eat fish and waterfowl? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
17	16	66	88	271	8	4	458	4.27	1.07

5 **PCBs cause harm to wildlife in and near the Bay of Green Bay.**

Birds **Forster's terns and common terns in the area reproduce at rates that are about half of the rate elsewhere in Wisconsin. Both are listed as Wisconsin endangered species.**

Bald eagles in the area also reproduce at about half the normal rate for Wisconsin. PCBs contribute to this problem. Bald eagles are no longer listed as endangered.

A small percentage of cormorants experience deformities such as crossed bills.

Fish **About 25% of walleye have abnormalities that can become cancerous liver tumors.**

Other Wildlife **Some sensitive fish-eating wildlife, like mink, may be harmed.**

Even though PCBs harm wildlife, it is unclear whether the total numbers of terns, eagles, cormorants, walleye, mink and other species in the area are less than if there were no PCBs. This is because wildlife migrates into and out of the area, because there is limited habitat in the area for some species, and because other factors influence wildlife populations.

How important to you, if at all, is it to remove PCBs in the Bay of Green Bay area to reduce harm to birds, fish, and other wildlife? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
13	17	69	93	270	6	2	462	4.28	1.03

6 **PCB removal would take about 10 years. Any PCB removal would use the best available technology to minimize stirring up PCBs, and the PCBs that are removed would be disposed of in a manner that would prevent future risks to humans and wildlife.**

Not all PCBs can be removed. The PCBs that are not removed may continue to harm some fish and wildlife. For example, with extensive PCB removal, fish consumption advisories for yellow perch and some impacts to wildlife would be eliminated shortly after PCB removal, but it would be 20 years total (10 years for removal plus 10 more years for nature to recover) before PCBs are at safe levels. By safe levels we mean there are no consumption advisories for, and no harm to, nearly all fish and wildlife.

Which of the following options do you prefer for PCBs in the Green Bay area of Wisconsin? *Circle the number of your answer.*

Category	Freq.
1 No further PCB investigations or removal. With no further removal it will be 100 years or more until PCBs are at safe levels.	77
2 Do more and spend more to remove PCBs. Depending on how many PCBs are removed, the time until PCBs are at safe levels would range from 20 years up to 70 years.	382
Missing	11
Total	470

Wisconsin Department of Natural Resources
Fish Consumption Advisories for PCBs

Wisconsin waters of Green Bay, including all tributaries up to the first dam
(PCB advisories in the Lower Fox River are the same or more restrictive)

Species	Eat no more than **One meal/week or 52 meals/year**	Eat no more than **One meal/month or 12 meals/year**	Eat no more than **One meal every two months or six meals/year**	**Do not eat**
Northern Pike	Less than 22"	Larger than 22"		
Walleye		Less than 17"	17-26"	Larger than 26"
Yellow Perch	All sizes			
Carp, White Bass, Sturgeon				All sizes
Smallmouth Bass, White Sucker, Rainbow Trout		All sizes		
Channel Catfish, White Perch, Whitefish			All sizes	
Chinook Salmon		Less than 30"	Larger than 30"	
Brown Trout		Less than 17"	17-28"	Larger than 28"

Outdoor Recreation

In 10 Wisconsin counties around the Bay of Green Bay, there are over 120 state parks, natural areas, and county parks covering more than 86,000 acres (see map on the facing page).

- **These parks include a variety of facilities such as picnic grounds, beaches, scenic sites, piers, boat ramps, biking and hiking trails, and interpretive centers.**
- **To meet the current and future needs of area residents, programs have been proposed to add facilities at existing parks and to open new parks.**

7 **Adding facilities at existing parks can improve recreational opportunities in these parks. For example, 10% more facilities would mean that most parks would see improvements. Some parks would add hiking or biking trails, some parks would add picnic areas, some parks would add a boat ramp, some parks would add adjacent land, and so forth.**

How important to you, if at all, is adding facilities at existing parks throughout the area to enhance recreational opportunities? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
22	43	168	103	131	3	0	467	3.60	1.13

8 **New parks can be opened throughout the area to increase recreational opportunities. How important to you, if at all, is opening new parks to enhance outdoor recreational opportunities?** *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
41	76	156	90	103	4	0	466	3.30	1.23

9 **Any new facilities at existing parks, and any new parks, would be located throughout the area to best meet the needs of residents and would take up to 10 years to accomplish. Which of the following options do you prefer for state and county parks in northeast Wisconsin?** *Circle the number of your answer.*

Category	**Freq.**
1 Do less and spend less to maintain existing outdoor recreation parks.	9
2 Do and spend about the same to maintain existing park conditions and facilities.	239
3 Do more and spend more to add facilities at existing parks and/or to open new parks.	220
Missing	2
Total	470

State and County Recreation Areas

Runoff

Runoff from farms, highways, construction sites, and residential and urban neighborhoods carries plant nutrients and sediments into the Bay of Green Bay and its tributaries, causing algae growth, muddy water, and changes in aquatic habitat (see figure on the facing page).

- **Runoff pollution can be reduced by decreasing erosion; controlling farm, urban, and residential wastes; fencing livestock away from streams; and other measures.**
- **Zebra mussels (small shellfish) have invaded Green Bay. They filter the water, making it clearer. However, scientists say we cannot count on zebra mussels to improve water clarity in the future.**
- **Runoff is not a significant source of the PCBs in the Lower Fox River and Green Bay and does not affect the quality of your drinking water.**

10 **When too many plant nutrients are present, excess algae coats the surface of the water with decaying plants and causes a foul odor. The frequency of excess algae varies by location in the Bay of Green Bay from seldom in the central and northern Bay to up to 80 days a summer in the southern Bay. Most excess algae occurs from mid-June to mid-September.**

How important to you, if at all, is it to control runoff to reduce the number of days with excess algae in Green Bay? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
13	35	134	129	146	13	0	457	3.79	1.07

11 **Because of sediments and algae, you can only see down into the water about 20 inches on average in southern Green Bay, with clearer water to the north. This not only makes the water look less appealing but also reduces the light that reaches underwater plants and thus reduces aquatic habitat. Populations of desirable fish and birds are smaller and carp populations are larger than they would be otherwise, but scientists cannot yet put numbers on the vegetation and wildlife effects.**

How important to you, if at all, is it to control runoff to improve water clarity? *Circle the number of your answer.*

Not at all important		Somewhat important		Very important	Don't know	N Missing	N	Mean	Std. Dev.
7	29	116	134	175	9	0	461	3.96	1.01

12 **Any actions to reduce runoff would take up to 10 years to reach their goals. Which of the following options do you prefer for controlling runoff around the Bay of Green Bay?** *Circle the number of your answer.*

Category	Freq.
1 1 Do less and spend less, resulting in reduced water clarity, increased days of excess algae, and less aquatic habitat in Green Bay and its tributaries.	7
2 Do and spend about the same. In the southern parts of Green Bay, average summer water clarity would remain about 20 inches, excess algae would occur up to 80 days a summer, and aquatic habitat would remain the same.	157
3 Do more and spend more to control runoff. Options range up to a 50% reduction in runoff. In the southern parts of Green Bay, this would result in about 34 inches of water clarity, excess algae up to 40 days per year, and increased aquatic habitat.	299
Missing	7
Total	470

Water Pollution from Runoff

What Alternatives Do You Prefer?

In each of the next questions there are two alternatives, labeled A and B (see Question 13).

- **Each alternative describes a possible combination of options for natural resources in and around the Bay of Green Bay and the additional costs to your household beyond what you are now paying.**
- **Depending on the options, some costs will be paid by industry, farmers, and conservation organizations. But taxpayers may have to pay something as well. Assume your household pays its share of any added costs through a combination of federal, state, and local taxes each year for the next 10 years.**
- **Since we do not yet know how much each alternative will actually cost you or others, we are asking about a range of costs.**
- **For each question, even if you do not view either Alternative A or B as ideal, still tell us which of the two alternatives you would prefer.**
- **To help you get started, for Question 13 we have provided information on the right-hand side indicating the differences, if any, between Alternatives A and B.**

REMEMBER

1. **The goal of wetlands restoration is to provide additional habitat for fish and wildlife.**
2. **For PCBs, the "years until safe" is the number of years until there are no consumption advisories for, and no harm to, nearly all fish and wildlife. Many advisories and effects will end sooner, but a few advisories and effects may last longer.**
3. **New recreation facilities at existing parks could include rest rooms, trails, boat ramps, and picnicking and camping facilities. Any new facilities at existing parks and any new parks would be located to best meet the needs of area residents.**
4. **Pollution from runoff creates excess algae, reduces water clarity, and causes the loss of aquatic habitat, all of which occur most often in the southern Bay.**

13 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

	Alternative A ▼	Alternative B ▼
Wetlands Acres in Wisc. around Green Bay. (Currently 58,000)		
PCBs Years until safe for nearly all fish and wildlife . . . . (Currently 100 years or more)		
Outdoor Recreation Facilities at existing parks		
Acres in new parks. . . . . (Currently 86,000 acres in state and county parks)		
Runoff Average water clarity in southern Bay (Currently 20 inches)		
Excess algae (Currently up to 80 summer days in the southern Bay)		
Added cost to your household Each year for 10 years.		

Check (✔) the box for the alternative you prefer ➔

☐ **I Prefer Alternative A**

☐ **I Prefer Alternative B**

Q13	**Version**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Alternative A	21	27	18	16	20	36	38	30	21	28	255
Alternative B	17	21	23	32	30	8	14	14	28	20	207
Neither A nor B	0	0	0	0	2	0	0	0	0	0	2
Don't Know	0	0	0	0	0	1	0	0	0	0	1
Missing	0	0	1	0	1	0	1	1	0	1	5
Total	38	48	42	48	53	45	53	45	49	49	470

14 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

Q14	**Version**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Alternative A	15	27	17	27	34	25	33	35	28	21	262
Alternative B	23	21	25	20	17	20	19	10	21	28	204
Neither A nor B	0	0	0	0	1	0	0	0	0	0	1
Missing	0	0	0	1	1	0	1	0	0	0	3
Total	38	48	42	48	53	45	53	45	49	49	470

15 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

Q15	**Version**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Alternative A	20	45	25	43	20	26	34	22	41	25	301
Alternative B	18	3	17	4	30	18	18	23	8	23	162
Neither A nor B	0	0	0	0	2	0	0	0	0	0	2
Don't Know	0	0	0	0	0	1	0	0	0	0	1
Missing	0	0	0	1	1	0	1	0	0	1	4
Total	38	48	42	48	53	45	53	45	49	49	470

16 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

Q16	**Version**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Alternative A	18	4	13	26	13	40	14	30	29	38	225
Alternative B	20	44	29	22	37	4	39	15	20	11	241
Neither A nor B	0	0	0	0	2	0	0	0	0	0	2
Don't Know	0	0	0	0	0	1	0	0	0	0	1
Missing	0	0	0	0	1	0	0	0	0	0	1
Total	38	48	42	48	53	45	53	45	49	49	470

17 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

Q17	**Version**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Alternative A	27	33	36	10	23	16	26	32	37	44	284
Alternative B	11	15	6	38	27	28	27	13	12	4	181
Neither A nor B	0	0	0	0	2	0	0	0	0	0	2
Don't Know	0	0	0	0	0	1	0	0	0	0	1
Missing	0	0	0	0	1	0	0	0	0	1	2
Total	38	48	42	48	53	45	53	45	49	49	470

18 **If you had to choose, would you prefer Alternative A or Alternative B?** *Check one box at the bottom.*

Q18	Version										
	1	2	3	4	5	6	7	8	9	10	Total
Alternative A	19	41	12	30	16	22	18	33	30	30	251
Alternative B	18	6	30	18	33	22	35	12	19	18	211
Neither A nor B	0	0	0	0	2	0	0	0	0	0	2
Don't Know	0	0	0	0	0	1	0	0	0	0	1
Missing	1	1	0	0	2	0	0	0	0	1	5
Total	38	48	42	48	53	45	53	45	49	49	470

19 **When you were making your choices between alternatives A and B in Questions 13 through 18, how important were each of the following?** *Circle the number of your answer for each item.*

	Not at all important		Average importance		Very important	N Missing	N	Mean	Std. Dev.
Acres of wetland	36	58	189	91	94	2	468	3.32	1.15
Years until safe levels of PCBs	17	37	123	110	181	2	468	3.86	1.13
Facilities at existing parks	43	78	173	113	57	6	464	3.14	1.12
Acres of new parks	68	107	154	87	50	4	466	2.88	1.19
Inches of water clarity	22	53	164	138	88	5	465	3.47	1.07
Days of excess algae each summer.	32	66	170	113	86	3	467	3.33	1.13
Annual cost to your household	15	49	135	99	168	4	466	3.76	1.14

20 **Overall, how confident do you feel about your choices between the alternatives in Questions 13 through 18?** *Circle the number of your answer.*

Not at all confident		Somewhat confident		Very confident	N Missing	Don't know	N	Mean	Std. Dev.
6	23	188	178	73	2	0	468	3.62	0.85

21 **Questions 13 through 18 were asked to provide citizen input for decision makers to consider along with other information from scientists and planners. With this in mind, how much should public officials consider your responses to Questions 13 through 18?** *Circle the number of your answer.*

Should not consider my responses at all		Should somewhat consider my responses		Should completely consider my responses	Don't know	N Missing	N	Mean	Std. Dev.
3	16	128	185	136	0	2	468	3.93	0.87

22 **Prior to receiving this survey, how aware were you of each of the four natural resource topics we addressed?** *Circle the number of your answer for each topic.*

	I was not aware of this topic		I was somewhat aware of this topic		I was very aware of this topic	Don't know	N Missing	N	Mean	Std. Dev.
Wetlands	41	46	172	116	94	0	1	469	3.38	1.17
PCBs	20	12	102	137	191	0	8	462	4.01	1.06
Outdoor recreation .	30	59	165	119	91	0	6	464	3.39	1.13
Runoff	37	51	141	129	106	0	6	464	3.47	1.19

About You and Your Household

This information is used to help group your responses with responses of other households. Your individual responses and your name will not be released.

23 **In the last 12 months, have you fished in Green Bay or its tributaries up to the first dam (see map on the cover)?** *Circle the number of your answer.*

1 No	326.		
(If no) in the last 12 months, have *other* household members fished in Green Bay or its tributaries up to the first dam? *Circle the number of your answer.*		1 No	281
		2 Yes	22
		3 Don't know/Uncertain	16
		Missing	7
		Total	326
2 Yes	143		
(If yes) in the last 12 months, on about how many days have you fished in Green Bay or its tributaries up to the first dam? _______ Days		N	143
		Mean	10.50
		Std. Dev	13.67
		Median	7
Missing	1		
Total	470		

Frequencies for Question 23 Part 2 " about how many days have you fished in Green Bay or its tributaries up to the first dam?"

Days	Frequency	Cumulative Frequency	Cumulative Percent
1	10	10	6.99
2	18	28	19.58
3	18	46	32.17
4	10	56	39.16
5	13	69	48.25
6	11	80	55.94
7	6	86	60.14
8	5	91	63.64
10	14	105	73.43
12	5	110	76.92
15	6	116	81.12
16	1	117	81.82
20	12	129	90.21
23	1	130	90.91
24	1	131	91.61
25	1	132	92.31
30	4	136	95.10
40	2	138	96.50
50	2	140	97.90
60	1	141	98.60
70	1	142	99.30
100	1	143	100.00

24 Do you own or rent your residence? *Circle the number of your answer.*

Own	395
Rent	73
Missing	2
Total	470

25 Do you have a vacation home or cabin in northeast Wisconsin? *Circle the number of your answer.*

1 Yes	85		
(If yes) about how many miles is it from your vacation home or cabin to the Bay of Green Bay? _______ Miles to Green Bay		N Mean Std. Dev. Median	84 63.91 35.43 65
2 No	377		
Missing	8		
Total	470		

Frequencies for Question 25 - Part 2 "(If yes) about how many miles is it from your vacation home or cabin to the Bay of Green Bay? "

Miles	Frequency	Cumulative Frequency	Cumulative Percent
1	5	5	5.88
6	1	6	7.06
8	1	7	8.24
10	3	10	11.76
15	2	12	14.12
29	1	13	15.29
30	2	15	17.65
35	1	16	18.82
36	1	17	20.00
40	7	24	28.24
45	4	28	32.94
50	6	34	40.00
60	6	40	47.06
64	1	41	48.24
65	5	46	54.12
69	1	47	55.29
70	5	52	61.18
75	4	56	65.88
80	7	63	74.12
90	2	65	76.47
100	12	77	90.59
110	2	79	92.94
125	2	81	95.29
130	1	82	96.47
135	1	83	97.65
140	1	84	98.82
150	1	85	100.00

26 **Your gender:**

Female	135
Male	335
Missing	0
Total	470

27 **Your age:** ______ Years old

Mean	50.92
Std. Dev.	15.85
N	470
Missing	0

Frequencies or responses to Age Question

Age (Years)	Frequency	Cumulative Frequency	Cumulative Percent
21	2	2	0.43
22	6	8	1.70
23	4	12	2.55
24	2	14	2.98
25	3	17	3.62
27	4	21	4.47
28	6	27	5.74
29	6	33	7.02
30	2	35	7.45
31	6	41	8.72
32	2	43	9.15
33	11	54	11.49
34	14	68	14.47
35	8	76	16.17
36	16	92	19.57
37	11	103	21.91
38	18	121	25.74
39	6	127	27.02
40	17	144	30.64
41	9	153	32.55
42	11	164	34.89
43	9	173	36.81
44	18	191	40.64
45	12	203	43.19
46	8	211	44.89
47	8	219	46.60
48	9	228	48.51
49	11	239	50.85
50	12	251	53.40
51	9	260	55.32

Age (Years)	Frequency	Cumulative Frequency	Cumulative Percent
52	11	271	57.66
53	10	281	59.79
54	8	289	61.49
55	11	300	63.83
56	8	308	65.53
57	8	316	67.23
58	7	323	68.72
59	9	332	70.64
60	9	341	72.55
61	8	349	74.26
62	11	360	76.60
63	9	369	78.51
64	5	374	79.57
65	6	380	80.85
66	6	386	82.13
67	3	389	82.77
68	7	396	84.26
69	7	403	85.74
70	7	410	87.23
71	4	414	88.09
72	5	419	89.15
73	3	422	89.79
74	4	426	90.64
75	3	429	91.28
76	1	430	91.49
77	7	437	92.98
78	4	441	93.83
79	2	443	94.26
80	5	448	95.32
81	3	451	95.96
82	5	456	97.02
83	3	459	97.66
84	1	460	97.87
85	1	461	98.09
86	3	464	98.72
87	2	466	99.15
89	1	467	99.36
91	1	468	99.57
96	1	469	99.79
99	1	470	100.00

28 How many people are there in your household, including yourself?

N	468
Mean	2.68
Std. Dev.	1.34
Missing	2

29 How many children do you have, whether living with you or not?

N	467
Mean	2.28
Std. Dev.	1.78
Missing	3

30 How many grandchildren do you have, whether living with you or not?

N	464
Mean	1.99
Std. Dev.	3.82
Missing	6

31 How many listed telephone numbers does your household have?

N	465
Mean	1.13
Std. Dev.	0.44
Missing	5

Frequencies for Question 28 - Number of People in Household

Number	Frequency	Cumulative Frequency	Cumulative Percent
0	2	2	0.43
1	79	81	17.31
2	186	267	57.05
3	67	334	71.37
4	85	419	89.53
5	34	453	96.79
6	13	466	99.57
7	2	468	100.00

Frequencies for Question 29 - Number of Children

Number	Frequency	Cumulative Frequency	Cumulative Percent
0	79	79	16.92
1	71	150	32.12
2	140	290	62.10
3	87	377	80.73
4	49	426	91.22
5	19	445	95.29
6	10	455	97.43
7	5	460	98.50
8	3	463	99.14
9	2	465	99.57
10	1	466	99.79
13	1	467	100.00

Frequencies for Question 30 - Number of Grandchildren

Number	Frequency	Cumulative Frequency	Cumulative Percent
0	286	286	61.64
1	36	322	69.40
2	28	350	75.43
3	20	370	79.74
4	15	385	82.97
5	18	403	86.85
6	11	414	89.22
7	9	423	91.16
8	7	430	92.67
9	6	436	93.97
10	5	441	95.04
11	5	446	96.12
12	4	450	96.98
13	1	451	97.20
14	4	455	98.06
15	3	458	98.71
16	2	460	99.14
17	2	462	99.57
18	1	463	99.78
33	1	464	100.00

Frequencies for Question 31 - Number of Listed Telephones in Household

Number	Frequency	Cumulative Frequency	Cumulative Percent
0	4	4	0.86
1	407	411	88.39
2	44	455	97.85
3	8	463	99.57
4	2	465	100.00

32 **What is the highest level of schooling you have completed?** *Circle the number of your answer*.

	Frequency
Did not complete high school	24
High school diploma or equivalent	179
Some college, two year college degree (AS) or technical school	149
Four year college graduate (BA, BS)	58
Some graduate work but did not receive a graduate degree	20
Graduate degree (MA, MS, MBA, PhD, JD, MD, etc.)	36
Missing	4
Total	470

33 **What is you present employment status?** *Circle the number of your answer.*

	Frequency
Employed full time	460
Employed part time	1
Retired	1
Homemaker	2
Student	4
Unemployed	0
Missing	2
Total	470

34 **Which of the following categories best describes your racial or ethnic background?** *Circle the number of your answer.*

	Frequency
White or Caucasian	460
Black or African American	1
Hispanic or Mexican American	1
Asian or Pacific Islander	2
Native American Indian	4
Other: __________	0
Missing	2
Total	470

35 **What was your household income (before taxes) in 1998?** *Circle the number of your answer.*

	Frequency
less than $10,000	20
$10,000 to $19,999	53
$20,000 to $29,999	58
$30,000 to $39,999	70
$40,000 to $49,999	65
$50,000 to $59,999	48
$60,000 to $79,999	74
$80,000 to $99,999	28
$100,000 to $149,999	17
$150,000 or more	15
Missing	22
Total	470

36 **Is there anything we have overlooked? Please use this space for any additional comments you would like to make.**

	Frequency
No comment	344
Made a comment	126
Total	470

County of respondent

County	Frequency
Brown	214
Calumet	13
Door	20
Kewaunee	17
Manitowoc	25
Marinette	33
Oconto	32
Outagamie	52
Shawano	13
Winnebago	51
Total	470

MAIL_RET - Dates of survey return

Date Code	Frequency	Cumulative Frequency	Cumulative Percent
1-Nov-99	2	2	0.43
1-Oct-99	7	9	1.91
3-Nov-99	2	11	2.34
3-Oct-99	1	12	2.55
4-Oct-99	4	16	3.4
5-Oct-99	2	18	3.83
7-Oct-99	1	19	4.04
8-Oct-99	7	26	5.53
13-Oct-99	13	39	8.3
14-Oct-99	20	59	12.55
14-Sep-99	65	124	26.38
15-Sep-99	30	154	32.77
16-Sep-99	53	207	44.04
17-Oct-99	16	223	47.45
17-Sep-99	30	253	53.83
18-Oct-99	16	269	57.23
19-Oct-99	11	280	59.57
20-Oct-99	9	289	61.49
20-Sep-99	73	362	77.02
21-Oct-99	2	364	77.45
21-Sep-99	24	388	82.55
22-Oct-99	1	389	82.77
22-Sep-99	23	412	87.66
23-Sep-99	6	418	88.94
24-Sep-99	16	434	92.34
25-Oct-99	2	436	92.77
26-Oct-99	1	437	92.98
27-Oct-99	1	438	93.19
27-Sep-99	18	456	97.02
28-Oct-99	2	458	97.45
28-Sep-99	2	460	97.87
29-Oct-99	1	461	98.09
29-Sep-99	5	466	99.15
30-Sep-99	4	470	100

Your Participation Is Greatly Appreciated!

Please return the survey in the enclosed envelope to:

Hagler Bailly Services
University Research Park
455 Science Drive
Madison, Wisconsin 53711

Appendix D — Existing Literature

Several studies have been conducted in the Great Lakes basin, and for Green Bay in particular, addressing the importance and value of environmental resources to the general public. While none of this literature is exactly applicable to the objective of selecting and scaling restoration options and/or valuing all of the specific injuries in this case, the literature shows considerable consistency in that residents are aware of, concerned about, and place a high priority and value on cleaning up contaminated water resources.

Breffle et al. (1999). In a related study to this one, Breffle et al. (1999) estimate damages to current Green Bay recreational anglers from the presence of fish consumption advisories by combining stated preference (SP) choice-pair data on different Green Bay alternatives with SP and revealed preference frequency data on current use and use under various conditions. Using variation on a probit model, it is estimated that anglers would be willing to pay $9.75 more per Green Bay fishing day if FCAs were removed, and $4.17 per existing fishing day to all sites for the option of choosing a Green Bay without FCAs. The study also estimates values for improved catch rates, and how anglers would trade off catch rates for FCAs. Aggregate recreational fishing damages for all **Wisconsin and Michigan** waters of Green Bay from 1980 until FCAs are removed range from $106 million with intensive remediation (FCAs totally removed by 2020) to $148 million with no remediation (all FCAs in place for over 100 years).[1] These damages do not include damages to non-anglers who would fish in the absence of injuries, or to other individuals who do or do not participate in other types of recreation.

Stoll (2000a and 2000b). Stoll (2000a,b) reports results from a 1997 repeat mail survey of the general population conducted to estimate benefits of contaminated sediment remediation in the Fox-Wolf River basin, which contains the Fox River and the entire Green Bay watershed and Area of Concern (21 square miles of lower Green Bay). As reported in an earlier presentation of survey results, the survey was administered to a stratified random sample of 1,500 individuals, 55% in contiguous counties and the rest in other Wisconsin counties (Stoll, 1997). The proportion of respondents reporting that they are “somewhat” or “very” worried about human health concerns from fish consumption is 60%.

Using a double-bounded referendum contingent valuation method (CVM), Stoll estimates total active and passive use benefits from the improvement of water quality within the Area of Concern in congruence with programs envisioned in the 1988 Lower Green Bay Remedial Action Plan (RAP). The basic goals of the Green Bay RAP, based on its Key Action Items, include (Baba et al., 1991; Stoll, 2000b):

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1. Breffle et al. (1999) summarize other relevant fishing studies, which generally provide comparable findings that FCAs are significantly adverse to recreational fishing.

- impose greater pollution controls on industry
- provide more public education about water quality issues
- do more to protect wetlands and marshes
- conduct more basic research on water quality
- make sure that harbor dredging does not make the water quality worse
- encourage farmers to use better soil conservation practices
- require much more treatment of municipal wastes
- remove toxins from bottom sediments
- restore swimming and an edible fishery
- provide suitable habitat for enhancing and sustaining a diversity of wildlife
- establish a self-sustaining, balance, and diversified, edible fish community
- improve the water quality and trophic state of the area to relieve ecological stresses
- achieve and maintain water quality that protects the ecosystem from toxic substances
- ensure sustainability of a restored and healthy environment through pollution prevention.

The results show that 70% of households would be willing to pay $10 every year for the removal of contaminated sediments, and 21% would pay at least $1,500 each year (Stoll, 1997). The adjusted mean value of remediation benefits for 100% actualization of RAP projects is $222 per household per year every year (in 1997 dollars), using a logistic function with a truncation at $300 (Stoll, 2000b). Most values fall generally in the range of $100 to $300. This survey addresses environmental problems much broader than the PCB contamination addressed in this study (e.g., the study also addresses dissolved oxygen and temperature), and the study area is much bigger than the Green Bay NRDA assessment area. It is not possible to scale Stoll's values to values that would be just for PCB restoration with the current information, although a significant portion of the value would be expected to be attributable to PCBs, based on the expressed concerns about FCAs in his work (and in the preference for PCB removal in this TVE study).

Another approach to making remediation decisions by considering costs relative to benefits was also presented by Stoll (2000a). Based upon an estimate of $700 million for remediation activities, if remediation costs were borne entirely by Fox River Basin counties, the estimated per household cost would be $167 per year for 30 years. This amount is commensurate with (or less than, considering the finite time frame for incurring costs) remediation benefits estimates typically ranging from $100 to $300 annually indefinitely into the future, with a mean of $222, as reported in Stoll (2000b).

Johnsen et al. (1992). An earlier study also examined public perceptions and attitudes toward environmental rehabilitation of the lower Green Bay watershed and the same Green Bay RAP. Johnsen et al. (1992) is the published article based on the initial report, Baba et al. (1991). The two documents contain different information. Johnsen et al. (1992) report wide public support for items in the RAP. In 1990, over 700 members of Brown County households (which contains the lower Fox River and its mouth), plus a small sample of recreationists to augment the original sample, were interviewed by telephone and asked 71 questions about recreational use, perceptions about water quality and water quality requirements for recreation, and willingness to pay to implement the RAP. Two-thirds of the sample had used the Area of Concern for recreational purposes in the previous year. On a 1-to-10 scale (from worst possible water quality to best), the mean perception of water quality in the lower bay near the mouth of the Fox River was 3.95, and the perceptions of water quality were far below what was considered appropriate for recreation (e.g., 8.05 was the rating associated with "game fish could live in it"). Each of the RAP goals was supported by at least 72% of respondents, and considered important by at least 75% of respondents.

The study also reports a lower-bound mean willingness to pay for implementation of the RAP of $34.08 per household per year every year (in 1990 dollars), although respondents felt that industries polluting the water, as well as recreationists, should help pay to improve water quality (Johnsen et al., 1992). WTP did not differ significantly between recreational users and nonusers. WTP estimates for lower resource quality than the RAP projects would yield (e.g., swimmable water with edible fish) were somewhat lower, ranging from $20.32 to $21.80 (Baba et al., 1991). The primary motivations to pay for resource improvements were for recreational opportunities and a cleaner environment.

Several study design features may be causing WTP values to be considerably lower in this study than the values reported by Stoll (1997 and 2000b). First, this study used a telephone survey format and presented very limited information on the injuries and benefits from remediation; Stoll's mail survey presented more comprehensive and detailed information, making it easier to assess the benefits of the RAP program. Second, this study was conducted seven years earlier than the Stoll study; only 21.8% of respondents had heard of the RAP prior to the survey. Finally, the range of presented values in the iterative referendum format may have been improperly truncated in this study (see Rowe et al., 1996): the highest value was $200, whereas values in the Stoll survey went up to $3,000. Stoll (2000b) reports the mean value for the RAP is higher than the highest value presented in this study ($222). Note that neither of these studies estimate how individuals would be willing to tradeoff different resource improvements.

St. Norbert College Survey Center (1999). An October 1999 news article (Campbell, 1999), based on a 1999 Fox River public opinion survey (St. Norbert College Survey Center, 1999), sums up the current attitudes about health concerns in the Fox River of nearby Brown County residents. The majority of individuals are displeased with the water quality in the Fox River; 38% rate the water quality as "poor," and 34% rate it as "not too good." Almost two-thirds report that they are "somewhat" or "very" concerned with the health effects of the Fox River, and that the paper mills should pay for the cleanup of the Fox River rather than the government. This survey was conducted only with individuals living in Brown County. Other studies confirm that individuals living farther away are also concerned about water quality in the Fox River basin and Green Bay (Breffle et al., 1999; Stoll, 2000b).

Other Studies. Other studies focus on Great Lakes areas outside of the NRDA assessment area. Katz and Schuler (1995) survey public knowledge and opinions about Great Lakes issues in general. Generally, respondents report that water quality is only fair overall. They also report wanting more to be done to reduce pollution harmful to people (93%) and to reduce pollution harmful to fish and wildlife (91%). There is significant concern even by respondents who live at distances over 100 miles from the site, and by individuals living outside of the Great Lakes basin.

Finally, a study was done to learn about environmental awareness and attitudes about Lake Erie and the Ashtabula River by surveying random samples of Ashtabula County voters in Ohio (Lichtkoppler and Blaine, 1999). Part of the contamination in Lake Erie is due to PCBs from the Ashtabula River. The survey and WTP question in particular note that three other rivers (Cuyahoga, Black, and Maumee) are sources of contamination to Lake Erie. While findings from this study are not directly applicable to the Green Bay assessment, the two sites are roughly comparable, and similar attitudes might be expected of Green Bay area residents as reported in the Lichtkoppler and Blaine (1999) study.

In general, respondents attach high levels of importance to improving water quality, and they are moderately aware of pollution problems. Out of 15 environmental issues related to Lake Erie and the Ashtabula River, the three most important were improving water quality in the lake, reducing contaminants in the river, and improving water quality in the river and harbor area. On a 1-to-6 scale (from not important to very important), each of these on average rated higher than 5.5. A higher awareness of contamination issues was significantly correlated with higher importance ratings as well, and higher WTP.

An iterative referendum CVM question for the dredging and disposal of contaminated sediment in the Ashtabula River and Harbor was asked to assess monetary value. In the WTP question, it is stated that the dredging will address the following five issues caused by contamination in the lower Ashtabula River and Harbor areas:

- restrictions on consuming fish from the Ashtabula River and Harbor
- degraded fish and wildlife populations and habitat
- restrictions on dredging that jeopardize commercial and recreational boating
- fish with tumors and other deformities
- diminished quality of bottom habitat in the river.

The lower bound mean estimate of WTP is $32.50 per household per year for 30 years (in 1996 dollars),[2] and value was significantly correlated with resource awareness and recreational use (and other individual characteristics), suggesting that those individual characteristics may be important determinants of preferences in the current study. Note the WTP question describes the benefits of dredging associated with the river only; it does not discuss any water quality improvements to Lake Erie. Also, the range of values presented in the referenda may again be truncated: the highest listed value is $200, although the respondent could report "more than $200" and write in a value.

2. For comparison with results of other studies, the present value of 30 years of payments of $32.50/year, at a 3% discount rate, is approximately $650.